1.

A REVIEW OF THE GROWTH OF *CROCODYLUS POROSUS* IN NORTHERN AUSTRALIA

by

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CONTENTS

ABSTRACT

We review the results of three major experiments on the growth of *C. porosus* in northern Australia and incorporate some new data. After examining embryonic growth rates we examine growth for the first four months after hatching and see that in some cases this can match the pre-hatching growth rate. The effect of wet and dry season on this growth rate is discussed and in Part 2 we re-examine the whole question of wet and dry season growth rates for *C. porosus*. Wet season growth rates appear to be consistently higher than those for the dry season.

In this paper we are particularly interested in any indications of there being different growth rates on different rivers and in Part 3 we examine growth over the first year and see that, in line with our earlier Blyth-Cadell results, there are strong indications of different growth rates on different rivers.

In Part 4 we examine growth of small crocodiles and see again strong indications of differences, especially between the Blyth-Cadell Rivers System and the Liverpool-Tomkinson Rivers System. Such differences may well be associated with a better food supply.

In Part 5 we examine growth of large specimens, incorporating valuable new data. Throughout, where possible, comparisons are made with growth of other crocodile species, but mainly with *C. niloticus*. Results indicate that there can be a substantial variation in growth rates not only within a river system but between river systems at all stages of growth and that care must be exercised when comparing data.

INTRODUCTION

The main data on growth in the wild of *C. porosus* in this paper comes from three extended experiments within the Sydney University — Northern Territory Government Joint Crocodile Research Project. All three have been reported on separately previously but our aim in this review is to look at the data as a whole, and reanalyse it to obtain the most information possible on aspects of growth of

C. porosus. Additional recently obtained recapture data is also incorporated. The first experiment involved a capture-recapture study of 254 individuals on the Liverpool-Tomkinson River System (Monograph 7); a multiple regression model was fitted to this data (Webb *et al.*, 1978) to derive growth curves and to examine variables affecting growth. The second experiment was carried out by Magnusson (PhD Thesis, Sydney University, 1978 and several papers) and he studied by capture-recapture techniques the growth of *C. porosus* up to 133 days, again by fitting growth curves. The third experiment (Chapter 8, Monograph 1) involved the capture of hatchlings on the Blyth-Cadell River System (some 30 km to the east of the Liverpool-Tomkinson System) in 1978 and recaptures in following years.

Throughout this paper we shall be referring to Monograph 1, which is but one of a series of 17 published by Pergamon Press between 1979 and 1982 and reporting on the lengthy *C. porosus* studies by Messel and his collaborators.

In seeking to understand the growth rates presented in this paper, we are unfortunately lacking quantitative data on an important piece of information — the food availability (or at least, the relative food availability) on the rivers considered at different times of the year, in different years and on any differences in food availability on different rivers. The ability of crocodilians to survive in a very low growth situation may be illustrated by an example given by Deraniyagala (1939). He quotes the case of two hatchling *C. porosus* (hatching total length around 30 cm), one of which was kept in a tub and the other in a small natural pond (with access to a wild diet). The animal in the tub died after 2 years at a length of only 35 cm, whereas the one in the pond had attained a length of about a metre after only 10 months. An example of the effect of feeding on growth may be taken from our own data. A hatchling captured at SVL 16.4 cm on the downstream Liverpool was recaptured after 3 months, on the Tomkinson. Its SVL had changed by only 0.3 cm and weight by only 5 g, which is essentially no growth over the period. This animal had a skewed jaw which presumably considerably interfered with its ability to catch food items; it was very thin on second capture. Other examples of very low growth over 3 months of the dry season were seen on the upstream Blyth (see Part 1). The differences in growth between Deraniyagala's two animals were probably due to a number of factors, the availability of a proper diet possibly being a major one. However, given that the animals can survive for so long in an essentially no growth situation, it is clear that attempts to interpret variations of growth amongst wild populations are fraught with difficulties, especially when so much necessary data is either unavailable or very difficult to obtain. The results in this paper obtained from recaptures over lengthy periods can be suggestive only and there is need for smaller scale experiments to examine particular points.

To avoid constant repetition, all growth rates referred to in this paper are snout-vent length (abbreviated SVL) rates. Units of growth, if not explicitly stated, are cm/day. For conversion between head length (HL) and snout-vent length (SVL) we have used the same equations as used by Webb *et al.* (1978) (see their page 388). Other conversions (e.g., SVL to total length, TL) may be obtained from Webb and Messel (1978). Unfortunately there are some errors in this latter paper; these are described in Appendix 1. All uncertainties quoted are standard deviations (n-1 method). Differences between means are tested for using the t-test.

Part 1

EMBRYONIC GROWTH AND POST-HATCHING GROWTH UP TO 133 DAYS

1.1 Embryonic growth

Estimates of growth rates for embryonic *C. porosus* may be obtained from data given by Deraniyagala (1939) for animals in Sri Lanka and by Magnusson and Taylor (1980) for animals in Arnhem Land, northern Australia. The data are inadequate but we have tried to look at the limited available data in a number of ways. The results are not claimed to be any more than indications of embryonic growth rates. The egg sizes reported by Deraniyagala are consistent with the egg sizes reported by Webb *et al.* (1977); they report for 22 nests mean egg lengths ranging from 7.2 cm to 8.1 cm, and Deraniyagala's nests I, II and III have mean egg lengths 7.4 cm, 7.9 cm and 8.3 cm. The sizes of hatchlings are also consistent (see Table 1.1). In fact, the mean HL of 17 animals in Table LVIII of Deraniyagala is 4.8 ± 0.2 cm, to be compared with 4.6 cm (no error limit given) as the mean for 5 nests given by Webb *et al.* (1978). [However, there can apparently be great variation in egg and hatchling sizes; results from Edward River crocodile farm in north Queensland, Australia appear to show that small females yield small eggs and small hatchlings (personal communication, Gordon Grigg)].

We shall now examine the available data on embryonic growth and derive some estimates for their growth rates. These can only be indications however, because the length of incubation can vary greatly, from some 80 to 120 days. Nests laid late in the dry season develop more slowly because of the cooler temperatures and there are indications from field observations that some late nests may not hatch at all. Detailed studies are required for embryonic growth under different temperature regimes, in the field.

Deraniyagala gives the following records for embryos from Nest II (days are estimated days after laying, allowing 97 days for incubation; he suggests, however, that the incubation was by no means normal).

Days	37	48	60	97
Total length (cm)	8.1	11.9	17.0	29.4 ± 0.5
	n = 1	n = 1	n = 1	n = 4

This shows a TL growth rate for the 37 days before hatching of 0.34 cm/day, which gives a SVL rate of 0.17 cm/day (using an approximate conversion factor of 2); Nest III gives 0.15 cm/day for 37 days before hatching. Deraniyagala states that his animals were incubated at temperatures which fluctuated daily between 27 and 30°C.

From Table I of Magnusson and Taylor we may also obtain some estimates for embryonic growth rates. They give measurements for two series of embryos taken from two different nests; the Series I nest was incubated at a mean 2.5°C lower than that of Series II (28.5°C against 31.0°C). For the Series I animals one obtains, from the 51st to 86th day, a SVL growth rate of 0.15 cm/day and for the

Series II animals a SVL growth rate, from the 49th to 86th day, of 0.155 cm/day. To obtain these results we have used a conversion factor of 4.01 between snout-vent and head length rates since fitting of the four pairs of snout-vent and head length values in their Table I to a straight line gives SVL = 4.01 HL − 3.7, with coefficient of determination 0.991. If we regress the total length against head length for all the animals in Table LVIII of Deraniyagala then we obtain TL = 8.37 HL − 10.53 (coefficient of determination 0.97). If we use the conversion factor 0.48 given in Appendix I of Webb and Messel (1978) for converting between the snout-vent length and total length (for their smallest class of animals; they do not consider embryos), then we obtain a conversion factor between snout-vent length growth rate and head length growth rate of 4.02.

When comparing Deraniyagala's results with Magnusson's and Taylor's, one must bear in mind possible variations in incubation period discussed already and differences in temperature.

Magnusson and Taylor give a HL (Series II) of 3.74 cm at 86 days whereas Deraniyagala (using his ages) has animals of 80 days with HL of 4.2 cm. Plotting of Deraniyagala's head length measurements against age for Nest II gives a good fit to a straight line between 26 and 81 days (8 points, coefficient of determination = 0.99), with a SVL growth rate of 0.20 cm/day (using 4.01 to convert) compared with 0.155 cm/day for the Series II animals. If the Series I head lengths are plotted against age, a good fit to a straight line is again obtained between 9 and 86 days (8 points, coefficient of determination 0.995; the 28 day value is omitted) with an average SVL growth of 0.17 cm/day. Taking the Nest II and III growths over the last 37 days, one obtains from the head lengths a SVL rate of 0.13 cm/day (somewhat less than that obtained from the total length change), indicating that there may have been a slow-down in growth near hatching time for these two nests (though the data is perhaps too limited to draw such a conclusion).

If one looks at Nest I and calculates the average SVL growth over the last 25 days it is 0.15 cm/day, comparable with the Nest II and Nest III rates over the last 37 days. Thus, a SVL growth rate of between 0.15 and 0.20 cm/day covers the range of results, with the various uncertainties mentioned previously, for the 80 or so days before hatching occurs.

Pooley (1962) presents an excellent and detailed study of pre-hatching and post-hatching growth of penned *C. niloticus* which allows interesting comparisons with the results for *C. porosus*. For embryonic growth over 29 days before hatching he has a rate (his Table 4) of 0.33 cm/day for total length which is very close to that of Deraniyagala previously given. For a 49 day period going roughly from 80 to 30 days before hatching, the total length growth rate is 0.29 cm/day. The mean skull length on hatching (his Table 5, 10 animals) was 4.1 cm, to be compared with 4.6 cm for *C. porosus*. The mean total length for these same animals was 30.5 cm, very comparable to *C. porosus* (Table 1.1). From Pooley's results the mean TL growth rate of these 10 animals over their first month was 0.27 ± 0.04 cm/day, not much less than over the month prior to hatching. It must be remembered that Pooley provided food as required, so these growth rates are presumably an optimum with respect to food supply.

1.2 Hatchling growth up to 133 days

Magnusson (1978) carried out a study on hatchling growth up to an age of 133 days by means of capture-recapture methods. He has presented (Magnusson and Taylor 1981) a mean growth rate for these animals during the wet season (months) for their first 80 days, obtaining a SVL rate of 0.09 cm/day. Since each animal in his study was individually marked and some were captured up to five times, much might be learnt by examining the individual growth records. This will also allow examination of variations of initial growth between animals from different nests. Nests are identified in Table 1.1.

TABLE 1.1

Examples of sizes on hatching of *C. porosus* from Arnhem Land, northern Australia (Liverpool-Tomkinson Rivers System) and Sri Lanka (Deraniyagala, 1939). Also shown are sizes for *C. niloticus* (Pooley, 1962). The description "artificial nest" means that the eggs were removed from a natural nest and incubated in an artificial nest.

Nest	Sample	SVL	Length	Weight	Age Processed
Myeeli 1 Removed from nest after hatching 4.3.76	48	14.1 ± 0.3	30.0 ± 0.7	83.0 ± 3.4	∿ 2 days
Myeeli 2 Removed from nest after hatching 16.2.76	46	13.6 ± 0.5	29.6 ± 0.6	74.5 ± 4.1	∿ 2 days
Myeeli 3 Removed from nest after hatching 18.4.76	50	13.8 ± 0.3	29.9 ± 0.5 (49 anmls)	69.6 ± 3.5	∿ 2 days
Liverpool km47.5 Artificial nest 17.3.76	15	13.7 ± 0.7 (14 anmls)	29.6 ± 1.2	81.2 ± 5.7	∿ 2 days
Atlas Creek Artificial nest hatched 15.2.77	26	14.9 ± 0.3	32.0 ± 0.7	82.8 ± 2.7	∿ 6 days
Billabong Morngarrie Creek Removed from nest after hatching 13.4.76	11	13.4 ± 0.5	28.8 ± 1.1	59.2 ± 6.0	∿ 1 day
Liverpool B22 Artificial nest hatched 30.4.76	26	14.1 ± 0.4	29.9 ± 0.6	63.2 ± 7.6	11-13 days
Tomkinson B48 Artificial nest hatched 30.4.76-10.5.76	8	13.6 ± 0.3	29.1 ± 0.5	59.8 ± 6.5	1-10 days
Tomkinson km68.5 Artificial nest hatched 19.2.77	9	14.4 ± 0.3	30.8 ± 0.7	73.1 ± 1.5	∿ 7 days
T12 Tomkinson km53.9 between 4-9.6.74	29	14.9 ± 0.2	31.7 ± 0.5	92.7 ± 4.2	∿ 7 days
T13 Tomkinson km59.7 between 4-9.6.74	14	14.0 ± 0.3	29.9 ± 0.5	87.4 ± 4.5	∿ 7 days
T14 Tomkinson km65.1 between 21-28.6.74	9	14.5 ± 0.2	31.0 ± 0.5	82.8 ± 2.8	∿ 7 days

TABLE 1.1 (continued)

Nest	Sample	SVL	Length	Weight	Age Processed
Deraniyagala Nest I Artificial	11	—	30.1 ± 1.0	90.2 ± 6.1	0
Deraniyagala Nest II Artificial	4	—	29.4 ± 0.5	78.8 ± 6.3	0
Deraniyagala Nest IV Artificial	5	14.6 ± 0.2	30.4 ± 0.3	79.4 ± 3.6	0
Liverpool 1975 hatched May 4. Artificial	23	13.5 ± 0.6	28.3 ± 1.4	64.7 ± 4.8	7 days
C. niloticus Clutch A Artificial nest	10	—	30.4 ± 1.5	—	0
Clutch B Artificial nest	14	—	31.5 ± 0.6	84.0 ± 2.5	0
Animals in Table 5 Artificial nest	10	13.7 ± 0.9	30.5 ± 1.4	—	0

TABLE 1.2

Capture histories of three hatchlings from the Liverpool-Tomkinson Rivers System. All hatched from a natural nest on March 4, 1976.

Animal 1360

Age (days)	0		37		65		96
SVL (cm)	13.8		16.5		19.1		21.0
Rate (cm/day)		0.073		0.093		0.061	

Animal 1370

Age	0		19		37		65		96		131
SVL	14.1		15.3		17.2		20.5		21.9		22.5
Rate		0.063		0.106		0.118		0.045		0.017	

Animal 1394

Age	0		35		65		94
SVL	14.7		17.5		20.1		21.0
Rate		0.080		0.087		0.031	

In Table 1.2 we give the individual growth records for the three animals that were captured four or more times; all came from the Myeeli I nest. We also present in records A to H, in Table 1.3, SVL growth records over different periods for animals from various nests. The identification numbers of each crocodile are given so that progress of particular crocodiles can be followed. The best record is for the animals from the Myeeli I swamp (records A, F, G). Comparison of the growth from 0-37 days and from 0-96 days shows little difference in average rate, despite the

0-96 day period including 40 days of dry season growth (of course, very early in the dry season; there is no sharp transition from wet season to dry season conditions). The 0-65 day average is higher than the shorter and longer period average, as is also shown for the three individuals in Table 1.2, all of whom show an increased rate of growth from their 37th-65th day. Animal 1403 also shows a slightly higher rate of growth from its 0th-65th day than from 0th-35th day.

The highest rates of growth (record C) are the 0-53 day growths of animals hatched at the base and released at km23.4 on the Tomkinson River. The average growth rate is 0.126 ± 0.021, with the highest rate being that of 1415 at 0.158 cm/day, almost double the rate of the slowest growing animal in this group. This high growth occurs at the end of the wet season. Record E shows growth rates for these animals from their 53rd to 82nd day, and the rates for 1404, 1406 and 1407 have dropped considerably. The growth over this period is all in the dry season.

The lowest average rates of growth are from a group of animals that were raised at the base and then released into the Liverpool River at km47.3. The growth record D, is from mid-May to mid-June and so is an all dry season growth rate. These animals may be compared with those in record C, whose wet season growth over a corresponding age span is up to four times higher.

Webb *et al.* (1977) give results for three nests (T12, T13, T14) on the Tomkinson River, all of which hatched in June, 1974. The initial sizes for the surviving hatchlings from these nests are given in Table 1.1. (It should be noted that all the standard errors in this reference were calculated incorrectly and are generally too small.) Mean daily SVL growth rates of the hatchlings from these nests were 0.06, 0.05 and 0.05 cm/day respectively, for periods of 69, 63 and 52 days. These growth rates are all in the dry season (all periods ending mid-August) and may be compared with records C, D and F. The dry season growth rate over the same age interval is again considerably less than the wet season one. Magnusson and Taylor (1981) also compared the wet season growth rate of hatchlings with these dry season rates, and found that they were significantly higher.

Additional information on early growth may be obtained from data on recaptures of some of the animals from the Liverpool 1975 Nest (see Table 1.1). Five of these animals were recaught after spending 18-21 days in the wild and their SVL mean growth rate was 0.086 ± 0.021 cm/day (period of growth from 6th to 26th day). Three other animals recaught after spending from their 6th to 70th day in the field showed an average growth rate of 0.058 cm/day. The growth period for these animals begins in mid-May and so is all dry season growth. The initial growth rates up to the 26th day are comparable with the purely wet season early growth rates.

The growth rates of Record C (mean 0.126 cm/day) are not far below those that we have obtained for embryonic growth rates, in agreement with the results of Pooley, and perhaps represent an upper limit to the initial growth rate of *C. porosus*. Since Pooley's animals were given access to plentiful food, it seems that food availability for the animals in Record C was also not a limiting factor to growth.

1.3 Blyth-Cadell hatchling study

Further information on early growth of *C. porosus* may be obtained from our capture-recapture study on the Blyth-Cadell Rivers System. A large number of hatchlings of various ages were captured in mid-June, 1978 and recaptured in late September, 1978. The results (Monograph 1, Chapter 8) show that the mean rate of growth of all hatchlings over the 3 month period (all dry season) was 0.030 ± 0.013 cm/day. Because this sample includes hatchlings of various initial ages, care should be exercised when comparing this with the most comparable previous results, those for the Tomkinson

T12, T13 and T14 nests of 1974 discussed in the previous section. The reader is referred to Chapter 8, Monograph 1 for a detailed discussion of the results.

In his thesis (Magnusson, 1978) Magnusson fits a curve to records of animals up to 133 days old. He found that a parabola gave a better fit to the data than a straight line and that the growth curve also predicted a rate of 0.031 cm/day at 120 days (well into the dry season).

The largest growth rate over the 3-month dry season period on the Blyth was for an animal that went from 19.0 to 24.7 SVL, a rate of 0.061 cm/day. As described in Chapter 8, growth on the freshwater section of the Blyth was particularly slow. Several animals only gained between 0.4 cm and 0.7 cm in the period, corresponding to growth rates ranging from 0.004 to 0.008 cm/day. Examination of Magnusson's growth records over dry season periods shows that animal 1370 grew only 0.6 cm from mid-June to mid-July (0.017 cm/day).

Record D of Table 1.3 shows a mean dry season growth rate (0.039 cm/day) for young animals consonant with that found on the Blyth-Cadell System (0.03 cm/day). Animal 1370 shows a mean rate from its 65th to 131st day of 0.030 cm/day and animal 1394 has the same rate from its 65th to 94th day.

To examine further the relationship between growth rate and SVL, the change in SVL over the 3-month dry season period was regressed against the initial SVL, for animals (both male and female) that remained on the km20-35 section of the Blyth River (we have selected this section to omit the slow growth freshwater sections). The slope was 0.20 (standard error 0.1), showing a slight upward trend of growth rate with size, but the coefficient of determination was only 0.08 so one should treat the result with care. From Magnusson's results for the wet season one might have expected a clear downward trend in hatchling growth with increasing initial SVL (and hence increasing age), though we did note previously some evidence for an increase in growth with age for some of Magnusson's animals up to 60 days. The possible discrepancy here could perhaps be understandable in the following way. During the wet season food availability is higher than during the dry and is not a restrictive factor on growth. Under the harsher conditions of the dry season, however, food accessibility may be greater for larger animals. In this way animals that are larger at the start of the dry season may be able to cope better in terms of food sources and so grow faster.

TABLE 1.3

SVL growth rates of animals from some of the nests in Table 1.1 for various periods measured in days after hatching.

RECORD A 0-(35-37) days
Myeeli 1 Nest

1360	0.073
1362	0.071
1367	0.074
1370	0.084
1389	0.083
1394	0.080
1403	0.094
Mean	0.080 ± 0.008

All wet season growth

RECORD B 0-(37-39) days
Myeeli 2 Nest

1316	0.085
1344	0.095
1348	0.122
Mean	0.100 ± 0.019

All wet season growth

RECORD C 0-53 days
Liverpool km47.5 Nest
Released on Tomkinson

1404	0.126
1405	0.125
1406	0.132
1407	0.109
1410	0.138
1414	0.081
1415	0.158
1416	0.132
1418	0.134
Mean	0.126 ± 0.021

Almost all wet season growth

RECORD D 13-52 days
Liverpool B22 Nest

1486	0.029
1492	0.047
1506	0.026
1514	0.028
1510	0.053
1517	0.053
Mean	0.039 ± 0.013

All dry season growth

RECORD E 53-82 days
Liverpool km47.5 Nest
Released on Tomkinson

1404	0.083
1406	0.072
1407	0.041
1413	0.038
Mean	0.058 ± 0.022

All dry season growth

RECORD F 0-96 days
Myeeli 1 Nest

1360	0.075
1364	0.074
1370	0.081
1391	0.083
1394	0.067
Mean	0.076 ± 0.006

40 days are dry season

RECORD G 0-65 days
Myeeli 1 Nest

1358	0.080
1360	0.0815
1370	0.098
1394	0.083
1396	0.102
1403	0.098
Mean	0.090 ± 0.010

Almost all wet season growth

RECORD H 0-82 days
Liverpool km47.5 Nest
Released on Tomkinson

1404	0.111
1406	0.111
1407	0.085
Mean	0.102 ± 0.015

Almost all wet season growth

Part 2

COMPARISON OF GROWTH IN THE WET AND DRY SEASON

2.1 Introduction

In northern Australia the year is divided into distinct wet and dry seasons (Chapter 3, Monograph 1). As has already been stated by several authors (Webb *et al.*, 1978; Chapter 8, Monograph 1; Magnusson (1978)) there are considerable differences between the growth rates of *C. porosus* over the wet season and over the dry season. It is suggested in Section 8.5.4 of Monograph 1 and by Webb *et al.* (1978) that increased abundance of food sources is the main reason for higher growth during the wet season, in contrast with the view of Magnusson (1978) who suggests that temperature and/or salinity are the major factors involved.

Our purpose here is to review the previous data and present some further data. The discussion is also necessary as a prelude to later sections. In Parts 1.2 and 1.3 we have already mentioned the influence of wet and dry season on early growth of hatchlings. Ideally one would like to have a continuous series of measurements, at say one monthly intervals, for a series of animals living in the wild over a number of years. Unfortunately such data would be very difficult, if not impossible, to obtain. To work on the rivers during the wet season is very difficult and recapturing animals over successive months would become increasingly difficult due to increasing wariness. For these reasons the main data available comprises capture-recapture records over periods normally involving a mixture of wet and dry season periods.

Another factor to be borne in mind in looking at data which extends over a number of years is that conditions relevant to growth may well vary from year to year. For example, we may have a particularly heavy wet season one year and a particularly dry one the following year. The availability of food could well be different during the two wet seasons and during the following dry seasons. The 1978-1979 wet season was a particularly dry one and growth rates between mid-1978 and mid-1979 obtained on the Blyth-Cadell Rivers System (Chapter 8, Monograph 1) could be less than normal on those rivers. Availability of various food species may also vary over the years and on different rivers in different ways. With all these varying factors affecting interpretation of differences between wet and dry season growth rates of animals in the wild, one must take results on a particular river at a particular period as a guide only. In the following we have attempted to obtain estimates of wet and dry season growth rates by careful examination of capture-recapture records for animals over the period 1973-1980 on the Liverpool-Tomkinson and Blyth-Cadell Rivers Systems.

2.2 Examples from the Liverpool-Tomkinson System

Examples illustrating dry and wet season growth may be gleaned from the capture-recapture records on the Liverpool-Tomkinson System. They are presented in Table 2.1 and we shall discuss some of these.

TABLE 2.1

Examples of growth on the Liverpool-Tomkinson Rivers System over intervals which are mainly in the dry season. The number of wet season days in the interval is shown in brackets.

Initial size	Sex	Mean SVL growth (cm/day)	Interval (days)
1. H	F	0.050	146 (17)
2. 2-3′	M	0.054	152 (51)
3. 3-4′	M	0.0355	124 (30)
4. 3-4′	M	0.0357	255 (145)
5. H	F	0.038	124 (30)
6. 2-3′	M	0.028	118 (36)
7. H	M	0.054	263 (49)
8. 2-3′	M	0.032	174 (41)
9. H	M	0.0527	387 (151)
		0.0552	270 (116)
		0.047	117 (35)

The simplest description of growth over an interval ($\triangle T$, days) involving both wet season ($\triangle T_w$) and dry season ($\triangle T_D$) periods is to assume linear growth (at different rates) over the two periods. Let a (cm/day) and b (cm/day) be the growth rates over the wet and dry season respectively. The change in SVL ($\triangle$SVL, cm) over $\triangle T$ is given by $\triangle SVL = a \triangle T_w + b \triangle T_D$. Such a model has of course a very artificial sharpness in the boundary between the two seasons. Following Webb *et al.* (1978) we take the wet season as extending from December to April (151 days) and the dry from May to November (214 days). Days 1-120 and 334-365 are wet season and days 121-333 are dry season. The coefficients a and b will also depend on the age of the crocodile. To illustrate this approach we take the example of animal 9 in Table 2.1 that was captured three times on the Liverpool-Tomkinson System over the period of approximately one year. Over a period of 387 days from mid-dry season (day 180) to mid-dry season (day 202) the growth rate was 0.0527 cm/day. From day 85 to day 202 the growth rate was 0.047 cm/day. Use of these results gives a = 0.091 cm/day and b = 0.028 cm/day when substituted into the equation above. This is the only example (besides the animals of Tomkinson nests T12, T13, T14 to be discussed shortly) we have on the Liverpool-Tomkinson System of an animal caught three times within approximately a year and so allowing calculation of a and b as above.

If an assumption is made about the magnitude of b then estimates of a may be made. These estimates can be a rough guide only, especially when one recalls the artificiality of a sharp boundary between the wet and dry season and that the growth rate probably varies over the wet season and over the dry season. However, by assuming various values for b, a range of values for a may be obtained. Consider for example animal 2 from Table 2.1 and taking b = 0.03, we obtain a = 0.10. Any lower value for b would give a higher value for a and vice-versa. Taking b = 0.05 gives a = 0.06. This animal is of 79 cm length initially, in the middle of its second dry season, and a rate of growth of 0.10 cm/day over the initial part of the following wet season would be a rate comparable to that of Magnusson's under 80 day old animals during the wet season (Part 1).

The group of hatchlings from the Tomkinson nests T12, T13, T14 (see Part 1.2) gives rates of growth over approximately 2 months of the dry season and then over the next year (see Part 3.2). These mean rates are both about 0.06 cm/day. This example is out of line with the rest of the data and the reason for this is not clear. Possibly there was a higher food supply on the relevant section of the Tomkinson that year than is usual during the dry season.

2.3 The Blyth-Cadell Study

The Blyth-Cadell capture-recapture study initiated in 1978 (Chapter 8, Monograph 1) was specifically designed to throw light on the question of wet and dry season growth rates. Hatchlings were initially captured in June, then again in September (giving a dry season growth rate) and then again in the following June. On the Blyth River the overall average dry season rate was 0.030, from September to the following June it was 0.053, and from June to June 0.048. Calculation of a wet season growth rate as in Part 2.2 gives a rate of 0.073 if we use the June to June rate and 0.070 if we use the September to June rate. Similar calculations for the Cadell results lead to rates of 0.084 in both cases. In this we have assumed, of course, that the average rate over the dry season period outside the June to September interval is also 0.030 in both the first and second year. If it is in fact lower (as appears likely) then the mean rate over the wet season will be larger.

It had been planned to obtain a growth rate over the animals' second dry season by recapturing in October, 1979 but extraordinary circumstances (Chapter 8, Monograph 1) meant that only 4 growth records could be obtained for this. The rates over some 4 months of the second dry season were 0.014, 0.015, 0.005 (males) and 0.008 (female) (Table 8.5.8, Monograph 1), with overall mean 0.010. The sample is so small that it is hard to conclude much but we may perhaps take the figure of 0.010 as an estimate of dry season growth rate in the second year, on the Blyth-Cadell Rivers, indicating decreasing growth rate with age (Chapter 8, Monograph 1). This figure is lower than the 0.03 used in the calculations of wet season rates above. If one uses the 0.010 in the above calculation for all dry season days in the second year, one obtains wet season rates of 0.079 on the Blyth and 0.091 on the Cadell. Given that the growth rate probably declines with the progress of the dry season and with age, we may take the wet season growth rate as being in the range 0.07 to 0.10, which again is comparable with the initial wet season growth of Magnusson's hatchlings.

In October, 1980 11 animals were recaptured on the Cadell River. These will be discussed in more detail in Part 4 (Table 4.4). However, they do throw some further light on differences between wet and dry season growth rates. Nine of the animals were recaptured in June, 1979 and so we may calculate for them an average growth rate over a 480 day period which includes 151 days of wet season; all these animals were at least one year old in June, 1979. For the 6 males the average growth rate was 0.0195 ± 0.0042 cm/day (range, 0.012-0.023) and for the 3 females it was 0.0137 ± 0.0021 cm/day (0.012-0.016). For the males, if we allow no growth at all over the dry season component of the 480 day interval we obtain a wet season growth rate of 0.064 cm/day. If we take the figure of 0.010 cm/day that we have just obtained from the June 1979-October 1979 captures, the wet season growth rate becomes 0.042 cm/day. For the females, the same calculations give rates of 0.045 and 0.023 cm/day. The sample size is of course small but the results appear to indicate, especially if we allow a second and third dry season growth rate of 0.01 cm/day, that the growth rate for both males and females over their second complete wet season is considerably less than over their first complete wet season. Further discussion of wet and dry season growth rates occurs in Parts 3 and 4.

2.4 The multiple regression model

In Webb *et al.* (1978) a multiple regression model was developed to quantify the influence of some variables on growth rates obtained by capture-recapture on the Liverpool-Tomkinson System. Among the variables was the percentage of dry season in the interval over which the growth rate was obtained. In the sample used the percentage of dry season varied between 35 and 90%. From the regression equations given one may calculate mean growth rates over the dry season and over the wet season for males and females (after substituting appropriate mean temperatures), and for different mean snout-vent lengths. In Table 2.2 we have done this for a succession of mean snout-vent lengths which are roughly appropriate for successive dry and wet seasons in the life of an animal. The results for males are in agreement with our previous discussion. The results for female growth rates over the dry season appear to be too high. This not only conflicts with the examples we have given of female growth rates over the dry season (especially on the Blyth-Cadell System) but also would raise the question of how females could differ so much from males in their dry season growth rates. It is not clear why the predictions for female growth over the dry season are in such apparent error. In substituting values of 0% and 100% for percentage dry season to obtain wet and dry season rates we are exceeding the range of values occurring in the data put into the model but one would expect that if the coefficients have much meaning then they would give sensible estimates for these two extreme cases.

As we shall see, the mean yearly growth rates predicted from the model are in good agreement with more direct calculation of such rates. However, some points may be made in relation to the model. It is stated as an assumption of the model that in the period between captures, deviations between the real growth curve and an assumed linear growth are negligible. Of the growth records used, however, approximately 75% involved intervals of between 300-399 days, and over 90% involved intervals of greater than 200 days. Intervals over 200 days must include a mixture of dry and wet season and we have seen (and the mode itself predicts this) that there are considerable differences in growth rate between

TABLE 2.2

Mean dry season and wet season SVL growth rates for males and females of different sizes calculated from the multiple regression model of Webb *et al.* (1978).

MALES

Mean SVL	Dry season rate	Mean SVL	Wet season rate
20.0	0.033	30.0	0.108
40.0	0.017	50.0	0.096
60.0	0.0006	70.0	0.085
80.0	negative	90.0	0.074

FEMALES

Mean SVL	Dry season rate	Mean SVL	Wet season rate
20.0	0.054	30.0	0.067
40.0	0.036	50.0	0.054
60.0	0.018	70.0	0.041
80.0	0.0008	90.0	0.028

the wet and the dry season. These differences appear to be in conflict with the assumption just stated and this possibly casts some uncertainty on the interpretation of the model. The coefficient in the multiple regression equation which gives the size of the dependence on the percentage dry season is β_2. For males this is -0.236 and for females it is -0.062; the two values thus differing by a factor of almost 4 [the coefficient β_7 on page 389 of Webb *et al.* (1978) is incorrectly given as -0.0174; it should be -0.174]. Again it would be hard to understand, if these results were to be correct, how males and females could differ so much in their response to the dry season.

We shall now give a brief discussion of the mathematical basis of the regression model. For simplicity we shall take one sex only and neglect any influence of temperature. The equation for growth thus becomes:

$$\text{Wet season: } \frac{dy}{dt} = a - by$$

$$\text{Dry season: } \frac{dy}{dt} = a - by - \alpha.$$

where y is SVL, say, and α is a positive constant giving the difference between dry and wet season growth rate. It will be seen that we have assumed that this difference is independent of the size of the animal. Suppose now that we have measurements (y_1 and y_3) of SVL at the beginning and end of a period going from T_1 to T_3; T_1 to T_2 being dry season and T_2 to T_3 being wet season. Then we have:

$$\Delta y = a(T_3 - T_1) - b \int_{T_1}^{T_2} y\,dt - b \int_{T_2}^{T_3} y\,dt - \alpha(T_2 - T_1)$$

The mean rate Y over the interval ΔT ($\Delta T = T_3 - T_1$) is thus given by:

$$Y = \Delta y/\Delta T = a - b\,\bar{y} - \alpha(T_2 - T_1)/\Delta T$$

$(T_2 - T_1)/\Delta T$ is just the fraction of dry season occurring in the period ΔT.

The assumption made in the growth paper is that it is permissible to replace $\bar{y}$ [$= \int y\,dt/\Delta T$] by $\frac{1}{2}(y_1 + y_3)$. This is only true if y depends linearly on t during the interval ΔT. If this assumption is made then we arrive at the form of equation given in the growth paper. As we have already commented, most of the intervals occurring in the data used to derive the model included significant mixtures of wet and dry season growth and so the growth is definitely not linear over the whole interval but only over parts of it.

If one had enough data to warrant the analysis, more realistic models than the above suggest themselves. The sharp distinction between wet and dry season is highly artificial and a more realistic approach might be to have an equation of the form:

$$\frac{dy}{dt} = a - by - \alpha \sin \omega t$$

where the sinusoid has a period of one year, with growth reaching a peak somewhere around the middle of the wet season and a minimum around the middle of the dry season. Further, the assumption that the difference between wet and dry season growth rate is independent of the size of the animal is also open to doubt. One might expect the difference to be greater for small animals, given that their major diet foods of insects and crustaceans are much more plentiful during the wet season, whereas larger animals depend more on fish, birds and mammals whose abundance (at least for fish and mammals) might not be so dependent on the different seasons. These are matters for further investigation, the available data being insufficient to enable much to be said.

2.5 Results for *C. niloticus*

Pooley's (Pooley, 1962) results for penned, juvenile *C. niloticus* show that growth decreases and virtually halts during the south African winter and spring. Over the first two months of life (in autumn) the growth is 12.1 cm (total length). Over the next six months it is 3.7 cm; a drop in the daily snout-vent length rate from 0.1 cm/day to 0.010 cm/day (obtained by dividing length by 2). It then rises again to 0.086 cm/day over summer, 0.054 cm/day over autumn and then 0.018 cm/day over the next winter/spring. The dependence on season of juvenile *C. niloticus* thus appears to be greater than that of *C. porosus*; probably principally due to much cooler temperatures prevalent in comparison to northern Australia. Availability of food is not a factor as these penned animals were provided with ample food.

Part 3

GROWTH OF *C. porosus* OVER THE FIRST YEAR

In order to allow comparison of growth rates on different rivers over the first year of life we have calculated growth rates for animals that remained on the Liverpool River and those that remained on the Tomkinson River over their first year. This will also allow comparison with the rates (Chapter 8, Monograph 1) already obtained for the Blyth and Cadell Rivers. These rates may also be compared with those given by the growth curve (Table 3.1) and obtained in a much less direct fashion (Webb *et al.*, 1978).

3.1 Liverpool hatchlings

23 hatchlings (including 12 males and 11 females) were captured in the mid-dry season of 1973 and recaught one year later. The overall mean growth rate for these animals was 0.054 ± 0.006 (range 0.043-0.069). For the males it was 0.056 ± 0.006 (range 0.047-0.069), for the females 0.050 ± 0.005 (range 0.043-0.058). 9 hatchlings were similarly recaptured over the 1974-1975 period. The overall average for these animals was 0.054 ± 0.008 (6 males, 3 females). The mean growth rates over the two periods are identical. The largest growth rate for an animal in the later period was for a male whose rate was 0.074, the snout-vent length increasing from 20.1 to 46.4 cm. The lowest growth was for a female, 0.045 cm/day, its snout-vent length changing from 20.5 to 37.3 cm. Taking all 32 animals, the growth rate was 0.054 ± 0.007 cm/day (0.056 ± 0.007 for males, 0.050 ± 0.005 for females). The interval between recaptures ranged between 340 and 370 days with most being within the range 350-365 days.

To investigate whether there were any differences in growth rates along the river (salinity gradient) the animals were grouped into various intervals between km20 and km60 (non-freshwater section). The sample is admittedly small, but there was no indication of any differences in the hatchling mean growth over a year dependent on their position on the brackish section of the river. Most of the animals were caught within a kilometre or so of their first capture positions and one may assume that they spent most of the year along the same stretch of river. These results are consistent with those of Webb *et al.* (1978) who found position along the brackish sections of the river to be an unimportant variable. The results are also consistent with those obtained for the Blyth River where there appeared to be no difference in growth over the full year between the brackish and freshwater sections (though there was over the three months of dry season growth). Magnusson (1978) and Magnusson and Taylor (1981) also found no dependence of growth on salinity in a somewhat limited salinity regime.

3.2 Tomkinson hatchlings

In Part 1.2 we referred to the initial growth rates of animals from the three nests T12, T13, T14 on the Tomkinson in June, 1974. 22 of these animals were recaught in July, 1975 and their average growth rate over a period of some 340 days from mid-August of 1974 was 0.060 ± 0.005. This rate is about the same as their initial growth rate over some two months in the 1974 dry season, and does not show the usual decline from the initial growth rate that was observed with animals that spent their initial growth period in the wet season. Of this sample, 12 were males (0.061 ± 0.005; range 0.054-0.074) and 10 were females (0.0585 ± 0.0040; range 0.052-0.063) and there thus was no significant difference in the male-female growth rates, though the female rate was, as usual, lower. The mean interval between captures was some 340 days.

21 other animals were captured in mid-dry season of 1973 and recaptured some 340 days later in 1974. The average growth rate was 0.054 ± 0.009 cm/day (8 males, 0.063 ± 0.007; range 0.052-0.071; 13 females, 0.049 ± 0.005; range 0.038-0.056). The female growth rates of the 1973-1974 season are lower than those of the 1974-1975 season. This difference is in fact significant at the 0.01% level. Since the male rates over the same two years are much the same it is hard to understand this difference.

The growth rates for hatchlings on the Liverpool-Tomkinson System calculated in this direct fashion are in good agreement with those predicted by the growth curve (Table 3.1).

TABLE 3.1

Sizes of male and female crocodiles at various ages as predicted by equations (5) and (6) of Webb *et al.* (1978). HL denotes head length, SVL denotes snout-vent length and TL denotes total length. The total length was calculated from the snout-vent length using equations from Appendix 2 of Webb and Messel (1978). The annual growth rates are also shown. For consistency with Webb *et al.* (1978) we have in this Table taken 13.2 cm as the SVL on hatching rather than 13.9 cm which was used in Part 3.4. The figure of 13.2 cm is obtained from HL using the equations on page 388 of Webb *et al.* (1978), as are all SVLs in this Table.

	Age (years)	**HL (cm)**	**SVL (cm)**	**TL (cm)**	**In feet**	**Annual rate (SVL; cm/day)**
MALE	0	4.6	13.2	28.0	11″	
	0.5	8.0	25.3	52.9	1′ 9″	0.062
	1.0	11.0	36.0	75.0	2′ 6″	
	1.5	13.7	45.3	94.1	3′ 1″	0.048
	2.0	16.0	53.6	111.1	3′ 8″	
	2.5	18.1	60.9	126.1	4′ 2″	0.038
	3.0	19.9	67.3	139.2	4′ 7″	
	3.5	21.5	72.9	150.7	4′ 11″	0.029
	4.0	22.9	77.8	160.7	5′ 3″	
FEMALE	0	4.6	13.2	28.0	11″	
	0.5	7.8	24.6	51.5	1′ 8″	0.058
	1.0	10.6	34.5	71.9	2′ 4″	
	1.5	13.0	43.1	90.0	2′ 11″	0.044
	2.0	15.2	50.5	104.9	3′ 5″	
	2.5	17.0	57.0	118.0	3′ 10″	0.033
	3.0	18.6	62.5	129.0	4′ 3″	
	3.5	19.9	67.4	138.9	4′ 7″	0.025
	4.0	21.1	71.6	147.3	4′ 10″	

3.3 Growth over the first year on different rivers

In Chapter 8 of Monograph 1 it was shown that growth over the first year was somewhat higher on the Cadell River than on the Blyth River, into which it runs about 20 km from the mouth of the Blyth. The sample on the Cadell was only small however. The Liverpool-Tomkinson Rivers System lies some 30 km to the west of the Blyth-Cadell Rivers System and the Tomkinson runs into the Liverpool about 20 km from its mouth (Monograph 15). By the end of the dry season the Cadell is slightly brackish at the upstream limit of navigation by survey boat whereas the Blyth is fresh; likewise the Tomkinson is slightly brackish whereas the Liverpool is fresh at the upstream level (see Monographs 1 and 7 for full details on the salinity regimes of these rivers). The two river systems are thus somewhat similar, the Blyth corresponding to the Liverpool and the Cadell to the Tomkinson. Now that we have obtained separate growth rates for the Liverpool and Tomkinson we can make some comparisons of growth rates.

Because most of the intervals for the Tomkinson recaptures are about 340 days compared with 350-360 days for the Liverpool and Blyth-Cadell recaptures, there is a slight upward bias (due to a higher percentage of wet season) in the Tomkinson rates. This may be corrected by using the two-rate model discussed in Part 2. Taking a dry season growth rate of 0.030 cm/day, one finds that the Tomkinson rates for 360 days are some 2% lower than the rates over 340 days given in Part 3.2. It is these corrected rates for the Tomkinson which we use in our comparisons.

Because of the small sample size for the growth over the first year on the Cadell, we shall not include the Cadell in the comparisons here; as we have already said, the rates of growth on the Cadell were higher than on the Blyth. The mean yearly rates on the Blyth were 0.050 ± 0.005 ($n = 33$) for males and 0.043 ± 0.008 ($n = 13$) for females (Table 8.5.7, Monograph 1). The various rates are collected in Table 3.2.

The male growth rates on the Liverpool and Tomkinson Rivers are not significantly different. The female rates are significantly different (at 0.1% level) if we use the 1973-1974 results for the Tomkinson but are not different if we use the 1974-1975 results for the Tomkinson.

Comparisons of the male rates on the Tomkinson with those on the Blyth give results that are highly significant (at 0.0001% level). Comparison of the rates for females on the Blyth and Tomkinson shows that the 1974-1975 rates are highly significantly different (at the 0.01% level), but the 1973-1974 rates are not.

Comparisons of male rates on the Liverpool with those on the Blyth show the difference to be significant at the 0.1% level. The female rates also differ significantly at the 1% level.

The results clearly indicate higher growth in the first year on the Liverpool and

TABLE 3.2

Mean SVL growth rates of hatchlings for the period from June, 1978 to June, 1979 on the Blyth, Cadell and Blyth-Cadell Rivers. Abstracted from Table 8.5.7, Monograph 1.

	Blyth		**Cadell**		**Blyth-Cadell**	
	Rate	**n**	**Rate**	**n**	**Rate**	**n**
All hatchlings	0.0483 ± 0.0065	46	0.0530 ± 0.0033	9	0.0484 ± 0.0063	61
Males	0.0502 ± 0.0046	33	0.0530 ± 0.0059	3	0.0495 ± 0.0052	41
Females	0.0432 ± 0.0079	13	0.0530 ± 0.0017	6	0.0461 ± 0.0079	20

Tomkinson Rivers than on the Blyth; in fact the largest growth rate on the Blyth was 0.060 cm/day, for a male, which is about the mean male growth rate on the Tomkinson (the rates on the Liverpool-Tomkinson System are also mostly higher than on the Cadell, though the numbers in the Cadell sample are only small). There is also a strong indication that males grow better on the Tomkinson than on the Liverpool; for females the picture is complicated by the disparity between the 1973-1974 and 1974-1975 growth rates.

3.4 Range of sizes amongst hatchling captures and ambiguities

Besides the capture-recapture records, we also have available many hundreds of single captures and much may be learned from the size structure of the population at a given time of year. In this section we shall use all available information to consider the range of size that a hatchling may assume during its first dry season. Because of the possibility of errors in measurement, we only take examples of size and growth that are paralleled by at least one other animal. These sizes may then be correlated with the growth rates we have been considering and the possible times of hatching.

Nesting of *C. porosus* in northern Australia (Webb *et al.*, 1977; Magnusson, 1978) is stated to take place between November and May, during the wet season. Incubation periods vary between 80 and 100 days, normally, though during the dry season hatching can take much longer (or as mentioned in Part 1.1 it may not even occur at all) because the temperature is lower. If a nest is laid on the earliest possible date, say November 1, then the eggs could be expected to hatch around February 1. If laid at the end of May they would probably hatch no sooner than September 1. R. Jenkins (personal communication) has found a riverside nest in the Alligator River region which was laid down in August. This is exceptionally early (or late) and we will use the November date in our discussions. It is unknown whether any eggs from such an August nest would hatch.

We first consider animals hatching early in the year. Animal 1406 (record H, Table 1.3) hatched on March 19 with a SVL of 14.5 cm and by June 9 had a SVL of 23.6 cm. If we assume that an animal with comparably high growth rate had hatched on February 1 with a SVL of 13.9 cm, we may make some calculations of the range of maximum sizes possible over the year. The figure of 13.9 has been adopted for the SVL on hatching, since the mean of the means in Table 1.1 for hatchlings ≤2 days old is 13.9 ± 0.43. Considering first the upper range of growth, we take a mean growth to the end of the wet season (April 30) of 0.1 cm/day. One hatchling, captured on day 205 (July 24) and recaptured on day 351 (December 17), had a mean growth of 0.05 cm/day (the SVL going from 23.0 to 30.3 cm). We may thus take 0.05 cm/day as a possible rate over the dry season, leading to the predicted lengths shown in Table 3.3. Taking a lower rate for growth during the wet season of 0.06 cm/day and during the dry of 0.03 cm/day we obtain the lower growth rate shown in Table 3.3.

TABLE 3.3

Possible SVL (cm) of hatchling hatched on February 1 for two different sets of growth rates (see text, part 3.4).

Day number	Feb 1 32	Mar 21 80	Apr 30 120	Jun 9 160	Jul 19 200	Aug 28 240	Oct 7 280	Nov 16 320
Upper Rate	13.9	18.7	22.7	24.7	26.7	28.7	30.7	32.7
Lower Rate	13.9	16.8	19.2	20.4	21.6	22.8	24.0	25.2

Examination of our capture-recapture records reveals the following examples. An animal (Blyth River) caught on June 22 (day 173) had a SVL of 25.1 cm. A group of animals was captured on the Blyth River around the end of October (day 300) with SVLs ranging from 29 to 31.5 cm, in agreement with the upper size suggested from an animal born near February 1. Animals were caught on the Goromuru River in 1975, around day 280, with a SVL of 31.1 and 31.5 cm. In late September (day 269), 1978, an animal was caught on the Cadell River with a SVL of 28.0 cm; an animal with the same SVL was caught in late August on the Tomkinson River. Another animal with a SVL of 18.5 cm on day 112 (late April) had a SVL of 32.7 cm by day 10 of the next year. If we allow an initial growth rate of 0.1 cm/day, then this animal hatched in early March. With this same sort of growth and a hatching in early February, it seems we could have an animal with a SVL of 33 cm by the end of November. After examining late hatchling growth we shall look again at the question of maximum hatchling sizes late in the dry season.

We now consider the lower size range of hatchlings later in the dry season and attempt to relate this to the latest possible times of hatching. Amongst the Blyth-Cadell captures of late October 1974 (around day 300), there were 3 hatchlings captured on the upstream Blyth River (around km42) with SVLs of 16.0, 16.5 and 16.5 cm. Some other animals in the range 17.0 to 18.5 cm were also captured at this time. During the September, 1978 captures on the same river system, the smallest animal caught had a SVL of 17.1 cm. So in 1974 one had animals 1 cm (SVL) shorter one month later. As we have discussed earlier, some very low growth rates occurred over the June-September period on the upstream Blyth in 1978 (see Chapter 8, Monograph 1). If we assume that the mean initial rate of growth of the late October, 1974 hatchlings was 0.06 cm/day (i.e., the same as the initial rate for the Tomkinson T12, T13 and T14 nests) and that their initial SVL was 14.0 cm, then a 16.5 cm SVL corresponds to an age of about 40 days and with a normal incubation period of 90 days we obtain a date of mid-June for the laying of the nest, which would be a late nest. A longer than normal incubation period (as would be highly likely during the colder dry season months) and a lower growth rate would of course push the date further back. Pushing laying back to the end of April (the end of the wet season) and assuming 90 day incubation, we would obtain an age of 90 days for the 16.0 cm hatchling, corresponding to a mean growth rate of 0.02 cm/day, a growth rate that seems possible after examination of the Blyth-Cadell capture-recapture data.

An animal that had a SVL of 16.0 cm in late October and grew at the average rate of 0.05 cm/day over the next year would by the following October have a SVL of 34.3 cm; at a rate of 0.04 cm/day it would have a SVL of 30.6 cm. Thus there could be an overlap in sizes in the late dry season of animals born early that same year or born late in the dry season of the previous year. It is possible that in our assignment of animals to the hatchling class for calculating the Liverpool and Tomkinson growth rates we have erred, in that the animal is actually in its second dry season. Such cases, and there would only be a few, would have the effect of lowering the mean growth rate since growth over the second year of life is slower (see later).

Another way of comparing growth on the two river systems is to compare the sizes of the animals in the second year, in mid-dry season. On the Blyth-Cadell System the largest recapture had a SVL of 42.0 cm, with several others over 40 cm. Examination of the Liverpool-Tomkinson data reveals several animals in mid-July with snout-vent lengths around 46 cm, and numbers between 42 cm and 46 cm. It is also interesting to note that one of the Blyth October 1979 captures, 1753, which had a SVL of 41.8 cm in June, had only 42.5 cm in October. These observations again indicate a higher growth rate on the Liverpool-Tomkinson System.

3.5 Other species of crocodile

From Pooley's (1962) results we can calculate mean growth rates for penned *C. niloticus* over the first year. From his Table 5 we can calculate a mean snout-vent length growth rate over the first year of 0.052 cm/day (range 0.035-0.061). This growth is thus very comparable to that of *C. porosus*. A specimen in natural conditions (Cott, 1961, p. 245) grew at a rate of 0.038 cm/day.

Whitaker and Whitaker (1977) present similar data for *C. palustris*. The animals were in pens with access to plentiful food. The mean growth rate (converting from length to snout-vent length by dividing by 2) over the first year was 0.074 cm/day (range possibly 0.04-0.1). Compared to wild *C. porosus* and penned *C. niloticus* the rates of growth of these animals are very high, and it is difficult to say whether they reflect an inherently faster growth rate for juvenile *C. palustris* or whether under equally favourable conditions *C. porosus* and *C. niloticus* could match this growth. There appears to be no reason why not. Some growths given by Deraniyagala (Deraniyagala, 1939) for a captive specimen of *C. palustris* are considerably less than those of Whitaker and Whitaker. After 20 months Deraniyagala's specimen was only 49.7 cm in total length, after hatching at 25.5 cm. This is smaller than any of Whitaker and Whitaker's animals after 12 months.

Part 4

GROWTH OF SMALL (3-6', 0.9-1.8 m) *C. porosus*

In this part we re-examine the growth records for animals after their first year on the river and up to the fourth year. This main purpose again is to look for differences between different rivers. For animals larger than (2-3') (0.6-0.9 m) it is impossible in some cases to be certain of an animal's age and this uncertainty increases with age. However amongst the capture-recapture records on the Liverpool-Tomkinson System there are a number of triple captures where animals were caught in three successive years and in these cases we know much more about the age of the animal. These triple captures of animals in the wild provide very valuable data and we have tried to make full use of them.

4.1 Growth from second to third year on the Liverpool-Tomkinson system

The capture-recapture records show 13 animals that spent their second year on the Liverpool River. The SVL growth rates for these initially (2-3') animals from mid-dry season to mid-dry season are:

All animals: 0.038 ± 0.007
(n = 13, range 0.029-0.050)
Males: 0.039 ± 0.007
(n = 7, range 0.031-0.050)
Females: 0.036 ± 0.006
(n = 6, range 0.029-0.044)

As expected the growth rate for males is higher than that for females, though not significantly.

There were 34 animals that spent their second year on the Tomkinson River from mid-dry season to mid-dry season and were initially (2-3') animals. The growth rates for these animals were:

All animals: 0.045 ± 0.006
(n = 34, range 0.034-0.059)
Males: 0.045 ± 0.007
(n = 8, range 0.038-0.054)
Females: 0.045 ± 0.006
(n = 26, range 0.034-0.059)

Interestingly, the male and female rates on the Tomkinson are identical. The hatchling growth rates for males and females over the one year period 1974-1975 were also very close.

The average time interval between these Tomkinson recaptures is only 340 days, somewhat short of the average full year interval between the Liverpool recaptures. To enable a comparison of these rates we may correct the Tomkinson rates by assuming a two rate growth over the year (see Part 2.2). If we assume a rate of growth of 0.02 cm/day (the mean of 0.03 for the first dry season and 0.01 for the second dry season, see Part 2.3) during the dry season component then we can calculate that the rate 0.045, over 340 days, represents a rate of 0.043 over 365 days. We may take then the corrected Tomkinson annual rates as:

All animals: 0.043 ± 0.006
(n = 34)
Males: 0.044 ± 0.007
(n = 8)
Females: 0.043 ± 0.006
(n = 26)

The male rates are not significantly different between the Liverpool and the Tomkinson; the female rates are significantly different at almost the 1% level. From the equations in the growth paper (see caption of Table 3.1) we can calculate the mean rate of growth of animals from 1.5 to 2.5 years to compare with the directly calculated rates above: 0.043 (males) and 0.038 (females).

4.2 Growth from the third to fourth year on the Liverpool-Tomkinson System

Examination of the capture-recapture records reveals 21 cases of animals that are likely to be going from their third year to their fourth year (mid-dry season to mid-dry season). Some are definite cases because they are triple captures; in a few cases the initial sizes may be a little large (the two largest animals we have included had SVLs of 58.8 cm and 60 cm). The mean SVL growth rates were:

All animals: 0.0316 ± 0.0072
(n = 21, range 0.018-0.047)
Males: 0.0337 ± 0.0049
(n = 5, range 0.026-0.038)
Females: 0.0309 ± 0.0078
(n = 16, range 0.018-0.047)

The time interval for these rates is (365 ± 25) days.

Six of the females on the Tomkinson included above are triple captures that we know are going definitely from their third to fourth year. The mean rate for these (over approximately 340 days) is 0.028 ± 0.010 (range 0.018-0.047). Thus the male growth rate is higher, but not significantly.

Unfortunately the numbers of animals which spent the year on one particular river are insufficient to allow any comparison of the Liverpool and Tomkinson growth rates. The equations from Webb *et al.* (1978) predict the following values for growth rates from 2.5 to 3.5 years: 0.033 (males) and 0.028 (females).

4.3 Two year growth rates from first to third year on the Liverpool-Tomkinson System

By selecting from triple captures and 2 year spaced captures we can obtain a mean SVL rate of growth from the hatchling to the (3-4′) (0.9-1.2 m) stage over a 2 year period from mid-dry season to mid-dry season. There are 19 such cases from the whole Liverpool-Tomkinson System, with the interval between recaptures varying between 675 and 740 days. The mean growth rates over the approximately 2 year interval are:

All animals: 0.044 ± 0.007
(n = 19, range 0.034-0.056)
Males: 0.046 ± 0.006
(n = 11, range 0.034-0.056)
Females: 0.042 ± 0.007
(n = 8, range 0.034-0.052)

These rates may be compared with those calculated using the equations of Webb *et al.* (1978), calculating from age 0.5-2.5 years; 0.049 cm/day for males and 0.044 cm/day for females. The rates predicted are in good agreement with the directly calculated rates. In Table 4.1 we give the individual records of growth of the 11 triple captures included in the above. It will be seen that the growth rate over the second year is on average only 60% of that over the first year.

From the 19 two-year spaced captures we can abstract some information on relative growths on the Liverpool and Tomkinson Rivers. The samples are very small unfortunately but the results are in support of earlier results indicating a higher growth rate on the Tomkinson. For male animals on the Liverpool, the mean growth rate was 0.0434 ± 0.0021 (n = 5, range 0.041-0.046). On the Tomkinson there were 2 males with mean 0.0528 (0.0499, 0.0557). For females on the Liverpool, the mean rate was 0.0362 ± 0.0018 (n = 4, range 0.0343-0.0384). On the Tomkinson it was 0.0489 ± 0.0026 (n = 3, range 0.0473-0.0519). Interpretation of these differences is complicated by the fact that the Liverpool capture intervals ranged from 718 to 739 days, whereas the Tomkinson intervals ranged

TABLE 4.1

Capture histories of animals caught on the Liverpool-Tomkinson System in their first year and recaptured in their second and third years. The rates of SVL growth are also given (the intervals between captures vary between 337 and 371 days).

Number	Sex	Initial SVL	1st year rate	SVL	2nd year rate	Final SVL
15	M	25.4	0.047	42.4	0.022	50.7
30	M	25.0	0.059	46.0	0.027	56.1
94	M	23.0	0.062	44.5	0.031	55.9
95	F	21.0	0.054	40.0	0.017	46.2
98	F	24.0	0.043	39.0	0.034	51.6
103	M	22.5	0.053	41.0	0.032	53.0
184	M	23.0	0.059	43.2	0.042	57.7
232	F	20.0	0.053	38.2	0.042	52.7
270	M	22.0	0.061	42.9	0.039	56.3
349	F	29.0	0.056	48.1	0.038	60.9
351	M	21.5	0.070	45.1	0.042	59.1

from 675 to 703 days. As we shall now show, even when this is compensated for, the strong indication is still that the growth rate is higher on the Tomkinson. We again use the simple model from Part 2.2. We take a two year growth, allowing 0.08 over the wet season and 0.02 over the dry season. Over 730 days (302 wet, 428 dry) this gives a mean rate of 0.045. Over 675 days, with 55 fewer dry season days, we get a rate of 0.047, so the shorter interval has little effect on the average rate.

4.4 Growth from second to fourth year on the Liverpool-Tomkinson System

By selecting from triple captures and 2 year spaced captures we can obtain a mean SVL rate of growth from the (2-3′) (0.6-0.9 m) stage on the Liverpool-Tomkinson System. The interval between captures vary from 666 days to 730 days with the majority of intervals being around 680 days. The mean growth rates are:

All animals:	0.0368 ± 0.0063
	(n = 21, range 0.025-0.047)
Males:	0.0380 ± 0.0076
	(n = 9, range 0.025-0.047)
Females:	0.0358 ± 0.0053
	(n = 12, range 0.028-0.046)

Unfortunately the samples are too small to permit any conclusions about differences between Liverpool and Tomkinson growth rates, the majority of the animals being from the Tomkinson River.

In Table 4.2 we give the individual histories of the triple captures included in the above animals. The equations in Webb *et al.* (1978) give rates of 0.038 for males and 0.033 for females for growth from 1.5 to 3.5 years. The male-female differences are not significant, though as usual the male rate is higher.

4.5 Growth rates of animals up to 6′ (1.8 m) — Liverpool-Tomkinson System

In Table 4.3 we present some interesting growth records for animals up to 6′ (1.8 m) in length. The ages of most of these animals is uncertain to within a year. We shall now comment on some of these growth records.

Animal 37 exhibits a very high growth rate for a non-hatchling over a 2 year period, going from a total length of 1.0 m to 1.81 m over the period. Because of a toe abnormality noted on both captures there is no question that this is the same animal both times. Its mean growth rate

TABLE 4.2

Capture histories of animals caught on the Liverpool-Tomkinson System in their second year and recaptured in their third and fourth years. The rates of SVL growth are also given (the intervals between captures average around 340 days, with 378 the longest interval and 335 the shortest).

Number	Sex	Initial SVL	1st year rate	SVL	2nd year rate	Final SVL
35	M	42.5	0.0431	58.8	0.0264	68.2
40	F	39.0	0.0368	52.1	0.0195	59.3
92	F	36.0	0.0429	51.0	0.0249	60.2
262	F	36.0	0.0436	50.9	0.0252	59.4
301	M	39.0	0.0376	52.0	0.0338	63.5
317	F	37.5	0.040	50.9	0.0251	59.5
318	F	36.0	0.0418	50.0	0.0240	58.2
321	F	36.5	0.0445	51.4	0.0466	67.4
322	F	31.0	0.0533	48.9	0.0297	59.0
355	F	36.5	0.0524	54.2	0.0184	60.4

TABLE 4.3

Growth records for animals up to 6′ (1.8 m) in length on their final capture. All animals are from the Liverpool-Tomkinson System.

No.	Sex	Initial SVL	Final SVL	Rate	Period (days)
37	M	49.0	87.1	0.0518	736
110	F	52.0	77.5	0.0351	727
124	M	55.0	80.7	0.0365	704
165	M	64.0	77.4	0.0388	345
176	M	58.0	82.8	0.0356	696
177	M	56.0	81.3	0.0364	696
195	M	48.0	74.4	0.0380	695
291	M	46.5	78.6	0.0467	687
451	M	65.0	75.3	0.0300	343
517	M	72.5	82.1	0.0291	330

over 2 years matches that of many hatchlings in their first year. This animal could conceivably be 1.5 years old on first capture and so had reached 1.8 m (6′) at age 3.5 years. Animal 291 exhibits a growth rate that is not much lower. The two males 451 and 517 exhibit a mean growth of 0.030 cm/day over what is probably their fourth year of growth (from age 3.5 to 4.5). Animals 124, 176, 177 and 195 have very similar mean growth rates of around 0.036 cm/day over a 2 year period which possibly is from their third to fifth year on the river (age 2.5 to 4.5 years). So at 4.5 years they have a SVL of 80 cm which is in agreement with the growth curve.

From Pooley's (1962) results we can calculate mean growth rates for penned *C. niloticus* over the second year. From his Table 5 we can calculate a mean growth rate of 0.038 cm/day over the second year (range 0.022-0.053). Again the growth is very comparable to *C. porosus*, with the mean growth being somewhat lower for *C. niloticus*. The mean rate over the two years from hatching is 0.040 cm/day.

Whitaker and Whitaker (1977) obtain for their penned animals, *C. palustris*, a mean rate of 0.066 cm/day (approximate range 0.045-0.090), over the second year, with the largest animal being 1.70 m in length at the end of its second year and the smallest 0.9 m. Average growth over the first two years of life was 0.070 cm/day. These are very high growth rates; recall that similar remarks applied to the comparison for first year growths, Part 3.5. Again, would *C. porosus* or *C. niloticus* under ideal conditions grow at such rates?

4.6 Blyth October 1980 recaptures

In October, 1980 11 animals (7 males, 4 females) were recaptured of the original animals of 1978; the animals were very difficult to approach and this was all that could be caught in the time available. Summary histories of the animals are given in Table 4.4. Since all these animals had been captured in September 1978 we can calculate 2 year SVL growth rates. For all animals it is 0.032 ± 0.005 cm/day; for the males, 0.033 ± 0.004 cm/day and for the females, 0.029 ± 0.06 cm/day. The largest rate was 0.040 cm/day, for a male, and the lowest, 0.022 cm/day, for a female. These rates may be compared with those for animals for which we calculated 2 year growth rates in Section 4.3. The rates are less than those on the Liverpool-Tomkinson System. The male rates differ at the 0.01 % level and the female rates at the 1 % level.

Though the sample of animals on the Blyth-Cadell is much smaller than for the Liverpool-Tomkinson it is interesting, by looking at individual examples, to compare the extremes of growth on the Liverpool-Tomkinson and Blyth-Cadell Rivers Systems. The largest animals captured (1617 and 1817) on the Blyth-Cadell System in October, 1980 had a SVL of 50 cm. Within a month or so, their ages may be estimated at 32 months. Two very comparable animals from the Liverpool-Tomkinson System (1 male, 1 female) of similar age had SVLs of around 63 cm, and there are many examples of animals of the same age with SVLs between 57 and 60 cm. The smallest male captured (1631) on the Blyth-Cadell System had a SVL of 43 cm and total length 87 cm, so it has not reached the (3-4′) category yet. This animal is at least 28 months old and may be compared with an animal from the T14 1974 Tomkinson Nest which had the same SVL at some 13 months (both animals were hatched around June-July). Again we see that the growth rate, on average, appears to be greater on the Liverpool-Tomkinson System than on the Blyth-Cadell System and that, as we have already discussed, the confident attribution of an age to a given animal more than a year old is impossible, especially if the animals are from different systems. In October, 1981 we managed to recapture one of the 1978 hatchlings, a female, and at the age of at least 42 months, its SVL was only 49 cm. Use of the growth curve (Fig. 3) in Webb *et al.* (1978) would give a SVL of 67 cm at 42 months. Some discussion of these animals recaptured on the Blyth-Cadell in October, 1980 has already been given in Part 2.3.

TABLE 4.4

Growth and movement histories of 11 hatchlings first captured in June or September, 1978 and recaptured in October, 1980, on the Blyth-Cadell Rivers System. Position shows the distance in km upstream at which the crocodile was captured on either the Blyth (B) or Cadell (C) River. Rates are cm/day.

	SVL	Position	Capture
1617	23.1	24.9 B	June 78
Male	26.2	26.4 B	Sept 78
Change	3.1		93
Rate	0.033		
	26.2	26.4 B	Sept 78
	38.8	25.6 B	June 79
Change	12.6		264
Rate	0.048		
	38.8	25.6 B	June 79
	50.0	11.5 B	Oct 80
Change	11.2		481
Rate	0.023		
1626	21.0	24.2 B	June 78
Female	25.2	24.2 B	Sept 78
Change	4.2		94
Rate	0.045		
	25.2	24.2 B	Sept 78
	41.5	20.3 C	Oct 80
Change	16.3		745
Rate	0.022		
1631	20.1	22.5 B	June 78
Male	21.2	23.0 B	Sept 78
Change	1.1		93
Rate	0.012		
	21.2	23.0 B	Sept 78
	34.0	25.7 C	June 79
Change	12.8		267
Rate	0.048		
	34.0	25.7 C	June 79
	43.0	27.0 C	Oct 80
Change	9.0		479
Rate	0.019		

	SVL	Position	Capture
1644	17.4	44.5 B	June 78
Male	18.0	30.6 B	Sept 78
Change	0.6		95
Rate	0.006		
	18.0	30.6 B	Sept 78
	37.0	31.0 B	June 79
Change	19.0		263
Rate	0.072		
	37.0	31.0 B	June 79
	48.0	21.3 C	Oct 80
Change	11.0		481
Rate	0.023		
1656	18.7	36.1 B	June 78
Male	20.2	36.5 B	Sept 78
Change	1.5		94
Rate	0.016		
	20.2	36.5 B	Sept 78
	35.4	36.8 B	June 79
Change	15.2		267
Rate	0.057		
	35.4	36.8 B	June 79
	46.0	10.5 B	Oct 80
Change	10.6		477
Rate	0.022		
1687	20.0	31.7 B	June 78
Male	23.2	31.4 B	Sept 78
Change	3.2		94
Rate	0.034		
	23.2	31.4 B	Sept 78
	45.0	16.0 B	Oct 80
Change	21.8		743
Rate	0.029		

TABLE 4.4 (continued)

	SVL	Position	Capture
1758	19.5	42.4 C	June 78
Female	21.7	42.1 C	Sept 78
Change	2.2		93
Rate	0.024		
	21.7	42.1 C	Sept 78
	39.0	42.0 C	June 79
Change	17.3		262
Rate	0.066		
	39.0	42.0 C	June 79
	45.0	42.2 C	Oct 80
Change	6.0		479
Rate	0.012		
1773	18.4	42.3 C	June 78
Female	20.3	42.2 C	Sept 78
Change	1.9		93
Rate	0.020		
	20.3	42.2 C	Sept 78
	38.2	41.8 C	June 79
Change	17.9		262
Rate	0.068		
	38.2	41.8 C	June 79
	46.0	42.5 C	Oct 80
Change	7.8		479
Rate	0.016		

	SVL	Position	Capture
1816	17.1	31.9 C	Sept 78
Male	37.2	31.7 C	June 79
Change	20.1		261
Rate	0.007		
	37.2	31.7 C	June 79
	43.0	31.0 C	Oct 80
Change	5.8		480
Rate	0.012		
1817	26.5	31.2 C	Sept 78
Male	41.5	31.0 C	June 79
Change	15.0		264
Rate	0.057		
	41.5	31.0 C	June 79
	50.0	30.2 C	Oct 80
Change	8.5		477
Rate	0.018		
1818	24.8	31.4 C	Sept 78
Female	39.0	39.2 C	June 79
Change	14.2		263
Rate	0.054		
	39.0	39.2 C	June 79
	45.0	31.5 C	Oct 80
Change	6.0		478
Rate	0.013		

Part 5

GROWTH OF LARGE ANIMALS

In October-November of 1980 and 1981 a number of animals caught originally between 1973 and 1976 on the Liverpool-Tomkinson Rivers System were recaptured, providing valuable information on the growth of *C. porosus* after the third year, i.e., for the ages where the data was very limited before. In Table 5.1 we give the capture histories of these animals and also the average rate of SVL growth between first and last capture. In Table 5.2 we give the size at the end of each year calculated using the growth curves in Webb *et al.* (1978); for large animals we have used, for males, the 65 cm maximum head length curve, and for females, the 51 cm maximum head length curve; we have also calculated the yearly growth rates.

It may be seen in Table 5.1 that for males, 0.025 cm/day seems to be about the average growth rate over the first seven or so years of life (491, 382, 454, 1418, 1059). From Table 5.2 and assuming an initial SVL of 13.9 cm (see Part 3.4) we see that the growth curve of Webb *et al.* (1978) predicts, over the first seven years, an average SVL growth rate of 0.037 cm/day; a figure which is too high when compared with the specific examples. Both animals 491 and 454 are from the June, 1974 Tomkinson nests and so are known to be 7.2 years old. Use of the growth curve for large males (the 65 cm case) would predict that their SVL should be around 110 cm which is much higher than these two examples and also than that of 382, about a year younger.

Animal 251 merits attention. Between its first two captures, about a year apart, its growth rate was 0.030 cm/day. Over the next six years, between the 1975 and the 1981 captures, it averaged 0.021 cm/day. According to the growth curve, an animal with a SVL of 65 cm should be

TABLE 5.1

Capture histories of animals recaught on the Liverpool-Tomkinson Rivers System in October, 1980 and October, 1981. The rate shown is that between the initial and final captures.

Animal	Sex	Capture Date	SVL (cm)	Capture Date	SVL (cm)	Capture Date	SVL (cm)	Rate (cm/day)
491	M	17.8.74	15.5	26. 7.75	38.3	23.10.81	82.0	0.025
251	M	16.8.74	65.0	25. 7.75	75.3	13.10.81	122.0	0.022
382	M	29.6.74	18.4	21. 5.75	38.8	1.11.80	86.0	0.029
438	F	2.8.74	22.4	1.11.80	77.4	—	—	0.024
454	M	16.8.74	18.9	24. 7.75	39.6	6.10.81	90.9	0.028
1418	M	17.3.76	14.9	11. 5.76	22.0	8.10.81	69.2	0.027
148	F	20.8.73	60.0	27. 8.74	72.1	22.10.81	110.0	0.017
1059	M	23.7.75	20.5	8.10.81	77.5	—	—	0.025

TABLE 5.2

Growth of large crocodiles calculated using the equations of Table 1 of Webb *et al.* (1978). For males we have taken the 65 cm maximum head length case; for females the 51 cm case. The annual growth rate (SVL, cm/day) is also shown. See Table 3.1 for symbols.

	Age (years)	HL (cm)	SVL (cm)	TL (cm)	TL (feet)	Growth rate
MALE	4.0	23.1	78.5	162.2	5′ 4″	0.028
	5.0	26.0	88.8	183.3	6′ 0″	0.026
	6.0	28.7	98.4	203.0	6′ 8″	0.0245
	7.0	31.2	107.3	221.2	7′ 3″	0.023
	8.0	33.6	115.7	238.4	7′ 10″	0.021
	9.0	35.8	123.4	254.2	8′ 4″	0.020
	10.0	37.8	130.6	269.0	8′ 10″	0.018
	11.0	39.7	137.3	282.7	9′ 3″	
FEMALE	4.0	21.1	71.6	147.3	4′ 10″	0.0215
	5.0	23.4	79.5	163.2	5′ 4″	0.020
	6.0	25.4	86.8	177.9	5′ 10″	0.018
	7.0	27.3	93.5	191.3	6′ 3″	0.017
	8.0	29.1	99.7	203.8	6′ 8″	0.016
	9.0	30.7	105.5	215.5	7′ 1″	0.015
	10.0	32.2	110.8	226.1	7′ 5″	0.014
	11.0	33.6	115.8	236.2	7′ 9″	

some 3 years old, and so by October 1981 animal 251 should be some 10 years old, with a SVL of 126 cm (53 cm case) or 131 cm (65 cm) case instead of the 122.0 cm found. The 65 cm case also predicts, between the 4th and 10th year, an average growth rate of 0.024 cm/day, which is fairly close to the observed value of 0.021 cm/day.

The two females recaptured in 1980 and 1981 (438 and 148) also deserve comment. Animal 438 has a SVL of 77.4 cm at an age of some 6.5 years, again somewhat less than that predicted by the growth curves. Animal 148 may be taken as approximately 2.5 years old on first capture (according to the growth curve) and so has a SVL of 110 cm at age approximately 10 years in good agreement with the 51 cm curve for females.

Animal 1418, one of Magnusson's 1976 hatchlings, at 5.5 years has a SVL of 69 cm, which by the growth curve should be the SVL of a 3 year old. However, as we have seen in Part 4.3, there are examples of animals that show growths up to their third year in line with that predicted by the growth curve.

Animals 176, 177 (see Table 4.3) both males from the Liverpool, have SVLs of about 58 cm in July 1973 and about 83 cm in June 1975. It is easily within reason that these animals hatched in June 1971, and thus at the age of 48 months have SVLs slightly larger than that of 491 which is some 88 months old. (One wonders if possibly 1978-1981 was not such a good period for growth. Since we are comparing the Blyth-Cadell and Liverpool-Tomkinson Systems for different years, it is possible the years on the Blyth-Cadell were bad ones for growth. However, the comparisons of the Liverpool and the Tomkinson in Parts 3 and 4 are over the same years and there are differences.)

Some other individual growth records for larger animals over the period 1973-1976 may also be examined. One female (359) changed from a SVL of 80.0 to 107.0 cm over a 22 month period, giving the high average rate of 0.040 cm/day (calculation from the head length change gives a SVL rate of 0.037 cm/day). This is a very high rate for a large animal, especially a female. Another female (1070) over a 460 day period grew from a SVL of 103 to

114 cm (0.024 cm/day); another (401) grew from 107 to 114 cm over a year (0.019 cm/day). The growth of two large males (called A and B) has already been detailed in Webb *et al.* (1978). Another record of a large male is that of 365 which changed in SVL from 149 to 160 cm over a 282 day period, giving a rate of 0.039 cm/day (however calculation from the head length change gives a SVL rate of 0.027 cm/day and shows that care must be taken in interpreting SVLs derived from HLs, especially for big animals).

Worrell (1964) presents information about a large *C. porosus* kept in a zoo. The animal was approximately 2 m originally and for 6 years grew at a SVL rate of 0.040 cm/day (at apparently a uniform rate) and then slowed, averaging only 0.010 cm/day over the following 16 years. The latter growth rate is hard to interpret as the animal may have stopped growing at some stage. However the rate of 0.040 cm/day from approximately its fifth to eleventh year is high. The animal of course is in a state of captivity and is presumably always well fed; however the figure indicates a possible rate of growth for a large animal, one that is higher than most of our observations in the wild. At age ∿ 27 years the animal was about 4.9 m in length. Animal 251 is 2.4 m, with an age of probably 10 years, in comparison with this captive animal which was 3.7 m at about 12 years.

Some information is available on growth of large specimens of another crocodilian species, *C. niloticus*. Stoneman (1969; Table 1) presents data for some penned, well-fed animals, kept over a period of some 9 years. Measurements were made in 1965, 1966 and 1969 and for the animals initially over 1.7 m in length the growth rate over 1966-1969 is down by a factor varying from 5 to 12 on that over 1965-1966. Average SVL growth rates over the 4 year period from 1965 to 1969 vary from 0.006 to 0.014 cm/day for these animals (rates obtained by halving total length rate). These rates may be compared with the 6 year growth of our specimen 251M (initially 1.5 m), averaging 0.021 cm/day and it may also be noted that the reduction in growth rate over the year prior to the 6 year period is only 30% (from 0.030 to 0.021), differing considerably from the large drops noted above. The ages of Stoneman's specimens are uncertain but they are known to lie between 9 and 12 years. The largest animal had a total length of 2.24 m which may be compared with 2.44 m for animal 251, which has a minimum age of 9 years but could be 10 or 11 years old. Cott (1961) presents a number of measurements of *C. niloticus* of known age from zoos and has one animal at 2.34 m after 8 years (kept at Cairo under fairly natural conditions of climate and environment) and two at 1.85 m after 4.5 years. The growths of the zoo animals are generally similar to that of an animal observed under natural conditions over 22 years, Cott (1961). The growth rate of *C. niloticus* from Cott's data, over the first 7 years, averages 0.035 cm/day, which is somewhat higher than that for *C. porosus* in our sample (Table 5.1). Again is is interesting to note that the wild specimen observed over 22 years exhibits roughly linear growth up to 7 years (at 0.036 cm/day) and then also very uniform growth at a rate of 0.005 cm/day over the next fifteen years. We see again, as with Stoneman's examples, a sharp drop in rate. The *C. porosus* specimen quoted by Worrell also shows this sharp decline in growth rate, but after the twelfth year. Our only really comparable animals for growth rates of large *C. porosus* are the cases A and B of Webb *et al.* (1978), one of which showed no appreciable growth over 3.3 years and another (B) which averaged 0.011 cm/day over 2.3 years (very similar to Worrell's rate over 16 years). This animal (of total length 4.0 m, 13 feet) was estimated as 20-24 years old.

In Webb *et al.* (1978), there is a discussion of typical maximum sizes reached by *C. porosus* on different rivers. For males, they estimate (from hunters' reports) 4.2–5.0 m and for females, 3.2–3.7 m (though some male specimens are known to exceed 6.0 m). Cott (1961) in discussing the maximum size of *C. niloticus* quotes (also from shooters' reports) 4.0 to 4.6 m as the average for large crocodiles shot in an area in Central Africa, with specimens up to 6 m. In other areas animals up to 6.5 metres have been taken. Webb and Messel (1978) report a reliable measurement of a *C. porosus* specimen of at least 6.15 m, and less reliable reports give lengths over 8 m. The typical maximum size reached by *C. niloticus* and *C. porosus* do not appear to be all that different. From his data, Cott takes it as evident that the maximum size attained by *C. niloticus* differs widely according to locality, in agreement with the general opinion amongst hunters (quoted by Webb *et al.* (1978)) that the typical maximum size of *C. porosus* males varies in different river systems and regions. This would fit in with our results for early growth, which appear to indicate differences between river systems. However in attempting to draw inferences about differences of growth of larger animals on different rivers, one must always remember that the animals can and do move between river systems.

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APPENDIX 1 ERRATA

There are a number of discrepancies in the tables given in Appendix 1 and Appendix 2 of Webb and Messel (1978).

The major error occurs with the results quoted for the Group IV animals — which are the largest animals, all males, and with snout-vent lengths greater than 126 cm. Looking at Appendix 2 in the N column it is seen that the number of Group IV is sometimes given as between 231 and 237 and sometimes as between 9 and 11. The actual number of animals in Group IV is 11 (but not all can be used for each measurement). The coefficients given when N is between 231 and 237 are in fact those appropriate for Group IV + males in Group III. This error occurred due to a logical error in programming and also occurs in Appendix 1.

The other major problem occurs for the group 41-126 cm snout vent length. In Appendix 1, N is given as 416 for M + F, tail length 45-135. In Appendix 2, N is given as 426 for supposedly the same animals. The discrepancy is due to 10 animals of undetermined sex being included (correctly) in Appendix 2 but omitted (incorrectly) in Appendix 1.

A number of other values of N are incorrect by 2. In Appendix 2 what is given as the handwidth is actually the footwidth and vice-versa.

There are also some errors in the paper entitled "Movement and dispersal patterns of *C. porosus* in some rivers of Arnhem Land, northern Australia" by Webb and Messel (Aust. Wildl. Res., 1978, 5, 263-83). The movements shown for 40, 232 and 321 in Fig. 5 are incorrect. No. 40 hardly moved between the three captures but has been given a movement of 21.1 km downstream followed by 21.6 km upstream. A paragraph (page 271) is devoted to this erroneous movement. No. 232 also does not move and is given a movement of 16.1 km. No. 321 is shown as not moving at all over the three captures when in fact it moved 17 km upstream between the second and third capture.

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3.

THE CONTINUING AND MYSTERIOUS DISAPPEARANCE OF A MAJOR FRACTION OF SUB-ADULT *C. POROSUS* FROM TIDAL WATERWAYS IN NORTHERN AUSTRALIA

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ABSTRACT

In previous publications we have developed a model of the dynamics of *C. porosus* populations on the tidal waterways of northern Australia, based on the results of repeated censuses. A highly important element of this model is the continuing loss of a major fraction of sub-adults. In this paper, by utilising the results of surveys in June-July 1982, and additional analysis of previous survey results, we give further support for our contentions about the high losses and considerably more detail about the some 30% or so of the non-hatchling population that survives. The reasons for the high losses remain, to some extent, a mystery. A very dynamic situation prevails, with movement of both adults and sub-adults between TYPE 1 river mainstreams, their extreme upstream reaches, and non-TYPE 1 systems (such as swamps, waterholes and coastal or non-coastal saline creeks). Through use of a small boat and a helicopter we have been able to survey previously inaccessible components of our monitoring area. With this additional knowledge we have been able to very considerably sharpen our understanding of the population changes occurring in our monitored systems. A detailed description and analysis of the systems and the population changes is presented within the framework of our model of the population dynamics. There is good evidence for a gradually increasing ratio of large to small animals, but no support for any contention of major population increases. Our discussion also suggests that adult *C. porosus*, rather than sharks, could be the major predators of sub-adult *C. porosus*.

INTRODUCTION

The eleven year systematic and continuing study of *Crocodylus porosus* in the local waterways of northern Australia by the University of Sydney Crocodile Research Group has done much to elucidate the behaviour, physiology, population status and population dynamics of this hitherto relatively poorly studied species. Like all such studies, it has given rise to more questions than answers and has encouraged further and more sharply defined research.

The present paper is directed towards bringing more sharply into focus, by using the results of our latest surveys in June 1982, some of the major findings (discussed later) of our previous study of the population dynamics of *C. porosus* in tidal waterways. The results of this study have been presented in a series of 17 monographs and 2 reports by Messel and his co-workers (Messel *et al.*, 1979, 1980, 1981, 1982). We also report on our latest results on the status of the *C. porosus* population in the 330 km of TYPE 1 to TYPE 3 tidal waterways east and west of our northern Arnhem Land headquarters at Maningrida, on the Liverpool-Tomkinson Rivers System. These relatively undisturbed waterways constitute our population dynamics and status monitoring systems (see pages 15 and 440 of Monograph 1).

The model we have built up for the dynamics of *C. porosus* populations on the northern Australian coastline (see Monographs 5, 7, 9, 10, 11, 16, 17 and specially Chapter 6 of Monograph 1) and which has been able to account in a consistent fashion for the results of our surveys of some 100 tidal systems is as follows:

The tidal waterways of northern Australia have been classified according to their salinity signatures into TYPE 1, TYPE 2 and TYPE 3 systems as delineated in Chapter 3, Figure 3.4.11A of Monograph 1 (see pages 100 and 101). TYPE 1 systems are the breeding ones and non-TYPE 1 systems are usually poor or non-breeding systems. It is the TYPE 1 systems which account for the major recruitment of *C. porosus*; the other systems contribute to a lesser degree and they must depend largely upon TYPE 1 systems for the provision of their crocodiles. In Table 9.2.1 (page 419) of Monograph 1, our results show that in TYPE 1 systems some 27% of the crocodiles sighted are hatchlings, whereas in TYPE 2-3 systems this figure falls to 14% and in TYPE 3 systems down to 4%, showing a much decreased hatchling recruitment in non-TYPE 1 systems. In TYPE 3 systems the percentage of crocodiles in the hatchling, (2-3′) and (3-4′) size classes combined is some 11% whereas in TYPE 1 systems it is at least 52%. On the other hand the percentage of crocodiles in the ≥(4-5′) size classes is some 39% in TYPE 1 systems and 73% in TYPE 3 systems (see page 431 of Monograph 1).

It appears that the populating of the non-TYPE 1 systems results mostly from the exclusion of a large fraction of the sub-adult crocodiles from TYPE 1 systems; a small fraction of these excluded crocodiles apparently find their way into non-TYPE 1 systems. Adult crocodiles appear generally to tolerate hatchlings, (2-3′) and sometimes even (3-4′) sized crocodiles in their vicinity (but not always — they sometimes eat them — see page 43, Monograph 14 — or kill them, see page 334, Monograph 1), but not larger crocodiles. Thus once a crocodile reaches the (3-4′) and (4-5′) size classes, it is likely to be challenged increasingly not only by crocodiles near or in its own size class (see pages 454-458, Monograph 1) but by crocodiles in the larger size classes and be excluded from the area it was able to occupy when it was smaller. Crocodile interactions appear to increase around October — during the breeding season (see page 445, Monograph 1). A substantial fraction (~80%) of the (3-6′) sized crocodiles may thus be excluded from the river or be predated upon by larger crocodiles. Of those crocodiles that have been excluded, some may travel along the coast until by chance they find a non-TYPE 1 waterway; others may take refuge in freshwater swamp areas and billabongs nearby; others may go out to sea and possibly perish (perhaps because of lack of food, as they are largely shallow water on edge feeders, or they may be taken by sharks). Those finding non-TYPE 1 systems frequent these areas, which act as rearing stockyards, for varying periods, until they reach sexual maturity, at which time they endeavour to return to a TYPE 1 breeding system. Both sub-adults and just mature adults might attempt to return and be forced out of the system many times before finally being successful in establishing a territory in a TYPE 1 system. The crocodiles may have a homing instinct (this important point requires further study) and even though a fraction of crocodiles finally return to and remain in a TYPE 1 system, the overall numbers missing — presumed dead — remain high and appear to be some 60-70%. Since a large fraction of crocodiles sighted in non-TYPE 1 systems must be derived from TYPE 1 systems, they are predominantly sub-adults or just mature adults (see page 431, Monograph 1). The loss factor which appears to occur during the exclusion stage can be expected to be lower for movements into and out of swamp areas than for movements into and out of coastal non-TYPE 1 systems.

The above model for the dynamics of *C. porosus* populations in tidal waterways was first proposed in 1979 (see Monographs 1, 9, 10 and 11) using the survey and resurvey results on some 100 tidal waterways on the northern Australian coastline. Since that date the 330 km of tidal waterways acting as our monitoring systems were resurveyed in October 1980, July 1981 and October 1981 and these results were included in Monograph 1 (the main Monograph of the series) as an "Addendum August 1981", pages 440 to 446 and as a "Stop Press, October 1981", pages 14 and 15. The 1980 and 1981 data provided further strong support for the model proposed, confirming for the sub-adults, the extraordinarily heavy loss factor of some 60-70% missing — presumed dead. Because of these heavy losses, it was not surprising that our data indicated no overall increase in non-hatchling numbers; the number of small (2-6′) crocodiles appeared to be steady or decreasing whereas the number of large crocodiles (≥6′) appeared to be increasing slightly (see Tables on page 14, Monograph 1, also see caption to Table 3 for division of "eyes only" classes).

We have been, and still are, somewhat perplexed by certain aspects of these results, for instance, so far we have been unable to substantiate suggestions as to what happens to the missing sub-adults. This is the major subject matter of the present paper.

RESULTS

In Table 1 we have updated those parts of Table 9.2.1 of Monograph 1 which relate to the 330 km of tidal waterways constituting our monitoring systems. It is to be noted that these include a mixture of TYPE 1 to TYPE 3 systems. Results for our June 1982 resurveys are included. Perhaps it is appropriate to state here that the data in Table 1 does not lend itself to quick answers or facile statements and furthermore that it does not reflect the almost inconceivable effort which has gone into obtaining it.

Table 2 is an update of the important and informative Table 6.2.31 from Monograph 1, again with the results for the June 1982 resurveys included. Table 2 is obtained using Table 1, and highlights a number of salient features of the data.

A further convenient way of viewing the data is shown in Table 3 which is an update of Table 6.2.30 from Monograph 1 but with results for the Liverpool-Tomkinson Rivers System (Monograph 7) included. Though Tables 1, 2 and 3 present data for the overall river systems, they do not show results broken down for the major components of the systems. In Tables 4 and 5 we show summary results for the number of crocodiles sighted in the hatchling, small and large size classes during the general night-time surveys of the major components of the Blyth-Cadell and Liverpool-Tomkinson Rivers Systems (Figs 1, 2 and 3).

TABLE 1

Number of *C. porosus* sighted within each size class on tidal waterways of the 330 km of control systems (see text) during night-time spotlight surveys. The midstream distance surveyed and density of non-hatchling crocodiles sighted on it is shown, as are the 95% confidence limits for the estimate of the actual number of non-hatchlings present. The TYPE classification of each waterway is given also.

Systems	**Total**	**Size Class Numbers**								**km surveyed**	**Density**	**95% Levels**	**TYPE**
		H	**2-3**	**3-4**	**4-5**	**5-6**	**6-7**	**>7**	**EO**				
MONOGRAPH 1													
Blyth-Cadell													
Oct 74	387	89	81	147	58	6	2		4	91.9	3.2	454-524	1
Nov 75	353	50	106	81	72	23	4	2	15	94.9	3.2	462-532	
Sept 76	348	82	63	104	46	14	7	6	26	92.0	2.9	403-469	
Nov 76	307	61	61	103	47	10	4	2	19	92.0	2.7	371-435	
Apr 77	327	72	70	108	48	10	2	4	13	92.0	2.8	386-450	
May 77	333	88	60	94	55	13	4	1	18	92.0	2.7	370-432	
June 77	365	108	36	102	69	13	10	3	24	90.5	2.8	389-453	
Sept 77	386	105	45	132	47	17	4	4	32	90.5	3.1	427-495	
Oct 77	360	112	68	83	47	18	8	3	21	90.5	2.7	375-439	
June 78	432	173	65	81	67	15	6	4	21	90.5	2.9	393-457	
Sept 78	399	155	60	79	56	18	8	6	17	90.5	2.7	369-431	
June 79	465	123	91	93	59	31	16	26	26	94.5	3.6	524-598	
Oct 80	400	119	89	71	48	22	9	4	38	92.9	3.0	427-495	
July 81	366	76	86	84	43	24	11	9	33	90.1	3.2	442-510	
Oct 81	315	72	77	60	32	20	16	7	31	89.2	2.7	367-430	
Jun 82	408	136	42	59	49	31	22	20	49	91.9	3.0	413-479	
Nov 82	347	111	43	66	46	28	15	10	28	92.5	2.6	356-418	
MONOGRAPH 5													
Goomadeer													
Aug 75	46		27	7	5	4			3	45.3	1.0	61-89	1
Sept 76	52	18	5	8	5	1	3	3	9	45.3	0.8	44-68	
June 77	50	2	9	13	10	6	2	1	7	45.3	1.1	65-83	
July 79	90	29	14	7	14	10	6	1	9	45.3	1.4	84-116	
June 81*	43	6	5(3)	11(8)	8(1)	4	3	1	5	45.0	0.8	49-73	
Oct 81	45	17	3	13	6	1			5	45.0	0.6	35-47	
June 82	61	18	5	12	5	2	4	4	11	45.3	0.9	58-84	
Oct 82	54	9	7	9	11	5	4	3	6	45.3	1.0	61-87	
Majarie													
Aug 75	12	1	1	2	2	1	1	2	2	20.1	0.5	11-25	3
Aug 76	7			3					4	20.1	0.4	7	
July 79	18			1	7	4	1	3	2	24.1	0.7	21-39	
June 81	19			2	2	4	2	3	6	21.2	0.9	22-40	
Oct 81	17			3	4	2	1		7	22.0	0.8	20-36	
June 82	17	2	1	1	2	2	1	3	5	23.8	0.6	17-33	
Oct 82	12				4	5	1	1	1	23.3	0.5	13-27	
Wurugoij													
Aug 75	4				3	1				16.4	0.2	4	3
Aug 76	1								1	16.4	0.1	1	
July 79	9					2	2	4	1	16.4	0.5	9	
June 81	6			1	1	1	1	1	1	16.4	0.5	6	
Oct 81	8		1	1	1	3			2	16.4	0.5	8	
June 82	7					2		2	3	16.2	0.4	7	
Oct 82	8	1			2	2	1	1	1	16.4	0.4	7	
MONOGRAPH 7													
Liverpool-Tomkinson													
July 76	248	19	39	58	29	15	6	3	79	158.9	1.4	346-406	1
May 77	245	40	6	51	59	30	13	5	41	145.1	1.4	307-365	
Oct 77	228	56	7	39	62	24	9	1	30	123.4	1.4	256-308	
Sept 78	233	37	18	37	65	19	14	8	35	141.4	1.4	293-349	
July 79	515	289	11	39	43	34	29	20	50	150.0	1.5	341-401	
Oct 79	355	161	16	36	37	29	17	23	36	141.1	1.4	290-346	
Oct 80	295	71	51	37	32	29	12	14	49	140.6	1.6	337-397	
July 81	256	26	52	48	29	23	15	15	48	140.6	1.6	347-407	
Oct 81	254	34	33	50	34	23	14	14	52	141.1	1.6	331-391	
June 82	467	193	29	64	50	37	23	17	54	141.1	1.9	416-482	
Oct 82	384	144	16	48	51	25	21	17	62	141.1	1.7	363-425	

* Numbers in brackets give numbers of crocodiles removed by Biology researchers before survey.

TABLE 1 (continued)

Systems	Total	Size Class Numbers								km surveyed	Density	95% Levels	TYPE
		H	2-3	3-4	4-5	5-6	6-7	>7	EO				
Nungbulgarri													
Aug 75	29		4	11	3		1		10	15.0	1.9	37-59	1*
July 76	15	2		3	5	1	1		3	13.6	1.0	14-28	
June 77	14	2	2		6	1	1		2	13.6	0.9	13-27	
July 79	35	10		4	4	6	5	2	4	14.8	1.7	31-51	
June 81	27	2	4	10	4		1		6	14.8	1.7	31-51	
Oct 81	25		2	12	4	2			5	14.8	1.7	31-51	
June 82	23		2	8	4	3	1	1	4	14.8	1.6	28-48	
Oct 82	29		1	9	8	2	2	4	3	14.4	2.0	37-59	

* Previously classified as TYPE 2.

TABLE 2

Update Table for the Blyth-Cadell Rivers System showing the 2-3′, 3-4′ and 4-5′ size classes grouped together (2-5′) and the size classes above those in another group (≥ 5′). We have also grouped the crocodiles sighted into small (2-6′), (3-6′) and large (≥ 6′). Also shown are the ratios small/large and (3-6′)/large.

Survey	Totals	Hatchlings	2-5′	≥ 5′	Small 2-6′	Large ≥ 6′	3-6′	Small/Large	3-6′/Large
26 October 74	387	89	286	12	292	6	211	48.7	35.2
1 November 75	353	50	263	40	289	14	183	20.6	13.1
Major Flooding									
23 September 76	348	82	221	45	240	26	177	9.2	6.8
4 November 76	307	61	217	29	230	16	169	14.4	10.6
11 April 77	327	72	230	25	242	13	172	18.6	13.2
3 May 77	333	88	215	30	231	14	171	16.5	12.2
8 June 77	365	108	215	42	232	25	196	9.3	7.8
16 September 77	386	105	234	47	257	24	212	10.7	8.8
23 October 77	360	112	204	44	226	22	158	10.3	7.2
10 June 78	432	173	219	40	238	21	173	11.3	8.2
12 September 78	399	155	200	44	221	23	161	9.6	7.0
No Flooding									
10 June 79	465	123	251	91	287	55	196	5.2	3.6
4 October 80	400	119	220	61	249	32	160	7.8	5.0
Heavy Flooding									
9 July 81	366	76	223	67	253	37	167	6.8	4.5
19 October 81	315	72	179	64	204	39	127	5.2	3.3
Dry Wet — Minor Flooding Only									
25 June 82	408	136	166	106	205	67	163	3.1	2.4
6 November 82	347	111	164	72	197	39	154	5.1	3.9

TABLE 2 (continued)

Summary Table for the overall Liverpool-Tomkinson Rivers System (Monograph 7).

Survey	Totals	Hatchlings	2-5′	≥5′	Small 2-6′	Large ≥6′	3-6′	Small/Large	3-6′/Large
				Major Flooding					
18 July 76	248	19	152	77	180	49	141	3.7	2.9
25 May 77	245	40	129	76	166	39	160	4.3	4.1
27 October 77	228	56	118	54	147	25	140	5.9	5.6
27 September 78	233	37	131	65	156	40	138	3.9	3.5
				No Flooding					
16 July 79	515	289	109	117	152	74	141	2.1	1.9
19 October 79	355	161	101	93	136	58	120	2.3	2.1
15 October 80	295	71	136	88	173	51	122	3.4	2.4
				Heavy Flooding					
2 July 81	256	26	145	85	176	54	124	3.3	2.3
5 October 81	254	34	134	86	166	54	133	3.1	2.5
				Dry Wet — Minor Flooding Only					
12 June 82	467	193	161	113	207	67	178	3.1	2.7
16 October 82	384	144	135	105	171	69	155	2.5	2.2

TABLE 3

Summary Table showing for each survey of the overall Blyth-Cadell Rivers System the number of crocodiles in the size classes indicated. The EO classes have been added together in each survey and 50% of these have been distributed equally among the 3-4′, 4-5′ and 5-6′ size classes; the remaining 50% have been distributed to the ≥6′ size classes with ⅓ being allocated to the 6-7′ size class and ⅔ to size classes ≥7′. This weights the distribution heavily in favour of larger crocodiles, which are known to normally be the most wary. For 1974, all EO crocodiles were put in the ≥7′ size class.

	Totals	H	≥2′	≥3′	≥4′	≥5′	≥6′	≥7′	km surveyed	Density
26 October 74	387	89	298	217	70	12	6	4	91.9	3.24
1 November 75	353	50	303	197	114	40	14	7	94.9	3.19
					Major Flooding					
23 September 76	348	82	266	203	95	45	26	15	92.0	2.89
4 November 76	307	61	246	185	79	29	16	6	92.0	2.67
11 April 77	327	72	255	185	75	25	13	9	92.0	2.77
3 May 77	333	88	245	185	88	30	14	7	92.0	2.66
8 June 77	365	108	257	221	115	42	25	11	90.5	2.84
16 September 77	386	105	281	236	99	47	24	15	90.5	3.10
23 October 77	360	112	248	180	94	44	22	10	90.5	2.74
10 June 78	432	173	259	194	110	40	21	11	90.5	2.86
12 September 78	399	155	244	184	103	44	23	12	90.5	2.70
					No Flooding					
10 June 79	465	123	342	251	154	91	55	35	94.5	3.62
4 October 80	400	119	281	192	115	61	32	17	92.9	3.02
					Heavy Flooding					
9 July 81	366	76	290	204	115	67	37	20	90.1	3.22
19 October 81	315	72	243	166	101	64	39	18	89.2	2.70
					Dry Wet — Minor Flooding Only					
25 June 82	408	136	272	230	163	106	67	37	91.9	2.96
6 November 82	347	111	236	193	123	72	39	19	92.5	2.55

TABLE 3 (continued)

Equivalent Table for Liverpool-Tomkinson System (also see caption to Table 5).

	Totals	H	≥ 2′	≥ 3′	≥ 4′	≥ 5′	≥ 6′	≥ 7′	km surveyed	Density
					Major Flooding					
18 July 76	248	19	229	190	119	77	49	30	158.9	1.44
25 May 77	245	40	205	199	142	76	39	19	145.1	1.41
27 October 77	228	56	172	165	121	54	25	11	123.4	1.39
27 September 78	233	37	196	178	136	65	40	20	141.4	1.39
					No Flooding					
16 July 79	515	289	226	215	168	117	74	37	150.0	1.51
19 October 79	355	161	194	178	136	93	58	35	141.1	1.38
15 October 80	295	71	224	173	128	88	51	31	140.6	1.59
					Heavy Flooding					
2 July 81	256	26	230	178	122	85	54	31	140.6	1.64
5 October 81	254	34	220	187	129	86	54	32	141.1	1.56
					Dry Wet — Minor Flooding Only					
12 June 82	467	193	274	245	172	113	67	35	141.1	1.94
16 October 82	384	144	240	224	166	105	69	38	141.1	1.70

TABLE 4

Number of *C. porosus* sighted within the hatchling, small and large size classes on the three major components of the Blyth-Cadell Rivers System: Blyth mainstream, Blyth side-creeks and Cadell River.

	Blyth Mainstream			Blyth Sidecreeks			Cadell			Totals		
	H	S	L	H	S	L	H	S	L	H	S	L
26 October 74	41	207	6	1	3	0	47	82	0	89	292	6
1 November 75	41	177	11	3	11	2	6	101	1	50	289	14
						Major Flooding						
23 September 76	48	159	14	2	16	5	32	65	7	82	240	26
4 November 76	40	142	10	3	16	1	18	72	5	61	230	16
11 April 77	65	142	6	3	17	3	4	83	4	72	242	13
3 May 77	74	144	10	0	15	3	14	72	1	88	231	14
8 June 77	88	129	19	2	23	4	18	80	2	108	232	25
16 September 77	75	164	19	2	18	2	28	75	3	105	257	24
23 October 77	76	136	14	3	15	2	33	75	6	112	226	22
10 June 78	136	148	14	1	21	4	36	69	3	173	238	21
12 September 78	115	130	15	1	17	1	39	74	7	155	221	23
						No Flooding						
10 June 79	85	171	40	1	15	9	37	101	6	123	287	55
4 October 80	86	139	22	0	16	4	33	94	6	119	249	32
						Heavy Flooding						
8 July 81	48	144	27	2	25	3	26	84	7	76	253	37
19 October 81	37	127	28	3	13	2	32	64	9	72	204	39
						Dry Wet — Minor Flooding Only						
25 June 82	84	118	41	1	14	6	51	73	20*	136	205	67*
5 November 82	55	116	26*	0	9	3	56	71	11*	111	197	39

* Bias to large.

TABLE 5

Number of *C. porosus* sighted within the hatchling, small and large size classes on the three major components of the Liverpool-Tomkinson Rivers System: Liverpool mainstream, Liverpool sidecreeks and Tomkinson (normally 57.0, 27.4 and 56.7 km respectively, but distances can vary from year to year — see page 16, Monograph 7; note specially that during the 1976 Tomkinson survey, the river was surveyed to km80.1 and that some 11 small and 7 large crocodiles were spotted between km75-80; normally the Tomkinson is surveyed to km73.7).

	Liverpool Mainstream			Liverpool Sidecreeks			Tomkinson			Totals		
	H	S	L	H	S	L	H	S	L	H	S	L
						Major Flooding						
18 July 76	11	64	14	4	27	7	4	89	28	19	180	49
25 May 77	13	67	12	4	28	7	23	71	20	40	166	39
27 October 77	23	77	13*	5	20	4*	28	49	9	56	147	25
27 September 78	13	69	21	7	20	5	17	67	14	37	156	40
						No Flooding						
16 July 79	24	63	29	5	24	21	260	65	24	289	152	74
19 October 79	17	63	32	2	21	5	142	52	21	161	136	58
15 October 80	28	61	25	17	25	7	26	87	19	71	173	51
						Heavy Flooding						
2 July 81	8	75	23	1	23	8	17	77	24	26	176	54
5 October 81	2	74	19	2	26	9	30	66	26	34	166	54
						Dry Wet — Minor Flooding Only						
12 June 82	7	66	30	8	36	10	178	105	27	193	207	67
16 October 82	6	82	27*	3	32	18	135	56	25*	144	171	69

* Bias to large.

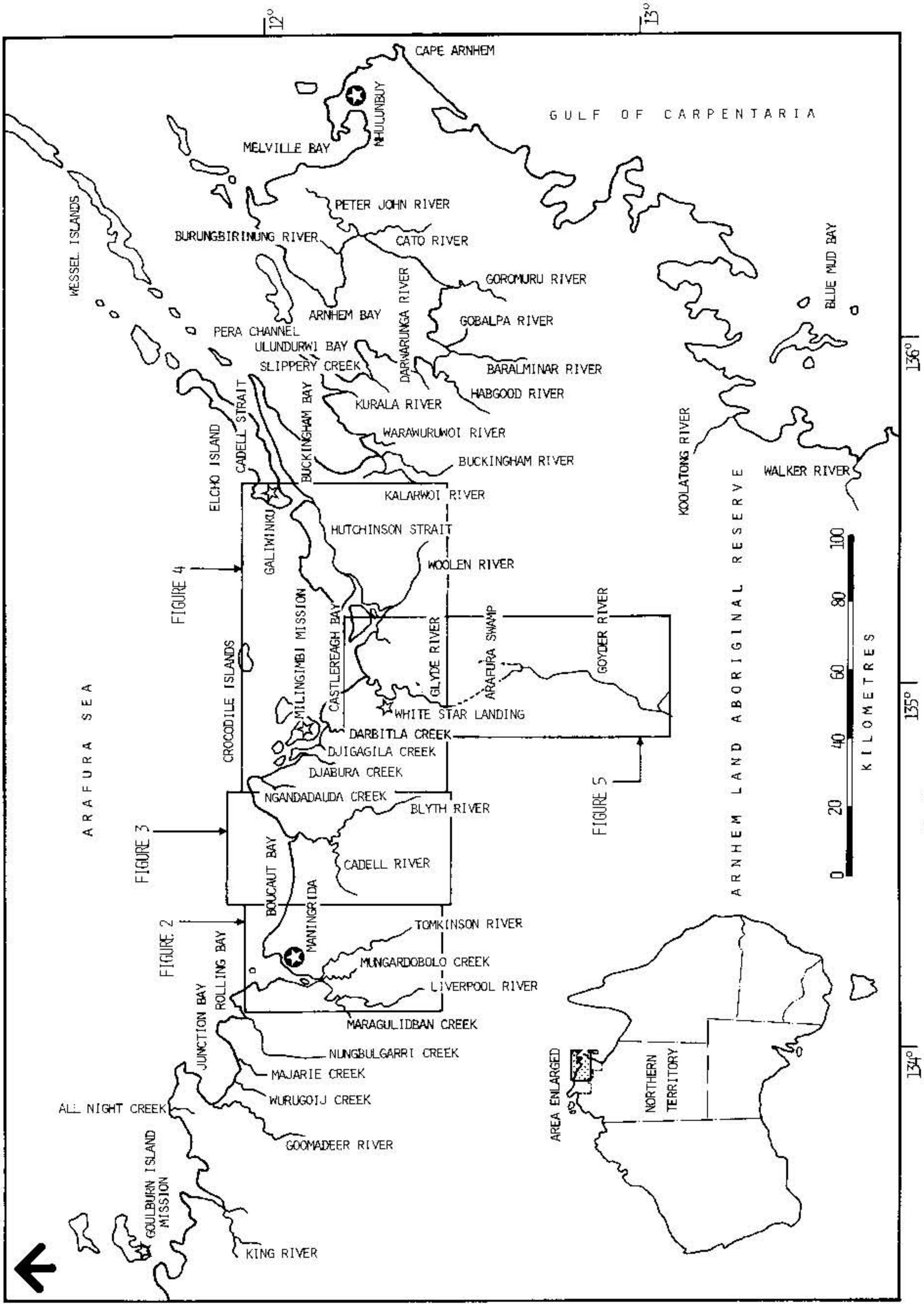

Fig. 1
General area map north eastern Arnhem Land.

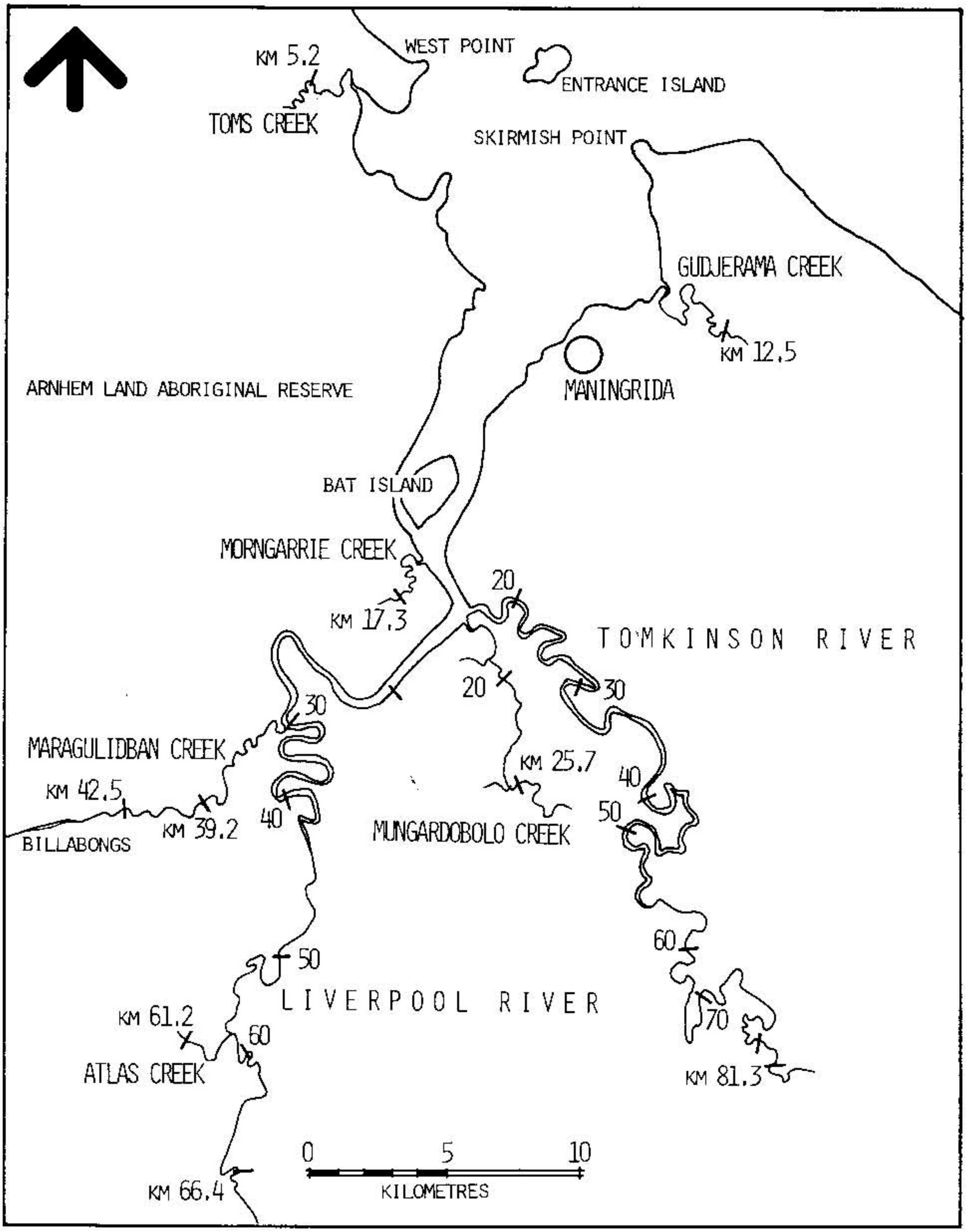

Fig. 2
The Liverpool-Tomkinson Rivers.

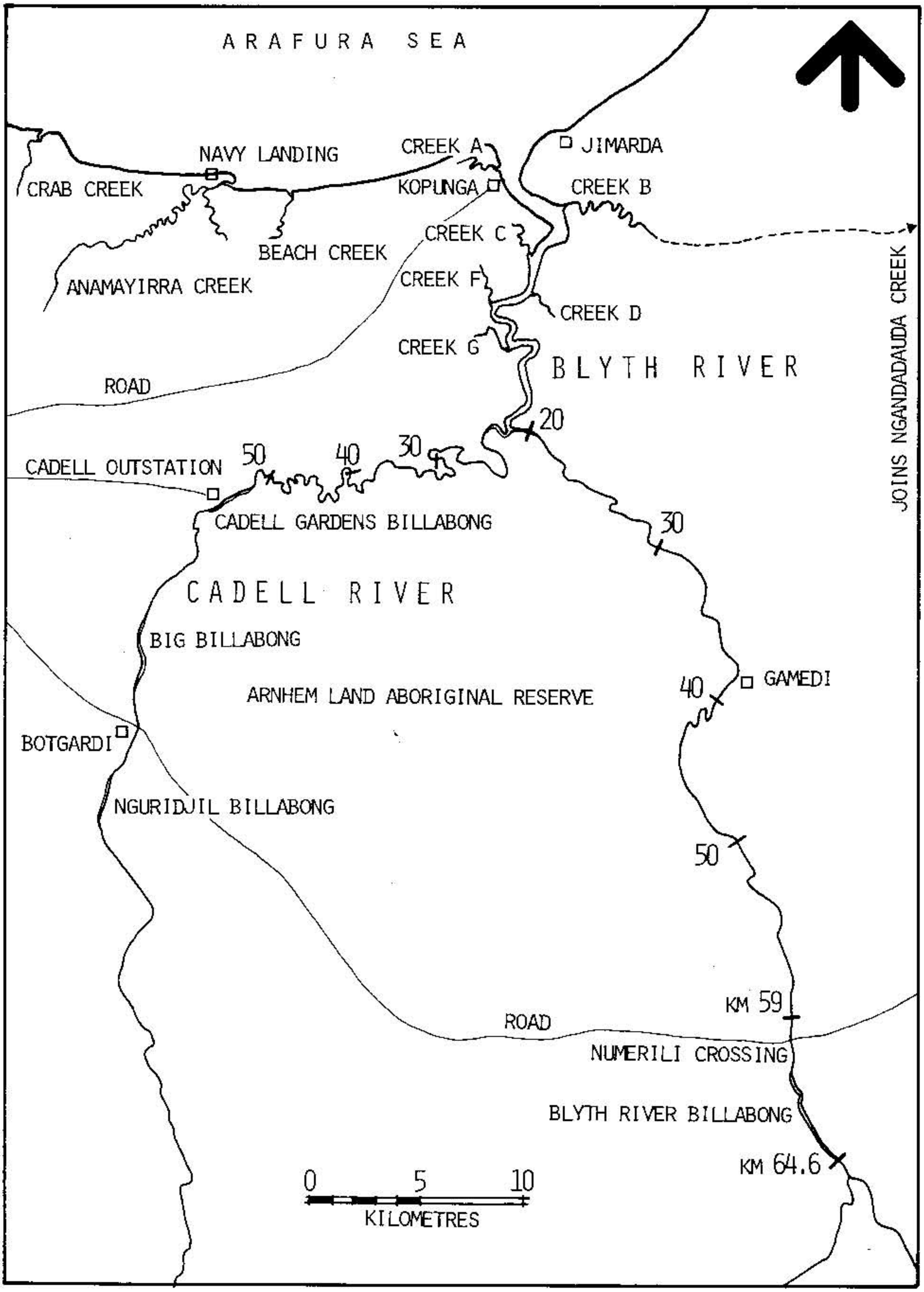

Fig. 3
The Blyth-Cadell Rivers.

DISCUSSION

A study of Table 1 shows that on the Blyth-Cadell System, despite the continuing and substantial yearly input of hatchlings, there has been no increase (in fact a decrease is indicated) in the number of non-hatchling crocodiles sighted during general night-time surveys of this waterway between October 1974 and June 1982, though there were a number of important variations during intervening surveys which indicate a potential recovery. We shall discuss these variations later.

Neither has there been a significant increase on the Goomadeer, Majarie, Wurugoij or Nungbulgarri Systems between the first survey carried out in 1975 and the June 1982 resurvey.

The number of non-hatchling crocodiles sighted on the Liverpool-Tomkinson System during the July 1976 survey was 229, whereas on the June 1982 survey the number was 274, indicating a significant (at the 95% level) increase in the number of non-hatchling crocodiles. As on the Blyth-Cadell System there is variation from year to year and within years.

Consideration of data from numerous surveys and resurveys leaves little doubt that the number of crocodiles sighted reflects well the number of crocodiles on the waterways (Chapters 4 and 5, Monograph 1) and hence that the variations referred to are real. We have pointed out time and again (Monographs 4 to 14 and Chapter 4 of Monograph 1) that one is viewing a highly dynamic situation. Apparently a major cause of this highly dynamic and fluctuating situation is increased interaction between animals in various size classes as the population proceeds through the recovery phase and towards eventual equilibrium conditions. Presumably at that stage there would be certain broad steady state ratios between the number of animals in the various size classes. These ratios could be expected to be system dependent.

Our data has revealed a number of unexpected features. One of these is the surprisingly long period of time that it has taken for the population to even show signs of an increase. *C. porosus* in the Northern Territory has not been hunted legally since 1971 and one might be tempted to assume that the population would surely have recovered to much higher numbers during the intervening 11 years. Even a brief study of Table 9.2.1 in Monograph 1 (covering some 100 tidal waterways in northern Australia) and Tables 1 to 3 in the present paper shows that it has not, and furthermore that any major sustained increase can be expected to be measured in terms of decades (Addendum, page 445, Monograph 1).

The Blyth-Cadell and Liverpool-Tomkinson Systems are among the best TYPE 1 tidal waterways for *C. porosus* in northern Australia. However, whereas on the Blyth-Cadell System, 292 small and 6 large crocodiles (Table 3) were sighted during the October 1974 survey (the results for the November 1975 survey were much the same), on the June 1982 survey only 205 small, and 67 large, crocodiles were sighted. It is common knowledge that the Blyth-Cadell was shot out illegally in 1972 (apparently a thorough job was done by white hunters) and hence one would expect the remaining large animals to still be very wary in 1974. Thus it is likely that the 6 large animals sighted were not a fair indication of the number of large animals remaining on the two rivers in 1974. There could have been substantially more large animals (see page 339, Monograph 1) in the System, but they were too wary to be sighted.

Thus the results in Tables 2 and 3 do not provide evidence yet for an increasing population on the Blyth-Cadell System; instead they indicate a static or decreasing one, however with the population structure changing. During the November 1975 survey, the ratio of small to large crocodiles sighted was 20.6; on the September 1976 survey it was 9.2 (Table 2). For the two 1981 surveys, this ratio was only 6.8 and 5.2, and for the June 1982 survey it was down to 3.1. It is to be noted that the ratio sometimes varies considerably from survey to survey during the course of a single year, however the long term trend on the Blyth-Cadell System is downward.

Unfortunately on the Liverpool-Tomkinson System the first reliable survey of the waterway was not made until 1976 so we are unable to compare data with other waterways, specially with the Blyth-Cadell System, for 1975. A survey of the Liverpool-Tomkinson System was made in 1975 under the guidance of an assistant (no longer with the research programme) to one of the authors (HM); however on that occasion, as on many others during 1975, youthful confidence unbacked by sufficient knowledge led to the accumulation of much worthless data — at enormous cost both financially and scientifically. On the July 1976 survey, 180 small and 49 large crocodiles were sighted (Table 2) yielding a (small/large) ratio of 3.7, which is to be compared with ratios of 9.2 and 14.4 for the two 1976 surveys of the Blyth-Cadell System. On the June 1982 survey, 207 small and 67 large crocodiles were sighted yielding a ratio of 3.1, which surprisingly is the same as that obtained for the Blyth-Cadell System. As shown in Table 2, there has been variation among surveys in the ratio of small to large crocodiles sighted, but these variations have not been nearly as large as those found for the Blyth-Cadell System. The increase in the number of large animals sighted on the Liverpool-Tomkinson System has been much less than on the Blyth-Cadell System.

It is known that the Liverpool-Tomkinson System was not as thoroughly shot out as the Blyth-Cadell System (personal communication to HM by the then two main aboriginal crocodile hunters at Maningrida, Silas Roberts and Billie Yirrinyin, both of whom worked on HM's crocodile research project during the early 1970's) and that a substantial number of large animals remained on the system when serious hunting of *C. porosus* ceased at Maningrida in the late 1960's. That large numbers of large crocodiles were shot on the Liverpool-Tomkinson, cannot be doubted for one of the authors (HM) recalls seeing in 1972, pathways in Maningrida outlined by large *C. porosus* skulls. During the course of writing the present paper, the authors had the fortunate opportunity of a discussion with Colonel (Retired) Syd Kyle-Little who was a Native Affairs Patrol Officer in the Maningrida area from 1946 to 1950 (he was revisiting this area in June 1982, after some 30 years) and who initiated a trial aboriginal project there for the shooting of *C. porosus* for skins. As a patrol officer he kept a daily diary in which he entered many casual observations of *C. porosus*. From his observations he had concluded that the Blyth-Cadell System not only contained the largest crocodiles but also contained considerably more than the Liverpool-Tomkinson System. The smallest crocodiles they shot for skins were 3 m in length and the average was 4.5 m. The largest crocodile shot and measured with a tape-measure was 6.6 m; this animal was shot on the bank near the mouth of the small creek at km48.7 on the Blyth River. According to Kyle-Little, large crocodiles were very numerous and he and two aboriginal helpers shot, on the Liverpool-Tomkinson System, 17 animals on the first night; all animals were ≥4 m in length. Every crocodile shot (some 150) had the stomach contents looked at and on 5 or 6 occasions, portions of smaller crocodiles were observed in the contents. He spent much time camped near various freshwater billabongs in the area and states that he never saw many *C. porosus* in these — usually 2 or 3. He believes that the small numbers are determined by the very limited food supply available in the billabongs.

We have already referred to the surprisingly long period of time that it has taken the *C. porosus* population to even show signs of a sustained increase. Why is this so? Tables 1 to 5 show that year after year there is recruitment of hatchlings into the systems — at various levels, sometimes high and sometimes low. We know that some 50% of these survive from June of one year to June of the next (Chapter 8, Monograph 1) and enter the (2-3′) size class; yet there appears to be little or no increase (and in the case of the Blyth-Cadell a decrease) in the number of non-hatchling crocodiles sighted on the tidal waterway. What is happening? Let us examine the matter more closely.

Consider the Blyth-Cadell System, Table 2. Note that during the October 1974 survey (or alternatively one may use the November 1975 survey; the end result will be essentially the same) 292 small and 6 large crocodiles were sighted. By the time of the June 1982 survey every one of these 292 small crocodiles would, if they survived, be in the large size class, yet in June 1982 only 67 large crocodiles were sighted, or 61 more than in 1974. Thus the minimum exclusion and/or loss of sub-adults is (292-61)/292 = 79%. This figure is probably an underestimate because of the wariness in 1974 of the large *C. porosus* remaining in the Blyth-Cadell System (referred to previously). On the Liverpool-Tomkinson System the situation is much the same; the 180 small crocodiles sighted during the July 1976 survey could all be expected to be in the large class by June 1982. There were 49 large crocodiles sighted on this first survey and only 67 on the June 1982 survey, giving an exclusion and/or loss of (180-18)/180 = 90%.

An alternative way of viewing the matter is given on page 336 of Monograph 1. Consider the number of hatchlings sighted on the latest survey of each year on the Blyth-Cadell System between 1974 and 1981. Hatchling recruitment has been (89 + 50 + 61 + 112 + 155 + 123 + 119 + 72) = 781. From our capture-mark-recapture study (Chapter 8, Monograph 1), it is known that the loss of hatchlings between September and the following June is some 30% and from June to the following June it is some 50%. Using these estimates, then some 501 of the 781 hatchlings could be expected to have entered the (2-3′) and non-hatchling class. The number of non-hatchlings sighted in the October 1974 survey (Table 3) was 298, and in the June 1982 survey it was 272, that is (501 + 26) = 527 non-hatchlings appear to be missing. Not only have the 501 animals recruited in the intervening 1974-1982 period disappeared but some 26 of the original 298 animals are missing also. For the Liverpool-Tomkinson System the recruitment of hatchlings between July 1976 and October 1981 was at least (19 + 56 + 37 + 161 + 71 + 34) = 378 and using the same exclusion and/or loss estimates as for the Blyth-Cadell System, one finds that some 249 hatchlings should have entered the non-hatchling class. There were 229 non-hatchlings sighted on the waterway during the July 1976 survey and 274 on the June 1982 one, yielding an increase of 45. Thus one may reason that the 249 non-hatchlings recruited into the waterway, in the period 1976-1982, gave rise to 45 additional non-hatchlings only and that there has been an exclusion and/or loss of some 82% of the non-hatchling class. No matter which way one views the matter, it is evident that there are very high and continuing exclusions and/or losses of non-hatchlings and that these occur predominantly in the small (2-6′) size class. There appear to be some (527 + 204) = 731 non-hatchling crocodiles missing from the sections normally surveyed on the Blyth-Cadell and Liverpool-Tomkinson Systems alone, for the period concerned. Thus the fact that there is little evidence for a major increase in the number of non-hatchling *C. porosus* sighted is not surprising.

But what has or is happening to the missing non-hatchling crocodiles? This appears to be an exceedingly difficult question to answer and we have been pondering on it over the past three years as we continue to survey and gather more data.

We are still almost as mystified about the matter now as we were in 1979 (see pages 14, 15 and 440 to 446, Monograph 1), however certain aspects of the problem are becoming defined more sharply. Study of Table 2 reveals that a small fraction (some 15 to 20%) of the 731 missing crocodiles cannot be classified as missing — presumed dead. We shall now discuss these.

On some surveys and in some years, the number of small and/or large crocodiles sighted shows a major increase over the immediately previous survey. It appears that when there is such an increase — it occurs around the June-September period; this was the case on the Blyth-Cadell System in June 1979, when our surveys revealed a major influx of both small (from 221 to 287, significant at the 99% level) and large animals (from 23 to 55). On the Liverpool-Tomkinson System, the July 1979 survey showed a major increase in the number of large animals sighted (from 40 to 74) but no increase for small animals. In fact, as discussed in Monograph 1, pages 441 to 445, it appears that a major increase in the number of large *C. porosus* sighted was a general phenomenon on the tidal waterways of the northern Australian coastline during the June-August 1979 surveys — with the exception of Arnhem Bay (Monograph 11).

We suggested that the common factor, which may have been connected with this general influx of animals, was the exceedingly dry wet season of 1978-1979 and the severe drought conditions which prevailed until the wet season of 1979-1980. Such conditions might be expected to force any itinerant animals in swamp areas and semipermanent waterholes back into the tidal waterways. However we pointed out that there are a number of worrisome points about this, firstly there are very few swamp areas in the vicinity of the Blyth-Cadell System (certainly not enough to hold the number of animals involved) and secondly if the subadults were returning from non-TYPE 1 tidal waterways elsewhere (for instance the Milingimbi Complex, see Monograph 9) then why would a very dry wet season and severe drought conditions trigger the return of sub-adults to TYPE 1 systems from non-TYPE 1 systems. In addition there were indications of an increase, rather than a decrease, in the number of non-hatchlings sighted in TYPE 3 systems in August 1979 — see the results for Majarie and Wurugoij Creeks, Table 1. Finally, how does one account for the decrease in the number of large crocodiles (from 74 to 58) spotted on the Liverpool-Tomkinson System during the October 1979 survey (Table 2); where did they disappear to? The missing crocodiles could not have returned to the freshwater swamps and/or billabongs from which it was postulated they had come, for these were even drier in October than in June and July. One is thus tempted to dismiss the "drying up swamp and billabong" explanation for 1979. However, the 1981-1982 wet season along the northern Arnhem Land coastline was again a dry one and again there has been an influx of large animals into the Goomadeer (from 3 to 14), Blyth-Cadell (from 39 to 67) and Liverpool-Tomkinson (from 54 to 67) Systems — see the results for the June 1982 surveys in Tables 1 and 2. The increase in the number of large animals sighted on the Liverpool-Tomkinson System was accompanied by a major increase of small (from 166 to 207, significant at the 95% level) and (3-6′) from 133 to 178 animals, whereas on the Blyth-Cadell it was accompanied by an increase of (3-6′) animals (from 127 to 163) only. The number of small animals remained constant. In June 1979 the increase in the number of large animals sighted (from 23 to 55) on the Blyth-Cadell System was accompanied by a significant increase at the 95% level (from 221 to 287) in the number of small, and an increase (from 161 to 196) in the number of (3-6′) animals sighted. However, on the Liverpool-Tomkinson System this was not so — both the number of small and (3-6′) animals remained essentially constant.

Thus we ask what role, if any, do the dry wet seasons play in determining the influx of small and specially large *C. porosus* onto the main sections of the tidal waterways?

It is to be noted from Table 2 that on the second survey of the Liverpool-Tomkinson System in 1979, namely the October survey, the number of large animals spotted had decreased (from 74 to 58), but still was at a considerably higher level than for the September 1978 survey when only 40 large animals were spotted. The number of small animals sighted had also decreased, but not significantly — from 152 to 136. For the Blyth-Cadell System there was a similar occurrence, however the next survey, after the June 1979 one, could not be made until October 1980; the drop in the number of small animals was from 287 to 249, just missing being significant at the 95% level and the number of (3-6′) animals sighted fell from 196 to 160.

Our results thus suggest that as the number of large animals increases on a TYPE 1 tidal waterway, the number of small crocodiles usually decreases or increases marginally only. Furthermore the results suggest that the disappearance or main ejection of small crocodiles from TYPE 1 waterways may occur around the October period — the breeding season, and they provide support for the model we have proposed for the dynamics of *C. porosus* populations.

Note again the results for the number of small and large animals sighted on the Blyth-Cadell and Liverpool-Tomkinson Systems since 1979. On the basis of those results one might guess that the number of small crocodiles which will be sighted on the October 1982 survey of the Liverpool-Tomkinson System will be less than on the June 1982 survey. One might also expect to see a small decrease on both the Blyth-Cadell and Liverpool-Tomkinson Systems, in the number of large crocodiles sighted; for it could be expected that a number of the large animals which entered the systems between the 1981 and 1982 surveys would still not be sexually mature (or just) and hence might be excluded by the breeding adults. The October 1982 survey may well provide some interesting results.

It is of interest to note that the number of both small and large animals sighted on the Blyth-Cadell and Liverpool-Tomkinson Systems during the June 1982 surveys are almost identical (Table 2), though the situation was much different when our surveys first started in the mid 1970s. The major increase in the number of small crocodiles sighted on the Liverpool-Tomkinson, during the June 1982 survey, is probably the result of the large hatchling recruitment on the Tomkinson River over the 1978-1979 wet season (Table 5). But where were these small animals in the intervening period, where did they come back from? The same question applies to the influx of large crocodiles on both the Liverpool-Tomkinson and Blyth-Cadell Systems. In an attempt to throw some light on these questions we must consider the two waterways in more detail.

The Liverpool-Tomkinson System is in many ways similar to the Blyth-Cadell System and at first sight the two TYPE 1 systems appear to parallel one another to a large degree (Monographs 1, 7 and 15). The Liverpool-Tomkinson System lies some 30 km to the west of the Blyth-Cadell System. The Blyth River has a major tributary, the Cadell River (TYPE 1) which joins it at km19.1. The Liverpool River also has a major tributary, the Tomkinson River (TYPE 1) which joins it at km17.0. The maximum navigable (by 4 m survey boat) length of the Liverpool mainstream is 66.4 km (normally can be surveyed to km60 only), whereas for the Blyth mainstream it is 59 km (normally can be surveyed to km49.8 only). Both mainstreams have large upstream drainages. If one compares low tide salinities towards the end of the dry season at corresponding distances on the Liverpool and Tomkinson Rivers, one finds that the Liverpool salinity is lower than that for the Tomkinson by a factor of 3 or so (Monograph 7). Looking at the Blyth and Cadell Rivers, the Blyth has salinities several times lower than the Cadell (Chapter 3, Monograph 1). Thus in the two systems, from the point of view of salinities, the Liverpool parallels the Blyth, the Cadell parallels the Tomkinson. In its upstream reaches, past km50, the Blyth River shows typical freshwater habitat; past km56 the river is very rocky and after km59.8 it breaks up into a series of freshwater waterholes. Correspondingly, the Liverpool River becomes sandy past km60 and is joined by the Mann River at km68. Both streams break up into a number of rivulets and numerous semipermanent and permanent freshwater waterholes in stony country. On the Liverpool, sporadic *C. porosus* might get upstream as far as Cuthbertson Falls, some 45 km upstream of the Mann Junction. Typically, the number of *C. porosus* sighted on the upper navigable freshwater sections of both of the mainstreams falls off rapidly (Chapters 6, 9 and Addendum, Monograph 1, also Monographs 7 and 12).

The maximum navigable length of the Cadell River is some 30 km (from km19.1 to 48.8); this is followed by some 4.5 km of shallow, narrow, giant log-strewn waterway, running through dense jungle. There is a narrower sidecreek running off from the mainstream at km48.8 and this runs through similar jungle for some 2 km until it peters out in waterholes. As viewed from a helicopter, the habitat looks as if it might be suitable as a refuge for some sub-adults, but the amount of sunlight getting through the dense jungle canopy would be limited on many sections. The river finally breaks up into a series of small semipermanent and some 8 larger permanent freshwater waterholes. It is to be noted that the dry season food supply for *C. porosus* in these would be fairly limited as the supply is only effectively replenished during some of the wet seasons.

The Tomkinson River, on the other hand, has a much longer navigable length of some 64 km (from km17 to 81.3, but normally can be surveyed to km73.7 only), beyond which it shallows out over a distance of several km into a semipermanent paperbark swamp which can be dry or wet during a given dry season, depending upon how wet the previous wet season was. Upstream of km70 the banks become lined increasingly with Melaleuca and though the stream is narrow (some 6 to 8 m), the mud banks are usually gently sloping. The terminal section of the river upstream of km70, though providing excellent *C. porosus* habitat, floods almost every year. Both the Cadell and Tomkinson Rivers are still tidal at their endpoints for navigation.

The nature and extent of the sidecreeks varies considerably between the Blyth-Cadell and Liverpool-Tomkinson Systems. On the Blyth-Cadell System there is only one major sidecreek, namely Creek B, at km3.5, which has a navigable section of 4.1 km; Creeks A, C, D, F and G have a total navigable length of some 8 km only. These minor creeks, which are on the downstream km0-15 section of the Blyth River, usually become hypersaline towards the end of the dry season and are TYPE 2-3. On the Liverpool-Tomkinson System there are a number of more substantial creeks:

	Type	**Navigable length (km)**
Gudjerama Creek at km5.5	3	5.8
Morngarrie Creek at km14.4	3	2.9
Mungardobolo Creek at km17.0	3	8.7
Maragulidban Creek at km30.0	1	7.8
Atlas Creek at km58.4	1	1 to 2.8

Mungardobolo Creek is one of the most hypersaline creeks in northern Australia and we discussed previously at some length (Monograph 7, also Chapter 7, Monograph 1) the matter of the itinerant *C. porosus* sighted in it. Essentially, it appears to be a small TYPE 3 rearing stockyard for sub-adults, large and small, excluded from elsewhere on the Liverpool-Tomkinson System.

On the other hand, Maragulidban Creek is a relatively short TYPE 1 system, joining the Liverpool mainstream at km30. It becomes quite narrow with steep cut-away banks and is quite log-strewn upstream of our normal terminal survey point at km37.8, but not as log-strewn as the unnavigable end section of the Cadell River. Beyond km37.8 the stream winds a further tortuous course for some 7 km through relatively thick jungle and then breaks up into a series of semipermanent and permanent freshwater waterholes, which are not as large as those on the Cadell River. At approximately km44, there is a sidecreek which runs for some 2 km through exceedingly dense jungle, finally breaking out into a shallow semi-permanent paperbark swamp. The upstream sections of both the Cadell River and Maragulidban Creek are quite similar and undoubtedly could provide a refuge for some sub-adults — probably mostly in the large size class — excluded from other sections of the systems.

We now examine the number of *C. porosus* sighted during the various surveys on the component parts of each System with a view to trying to track down where the increases and decreases occur. Tables 4 and 5 contain the relevant data.

Consider the small crocodiles sighted on the Blyth-Cadell System during the 1975 and 1976 surveys. It will be noted that the number of small crocodiles sighted on the system dropped significantly at the 95% level, from 289 to 240, between the November 1975 and September 1976 surveys; this decrease occurred mainly on the Cadell River, though there was a decrease of 18 small animals sighted on the Blyth mainstream also. The major flooding that occurred over the 1975-1976 wet season was of historic dimensions and this may well have been connected with the decrease in the number of small animals sighted (page 335, Monograph 1). However, the decrease in small animals was associated with an increase from 14 to 26 in the number of large animals sighted. This increase was mainly on the Cadell River and this too might have been responsible for the decrease in small animals. We are unable to say where the small animals disappeared to or what happened to them.

The number of both small and large animals sighted then fluctuated within surprisingly narrow limits until the June 1979 survey. On this survey, on the Blyth mainstream, the number of large animals sighted increased dramatically from 15 to 40 and from 23 to 55 for the overall Blyth-Cadell System. For us it was exciting to see so many large animals; they were mostly concentrated at the mouth region of the Blyth River and on the sidecreeks of the downstream section of the river. Where had these animals come from and were they coming into the river or leaving it? Since they were not sighted during the September 1978 survey, the evidence points to these animals trying to gain entrance to the waterway. The number of small crocodiles sighted also increased significantly at the 95% level, from 221 to 287; there being an increase of 41 small animals on the Blyth mainstream, between km15 and 35, 27 of these were in the (2-3′) size class and these were mostly sighted on the km20-30 section. Ten of the remaining 14 animals in the (3-6′) size class were sighted on the km0-20 mouth section. There was also an increase of 27 small animals on the Cadell River of which 6 were in the (2-3′) size class, and 21 in the (3-6′) size class; 15 of the latter were in the (3-4′) size class. The distribution of the crocodiles along the Cadell River suggests that most of the (3-6′) animals may have come downstream from the inaccessible extreme upstream section of the waterway. Note that there had been no increase in the number of large animals sighted on the Cadell River on the June 1979 survey.

On the October 1980 survey of the Blyth-Cadell System, the number of non-hatchling crocodiles sighted had decreased from the June 1979 level, from 342 to 281; significant at the 95% level. This decrease consisted of a drop of 38 small animals and 23 large ones. As shown in Table 4, it appears that the loss of both small and large animals (32 and 18 respectively) was largely from the Blyth mainstream; 5 large animals were also missing from the sidecreeks. Again we are unable to say what happened to these animals. There was little change on the Cadell River.

The survey of July 1981 revealed a situation much like that of the October 1980 survey, with only minor changes in the number of large and small crocodiles sighted on the Blyth-Cadell System. However, the October 1981 survey revealed a further major decrease, from 253 to 204, significant at the 95% level, in the number of small, and a decrease from 167 to 127 (3-6′) animals sighted. Note that the number of small animals had by then gone down from 292 in 1974 to 204 and the number of (3-6′) animals had decreased from 211 to 127. The losses occurred on all three major components of the Blyth-Cadell System. On the Blyth mainstream, the losses occurred on the downstream and extreme upstream sections; on the Cadell the losses were on the downstream sections. Interestingly, there was an increase of small and (3-6′) animals on the upstream end sections of the Cadell, suggesting that some of the missing animals may have moved into the inaccessible region of the Cadell, discussed previously. The loss of (3-6′) animals from the mouth region of the Blyth suggests that the animals may have left the waterway; if they are alive at all. The number of large crocodiles remained essentially the same.

The survey of the Blyth-Cadell System in July 1982 showed essentially no increase in the number of small animals sighted (there was a loss of 35 (2-3′) but a gain of 36 (3-6′) animals, mostly in the (4-6′) range); a decrease of 9 animals on the Blyth mainstream was counterbalanced by an increase of 9 on the Cadell. However, the distributional pattern of the small animals along the Blyth mainstream and the Cadell had changed since the October 1981 survey. Whereas on the October 1981 survey some 30 small animals were sighted on the km0-20 section of the Blyth mainstream, on the June 1982 survey, 54 small animals were sighted on the same section. On the other hand the number of animals on the km-25-40 section had decreased from 69 to 30. These results suggest that the small animals downstream, may have been in the process of being excluded from the waterway by large crocodiles (or since many were in the (4-6′) range, they may have been entering it?). This possibility is supported by the fact that there was an increase from 39 large animals sighted on the system during the October 1981 survey to 67 during the June 1982 one; 17 of the increase of 28 were sighted on the km0-15 section of the Blyth mainstream and its sidecreeks thus suggesting strongly that these large crocodiles had entered the Blyth through its mouth. A total of 31 large *C. porosus* were sighted on the km0-15 mouth section and sidecreeks; exactly the same number were sighted on this section during the June 1979 survey. However, whereas there was no increase in large animals sighted on the Cadell during the June 1979 survey (the number fluctuated between 0 in 1974 to 9 in October 1981), the June 1982 survey shows 20 large animals in the Cadell — an increase of 11 and all this increase occurred on the mouth sections of the Cadell. Since the Cadell joins the Blyth River at km19.1 and since there was no increase at all in the number of large animals sighted upstream on the Cadell, it appears that the 11 new animals also entered the Blyth-Cadell System through the Blyth River mouth. The increase of 9 small animals sighted on the Cadell is interesting, for their distribution along the river is such as to suggest exclusion from the Blyth mainstream. The October 1982 survey of the Blyth-Cadell System may well reveal considerable readjustment between the increased number of small and large animals sighted on the mouth sections of both the Blyth and Cadell Rivers and show not only a small decrease (mentioned earlier) in the number of large animals sighted on the overall Blyth-Cadell System but perhaps a further decrease in the number of small animals sighted as well. However, it is difficult to believe that the number of small *C. porosus* could decrease much further on the system and it appears that a stage is being reached where the number of small animals sighted will commence increasing, but with the number of large animals increasing faster, thus yielding a decreasing, but fairly fluctuating ratio of small to large *C. porosus*.

As is evident from our discussion, consideration of the survey results for the Blyth-Cadell System can be indicative only as to where the fluctuating numbers of small and large crocodiles disappear to and return from. Most of these large *C. porosus* are in the (6-8′) size class and thus are sexually immature or just sexually mature animals for it is known that females are often sexually mature when they reach the (6-7′) size class (see page 339, Monograph 1, also personal communication from Dr Gordon Grigg). The evidence suggests strongly that most of these large crocodiles and a substantial fraction of the excluded small crocodiles leave and re-enter the Blyth-Cadell System through the mouth of the Blyth River. Those that leave, go out to sea and are probably lost or they travel along the coastline until they reach another tidal waterway to which they gain entrance.

To the east of the Blyth River mouth, the closest tidal waterways are those discussed in Monograph 9, Ngandadauda, Bennett, Darbitla, Djigagila and Djabura Creeks, all TYPE 3 or 2-3 waterways, and which provide excellent rearing stockyards for sub-adult and just mature *C. porosus*, referred to in our model. However to reach the first of these waterways, Ngandadauda Creek, necessitates a sea journey of some 36 km and the rounding of Cape Stewart. This creek is also joined to Creek B on the Blyth River by an open paperbark swamp and crocodiles could move from one to the other during the height of the wet season (see page 39, Monograph 9). There is a very small but distinct channel joining the two creeks.

When last surveyed in June 1979, 39 large and 44 (3-6′) animals were sighted in the creeks above and since they are all TYPE 3 or 2-3 waterways, nearly all the animals sighted must have been derived from elsewhere. The Blyth-Cadell System is probably one of the sources for these crocodiles.

Between the Blyth River mouth and the Liverpool River (to the west) there are four small TYPE 3 coastal creeks, each having extensive sand bars at the mouth and which may be entered only from the sea with great difficulty, even at high tide. The first two of these, Beach (local name) and Anamayirra Creeks, are some 10 km from the Blyth River mouth. Crab Creek (local name) and another unnamed creek, so small as to be of no consequence, are a further 13 km to the west. We were able to gain entrance by land and to survey Crab Creek in October 1981 for the first time and sighted 2 large animals in it. For the June 1982 survey, a helicopter was chartered from Darwin (some 320 km from Maningrida) so that access could be gained to Anamayirra and Beach Creeks and 2 large waterholes on the Cadell River, and to check various other regions hitherto inaccessible to us. On the spotlight survey of Beach and Anamayirra Creeks, 13 small and 9 large animals were sighted, thus revealing two further good rearing stockyards for crocodiles excluded from TYPE 1 systems nearby, such as the Blyth-Cadell and Liverpool-Tomkinson. Both Anamayirra and Beach Creeks drain paperbark swamps, and Anamayirra Creek then breaks into a number of waterholes, containing sporadic *C. porosus* — we caught one of these in 1976. Our June 1982 survey of these waterholes revealed no crocodiles.

The only other areas to which crocodiles, excluded from the sections of the waterway normally surveyed, could move to or come from, in the vicinity of the Blyth-Cadell System, are the Cadell River waterholes and the extreme upstream sections of the Blyth and Cadell River mainstreams.

As reported on page 446 of Monograph 1, in October 1980 we surveyed the extreme upstream freshwater sections of the Blyth River from our normal terminal point at km49.8 to km59 and the two large waterholes extending from km59.8 to 64.6. We sighted 6 crocodiles (H, EO>6′, 7-8′, 2-3′ and 6-7′ in that order) on the km49.8-56 section, none on the km56-59 section and none in the two large waterholes. We resurveyed the km49.8-59 portion of the river in July 1982. On this survey, only 5 crocodiles were sighted, one hatchling and 4 large, all between km50.1 and 54.5. Strangely the stream appears to be barren not only of crocodiles but of fish also, upstream of km55-56.

On the Cadell River, we are unable to survey upstream of km48.8 because the stream shallows and narrows beyond that point and is strewn by giant logs as it winds a further tortuous 4.5 km through dense jungle — undoubtedly we would sight a number of both small and large crocodiles if we were able to survey it, for the waterholes which the stream drains do contain some small and large *C. porosus*. There are 8 main permanent waterholes at varying distances upstream of km53.3, with a total length of some 10 km. Using a vehicle or a helicopter to gain entrance, we were able to survey 4 of the main waterholes with lengths of 4.0, 2.0, 0.9 and 0.8 km. Our surveys revealed 2 small and 12 large crocodiles, 5 in each of the large waterholes and 2 each in the smaller ones. Thus as expected, the waterholes do provide limited alternative habitat for a small number of both small and large *C. porosus* which may be excluded from the river system proper.

Thus one is led to the conclusion that there is sufficient alternative habitat for that relatively small percentage (15-20%) of both small and large crocodiles which leave and later re-enter the TYPE 1 Blyth-Cadell System and that such crocodiles are sighted in these. However, we are unable to provide direct proof with specific animals; this can only be done using capture-mark-recapture methods or radio telemetry. However, there are a number of major difficulties related to the use of either method. The capture and handling of an animal may well be the cause of it leaving the system temporarily (see pages 75 and 76, Monograph 7 for a case at point) — how is one to know? This matter is particularly relevant for the present study concerning, apparently, excluded and returning animals. In addition there would be the great difficulty and cost of endeavouring to capture a very large fraction of the sub-adults inhabiting a waterway, for one would have to use passive techniques to minimise the problem referred to above. Some 15 to 20% of the sub-adults appear to remain on a TYPE 1 waterway, another 15 to 20% appear to fluctuate in and out of the waterway (or proceed to the more inaccessible and normally unsurveyable sections), with the remainder entering the missing — presumed dead class; for a meaningful study, it would be necessary to work with a very large fraction of the animals in a system. There is also the technical difficulty of running a microprocessor based telemetry system (which would have to be used) in a remote area such as Maningrida. Finally, there is the major stumbling block of scientific permits; these are required by law before a crocodile may be captured. The Northern Territory Government demonstrated recently how dangerous and costly it can be to try to carry out a research programme requiring scientific permits, when it launched a prosecution against one of the authors (HM) who was holding two, supposedly valid, permits. This not only wrecked some very important scientific work (see pages 387 and 438, Monograph 1) but also effectively ensured that we do not proceed with radio telemetry studies of *C. porosus*. The risk of further prosecution appears to be far too great. We need to use an alternative method and have some ideas on this matter.

We now turn to the some 527 missing crocodiles in the missing — presumed dead class on the Blyth-Cadell System. What has happened to them? We have direct evidence that over the past year at least 3 large animals were drowned in barramundi fishermen's nets set outside and inside the mouth of the Blyth River, where, as discussed previously, the density of animals appearing to leave or enter the river is greatest. As to the remainder, we are simply unable to say and radio telemetry or capture-mark-recapture methods are unlikely to provide the answer for once an animal is dead, these methods are unlikely to be of value. It is known that large *C. porosus* sometimes kill smaller *C. porosus* and it is known that they sometimes eat smaller *C. porosus* (see pages 33 and 334, Monograph 1). It is known that large sharks take crocodiles also, for recently a 16 foot white pointer was caught in Moreton Bay, Queensland with a (4-5′) *C. johnstoni* in its stomach and our own studies have documented many cases of *C. porosus* being bitten by sharks which are very prevalent in the tidal waterways of northern Australia, specially in the mouth sections. However, hitherto we believed these were isolated cases. Now we wonder about it and are becoming more convinced that mature adult *C. porosus* and sharks may account for the high fraction of missing — presumed dead *C. porosus*.

Just as for the Blyth-Cadell System, we can give also, a detailed analysis of the number of *C. porosus* sighted on the three major components of the Liverpool-Tomkinson System (Table 5). The analysis runs along the same lines but there are important differences between the two systems. Note the essential constancy of the number of small crocodiles sighted on the Liverpool mainstream, on the surveys between 1976 and 1982. There is some indication of perhaps a minor drop in the number of small crocodiles sighted as the number of large animals increased. Note too the exceedingly small recruitment of hatchlings on the Liverpool mainstream, which of course could partly account for the fact that there have been only minor variations in the number of small animals sighted.

The small recruitment of hatchlings is difficult to understand for there are numerous nesting sites on the mainstream (see page 34, Monograph 7). From our capturing programme in 1973, 1974 and 1975 we know that there were at least 62, 34 and 60 hatchlings respectively, on the Liverpool mainstream in those years. The figure of 11 hatchlings during the November 1976 survey is understandable, for the wet season of 1975-1976 was of historic dimensions and the Liverpool System was flooded accordingly. No nests could have survived the exceedingly high flood levels and the few hatchlings sighted in 1976 probably came from one or more swamp nests. Since 1976, the maximum number of hatchlings sighted has been 28. This simply does not correspond with the excellent nesting habitat on the Liverpool mainstream or with the number of large animals sighted on it.

It will be noted that there was only minor recruitment of hatchlings on the side-creeks of the river system but in 1979 and again in 1982 there was, relatively speaking, very heavy recruitment of hatchlings on the Tomkinson River. The Tomkinson also has some excellent nesting habitat and almost the same number of large animals are sighted on it during surveys as on the Liverpool mainstream. Did Magnusson's disturbance of nesting and large animals during the course of his Ph.D. nesting studies between 1975 and 1977 on the Liverpool-Tomkinson have something to do with the matter? It seems farfetched, but we know of no other relevant factor. The matter of breeding and nesting on the Liverpool-Tomkinson obviously requires more detailed study.

The increase in the number of large animals sighted during the 1979 surveys of the Liverpool mainstream occurred mostly downstream of the mouth of Maragulidban Creek which joins the Liverpool mainstream at km30. The decreases which followed in 1980 and 1981, also occurred on the same sections. There was an increase of 11 large animals sighted on the June 1982 survey of the mainstream, and 8 of these were again centred on these sections. The remaining 3 were sighted on the km3-10 mainstream mouth section, indicating their arrival via the river mouth.

One should now note the major increase from 5 large animals sighted on the side-creeks during the September 1978 survey to 21 on the July 1979 survey and then the drop back to 5, for the October 1979 survey. The increases and decreases took place largely on Maragulidban and Mungardobolo Creeks. The results suggest strongly that Maragulidban Creek is acting as a major channel for the entry and departure of large animals — but not for small crocodiles. To check this matter further, it was decided to use a small dinghy, rather than our normal survey boat and to survey upstream as far as possible beyond our normal terminal point at km37.8. We were able to survey to km42.5 which is some 2.6 km before the stream breaks up. Only one large crocodile was sighted, in the (EO > 6′) class, and no small crocodiles were seen. Thus our suggestion that Maragulidban Creek acts as a channel, between the paperbark swamp and waterholes which start at km49.8, for the entry and departure of large but not small *C. porosus* gains support.

On the Tomkinson River (Table 5) the number of large animals sighted during surveys has varied from 28 in July 1976 to 9 in October 1977, gradually rising to 27 in June 1982. The decrease from the 20 large animals sighted in the May 1977 survey to 9 sighted on the October 1977 survey was spread fairly evenly over all sections of the river surveyed normally. Those animals lost from the mouth section of the Tomkinson may have left the Liverpool-Tomkinson System. However, it is more likely that these, as with the other large animals (probably sexually immature sub-adults or just mature adults) missing from the upstream sections of the river, were forced by the breeding adults of October 1977, even further upstream onto the terminal sections. On these sections, nesting appears to take place seldomly and we have been unable to gain entrance to them on most surveys. Support for the view just expressed is provided by the survey of July 1979 when the number of large animals sighted was 24, having increased from 9 in October 1977. The increase occurred predominantly on the upstream sections of the Tomkinson.

Also note the decrease in the number of small animals sighted on the Tomkinson during the October 1979 survey. Though this decrease is not significant statistically, it does point to the small animals being excluded by breeding adults on the Tomkinson where most of the nesting on the Liverpool-Tomkinson System appears to be taking place. The increase from 52 small animals sighted on the October 1979 survey to 87 for the October 1980 survey is accounted for purely by an increase of 36 (2-3′) animals arising from the 142 hatchlings sighted during the October 1979 survey. Using results on survivorship for the Blyth-Cadell System (Table 8.4.1, Monograph 1), one would have expected some 50% or 71 of the 142 hatchlings to be in the (2-3′) size class by October 1980. Thus the increase of 36 (2-3′) animals appears to be too small by a factor of about two and the missing portion must have been either excluded, probably to the upstream terminal sections of the Tomkinson referred to, and/or entered the class, missing — presumed dead. The number of small crocodiles sighted on the July and October 1981 surveys then decreased from the 87 of the October 1980 survey to 77 and 66 respectively but the results of the June 1982 survey show a significant increase at the 95% level in the number of small animals sighted on the Tomkinson, the number rising to 105. In addition, on Mungardobolo Creek, there was an increase of 6 small and 2 large crocodiles. It should be recalled that the Tomkinson and Mungardobolo both join the Liverpool mainstream at km17.0. Of the increase of 45 small animals on the Tomkinson and Mungardobolo, 9 were in the (2-3′) size class, derived from hatchling recruitment the previous year, 29 were in the (3-5′) and 7 in the (5-6′) size classes and hence it appears that the major increase consisted of animals derived from the large hatchling recruitment on the Tomkinson in 1979. The increase in the small size classes was distributed relatively uniformly over the Tomkinson and Mungardobolo indicating that the animals had come downstream from the normally inaccessible terminal sections of the Tomkinson. By making special efforts during the June 1982 survey we were able to survey the Tomkinson from our normal terminal point at km73.7 to km81.3. We spotted 32 *C. porosus* as follows: 1(3-4′), 7(4-5′), 5(5-6′), 5(6-7′), 3(>7′) and 11(EO), thus supporting our suggestion that the terminal sections of the Tomkinson are providing rearing stockyards for sub-adults excluded from other sections of the waterway. In the future, we shall make great efforts to survey this section of the waterway during the course of our normal surveys.

From our discussion, it appears that though there are many similarities between the Blyth-Cadell and Liverpool-Tomkinson Systems, there are also a number of important differences. Whereas on the Blyth-Cadell System there are relatively few alternative areas for excluded sub-adults to go to, on the Liverpool-Tomkinson System the opposite appears to be the case. Thus, whereas sub-adult *C. porosus* on the Blyth-Cadell System appear to be excluded and re-enter largely via the mouth of the Blyth River, on the Liverpool-Tomkinson System there are alternative rearing stockyards within the system, such as the terminal sections of the Tomkinson and Maragulidban or within Type 3, Mungardobolo Creek. In view of this one might expect that the percentage of sub-adults classified as missing — presumed dead, on the Liverpool-Tomkinson System would be less than on the Blyth-Cadell System. However as we have seen, the reverse appears to be the case. We had previously suggested in our model that sharks might be the main predator on sub-adult *C. porosus*. Though not dismissing this suggestion at this stage, our discussion above also suggests that one of the main predators of sub-adult *C. porosus* may be adult *C. porosus*.

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APPENDIX ON SURVEY OF WATERWAYS IN THE MANINGRIDA MONITORING AREA — OCTOBER-NOVEMBER 1982

This appendix follows on and should be read in conjunction with the paper titled: "The continuing and mysterious disappearance of a major fraction of sub-adult *C. porosus* from tidal waterways in northern Australia", prepared after the June-July survey for the 6th Working Meeting of the Species Survival Commission, Crocodile Specialist Group held at Victoria Falls and St Lucia, 28-30 September, 1982.

Liverpool-Tomkinson and surrounding waterways — surveys October 16-November 1, 1982

1. *Liverpool mainstream (Table 5)*

There was an increase from 66 small crocodiles sighted during the June 1982 survey to 82 small crocodiles sighted during the October 1982 survey. This increase occurred just upstream and downstream of the mouth of the Tomkinson River and hence it is likely that it is accounted for by small crocodiles excluded from the Tomkinson River.

A small decrease — from 30 to 26 — in the number of large animals sighted on the mainstream could be real or just normal fluctuation in counts, however the distribution of the large animals sighted varied considerably from that in June 1982. From km3-30 there were 19 large animals sighted in June 1982, whereas in October 1982 only 14 were seen. As discussed below, a number of large crocodiles probably moved from the Liverpool mainstream into the sidecreeks.

The extreme upstream section of the Liverpool mainstream (km60-66.4) was surveyed for the first time and 5 small and 3 large *C. porosus* were sighted. This section, which is quite shallow, very sandy and stump-ridden, provides limited alternative habitat for sub-adults driven from the more desirable sections of the mainstream.

The number of hatchlings sighted on the mainstream remained essentially constant (6 instead of 7).

2. *Tomkinson River (Table 5)*

As predicted after the June 1982 survey, the number of small crocodiles sighted on the section of the Tomkinson normally surveyed (km17.0-73.7) dropped dramatically, from 105 to 56 (~47%).

There also was a decrease from 18 to 11 in the number of small animals sighted on the extreme section of the Tomkinson (km73.7-81.3), not included in the normal survey section.

The number of large animals sighted decreased only marginally from 27 to 25 on the km17-73.7 section and the number of hatchlings sighted decreased from 178 to 135. However, it should be noted that there was an input of hatchlings from one or more late nests during the intervening period. A late June nest sighted at km65 in July 1982 (no nests laid down after the end of March had been observed previously) was excavated by October and some of the hatchlings sighted on the Tomkinson were very small — obviously coming from successful late nest(s).

The number of large crocodiles sighted between km73.7-81.3 did not change (13), however their increased number (from 4 to 11) on the km17-30 mouth section suggests that a number of large animals were being excluded from the upstream breeding sections of the Tomkinson (km30-73.7) where the number had dropped from 23 to 14.

Comparison of the number of small crocodiles sighted during the June and October surveys on each of the sections of the Tomkinson shows that, with the exception of the km20-30 section, the losses were fairly uniform throughout the river, including the extreme km73.7-81.3 section. The missing (105-56) = 49 small crocodiles from the km17-73.7 section (of which 37 were in the (3-6′) size classes) and the missing (18-11) = 7 from the 73.7-81.3 section (all in the (3-6′) size classes) must either be "missing-presumed dead" or have been excluded from the surveyable sections of the river; recall the 16 additional small animals sighted on the Liverpool mainstream (actually there was an increase of 19 (3-6′) and a loss of 3 (2-3′) animals), mainly near the mouth of the Tomkinson. Some may have been forced upstream of km81.3 since 13 crocodiles were sighted on the terminal 1.3 km surveyed, from km80-81.3. However, the Tomkinson becomes very shallow upstream of km81.3 and soon simply peters out, so the amount of adequate habitat there is limited. Comparison of the June and October histograms for the km73.7-81.3 section of the river shows the crowding of the crocodiles towards the terminal portion of this section. However, it should be noted that heavy barramundi activity was observed there during the survey of the km73.7-81.3 section and hence the crocodiles may have been concentrating there because of the plentiful supply of food.

Exclusion and even killing of sub-adults by the mature animals, specially during the breeding season, which occurs around the October-November period, appears to be a major factor involved in the decrease and redistribution of sub-adult *C. porosus*. These factors could be expected to be more important on the Tomkinson than on the Liverpool River, since most of the successful breeding appears now to be taking place on the Tomkinson rather than on the Liverpool River — even though the number of large *C. porosus* sighted on each is closely the same. Our results bear this out.

During the night-time survey of km73.7-81.3 on November 1, 1982 a (7-8′) freshly dead male *C. porosus* was found floating in the water at km73. It appeared to be in excellent condition and had blood coming from its nostrils — it was probably killed by a blow from a larger crocodile.

3. *Sidecreeks of the Liverpool River (Table 5)*

A minor decrease in the number of small animals sighted, from 36 to 32, is essentially accounted for by the decrease from 17 to 12 in the number sighted on Mungardobolo Creek; there were minor variations of one to two small crocodiles on the other sidecreeks.

The most noteworthy change occurred in the number of large animals sighted, the number increasing from 10 in June to 18 in October, with 5 of the increase occurring on Gudjerama Creek (from 1 to 6); one on Mungardobolo (3 to 4) and 2 on Maragulidban Creek (5 to 7). These animals probably include the 6 large animals not sighted on the Liverpool-Tomkinson mainstreams. Both Mungardobolo and Gudjerama Creeks are TYPE 3 and hence do provide temporary alternative habitat for the excluded large crocodiles.

4. *Overall Liverpool-Tomkinson Rivers System (Tables 1, 2, 3 and 5)*

Table 5 shows the overall results for the various detailed changes between the June and October 1982 surveys, discussed above — a decrease of 49 hatchlings (193 to 144), a decrease of 36 small crocodiles (207 to 171) of which 23 were in the (3-6′) size classes and an increase of 2 large *C. porosus* (67 to 69). A portion of the 13 (2-3′) animals can probably safely be assumed to be in the class missing — presumed dead, however some of the remaining 23 (3-6′) missing animals could even be among the additional 10 (3-6′) animals sighted on the waterways of Rolling and Junction Bays (Tables 1, 2, 6 and 7).

These changes are in keeping with the predictions made by our model for the dynamics of a population of *C. porosus* and provide further support for its basic correctness. A minor variation occurred in relation to the number of large animals sighted, rather than decreasing slightly as predicted, there was an increase of 2. This variation is partially accounted for by the 3 additional large animals sighted on Mungardobolo and Maragulidban Creeks and by the 5 large animals entering TYPE 3 Gudjerama Creek near the mouth of the Liverpool rather than leaving the river system. They might well be excluded later in the breeding season.

The results shown for the number of non-hatchling *C. porosus* sighted on the Liverpool-Tomkinson Rivers System, during surveys from 1976 to 1982, provide some evidence for the commencement of a slow recovery in the *C. porosus* population on this waterway. Though the number of non-hatchlings sighted dropped from 274 for the June 1982 to 240 for the October 1982 survey, this latter number is still greater than that for any previous year's survey. When this fact is combined with the sighting of 144 hatchlings during the October 1982 survey, then it is likely that the non-hatchling numbers will continue to rise, albeit slowly, with a generally decreasing small/large ratio. Fairly wide fluctuations, however, may be expected.

The tidal waterways of Rolling and Junction Bays, October 11-14, 1982

Table 6 summarizes data shown in Table 1, obtained during surveys of the tidal waterways of Rolling and Junction Bays from 1975 to 1982.

The Goomadeer River and Nungbulgarri Creek are both small TYPE 1 systems (note that Nungbulgarri was previously

TABLE 6

Number of *C. porosus* sighted within the hatchling, small and large size classes on the tidal waterways of Junction and Rolling Bay, which are within the Maningrida monitoring area.

	Goomadeer			**Wurugoij**			**Majarie**			**Nungbulgarri**			**Totals**			
	H	**S**	**L**	**H**	**S**	**L**	**H**	**S**	**L**	**H**	**S**	**L**	**H**	**S**	**L**	**S/L**
August 75	—	44	2	—	4	—	1	7	4	—	23+	6	1	78+	12	6.5
Major Flooding																
July/August/ September 76	18	23	11	—	—	1	—	5	2	2	10	3	20	38	17	2.2
June 77	2	41	7	No Survey			No Survey			2	10	2				
No Flooding																
July 79	29	49	12	—	2	7	—	13	5	10	16	9	39	80	33	2.4
Heavy Flooding																
June 81	6	30(7)*	7	—	3	3	—	11	8	2	21	4	8	65(7)*	22	3.0
October 81	17	25	3	—	7	1	—	12	5	—	22	3	17	66	12	5.5
Dry Wet — Flooding Only																
June 82	18	29	14	—	3	4	2	8	7	—	19	4	20	59	29	2.0
October 82	9	35	10	1	4	3	—	9	3	—	21	8	10	69	24	2.9

+ This relatively high number may have resulted from animals leaving the Liverpool System after our intensive catching effort on it during the period of 1973-1975. See page 75, Monograph 7.

* Numbers in brackets give numbers of crocodiles removed by Biology researchers before survey.

incorrectly classified as TYPE 2); the normal surveyable distance being 45.3 km and 14.8 km respectively. Hatchling recruitment on the Goomadeer, to date, has been relatively small and on Nungbulgarri it has been almost negligible, even though both waterways contain some excellent nesting habitat. Upstream of the terminal survey points, both streams break up into a number of riverlets and semipermanent and permanent freshwater billabongs. These could provide limited alternative habitat for crocodiles excluded from the sections normally surveyed.

Wurugoij and Majarie Creeks are typical coastal hypersaline creeks — TYPE 3 systems — and hatchling recruitment on them is negligible. They do, however, act as temporary rearing stockyards for sub-adults and just mature adults excluded from the TYPE 1 systems nearby — the Goomadeer, Nungbulgarri and the Liverpool-Tomkinson Systems and one notes significant readjustment in numbers of both small and large crocodiles between the systems. Compare for instance the results for the June and October 1982 surveys; some of the missing 23 (3-6′) animals from the Liverpool-Tomkinson System could account for the increase of 10 small animals (mostly 4-5′ and 5-6′) sighted in the waterways of Rolling and Junction Bays.

Examination of Table 6 shows that within each of the 4 waterways there was substantial variation in the numbers of small and large *C. porosus* sighted during the surveys carried out between 1975 and 1982; for instance the number of non-hatchlings (small and large) sighted varied from 90 in 1975 to 55 in 1976, to 113 in 1979, to 78 in October 1981 and to 93 in October 1982. As we have pointed out on previous occasions (Chapters 4 and 5 of Monograph 1, or see present main paper), the number of crocodiles sighted reflects well the number of crocodiles on the waterways and hence the variations are usually real. These variations highlight further the highly dynamic situation which prevails on the tidal waterways — the movement within, into and out of the waterways, the continuing loss of a very large fraction of the sub-adult population — and emphasize the need to consider broad groups of adjacent waterways over a period of a number of years, otherwise one could easily be misled by considering results for one survey only or from one or just part of one tidal system. Thus due care must be exercised when one attempts to draw conclusions from the survey data for Rolling and Junction Bay waterways alone. The number of small crocodiles sighted on these four waterways in August 1975 was 78, in October 1982 it was 69, with wide variations occurring for the intervening years. The number of large crocodiles sighted varied between 12 in August 1975 and October 1981 to 33 in July 1979. At best one may conclude that the population of non-hatchling *C. porosus* on these 4 waterways is remaining steady or increasing slowly and that there is some slight indication that the size structure of the population is changing slowly with the ratio of small/large tending downwards.

Anamayirra, Beach, Crab and Toms Creek and Cadell Gardens Billabong

1. *Cadell Gardens Billabong — October 31, 1982*

This 2 km billabong had been surveyed in October 1981 at which time 4 crocodiles were sighted in it, 3 EO and a (6-7′). The resurvey this year yielded 3 crocodiles, 2 EO and a (3-4′).

2. *Toms Creek — October 25, 1982*

This short (8.9 km) hypersaline coastal creek on the western shore near the mouth of the Liverpool River (page 133, Monograph 15) was surveyed annually from 1976 to 1979 inclusive, but at no time were more than 2 non-hatchlings sighted. Our resurvey this year yielded 2 (4-5′) crocodiles and one hatchling only, again demonstrating that for reasons unknown, Toms Creek is not favoured as a refuge for sub-adults excluded from the Liverpool-Tomkinson Rivers System. The creek is only slightly hypersaline (40‰) and high fish activity — specially of mullet — was observed.

One hatchling was also sighted during the July 1979 survey of the creek. A helicopter survey was therefore made of the upstream sections of the waterway on October 28 and a number of possible nesting sites observed but no old nests were sighted. It appears that there is some freshwater inflow into the creek, even at the end of the dry season, thus preventing the creek from becoming overly hypersaline. In 1974, one of the authors (HM) sighted 2 (3-4′) crocodiles buried in mud underwater; the water in the shallow pond, beyond km6, was only some 15 cm deep.

We have always experienced great difficulty in getting into or out of Toms Creek at night. During 1979, four separate attempts were made (at great cost) before the creek was surveyed. Our 1982 survey was made easier with the help of a helicopter, to ferry in survey staff. However, Toms Creek lived up to its reputation on this occasion also; a 20-25 knot NE wind sprang up near the end of the survey making the return boat journey to Maningrida difficult.

3. *Crab Creek — October 28, 1982*

Utilizing vehicular access, Crab Creek was surveyed in November 1981 and again in October 1982. This is also a very short (3 km) shallow hypersaline creek and only the west arm is surveyable by dinghy at tide levels when EB > 60 cm. Only two crocodiles (EO > 6′, > 7′) were sighted in November 1981 and one (EO > 6′) during the October 1982 survey.

4. *Anamayirra and Beach Creeks — October 23-24, 1982*

These two adjacent coastal hypersaline creeks are only some 10 km to the west of the mouth of the Blyth River and both could provide excellent alternative habitat for crocodiles excluded from it. The creeks were surveyed in July and again in October 1982. Sixteen non-hatchlings were sighted on Anamayirra Creek on both occasions (9S, 7L in July, 11S, 5L in October), whereas on Beach Creek six non-hatchlings (3S, 3L) were sighted in July and only 3 (3S) in October.

The survey results for the coastal creeks are somewhat surprising as one might have expected to have sighted more excluded crocodiles in them in October-November than in June-July. But this was not the case. The crocodiles missing from the Liverpool-Tomkinson and Blyth-Cadell Rivers Systems must have gone elsewhere (Milingimbi Complex?) or have been killed by the larger mature adults. Our finding, during the course of the October-November 1982 surveys, of the freshly dead (7-8′) crocodile on the Tomkinson River and the sighting of a (7-8′) *C. porosus* with one rear limb freshly torn off (see Cadell section notes) provides further support for the hypothesis that a substantial fraction of sub-adult or just mature crocodiles are killed by the larger animals.

Blyth-Cadell Rivers System, November 6-8, 1982

1. *Cadell River (Table 4)*

Following the June 1982 survey of the Cadell River it was predicted, both for the Cadell and Blyth Rivers, that one could expect the number of small *C. porosus* sighted to remain essentially constant and for the number of large crocodiles sighted on it to decrease. These predictions have turned out to be correct for the Cadell, and as we shall shortly see, for the Blyth River as well. As may be seen in Table 4 — 73 small crocodiles were sighted on the June survey and 71 on the October one. The number of large animals sighted decreased from 20 in June to 11 in November; the decrease occurring on the mouth sections of the Cadell River, precisely where the original increase from 9 in October 1981 to 20 in June 1982 had taken place. These crocodiles undoubtedly had come in and also left via the Blyth River at km19.1. Not all of the missing large *C. porosus* are necessarily still alive; it is highly likely that a number of them have been killed by larger crocodiles. On the survey of the night of November 6, a (7-8′) crocodile was sighted at km45.9 (the breeding area) with a rear leg freshly torn off — obviously done by a larger crocodile.

The number of hatchlings sighted during the June survey was 51 whereas on the November survey it was 56. During the course of the latter survey it was noted that many of the hatchlings were very small and hence a number of late nests had hatched since the June survey. No creches were seen.

The distribution along the Cadell River, of small crocodiles, changed between the June and November surveys. Whereas only 5S were spotted on the km41.5-48.8 portion of the river in June, this number had risen to 12S for the November survey. The number of small crocodiles sighted on the km19.1-29.1 section fell from 38 to 30, thus indicating that the small crocodiles were being forced upstream from the mouth sections of the river, perhaps by the remaining large crocodiles there.

2. *Blyth River sidecreeks (Table 4)*

The number of both small and large *C. porosus* sighted on the sidecreeks of the Blyth mainstream decreased from the June to the November 1982 survey (Table 4). The number of small animals decreased from 14 to 9 and the number of large animals sighted decreased from 6 to 3. Though the number of animals sighted on the sidecreeks was small, the general decrease was indicative of the results found for the overall Blyth-Cadell Rivers System. It is interesting to note that the main decrease in small animals occurred on Creek B at km3.5, near the mouth of the Blyth River where the concentration of large animals was greatest during the June 1982 survey. The decrease of 3 large animals in the sidecreeks, also occurred near the mouth of the Blyth, on Creeks B and C.

3. *Blyth River mainstream (Table 4)*

The number of hatchlings sighted on the Blyth mainstream decreased from 84 for the June survey to 55 for the November 1982 one (Table 4). However the loss of hatchlings between June and November was greater than that implied by the difference between the two figures, for a number of very small hatchlings were sighted during the November survey, indicating that there had been an input of hatchlings since the June survey, from late nest(s).

Though the number of small *C. porosus* sighted on the Blyth mainstream during the November survey (116) was essentially the same as on the June survey (118, see Table 4), their distribution along the stream had changed considerably. For instance on the km0-10 mouth section, 19 small crocodiles were sighted during the June survey whereas in November only 9 small animals were sighted. Small crocodiles excluded from the sidecreeks of the Blyth and from its downstream sections moved to what appears to always have been the most desirable sections of the mainstream, namely the brackish km25-40 sections (page 334, Monograph 1).

The extreme upstream sections of the Blyth mainstream which were surveyed in October 1980 (page 446, Monograph 1) and June 1982 were resurveyed again November 1982. These are not included in our standard monitoring sections. Interestingly, on the km49.8-59 section the number of small animals sighted had increased between June and November from 1 to 7 and the number of large from 3 to 4. Three large crocodiles were also sighted in the two billabongs between km59-64.6. There is thus additional evidence that sub-adults are probably being excluded by the larger animals from the breeding sections of the waterway — specially during the breeding season.

The number of large animals sighted during the November 1982 survey had dropped to 26 from the 41 sighted in June 1982 and the decrease occurred almost exclusively on the km0-15 mouth section of the river — precisely on the same section where one of the major increases in large animals was observed, between the October 1981 and June 1982 surveys. There is thus ever increasing evidence that substantial numbers of large animals enter and leave the Blyth-Cadell Rivers System via the mouth of the Blyth River.

4. *Overall Blyth-Cadell Rivers System (Tables 1, 2, 3 and 4)*

The 111 hatchlings sighted on the Blyth-Cadell Rivers in November 1982 can be expected to yield an input of some 80 (2-3′) animals for the June 1983 survey.

One might thus expect a major increase of this order in the number of (3-6′) crocodiles sighted during future surveys. However, as may be readily seen from Tables 2, 3 and 4, this is not likely because of the continuing major losses (60-70%) of the sub-adults. It is difficult to believe that in October 1974 and again in November 1975 some 290 small *C. porosus* were sighted in the rivers system (Table 2), furthermore that since that date there has been an input of some 800 hatchlings and yet in November 1982 we sighted only 197 small (of which 154 were in the (3-6′) size classes) and 39 large crocodiles!

The density and number of non-hatchling *C. porosus* sighted on the Blyth-Cadell Rivers System in November 1982 was smaller than on any other survey since surveys started in 1974 — in fact the number of non-hatchlings sighted in November 1982 was some 20% less than in October 1974. However, the data is readily understood in terms of our model of the dynamics of *C. porosus* populations given in Chapter 6 of Monograph 1. In fact, on the basis of this model, following the June 1982 survey, we predicted in our paper to the 6th Working Meeting of the SSC/IUCN Crocodile Specialist Group:

> *"The October 1982 survey of the Blyth-Cadell System may well reveal considerable readjustment between the increased number of small and large animals sighted on the mouth sections of both the Blyth and Cadell Rivers and show not only a small decrease in the numbers of large animals sighted on the overall Blyth-Cadell System but perhaps a further decrease in the number of small animals sighted as well. However, it is difficult to believe that the number of small* C. porosus *could decrease much further on the System and it appears that a stage is being reached where the number of small animals sighted will commence increasing, but with the number of large animals increasing faster, thus yielding a decreasing, but fairly fluctuating ratio of small to large* C. porosus."

As already discussed, a major readjustment did take place at the mouths of both the Blyth and Cadell Rivers and this resulted in the redistribution of both large and small crocodiles along the two waterways and the loss of only 8 small but 28 large animals. The 72% increase from 39 large animals sighted in October 1981 to 67 in June 1982 had disappeared by November 1982 when only 39 large animals were again sighted. Where did the animals come from and go to?

There is now little doubt that a major exclusion (including killing) and redistribution of both small and large *C. porosus* occurs during the breeding season which appears to commence around September-October (we do not know how long it lasts — perhaps right over the wet season) and it is during this period that the heavy losses of sub-adults largely occurs. Some of the missing animals from the Blyth-Cadell System appear to leave it via the mouth of the Blyth River, others take up territory in less suitable habitat such as the extreme upstream sections of the Blyth and Cadell mainstreams. These "surviving missing animals" overall probably constitute some 15 to 20% of the non-hatchling population and apparently usually re-enter the main river system during the wet or early dry season, for it is usually the June-July surveys which reveal an influx — if any — of small and large animals. The remainder of the missing non-hatchlings from the normal annual recruitment simply must be presumed dead and evidence is accumulating that mature *C. porosus* and sharks are probably responsible. The "missing — presumed dead" constitute some 60-70% of the non-hatchling population overall.

Monitored major waterways in the Maningrida area

In Table 7 we have assembled a summary of our survey results for the major tidal waterways monitored in the Maningrida area since 1975 in order to emphasize overall changes in the non-hatchling *C. porosus* population for a broad geographical area containing TYPE 1 to TYPE 3 systems. Comparing the results in the Totals Column for 1976, 1979 and 1982 one immediately sees that the number of small crocodiles sighted has essentially remained constant and that there appears to be a slow and small increase in the number of large animals sighted. Thus the ratio of small/large animals appears to be decreasing, but the fluctuations are substantial.

There is little evidence — other than in the changing size structure of the crocodile population — for a sustained recovery and no evidence whatsoever for a major increase in the number of non-hatchling animals. From our model for the dynamics of a population of *C. porosus* we may predict — and the data supports the model — that a major sustained increase in non-hatchling numbers must be measured in decades.

The results of Table 7 also show that the crocodiles missing from one large system are not necessarily compensated for by an equal increase in another large system nearby. For instance, the 28 large crocodiles missing from the Blyth-Cadell System in October 1982 did not result in an increase of 28 large animals in the Liverpool-Tomkinson System. Furthermore, as discussed elsewhere in these notes, there was no sign of an increase in the number of large animals sighted on either Crab, Anamayirra or Beach Creeks which lie between the mouths of the Blyth and Liverpool Rivers. Where then can the missing 28 large crocodiles be? We can only guess: some already have been

TABLE 7

Number of *C. porosus* sighted within the hatchling, small and large size classes on the major component tidal systems within the Maningrida monitoring area. Also shown is the ratio of small to large crocodiles.

	Blyth-Cadell System			**Liverpool-Tomkinson System**			**Rolling & Junction Bays**			**Totals**			
	H	**S**	**L**	**H**	**S**	**L**	**H**	**S**	**L**	**H**	**S**	**L**	**S/L**
Aug/Nov 75	50	289	14	Data Unusable			1	78	12				
Major Flooding													
July/Sept 76	82	240	26	19	180	49	20	38	17	121	458	92	5.0
May/June 77	108	232	25	40	166	39	4	51	9+	152	449	73+	6.2+
October 77	112	226	22	56	147	25	No Surveys						
September 78	155	221	23	37	156	40	No Surveys						
No Flooding													
June/July 79	123	287	55	289	152	74	39	80	33	451	519	162	3.2
October 80	119	249	32	71	173	51	No Surveys						
Heavy Flooding													
June/July 81	76	253	37	26	176	54	8	65(7)*	22	110	494(7)*	113	4.4
October 81	72	204	39	34	166	54	17	66	12	123	436	105	4.2
Dry Wet — Minor Flooding Only													
June/July 82	136	205	67	193	207	67	20	59	29	349	471	163	2.9
Oct/Nov 82	111	197	39	144	171	69	10	69	24	265	437	132	3.3

+ See Table 6; Majarie and Wurugoij Creeks were not surveyed thus resulting in the omission of a few small and large crocodiles. Hence the value of S/L is probably slightly *TOO LOW*.

* Numbers in brackets give numbers of crocodiles removed by Biology researchers before survey.

killed by larger crocodiles and/or sharks and some may have migrated temporarily to the Milingimbi Complex, to the east of the Blyth River mouth. If this is so, then over the next few years we might again expect an influx of large crocodiles to the Liverpool-Tomkinson System and at the Blyth River mouth. It is still not clear what triggered the influx of large animals into the Blyth-Cadell and Liverpool-Tomkinson Systems in 1979 and 1982 — however the evidence is now strong that it was the "dry wet" seasons preceding the surveys of those years.

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4.

C. POROSUS — A TEN YEAR OVERVIEW

THE POPULATION MODEL AND THE IMPORTANCE OF "DRY WET" SEASONS AND STATUS, MANAGEMENT AND RECOVERY

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Message to the Reader: Before reading this paper please turn to Tables 4 to 7 and in each case spend several minutes carefully looking down the numbers in each column. Then read on!

CONTENTS

ABSTRACT

This paper provides the overall results for 10 years of spotlight surveys carried out in the tidal waterways in the Maningrida area of northern Arnhem Land.

In previous publications we have developed a model of the dynamics of *C. porosus* populations on the tidal waterways of northern Australia, based on the results of repeated censuses. In this paper, by utilizing the results of additional surveys carried out in our monitoring area in June-July and October 1983, further confirmation and refinement of the basic features of the model is obtained and more is added to our already detailed understanding of population changes in the monitoring area. This paper focuses particular attention on a question raised in our previous paper: what role do "dry wet" seasons play in determining observed influxes of (3-6′) and specially large *C. porosus* onto the main sections of the tidal waterways and where do the animals come from? The wet season of 1982-1983 was a "dry" one, as was that of 1981-82, and this has enabled a detailed analysis, based on our model, of the population dynamics during such periods.

We found it essential to carry out surveys, in both June-July and October, of two additional systems last surveyed in 1979, Ngandadauda Creek and the Glyde River. Extensive aerial surveys of the large Arafura Swamp, draining into the Glyde, were also carried out. With these additional surveys, we believe we have essentially unravelled the importance of "dry wet" seasons in the dynamics of *C. porosus* populations in our monitoring area. There is very considerable interaction between our monitoring area and the Arafura Swamp, some 150 km away by water. Animals forced out due to the drying back of the swamp habitat have moved into our monitoring area and a proportion have remained, giving rise to an increase in the number of large animals in the systems. Some of these animals may well have been originally recruited in our monitoring area.

We also review the results of some ten years' work on the 330 km of tidal waterways in the monitoring area. The results and analysis of this work clearly indicate that further work in this area would yield little new knowledge in the short-term and we will now shift our attention to another section of northern Australia, to check whether our model is applicable there and if it is not, then to develop it further. Different estimates are given for the very high losses (but it is at least 70%) that we have found as *C. porosus* grows to sexual maturity, and these mostly account for the essentially unchanged number of (3-6′) animals and for the only small increase in large animals that we have found over ten years. It is almost as if there were a set number of territories or slots in a river system, and the crocodiles themselves are primarily responsible for the very high losses that occur in the process of trying to secure these slots or to increase them in number. After reviewing prospects for recovery and management of Australia's *C. porosus* population, we feel we can realistically and unfortunately conclude only this about the saltwater crocodile's future:

IT HAS NONE.

INTRODUCTION AND THE POPULATION MODEL

It is 12 years since the University of Sydney Crocodile Research Group commenced its study of *Crocodylus porosus* in northern Australia. The results of this lengthy and extensive study have appeared in numerous publications covering the physiology, nesting, growth, movement, mortality and population structure and status of *C. porosus* over much of the northern Australian coastline. Our basic work on the status and population dynamics of *C. porosus* in tidal waterways up to and including 1979 has been presented in a series of 17 monographs and 2 reports by Messel and his co-workers (Messel *et al.* 1979-1982).

Intensive population surveys and studies were continued during 1980, 1981, 1982 and 1983 on some 330 km of tidal waterways (Figs. 1 to 3) centred on our northern Arnhem Land headquarters at Maningrida on the Liverpool-Tomkinson Rivers System (Monograph 7, see also pages 14, 15 and 440-446 Monograph 1 where the results of the 1980 and 1981 surveys appear as addenda). The results of the 1979-1982 surveys were analysed and discussed in a paper entitled *"The continuing and mysterious disappearance of a major fraction of sub-adult C. porosus from tidal waterways in northern Australia"* presented to the 6th Working Meeting of the IUCN/SSC Crocodile Specialist Group at St Lucia, South Africa, September 28-30, 1982. The results of our October 1982 surveys appear as an Appendix to the above paper. For brevity, we shall refer to the paper and appendix as the "St Lucia 1982" paper.

The model which we have built up (see specially Chapter 6, Monograph 1 and Monographs 5, 7, 9, 10, 11, 16 and 17) and have been refining, as more data is obtained, enables us to account in a consistent fashion for the vast store of field observations and results we have accumulated for some 100 tidal waterways in northern Australia. It also enables us to predict successfully, results to be expected on future surveys — as we did in July 1982 when we made predictions about the decrease in the number of small and/or large *C. porosus* which would be sighted in October 1982, on the 330 km of tidal waterways monitored in the Maningrida area. The model runs as follows:

The tidal waterways of northern Australia have been classified according to their salinity signatures into TYPE 1, TYPE 2 and TYPE 3 systems as delineated in Chapter 3, Fig. 3.4.11A of Monograph 1 (pages 100 and 101). TYPE 1 systems are the main breeding ones and non-TYPE 1 systems are usually poor or non-breeding systems. It is the TYPE 1 systems and the freshwater billabongs and semipermanent and permanent freshwater swamps associated with them which account for the major recruitment of *C. porosus*; the other systems contribute to a lesser degree and they must depend largely upon TYPE 1 systems and their associated freshwater complexes for the provision of their crocodiles. Non-TYPE 1 systems also sometimes have freshwater complexes associated with them but these are normally quite minor.

In Table 9.2.1 (page 419) of Monograph 1, our results show that in TYPE 1 systems some 27% of the crocodiles sighted are hatchlings (of which some 50% are normally lost between June of one year and June of the next, page 394 Monograph 1), whereas in TYPE 2-3 systems this figure falls to 14% and in TYPE 3 systems down to 4%, showing a much decreased hatchling recruitment in non-TYPE 1 systems. In TYPE 3 systems the percentage of crocodiles in the hatchling, (2-3′) and (3-4′) size classes combined is some 11% whereas in TYPE 1 systems it is at least 52%. On the other hand the percentage of crocodiles in the ≥(4-5′) size classes is some 39% in TYPE 1 systems and 73% in TYPE 3 systems. Some 79% of the non-hatchling crocodiles are sighted on TYPE 1 waterways and 21% on non-TYPE 1 waterways (page 419 Monograph 1).

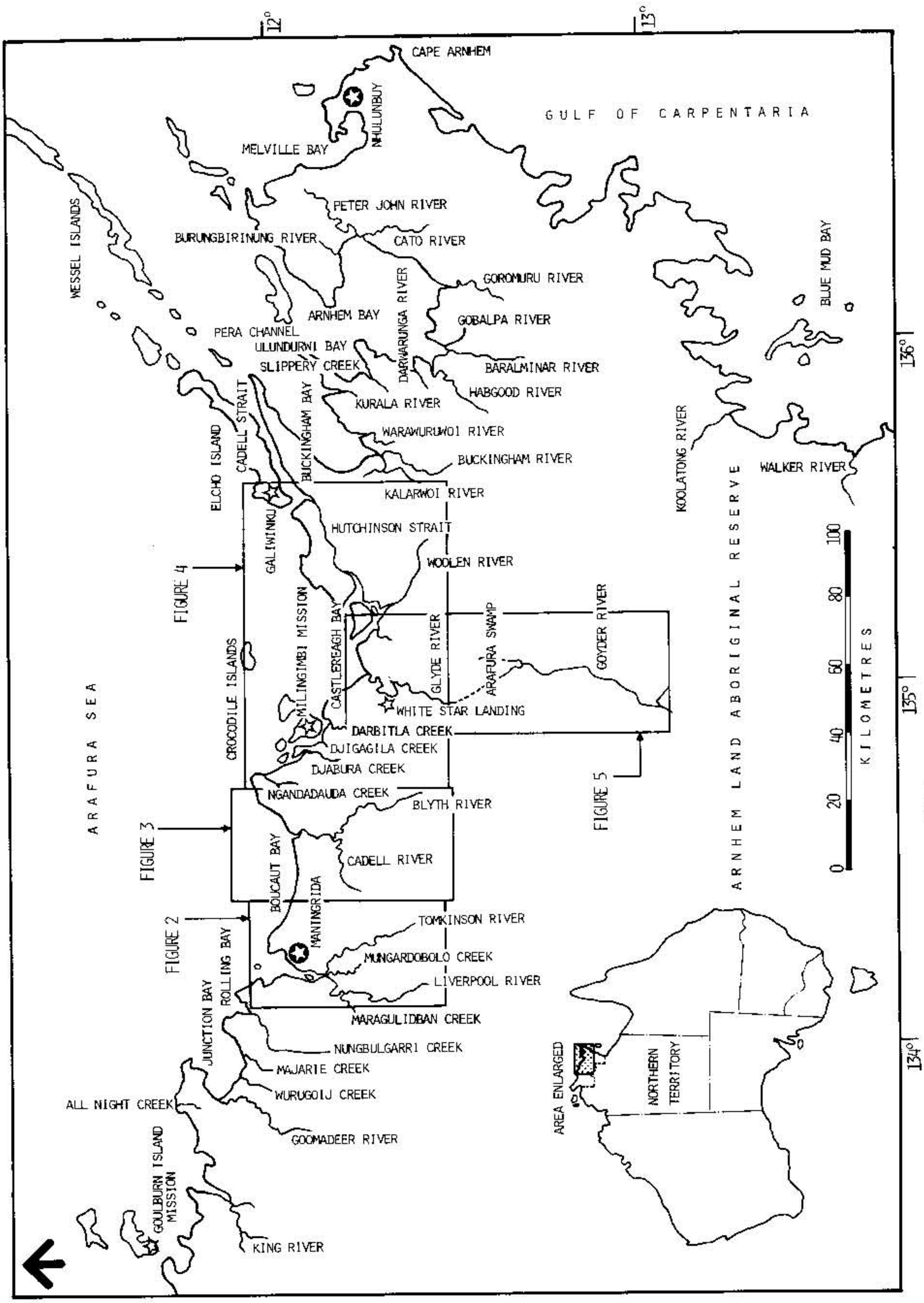


Fig. 1
General area map north eastern Arnhem Land.

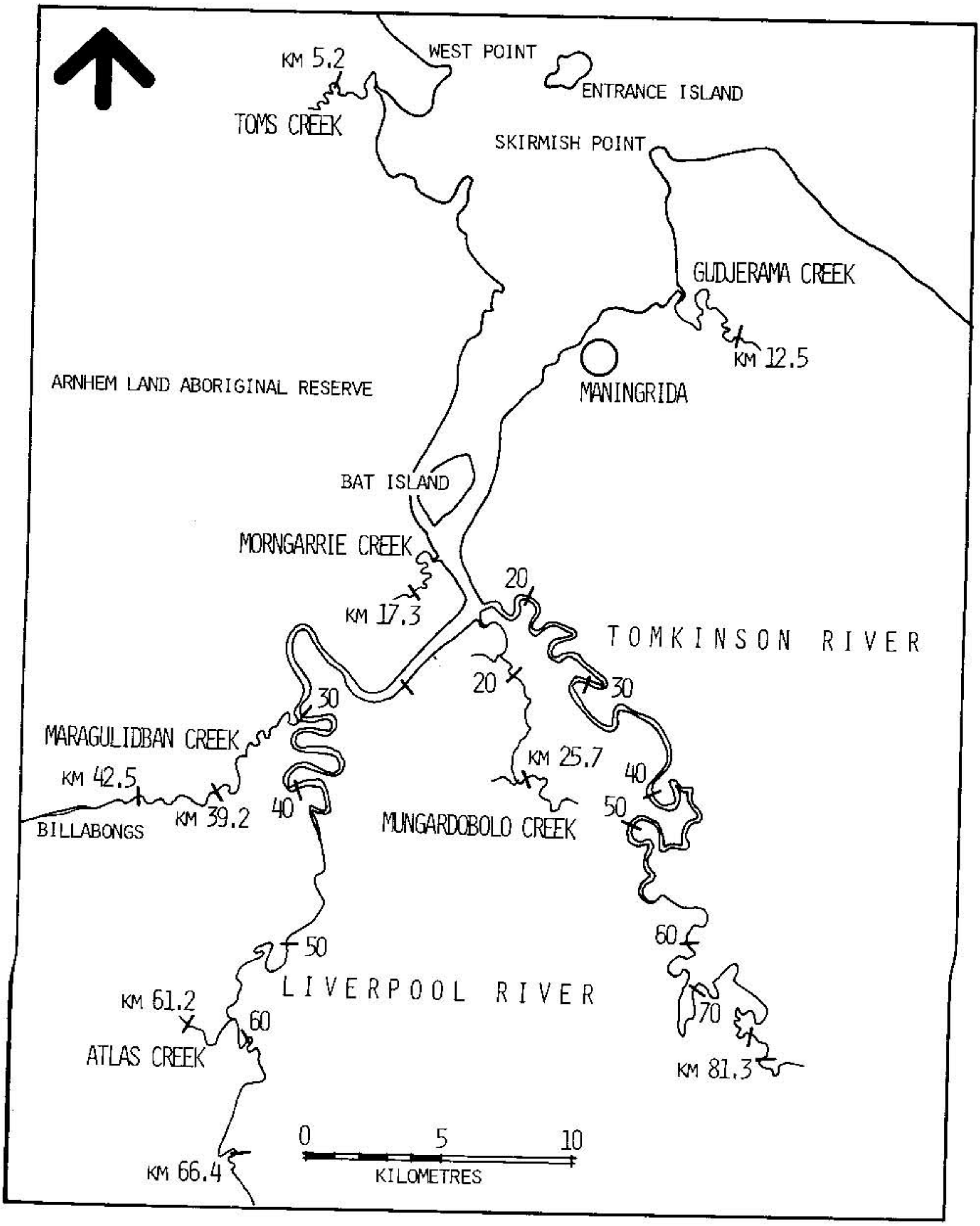


Fig. 2
The Liverpool-Tomkinson Rivers.

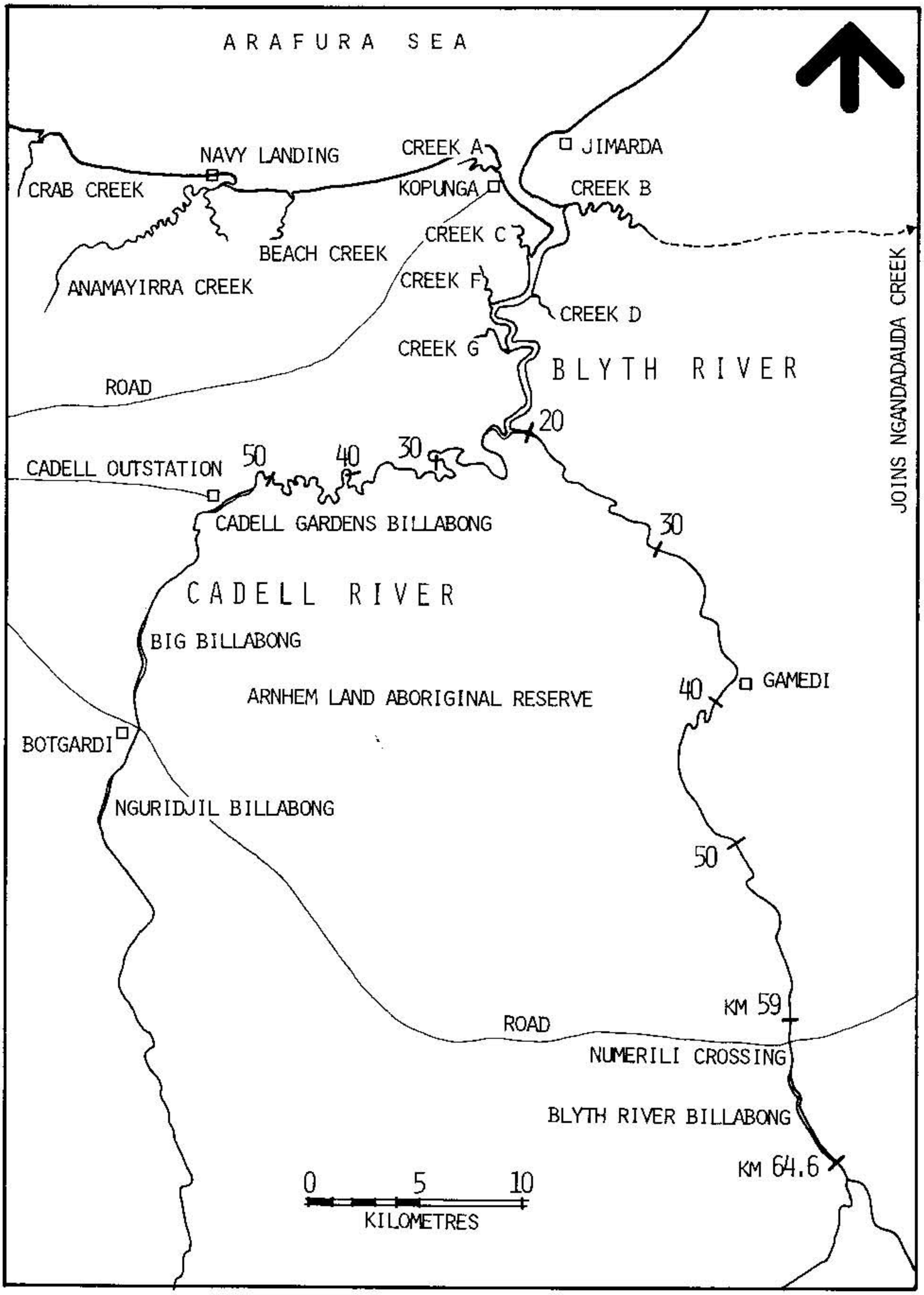


Fig. 3
The Blyth-Cadell Rivers.

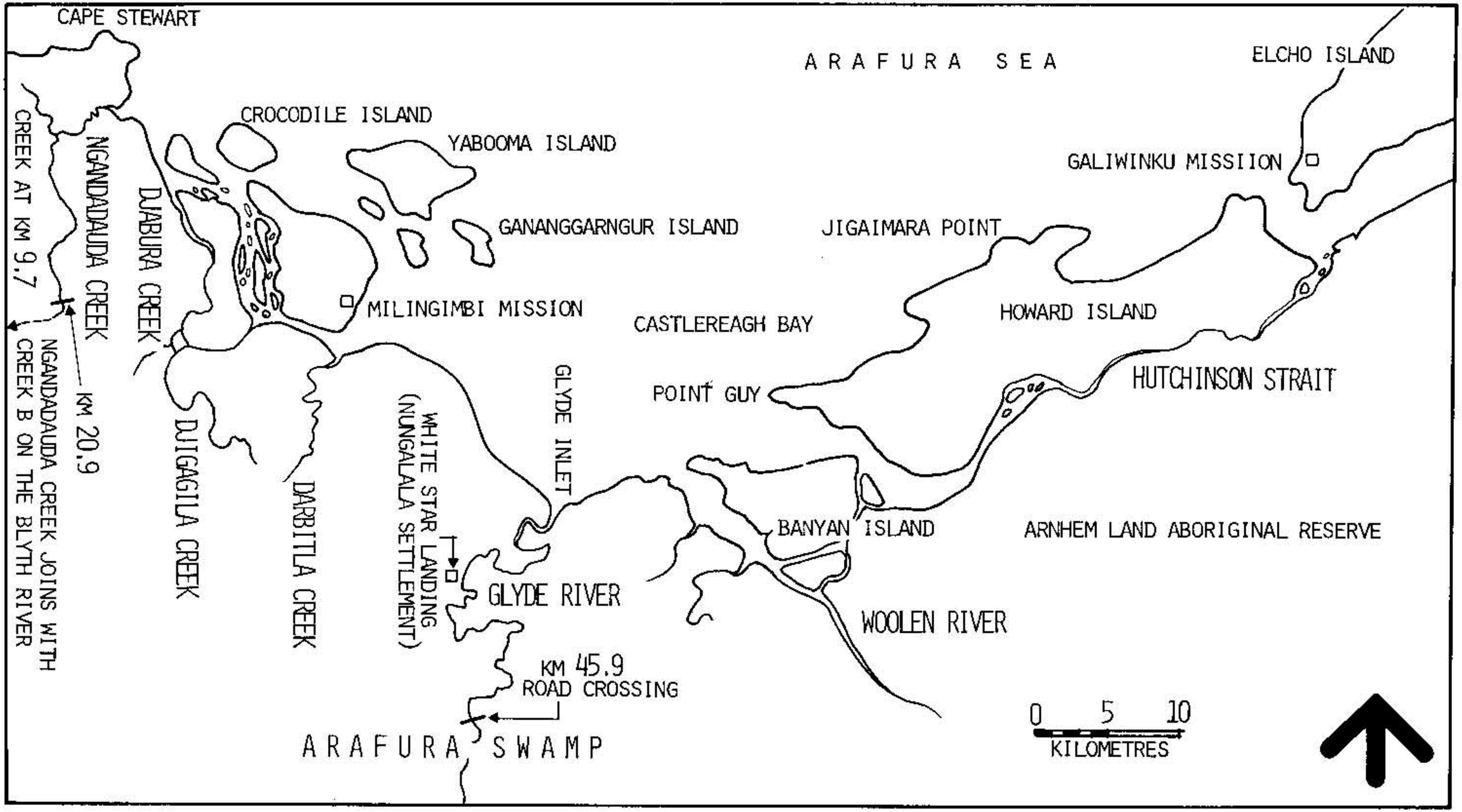


Fig. 4.
General area map showing the tidal waterways of the Milingimbi Complex and Castlereagh Bay.

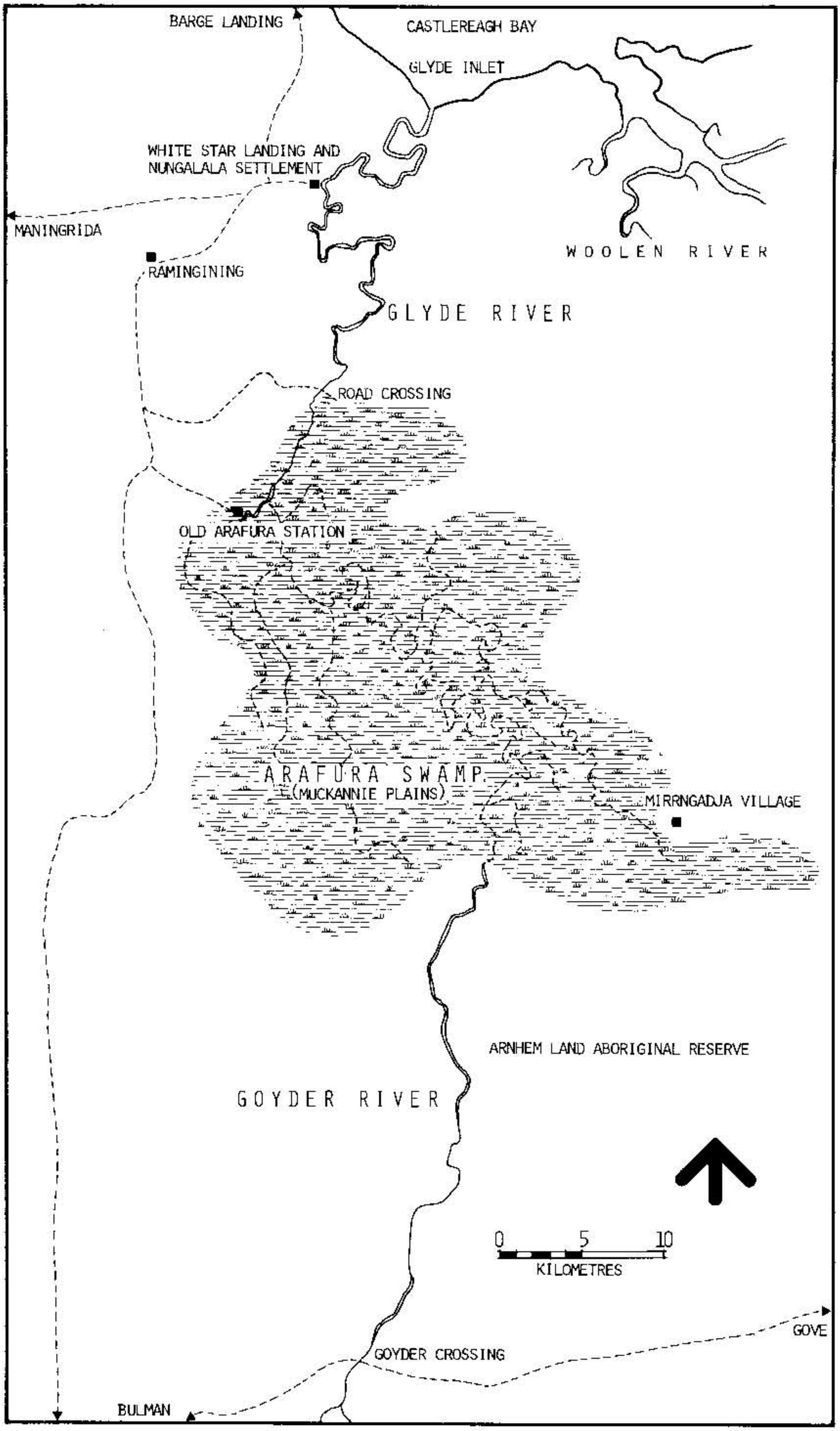


Fig. 5
The Glyde-Arafura and Goyder areas.

The relatively few large, and more frequent small freshwater billabongs and semipermanent and permanent freshwater swamps associated with tidal waterways are known to contain *C. porosus* but have not been inventoried systematically, except in a few cases. The accurate extent of their non-hatchling *C. porosus* populations is unknown. Based upon the fact that the number of large freshwater swamp areas, *with substantial water* (normally bordering old river channels), in northern Australia is very limited — perhaps 400 km^2 maximum — and upon limited observations, we estimated *that in 1979* the non-hatchling *C. porosus* population was less than 20% of the non-hatchling population sighted in tidal systems (page 433 Monograph 1, note error on page 433 when the statement "less than 20% of the population sighted in TYPE 1 tidal river systems" is made, and again in the Table below it; the words "TYPE 1" should have been omitted. The figure of 836 is based on 20% of the number of non-hatchlings sighted in tidal systems). We now believe that the 20% figure was an overestimate for 1979 — an unusual year associated with one of the "driest wet" seasons on record.

It appears that the populating of non-TYPE 1 systems (hypersaline or partially hypersaline coastal and non-coastal waterways) results mostly from the exclusion of a large fraction of the sub-adult crocodiles from TYPE 1 systems and any freshwater complexes associated with them. Adult crocodiles appear generally to tolerate hatchlings, (2-3′) and sometimes even (3-4′) sized crocodiles in their vicinity (but not always — they sometimes eat them, page 43 Monograph 14 — or kill them, page 334 Monograph 1), but not larger crocodiles. Thus once a crocodile reaches the (3-4′) and (4-5′) size classes, it is likely to be challenged increasingly not only by crocodiles near or in its own size class (pages 454-458 Monograph 1) but by crocodiles in the larger size classes and to be excluded from the area it was able to occupy when it was smaller. A very dynamic situation prevails with both adults and sub-adults being forced to move between various components of a system and between systems. Crocodile interactions or aggressiveness between crocodiles in all size classes increases around October — during the breeding season (page 445 Monograph 1 and St. Lucia 1982) and exclusions, if any, normally occur around this period. A substantial fraction (∿80%) of the sub-adults, mostly in the (3-6′) size classes but also including immature larger crocodiles, are eventually excluded from the river proper or are predated upon by larger crocodiles. Of those crocodiles that have been excluded, some may take refuge in freshwater swamp areas and billabongs associated with the waterway from which they were excluded or in the waterways' non-TYPE 1 creeks if it has any. Others may travel along the coast until by chance they find a non-TYPE 1 or another TYPE 1 waterway, however in this latter case they may again be excluded from it; others may go out to sea and possibly perish (perhaps because of lack of food, as they are largely shallow water on edge feeders, or they may be taken by sharks). Those finding non-TYPE 1 systems, or associated freshwater complexes, frequent these areas, which act as rearing stockyards, for varying periods, until they reach sexual maturity, at which time they endeavour to return to a TYPE 1 breeding system. Both sub-adults and just mature adults might attempt to return and be forced out of the system many times before finally being successful in establishing a territory in a TYPE 1 system or in its associated freshwater complex. Crocodiles may have a homing instinct (this important point requires further study) and even though a fraction of crocodiles may finally return to and remain in a TYPE 1 system or in its associated freshwater complex, the overall sub-adult numbers missing — presumed dead — remain high and appear to be at least 60-70%. Since a large fraction of the crocodiles sighted in non-TYPE 1 systems must be derived from TYPE 1 systems and their associated freshwater complexes, they are predominantly sub-adults or just mature adults (page 431 Monograph 1).

Normally, the freshwater complexes (swamps and/or billabongs) associated with tidal systems, are found at the terminal sections of small and large creeks running into the main waterway, or at the terminal sections of the mainstream(s). Though this alternative habitat is usually very limited in extent, sporadic (and sometimes extensive yearly) nesting does take place on it. There are, however, several fairly extensive freshwater complexes associated with TYPE 1 tidal systems and these are important as they may act both as rearing stockyards and as breeding systems, just as the TYPE 1 waterway does itself. Examples of these are the Glyde River with the Arafura Swamp (Monograph 9), the Alligator Region Rivers with their wetlands (Monographs 4 and 14), and the Daly, Finniss, Reynolds and Moyle Rivers with their wetlands (Monograph 2). Not only can the loss factor, which appears to occur during the exclusion stage, be expected to be lower for movements into and out of swamp areas associated with a TYPE 1 waterway, than for movement into and out of coastal non-TYPE 1 systems, but the loss of nests due to flooding can also be expected to be less. We have observed nests made on floating grass cane mats in the Daly River Aboriginal Reserve area. Thus recovery of the *C. porosus* population of TYPE 1 tidal waterways, with substantial associated freshwater complexes, can be expected to be faster than on other systems (page 445 Monograph 1, page 98 Monograph 14).

Though we are confident about the correctness of the basic structure of the above model, this is not to imply that amendments will not be necessary in the future as more data becomes available. Every good model should be capable of refinement and improvement, based upon further systematic and accurate observations.

The following additional important results, some of which have been only partly incorporated into the model itself, are understandable on the basis of it (pages 14, 15, 440-446 and Chapters 6 and 9 Monograph 1, St. Lucia 1982):

1. Because of the ~80% exclusion and at least 60-70% losses of sub-adult crocodiles as they proceed toward sexual maturity, there has been no significant sustained increase in the non-hatchling *C. porosus* population on the tidal waterways of our monitored area in northern Australia since the commencement of our systematic surveys, a period of ten years.

2. Assuming the results from our monitored area apply elsewhere, any significant sustained increase in the non-hatchling *C. porosus* populations on the tidal waterways of northern Australia must be measured in decades.

3. Though there has been no sustained significant increase in the number of non-hatchling crocodiles sighted on the tidal waterways since our surveys started in 1974, the size structure of the animals sighted appears to be changing slowly. Notwithstanding substantial fluctuations, the ratios of small (2-6′) to large (≥6′), and (3-6′) to large animals is decreasing on the Blyth-Cadell, may be decreasing on the Liverpool-Tomkinson and is decreasing overall on the tidal waterways of the Maningrida monitoring area. Thus there is some indication of the commencement of a slow recovery phase. However even this could be open to dispute.

4. Though there are wide fluctuations, specially after "dry wet" seasons when the animals are concentrated into the tidal waterways, it appears that as the number of large crocodiles in a tidal waterway increases, there is a tendency for the number of sub-adults in the (3-6′) size classes to decrease or increase marginally only. Thus the total number of (3-6′) and large animals sighted appears generally to be holding steady or increasing slowly only. It is almost as if there were a set number of territories or slots in a river system, and the crocodiles themselves are primarily responsible for the very heavy losses of ~70% that occur in the process of trying to secure these slots or to increase them in number.

5. When a steady state is reached in a "recovered" population, the ratio of (3-6′) to large animals might be considerably less than one.

6. If one considers a group of 100 of the sub-adult crocodiles in a TYPE 1 tidal system, one can expect some 80 to be excluded from it, at least 60-70 to end up missing — presumed dead, less than 15-20 to successfully establish territories on the system without having to leave it and the remainder might eventually also return and establish a territory, specially after becoming sexually mature. The very nature of this matter is such as to preclude precise figures and they must be looked upon as broad estimates only. However study of Tables 4, 5, 6 and 7 now indicates that the missing — presumed dead figure is likely to be in excess of 70.

7. When there is an exclusion of sub-adult animals, mostly (3-6′) in size but also including immature larger animals, this takes place mainly in the breeding season, normally commencing around September-October and apparently lasting throughout the wet season. Any influx of animals, in the (3-6′) and/or large size classes, appears to occur mainly in the early dry season and to be completed in the June-early September period, but may in some years be earlier.

8. After a single "dry wet" season there is a substantial influx of large and sometimes (3-6′) animals, forced out of freshwater complexes, into the tidal waterways and these are sighted during June-July surveys. Surveys made in October-November of the same year, usually reveal a substantial decrease in the number of (3-6′) and/or large animals sighted, however the number of large animals sometimes remains higher than previously and hence a number of new large animals do not return to where they came from. These animals appear successful in establishing a territory on the waterway, and it could be the waterway from which they had originally been excluded. The "dry wet" variation in the number of animals sighted appears to be superimposed upon the variations normally found during surveys following usual wet seasons — which generally result in extensive flooding on the upstream sections of the tidal waterways. Hatchling recruitment on the tidal waterways is generally greatly enhanced during "dry wet" seasons but appears to be greatly reduced in major swamp habitat. The reverse appears to be true during normal or heavy wet seasons.

Observation 8 indicates the important role which "dry wet" seasons play in the dynamics of *C. porosus* populations and this is the main subject of the present paper, which also reports the results of our June-July and October 1983 surveys and gives an overview of the surveys carried out over the past ten years in our monitoring area.

It is fortunate that we continued to monitor the tidal waterways after 1979. If our survey programme had been discontinued at the end of 1979, it would have been natural to interpret the significant increase, between the 1975 surveys and the 1979 resurveys, in the non-hatchling *C. porosus* population sighted on a number of major tidal waterways, as indicating the commencement of a sustained recovery in the population (Chapters 6 and 9 Monograph 1, then also see pages 440-446). The results of the October 1980 resurvey of some 330 km of tidal systems in our Maningrida monitoring area, and of the resurveys made in June-July and October-November in each succeeding year indicate that such an interpretation may have been premature. One is viewing an exceedingly complex and dynamic situation in relation to *C. porosus* populations, which apparently does not lend itself to facile interpretations and answers.

Not only were we fortunate in continuing our survey programme after 1979, but we were also lucky in that the "driest wet" on record, that of 1978-1979, was followed by two usual wet seasons, those of 1979-1980 and 1980-1981. These in turn were followed by two consecutive "dry wets", those of 1981-1982 and 1982-1983. Though the latter "dry wets" were not as dry as that of 1978-1979, we again observed in 1982 a repetition of the events given in (8) above, in relation to the influx and departure of (3-6′) and/or large crocodiles. Two major questions quickly come to mind; where did the influx in 1979 and again in 1982 of (3-6′) and large crocodiles come from and where did they go to when they left? What happened to these temporarily missing (3-6′) and large animals?

By the end of the 1980 surveys, it was already becoming evident that in order to eliminate some of the many possible answers, we would have to survey all possible *C. porosus* habitat to which we could gain access in our monitoring area. This was a daunting task and a helicopter would be required to ferry survey boat and staff to many of the areas. Pragmatic cost considerations, as well as the logistics and time and effort involved — specially after already having spent some 10 years working on *C. porosus* on the tidal waterways of one of the world's most remote areas — made us wonder whether further understanding of the dynamics of *C. porosus* populations really warranted the money and enormous effort required. Each of the two annual resurveys made of the waterways in our monitoring area requires over 1000 km of survey boat travel at night and 20 hours of helicopter flying time. The "dry wet" of 1981-1982 settled the issue, again bringing about an influx of (3-6′) and large animals into the tidal waterways of our monitoring area. The decision to continue for two further years was probably correct, for we believe we have essentially unravelled another important component of the dynamics of *C. porosus* populations.

The success of our model in being able to account in a consistent fashion for the data resulting from the repeated night surveys of the tidal waterways and their associated freshwater complexes in the Maningrida area on the northern Arnhem Land coast, and to successfully predict results of surveys, indicates that it would now be more rewarding scientifically to shift our centre of studies. It is unlikely that a further 4 years' study on the waterways in the Maningrida area would add much to the picture gained over the past 10 years. Furthermore, the senior author (HM) retires from the University of Sydney in 4 years' time and it is most important that before that happens we determine whether one is justified in extrapolating the conclusions, gained from the study of *C. porosus* on some 460 km of waterways in the Maningrida area (Tables 1 and 8, Figs. 1 to 5), to tidal systems elsewhere on the coast of northern Australia. We believe that one can do so, but this point must be tested and it will take the 4 years to do so.

The University of Sydney Crocodile Research Facility at Maningrida was closed in November 1983, after functioning in this remote and costly area for some 11 years. From 1984 onwards our studies will concentrate on the waterways of the southwestern Gulf of Carpentaria (Monographs 12 and 13) using our excellent research facility at Urapunga on the Roper River (page 440 Monograph 1). We will also resurvey a number of other important tidal systems which we have not resurveyed since 1979.

Part 1

LIVERPOOL-TOMKINSON RIVERS SYSTEM, JULY 1-6 AND OCTOBER 13-18, 1983 SURVEYS

The 1983 surveys of the Liverpool-Tomkinson System (Figs. 1 and 2) were particularly important because this was the first occasion, since our research programme commenced 12 years ago, that there have been two consecutive "dry wet" seasons, those of 1981-1982 and 1982-1983. These coincided with the now famous El Nino weather pattern which drastically changed weather conditions in many areas of the world. The results of the surveys are shown in Tables 1, 2, 3, 5, 7 and 8.

1.1 July 1983 Survey

We sighted a total of 54 large animals during our July 1983 survey (the same number as in July and October 1981), compared to 69 on the October 1982 one. On the Liverpool mainstream we sighted 7 large animals less, on the sidecreeks 7 less, and 1 less on the Tomkinson River (Table 5). This decrease was not unexpected. In the Appendix to the St Lucia 1982 paper, we pointed out that the number of large animals sighted on the System, during the October 1982 survey, had not yet decreased and that this was largely due to the large animals entering the sidecreeks of the Liverpool-Tomkinson System, probably on their way out. Apparently, as predicted, the exclusion from the System eventually did occur. Where did the excluded animals go?

No overall increase in the number of large animals frequenting the tidal waterways of Rolling and Junction Bays (Fig. 1) was sighted during the June 1983 survey — in fact 3 less were seen (Tables 6 and 7). Examination of Table 8 also reveals that additionally there may have been 3 large animals missing from the alternative habitat associated with the Liverpool-Tomkinson System. Thus, what happened to the missing 15-21 large animals? On the basis of our model we must assume that some are probably missing — presumed dead — some may have entered the Blyth River and some may be temporarily frequenting the tidal waterways of the Milingimbi Complex (Monograph 9, also see DISCUSSION later). One thing is certain; if the excluded large animals were in the process of returning to swamp habitat after October 1982 — such as the Arafura and/or smaller swamps — they could not have returned for long, because the second "dry wet" ensured that the water levels were eventually just as low as that which forced them out in the first instance. Thus some of the excluded animals were probably temporarily frequenting the Blyth-Cadell System and/or the Milingimbi Complex until freshwater levels rose sufficiently for them to return to swamps — though this return could be temporary also.

TABLE 1

Number of *C. porosus* sighted within each size class on tidal waterways of the 330 km of control systems in the Maningrida area of northern Arnhem Land (see pages 14, 15, 440-446 Monograph 1) and on Ngandadauda Creek and the Glyde River draining the Arafura Swamp, during night-time spotlight surveys. The midstream distance surveyed and density of non-hatchling crocodiles sighted on each waterway is shown, as are the 95% confidence limits for the estimate of the actual number of non-hatchlings present. The TYPE classification of each waterway is given also. Note that we corrected the 1976 results for the Liverpool-Tomkinson, given on pages 14 and 416 of Monograph 1 and in the Tables of the St Lucia, 1982 paper, by subtracting 20 animals seen between the normal terminal point at km73.7 and km80.1 on the Tomkinson River. This makes the survey results more comparable. The 20 animals are now shown in Table 8.

Systems	Total	Size Class Numbers								km surveyed	Density	95% Levels	TYPE
		H	2-3	3-4	4-5	5-6	6-7	>7	EO				
MONOGRAPH 1													
Blyth-Cadell													
Oct 74	387	89	81	147	58	6	2		4	91.9	3.2	454-524	1
Nov 75	353	50	106	81	72	23	4	2	15	94.9	3.2	462-532	
Sept 76	348	82	63	104	46	14	7	6	26	92.0	2.9	403-469	
Nov 76	307	61	61	103	47	10	4	2	19	92.0	2.7	371-435	
Apr 77	327	72	70	108	48	10	2	4	13	92.0	2.8	386-450	
May 77	333	88	60	94	55	13	4	1	18	92.0	2.7	370-432	
June 77	365	108	36	102	69	13	10	3	24	90.5	2.8	389-453	
Sept 77	386	105	45	132	47	17	4	4	32	90.5	3.1	427-495	
Oct 77	360	112	68	83	47	18	8	3	21	90.5	2.7	375-439	
June 78	432	173	65	81	67	15	6	4	21	90.5	2.9	393-457	
Sept 78	399	155	60	79	56	18	8	6	17	90.5	2.7	369-431	
June 79	465	123	91	93	59	31	16	26	26	94.5	3.6	524-598	
Oct 80	400	119	89	71	48	22	9	4	38	92.9	3.0	427-495	
July 81	366	76	86	84	43	24	11	9	33	90.1	3.2	442-510	
Oct 81	315	72	77	60	32	20	16	7	31	89.9	2.7	367-430	
Jun 82	408	136	42	59	49	31	22	20	49	91.9	3.0	413-479	
Nov 82	347	111	43	66	46	28	15	10	28	92.5	2.6	356-418	
July 83	465	157	98	61	48	30	19	9	43	91.8	3.4	470-540	
Oct 83	354	73	95	69	45	24	11	10	27	92.8	3.0	427-495	
MONOGRAPH 5													
Goomadeer													
Aug 75	46		27	7	5	4			3	45.3	1.0	61-89	1
Sept 76	52	18	5	8	5	1	3	3	9	45.3	0.8	44-68	
June 77	50	2	9	13	10	6	2	1	7	45.3	1.1	65-83	
July 79	90	29	14	7	14	10	6	1	9	45.3	1.4	84-116	
June 81 *	43	6	5(3)	11(3)	8(1)	4	3	1	5	45.0	0.8	49-73	
Oct 81	45	17	3	13	6	1			5	45.0	0.6	35-47	
June 82	61	18	5	12	5	2	4	4	11	45.3	0.9	58-84	
Oct 82	54	9	7	9	11	5	4	3	6	45.3	1.0	61-87	
June 83	63	24	5	6	8	3	3	4	10	45.3	0.9	51-77	
Oct 83	73	33	8	5	8	5	4	3	7	45.3	0.9	53-79	
Majarie													
Aug 75	12	1	1	2	2	1	1	2	2	20.1	0.5	11-25	3
Aug 76	7			3					4	20.1	0.4	7	
July 79	18			1	7	4	1	3	2	24.1	0.7	21-39	
June 81	19			2	2	4	2	3	6	21.2	0.9	22-40	
Oct 81	17			3	4	2	1		7	22.0	0.8	20-36	
June 82	17	2	1	1	2	2	1	3	5	23.8	0.6	17-33	
Oct 82	12				4	5	1	1	1	23.3	0.5	13-27	
June 83	24	4		4	4	5	2		5	24.1	0.8	24-42	
Oct 83	19		1	4	1	6	3	1	3	24.1	0.8	22-40	
Wurugoij													
Aug 75	4				3	1				16.4	0.2	4	3
Aug 76	1								1	16.4	0.1	1	
July 79	9					2	2	4	1	16.4	0.5	9	
June 81	6			1	1	1	1	1	1	16.4	0.5	6	
Oct 81	8		1	1	1	3			2	16.4	0.5	8	
June 82	7					2		2	3	16.2	0.4	7	
Oct 82	8	1			2	2	1	1	1	16.4	0.4	7	
June 83	6		1		1	2	1		1	16.4	0.4	6	
Oct 83	11			2	3	1	2		3	16.4	0.7	11-25	

* Numbers in brackets give numbers of crocodiles removed by Biology researchers before survey.

TABLE 1 (continued)

Systems	Total	Size Class Numbers								*km* surveyed	Density	*95%* Levels	TYPE
		H	2-3	3-4	4-5	5-6	6-7	>7	EO				
MONOGRAPH 7													
Liverpool-Tomkinson													
July 76[1]	228	19	39	56	27	13	3	3	68	152.5	1.4	314-372	1
May 77[1]	245	40	6	51	59	30	13	5	41	145.1	1.4	307-365	
Oct 77	228	56	7	39	62	24	9	1	30	123.4	1.4	256-308	
Sept 78[1]	233	37	18	37	65	19	14	8	35	141.4	1.4	293-349	
July 79[1]	515	289	11	39	43	34	29	20	50	150.0	1.5	341-401	
Oct 79	355	161	16	36	37	29	17	23	36	141.1	1.4	290-346	
Oct 80	295	71	51	37	32	29	12	14	49	140.6	1.6	337-397	
July 81	256	26	52	48	29	23	15	15	48	140.6	1.6	347-407	
Oct 81	254	34	33	50	34	23	14	14	52	141.1	1.6	331-391	
June 82	467	193	29	64	50	37	23	17	54	141.1	1.9	416-482	
Oct 82	384	144	16	48	51	25	21	17	62	141.1	1.7	363-425	
July 83	432	121	83	64	56	32	17	15	44	141.1	2.2	475-545	
Oct 83	327	63	77	47	39	34	8	14	45	141.1	1.9	400-466	
Nungbulgarri													
Aug 75	29		4	11	3		1		10	15.0	1.9	37-59	1*
July 76	15	2		3	5	1	1		3	13.6	1.0	14-28	
June 77	14	2	2		6	1	1		2	13.6	0.9	13-27	
July 79	35	10		4	4	6	5	2	4	14.8	1.7	31-51	
June 81	27	2	4	10	4		1		6	14.8	1.7	31-51	
Oct 81	25		2	12	4	2			5	14.8	1.7	31-51	
June 82	23		2	8	4	3	1	1	4	14.8	1.6	28-48	
Oct 82	29		1	9	8	2	2	4	3	14.4	2.0	37-59	
June 83	55	34	2	6	5	5			3	14.4	1.5	25-43	
Oct 83	38	15	1	5	4	6	1	1	5	14.4	1.6	28-48	
MONOGRAPH 9													
Ngandadauda													
Sept 75	19	3	2	5	1	1	2	1	4	22.6	0.7	18-34	3
June 79	21			2	3	3	4	4	5	23.9	0.9	25-43	
June 83	30			2	5	7	1	2	13	23.6	1.3	38-60	
Oct 83	21				5	8	4	2	2	23.6	0.9	25-43	
Glyde													
Sept 75	28			3	6	2	1	4	12	45.9	0.6	35-57	1
July 79	100	36	9	10	9	10	6	6	14	45.9	1.4	89-121	
July 83	118	5	9	35	16	8	6	10	29	45.9	2.5	164-206	
Oct 83	91		3	22	12	11	5	11	27	45.9	2.0	130-168	

[1] Results for Toms Creek included in these surveys; July 1976 survey, 1 (4-5'); May 1977 survey, 1 (3-4') and 1 (6-7'); September 1978 survey, no crocodiles sighted; July 1979 survey, one hatchling and 2 (>7') sighted. No further surveys of Toms Creek were made until October 1982; results for this and subsequent surveys are shown under alternative habitat, in Table 8 and are not included in the totals below.

* Previously classified as TYPE 2.

TABLE 2

Update Table for the Blyth-Cadell Rivers System (Monograph 1) showing the (2-3′), (3-4′) and (4-5′) size classes grouped together (2-5′) and the size classes above those in another group (≥ 5′). We have also grouped the crocodiles sighted into small (2-6′), (3-6′) and large (≥ 6′). Also shown are the ratios small/large and (3-6′)/large. This Table was obtained by using the data given in Table 1. See caption to Table 3 for division of the EO crocodiles among the various size classes and the Section on the July 1983 survey of the Liverpool-Tomkinson System for the reason we sometimes use the small rather than the important (3-6′) size class.

Survey	**Totals**	**Hatchlings**	**2-5′**	**≥ 5′**	**Small 2-6′**	**Large ≥ 6′**	**3-6′**	**Small/Large**	**3-6′/Large**
26 October 74	387	89	286	12	292	6	211	48.7	35.2
1 November 75	353	50	263	40	289	14	183	20.6	13.1
Major Flooding									
23 September 76	348	82	221	45	240	26	177	9.2	6.8
4 November 76	307	61	217	29	230	16	169	14.4	10.6
11 April 77	327	72	230	25	242	13	172	18.6	13.2
3 May 77	333	88	215	30	231	14	171	16.5	12.2
8 June 77	365	108	215	42	232	25	196	9.3	7.8
16 September 77	386	105	234	47	257	24	212	10.7	8.8
23 October 77	360	112	204	44	226	22	158	10.3	7.2
10 June 78	432	173	219	40	238	21	173	11.3	8.2
12 September 78	399	155	200	44	221	23	161	9.6	7.0
No Flooding — Driest Wet on Record									
10 June 79	465	123	251	91	287	55	196	5.2	3.6
4 October 80	400	119	220	61	249	32	160	7.8	5.0
Heavy Flooding									
9 July 81	366	76	223	67	253	37	167	6.8	4.5
19 October 81	315	72	179	64	204	39	127	5.2	3.3
Dry Wet — Minor Flooding Only									
25 June 82	408	136	166	106	205	67	163	3.1	2.4
6 November 82	347	111	164	72	197	39	154	5.1	3.9
Dry Wet — Minor Flooding Only									
15 July 83	465	157	221	87	258	50	160	5.2	3.2
26 October 83	354	73	217	64	246	35	151	7.0	4.3

Tables 1, 2, 3 and 5 show the number of small animals sighted during the July 1983 survey. At first sight, the jump from 171 small animals (2-6′) sighted during the October 1982 survey to 257 on the July 1983 one, looks spectacular. However, matters are not as good as they seem. Of the increase of 86 small animals, Table 1 shows that some (83-16) = 67 are in the (2-3′) size class. In June 1982, 193 hatchlings were sighted and from Table 8.4.1, Monograph 1, one could expect some 45% or 87 of these to be in the (2-3′) size class in July 1983 (note that the Blyth-Cadell survivorship figure was also obtained for a "dry wet", that of 1978-1979). This was approximately so with 83 being sighted. However from our previous results one can expect a large fraction of the increase to disappear once the animals enter the ≥(3-4′) size classes. It is to be noted that for reasons unknown to us, but perhaps related to losses being greater during usual wet seasons than during "dry wet" ones, the 289 hatchlings of July 1979 gave rise to only 51 sightings in the (2-3′) size class in October 1980. Unfortunately, we are unable to say how many (2-3′) animals there were in June-July of that year as no surveys were made during that period.

TABLE 2 (continued)

Summary Table for the overall Liverpool-Tomkinson Rivers System (Monograph 7). See caption of Table 1 for changes made in relation to the 1976 survey results. Note also that the 1976 survey shows 68 (EO) crocodiles sighted and 34 of these were taken to be large. This is probably too high a figure for the large animals. An intensive recapture programme was carried out in 1975 thus making many more animals more wary than normal. Most of the animals involved in the recapture programme were small. It is thus likely that the true ratios for 1976 are somewhat higher than those shown.

Survey	Totals	Hatchlings	2-5′	≥5′	Small 2-6′	Large ≥6′	3-6′	Small / Large	3-6′ / Large
Major Flooding									
18 July 76	228	19	144	65	169	40	130	4.2	3.3
25 May 77	245	40	129	76	166	39	160	4.3	4.1
27 October 77	228	56	118	54	147	25	140	5.9	5.6
27 September 78	233	37	131	65	156	40	138	3.9	3.5
No Flooding — Driest Wet on Record									
16 July 79	515	289	109	117	152	74	141	2.1	1.9
19 October 79	355	161	101	93	136	58	120	2.3	2.1
15 October 80	295	71	136	88	173	51	122	3.4	2.4
Heavy Flooding									
2 July 81	256	26	145	85	176	54	124	3.3	2.3
5 October 81	254	34	134	86	166	54	133	3.1	2.5
Dry Wet — Minor Flooding Only									
12 June 82	467	193	161	113	207	67	178	3.1	2.7
16 October 82	384	144	135	105	171	69	155	2.5	2.2
Dry Wet — Minor Flooding Only									
1 July 83	432	121	217	94	257	54	174	4.8	3.2
13 October 83	327	63	177	87	219	45	142	4.9	3.2

Though we include the (2-3′) size class in the small animals in order to decrease errors in size estimation, the more meaningful size classes to consider are those in the (3-6′) range. This is so because it appears that it is crocodiles in these size classes which are most susceptible to exclusion and loss from the tidal waterways; interactions between crocodiles generally increase with size. Note however that caution is required when interpreting data for an individual size class or small group of size classes because of inevitable error in size class determination. On June surveys one can sometimes classify animals just in the (3-4′) size class as (2-3′) animals thus yielding too large a number of (2-3′) animals and too few (3-4′) ones (page 335 but also pages 80 and 389 Monograph 1).

Examination of Table 5 shows that for the Liverpool-Tomkinson System, the number of (3-6′) animals sighted during the July 1983 survey was 174, compared to 178 in June 1982 and 155 in October 1982. The number of (3-6′) crocodiles sighted on the July 1983 survey thus appears to have returned almost to the June 1982 survey figure. The number of (3-6′) animals sighted on the Liverpool mainstream, km3-60, was 59 in June 1982, 78

TABLE 3

Summary Table showing for each survey of the overall Blyth-Cadell Rivers System the number of crocodiles in the size classes indicated. The EO classes have been added together in each survey and 50% of these have been distributed equally among the (3-4′), (4-5′) and (5-6′) size classes; the remaining 50% have been distributed to the (≥6′) size classes with ⅓ being allocated to the (6-7′) size class and ⅔ to size classes (≥7′). This weights the distribution heavily in favour of larger crocodiles, which are known to normally be the most wary. When the EO is an odd number, the bias is also given to the larger size classes. For 1974, all EO crocodiles were put in the (≥7′) size class.

Survey	Totals	H	≥2′	≥3′	≥4′	≥5′	≥6′	≥7′	km surveyed	Density
26 October 74	387	89	298	217	70	12	6	4	91.9	3.24
1 November 75	353	50	303	197	114	40	14	7	94.9	3.19
Major Flooding										
23 September 76	348	82	266	203	95	45	26	15	92.0	2.89
4 November 76	307	61	246	185	79	29	16	6	92.0	2.67
11 April 77	327	72	255	185	75	25	13	9	92.0	2.77
3 May 77	333	88	245	185	88	30	14	7	92.0	2.66
8 June 77	365	108	257	221	115	42	25	11	90.5	2.84
16 September 77	386	105	281	236	99	47	24	15	90.5	3.10
23 October 77	360	112	248	180	94	44	22	10	90.5	2.74
10 June 78	432	173	259	194	110	40	21	11	90.5	2.86
12 September 78	399	155	244	184	103	44	23	12	90.5	2.70
No Flooding — Driest Wet on Record										
10 June 79	465	123	342	251	154	91	55	35	94.5	3.62
4 October 80	400	119	281	192	115	61	32	17	92.9	3.02
Heavy Flooding										
9 July 81	366	76	290	204	115	67	37	20	90.1	3.22
19 October 81	315	72	243	166	101	64	39	18	89.2	2.70
Dry Wet — Minor Flooding Only										
25 June 82	408	136	272	230	163	106	67	37	91.9	2.96
6 November 82	347	111	236	193	123	72	39	19	92.5	2.55
Dry Wet — Minor Flooding Only										
15 July 83	465	157	308	210	142	87	50	24	91.8	3.36
26 October 83	354	73	281	186	113	64	35	19	92.8	3.03

Equivalent Table for Liverpool-Tomkinson System. Also see caption to Tables 1, 2 and 5 for the 1976 survey.

Survey	Totals	H	≥2′	≥3′	≥4′	≥5′	≥6′	≥7′	km surveyed	Density
Major Flooding										
18 July 76	228	19	209	170	103	65	40	26	152.5	1.37
25 May 77	245	40	205	199	142	76	39	19	145.1	1.41
27 October 77	228	56	172	165	121	54	25	11	123.4	1.39
27 September 78	233	37	196	178	136	65	40	20	141.4	1.39
No Flooding — Driest Wet on Record										
16 July 79	515	289	226	215	168	117	74	37	150.0	1.51
19 October 79	355	161	194	178	136	93	58	35	141.1	1.38
15 October 80	295	71	224	173	128	88	51	31	140.6	1.59

TABLE 3 (continued)

Survey	Totals	H	≥ 2′	≥ 3′	≥ 4′	≥ 5′	≥ 6′	≥ 7′	km surveyed	Density
Heavy Flooding										
2 July 81	256	26	230	178	122	85	54	31	140.6	1.64
5 October 81	254	34	220	187	129	86	54	32	141.1	1.56
Dry Wet — Minor Flooding Only										
12 June 82	467	193	274	245	172	113	67	35	141.1	1.94
16 October 82	384	144	240	224	166	105	69	38	141.1	1.70
Dry Wet — Minor Flooding Only										
1 July 83	432	121	311	228	157	94	54	30	141.1	2.20
13 October 83	327	63	264	187	133	87	45	29	141.1	1.87

TABLE 4

Number of *C. porosus* sighted within the hatchling, small (2-6′), (3-6′) and large (≥6′) size classes on the three major components of the Blyth-Cadell Rivers System: Blyth mainstream, Blyth sidecreeks and Cadell River; 49.8, 12.5 and 29.7 km respectively.

Survey	Blyth Mainstream				Blyth Sidecreeks				Cadell				Totals			
	H	S	(3-6′)	L	H	S	(3-6′)	L	H	S	(3-6′)	L	H	S	(3-6′)	L
26 October 74	41	207	151	6	1	3	3	0	47	82	57	0	89	292	211	6
1 November 75	41	177	120	11	3	11	7	2	6	101	56	1	50	289	183	14
Major Flooding																
23 September 76	48	159	108	14	2	16	14	5	32	65	55	7	82	240	177	26
4 November 76	40	142	108	10	3	16	13	1	18	72	48	5	61	230	169	16
11 April 77	65	142	104	6	3	17	14	3	4	83	54	4	72	242	172	13
3 May 77	74	144	111	10	0	15	15	3	14	72	45	1	88	231	171	14
8 June 77	88	129	107	19	2	23	20	4	18	80	69	2	108	232	196	25
16 September 77	75	164	139	19	2	18	15	2	28	75	58	3	105	257	212	24
23 October 77	76	136	94	14	3	15	11	2	33	75	53	6	112	226	158	22
10 June 78	136	148	99	14	1	21	18	4	36	69	56	3	173	238	173	21
12 September 78	115	130	92	15	1	17	17	1	39	74	52	7	155	221	161	23
No Flooding — Driest Wet on Record																
10 June 79	85	171	106	40	1	15	14	9	37	101	76	6	123	287	196	55
4 October 80	86	139	101	22	0	16	12	4	33	94	47	6	119	249	160	32
Heavy Flooding																
9 July 81	48	144	97	27	2	25	22	3	26	84	48	7	76	253	167	37
19 October 81	37	127	75	28	3	13	12	2	32	64	40	9	72	204	127	39
Dry Wet — Minor Flooding Only																
25 June 82	84	118	94	41	1	14	13	6	51	73	56	20*	136	205	163	67*
6 November 82	55	116	93	26*	0	9	9	3	56	71	51	11*	111	197	154	39
Dry Wet — Minor Flooding Only																
15 July 83	146	127	84	35*	2	10	10	2	9	121	66	13	157	258	160	50*
26 October 83	70	140	84	23	0	10	10	2*	3	96	57	10	73	246	151	35*

* Bias to large.

TABLE 5

Number of *C. porosus* sighted within the hatchling, small (2-6′), (3-6′) and large (≥6′) size classes on the three major components of the Liverpool-Tomkinson Rivers System: Liverpool mainstream, Liverpool sidecreeks and Tomkinson (normally 57.0, 27.4 and 56.7 km respectively, but distances can vary from year to year — see page 16, Monograph 7; also see captions to present Tables 1 and 2). Note specially that during the 1977 and 1978 Tomkinson surveys, the river was surveyed to km70 only and that a number of small and large crocodiles were thus not counted. Probably not more than 3 or 4 of each were thus omitted. Normally the Tomkinson is surveyed to km73.7. Also see Table 8.

	Liverpool Mainstream				Liverpool Sidecreeks				Tomkinson				Totals			
	H	S	(3-6′)	L	H	S	(3-6′)	L	H	S	(3-6′)	L	H	S	(3-6′)	L
								Major Flooding								
18 July 76	11	64	51	14	4	27	22	7*	4	77	56	20*	19	169	130	40
25 May 77	13	67	64	12	4	28	27	7*	23	71	69	20	40	166	160	39*
27 October 77	23	77	73	13*	5	20	20	4*	28	49	46	9	56	147	140	25
27 September 78	13	69	63	21	7	20	17	5	17	67	58	14*	37	156	138	40*
								No Flooding — Driest Wet on Record								
16 July 79	24	63	59	29	5	24	20	21	260	65	62	24	289	152	141	74
19 October 79	17	63	51	32	2	21	20	5	142	52	49	21	161	136	120	58
15 October 80	28	61	51	25	17	25	23	7*	26	87	48	19	71	173	122	51*
								Heavy Flooding								
2 July 81	8	75	47	23	1	23	18	8*	17	77	58	24*	26	176	124	54
5 October 81	2	74	54	19	2	26	22	9*	30	65	57	27*	34	166	133	54
								Dry Wet — Minor Flooding Only								
12 June 82	7	66	59	30	8	36	34	10	178	105	85	27	193	207	178	67
16 October 82	6	82	78	27*	3	32	28	18	135	56	48	25*	144	171	155	69
								Dry Wet — Minor Flooding Only								
1 July 83	27	74	67	20	3	37	35	11*	91	145	71	24*	121	257	174	54
13 October 83	21	70	64	19	2	28	25	9	40	121	53	17*	63	219	142	45*

* Bias to large.

in October 1982 and 67 in July 1983; on the sidecreeks the numbers were 34, 28 and 35; and on the Tomkinson River, km17-73.7, the numbers were 85, 48 and 71 respectively.

Our field data enables us to analyse every section of the river system surveyed, even down to fractions of a km and we are able to follow changes on various sections of the waterway. For instance, one could easily see from the October 1982 survey results that the increase, since the June 1982 survey, of the 19 (3-6′) crocodiles sighted on the Liverpool mainstream sections (mainly in the vicinity of the mouth of the Tomkinson River, see Appendix, St Lucia 1982), probably mostly came from the mouth sections of the Tomkinson River and from Mungardobolo Creek, where decreased numbers were sighted (Fig. 2). Likewise, essentially the same phenomenon appears to have occurred in reverse when one compares the October 1982 data with that of the July 1983 survey.

One point which stands out strongly from our data (Table 5) is that the Tomkinson River, the present main breeding area of the Liverpool-Tomkinson Rivers System, is where many of the major changes in the population of hatchlings, (2-3′) and (3-6′) crocodiles occur. The number of large animals sighted on the Tomkinson has remained fairly constant since 1976,

TABLE 6

Number of *C. porosus* sighted within the hatchling, small and large size classes on the tidal waterways of Junction and Rolling Bays, which are within the Maningrida monitoring area. Also shown is the number of (3-6′) crocodiles and the ratios of small to large and (3-6′) to large for the overall systems.

	Goomadeer			Wurugolj			Majarie			Nungbulgarri			Totals					
	H	**S**	**L**	**H**	**S**	**L**	**H**	**S**	**L**	**H**	**S**	**L**	**H**	**S**	**(3-6′)**	**L**	**S/L**	**(3-6′)/L**
August 75	—	44	2	—	4	—	1	7	4	—	23[1]	6	1	78[1]	46	12	6.5	3.8
Major Flooding																		
July/August/ September 76	18	23	11	—	—	1	—	5	2	2	10	3	20	38	33	17	2.2	1.9
June 77	2	41	7	No Survey			No Survey			2	10	2	4	51	40	9	5.7[2]	4.4[2]
No Flooding — Driest Wet on Record																		
July 79	29	49	12	—	2	7	—	13	5	10	16	9	39	80	66	33	2.4	2.0
Heavy Flooding																		
June 81	6	30(7)*	7	—	3	3	—	11	8	2	21	4	8	65(7)*	56(4)*	22	3.0	2.5
October 81	17	25	3	—	7	1	—	12	5	—	22	3	17	66	60	12	5.5	5.0
Dry Wet — Minor Flooding Only																		
June 82	18	29	14	—	3	4	2	8	7	—	19	4	20	59	51	29	2.0	1.8
October 82	9	35	10	1	4	3	—	9	3	—	21	8	10	69	61	24	2.9	2.5
Dry Wet — Minor Flooding Only																		
June 83	24	27	12	—	4	2	4	15	5	34	19	2	62	65	57	21	3.1	2.7
October 83	33	29	11	—	7	4	—	13	6	15	18	5	48	67	57	26	2.6	2.2

[1] This relatively high number may have resulted from animals leaving the Liverpool system after our intensive catching effort on it during the period of 1973-1975. See page 75, Monograph 7.

[2] Wurugoij and Majarie Creeks were not surveyed resulting in the omission of a few small and large animals. Hence the values of S/L and (3-6′)/L are probably slightly TOO HIGH.

* Numbers in brackets give numbers of crocodiles removed by Biology researchers before survey.

first hovering around the 20 figure and then around 24 since 1979 with fluctuations up and down on these. Changes in the number of large animals sighted occur also on the Liverpool mainstream and its sidecreeks and there is little doubt that some large animals are excluded from the System and later re-enter it. Since hatchling recruitment on the Liverpool is very low, the fact that one sights over 60 (3-6′) animals on it each year shows that these must come largely from the Tomkinson. Some of the small, and specially animals in the (3-6′) size classes, may also leave the Liverpool-Tomkinson System (for instance see the results for Toms Creek, Table 8), but the Liverpool-Tomkinson has a number of alternative unsurveyed habitats (St Lucia 1982), such as the extreme upstream section of the Tomkinson beyond km81.3 and numerous tiny creeks, for the animals to hide and take haven in. Thus a substantial fraction of the 23 (3-6′) animals missing on the October 1982 survey may have never left the waterway, and these could easily constitute some of the additional 19 (3-6′) animals sighted in July 1983 (Table 2). This picture differs considerably from what is observed on the Blyth-Cadell Rivers System, where both the small and large animals have only very limited alternative habitat within the System and thus a large fraction of the sub-adults excluded from the mainstream have little choice but to leave the System.

TABLE 7

Number of *C. porosus* sighted within the hatchling, small (2-6′), (3-6′) and large (≥6′) size classes on the major component tidal systems within the Maningrida monitoring area. Also shown is the ratio of small to large and (3-6′) to large crocodiles and the total number of (3-6′) plus large animals (that is animals ≥3′).

	Blyth-Cadell System				**Liverpool-Tomkinson System**				**Rolling & Junction Bays**				**Totals**						
	H	**S**	**(3-6′)**	**L**	**H**	**S**	**(3-6′)**	**L**	**H**	**S**	**(3-6′)**	**L**	**H**	**S**	**(3-6′)**	**L**	**≥3′**	**S/L**	**(3-6′)/L**
Aug/Nov 75	50	289	183	14	Data Unusable				1	78	46	12							
Major Flooding																			
July/Sept 76	82	240	177	26	19	169	130	40**	20	38	33	17	121	447	340	83	423	5.4	4.1
May/June 77	108	232	196	25	40	166	160	39	4	51[1]	40[1]	9[1]	152	449[1]	396[1]	73[1]	469[1]	6.2[1]	5.4[1]
October 77	112	226	158	22	56	147	140	25	No Surveys				168	373	298	47	345	7.9	6.3[2]
September 78	155	221	161	23	37	156	138	40	No Surveys				192	377	299	63	362	6.0	4.7[2]
No Flooding — Driest Wet on Record																			
June/July 79	123	287	196	55	289	152	141	74	39	80	66	33	451	519	403	162	565	3.2	2.5
October 80	119	249	160	32	71	173	122	51	No Surveys				190	422	282	83	365	5.1	3.4[2]
Heavy Flooding																			
June/July 81	76	253	167	37	26	176	124	54	8	65(7)*	56(4)*	22	110	494(7)*	(4)* 347	113	460	4.4	3.1
October 81	72	204	127	39	34	166	132	54	17	66	60	12	123	436	320	105	425	4.2	3.0
Dry Wet — Minor Flooding Only																			
June/July 82	136	205	163	67	193	207	178	67	20	59	51	29	349	471	392	163	555	2.9	2.4
Oct/Nov 82	111	197	154	39	144	171	155	69	10	69	61	24	265	437	370	132	502	3.3	2.8
Dry Wet — Minor Flooding Only																			
June/July 83	157	258	160	50	121	257	174	54	62	65	57	21	340	580	391	125	516	4.6	3.1
Oct/Nov 83	73	246	151	35	63	219	142	45	48	67	57	26	184	532	350	106	456	5.0	3.3

* Numbers in brackets give numbers of crocodiles removed by Biology researchers before survey.

** See captions to Tables 1, 2 and 5 for the Liverpool-Tomkinson.

[1] See Table 6; Majarie and Wurugoij Creeks were not surveyed thus resulting in the omission of a few small and large animals. Hence the values of S/L and (3-6′)/L are probably slightly TOO HIGH.

[2] Because the 4 waterways of Rolling and Junction Bays were not surveyed in October 1977, September 1978 and October 1980 the Totals for those surveys are TOO LOW. Inspection of the results for immediately preceding and succeeding surveys indicates that the Totals for the 3 missing cases are too low by a MAXIMUM of 40(H), 80(S), 66(3-6′), 33(L) and 99(≥3′). The ratios shown for these surveys are thus probably TOO HIGH.

Hatchling recruitment on the Liverpool-Tomkinson over the "dry wet" of 1978-1979 appears to have been excellent, with 24, 5 and 260 hatchlings being sighted on the Liverpool mainstream, sidecreeks and Tomkinson River, respectively, on the July 1979 survey. Following the "dry wet" of 1981-1982 there was again a major input of hatchlings with 178 being sighted on the Tomkinson during the June 1982 survey (Table 5). Then came the second consecutive "dry wet", that of 1982-1983, and one would again have expected heavy hatchling recruitment. However, this was not to be. Why this was so, we do not know. Only 91 hatchlings were sighted on the Tomkinson, but hatchling recruitment was up slightly on the Liverpool mainstream where we sighted 27 on the July 1983 survey. Could it be that some of the females do not nest each year, or could it be that some nest more than once in a wet season? Could it be that food supply is the proximal factor involved? Perhaps the second consecutive "dry wet" resulted in a substantial decrease of available food and hence some of the females

TABLE 8

Number of *C. porosus* sighted within the hatchling, small and large size classes on the main alternative habitats of the Blyth-Cadell and Liverpool-Tomkinson Rivers System, such as various fresh and saltwater complexes and the extreme upstream sections of the Systems (see Figs. 2 and 3). The results for these 59.3 km of waterways are not included in Tables 1 to 7. The first seven habitats listed appear to provide alternative habitat largely for animals from the Liverpool-Tomkinson and Rolling and Junction Bay Systems. Subscripts show the number of (2-3′) animals included.

	km surveyed	Oct-Nov 1981			June-July 1982			Oct-Nov 1982			June-July 1983			October 1983		
		H	S	L	H	S	L	H	S	L	H	S	L	H	S	L
Liverpool River km60.0-66.4	6.4	No Survey			No Survey			—	5	3	—	5	1	—	1	4
Maragulidban Ck. km37.8-42.5	4.7	No Survey			—	—	1	—	1	1	—	1	—	—	—	1
Tomkinson River km73.7-81.3	7.6	—	11	9	—	18	14	—	11	13	2	18_1	9	—	8	9
		July 1976 to km80.1														
Toms Creek	8.9	1	—	2	No Survey			1	2	—	—	5	1	—	2_1	2
		July 1979														
Crab Creek	3.0	—	—	2	No Survey			—	—	1	—	—	2	—	1	1
Anamayirra Creek	7.3	No Survey			—	9	7	—	11	5	—	10	6	—	5	3
Beach Creek	2.2	No Survey			—	3	3	—	3	—	—	6	1	—	2	—
Blyth R. + Billabong km49.8-64.6	13.2	1	2_2	3	1	1	3	5	7_2	7	1	4_2	1	—	8_4	4
		Oct. 1980														
Cadell Gardens Billabong	2.0	—	1	3	No Survey			—	2	1	—	2	1	—	2	1
Cadell Big Billabong	4.0	No Survey			—	2	3	No Survey			—	—	3	—	—	3

did not nest since their condition factor might already be low at the onset of the second "dry wet" season? This would not necessarily be so at the beginning of a first "dry wet".

We now return to a further perplexing matter which we discussed at some length in the St. Lucia 1982 paper. This is the matter of nesting on the Liverpool mainstream and the Tomkinson River. From our capture programme of 1973, 1974 and 1975 we know definitely that there were at least 62, 34 and 60 hatchlings on the Liverpool mainstream during those respective years (Tables 7.2 to 7.4, page 59 Monograph 7) and that on the Tomkinson River there were respectively 55, 53 and 10 hatchlings. In 1972 one of the authors (HM) sighted over 100 hatchlings on the Liverpool mainstream and 44 (2-3′) animals were caught on it in 1973. After one of the largest floods ever recorded, over the 1975-1976 wet season, very few hatchlings were sighted — only 19 on the overall Liverpool-Tomkinson System, during the July 1976 survey (Table 5). Thereafter low hatchling recruitment persisted until 1979 when 260 hatchlings and 24 large animals were sighted on the Tomkinson during the July survey. On the Liverpool mainstream only 24 hatchlings were seen; however 29 large animals were sighted. Thereafter, hatchling recruitment remained low on both the Liverpool and Tomkinson, until the "dry wet" of 1981-1982 when, during the June 1982 survey, 7 hatchlings only and 30 large crocodiles were sighted on the Liverpool mainstream and 178 hatchlings and 27 large animals on the Tomkinson. Essentially, we had a repeat of the above along the same lines, over the second consecutive "dry wet" of 1982-1983.

The Liverpool mainstream has some excellent nesting habitat (Monograph 7); this habitat was utilized during the early 1970s and hatchling recruitment on it was equal to or greater than on the Tomkinson. The Liverpool mainstream and the Tomkinson appear to contain roughly equal numbers of large animals. Why is the major hatchling recruitment now taking place on the Tomkinson rather than on the Liverpool mainstream? Why did it change? Again, has food supply something to do with this matter; could the food supply on the Liverpool have decreased, and increased on the Tomkinson? If so, why haven't the breeding animals moved from the Liverpool mainstream to the Tomkinson? We simply do not have the answers to these questions and obviously considerable further research into breeding and nesting is indicated. The purely descriptive field naturalist study stage of breeding and nesting is over. Now the hard questions should be researched.

1.2 October 1983 Survey

Table 5 summarizes the results obtained from the October 1983 survey series for the Liverpool-Tomkinson System and the first seven entries of Table 8 show the relevant data for surveys of various associated alternative habitats.

On the Liverpool River mainstream and its sidecreeks, the number of animals sighted on the October survey was down on the number sighted during the June 1983 one; 7 hatchlings, 13 (3-6′) and 3 large animals were missing; 10 of the missing 13 (3-6′) animals were from the sidecreeks.

As in June, again the most important changes occurred on the Tomkinson River. The number of hatchlings sighted dropped from 91 to 40, a fall of 57%. This is to be compared with falls of 45% and 24%, over the same time periods, for the 1979 and 1982 survey series respectively. However, it should be noted that during 1982 there were a number of late nests on the Tomkinson River which hatched after the June survey (Appendix, St Lucia 1982).

Though the number of hatchlings sighted fell steeply, it is interesting to note that the number of (2-3′) animals sighted during the October survey was only one less on the Liverpool mainstream, one more on its sidecreeks and 6 less on the Tomkinson River, than on the June survey. The matter of high hatchling and very low (2-3′) losses is considered again in our discussion of the Blyth-Cadell results where the same thing happened.

The number of (3-6′) *C. porosus* spotted was 18 less than on the June survey and in addition 10 (3-6′) crocodiles were missing on the extreme upstream km73.7-81.3 section of the river (Table 8). The number of large animals sighted decreased also, from 24 to 17. This is the largest variation between two consecutive surveys, in the number of large animals sighted on the Tomkinson River, since 1978.

On the overall Liverpool-Tomkinson System there was a decrease from 121 to 63 hatchlings, from 83 to 77 (2-3′), 174 to 142 (3-6′), and 54 to 45 large animals. In addition, on the alternative habitat (Table 8) there was a decrease from 45 to 19 small animals; all of the 26 missing animals were in the (3-6′) size class. Thus (32 + 26) = 58 (3-6′) and 9 large animals are to be accounted for between the June and October 1983 surveys. Undoubtedly some of the 58 (3-6′) animals joined the ranks of the missing — presumed dead and most of the remainder probably took refuge — as appeared to be the case on previous occasions — in the inaccessible sections of the Tomkinson River (upstream of km81.3) and in the numerous unsurveyable tiny creeks. Of the missing 9 large crocodiles, 7 were missing from the Tomkinson and the decrease was spread fairly uniformly over it. A number of these 7 missing animals are likely to be upstream of km81.3. Two additional large animals were sighted on Toms and Maragulidban (km37.8-42.5) Creeks and 3 additional ones on the extreme upstream Liverpool River section, km60.0-66.4 (Table 8). Thus, there is no problem in accounting for the 9 large animals missing; they appear to be still in the System but excluded to the alternative habitat. This matter also highlights the importance of comparing results for equivalent survey seasons, that is, breeding versus breeding and non-breeding versus non-breeding periods whenever possible. For example, October-November surveys should, if possible, be compared with other October-November surveys and not June-July ones.

It is interesting that the influx of both (3-6′) and large animals into the Liverpool-Tomkinson System following the "dry wet" of 1981-1982 was almost totally dissipated by the time of the October 1983 survey when the number of (3-6′) animals sighted was only 9 more than in October 1981 and the number of large animals was in fact 9 less. So far, the outcome of the 1981-1982 and 1982-1983 "dry wets" contrasts with that of the 1978-1979 "dry wet", when the number of large animals sighted on the System established itself at a level of around 54 animals rather than 40 which appeared to be the level before 1979 (Table 5).

1.3 An eight year overview

In Figure 6 we have plotted, using Tables 3 and 5, the number of (3-6′), large and their sum (3-6′) plus large (or (≥3′)) animals sighted on the 13 surveys of the Liverpool-Tomkinson Rivers System over the past 8 years. As is evident from our population dynamics model and as mentioned previously, the more important size classes are the (3-6′), large and (≥3′). A plot of small and non-hatchling crocodiles can be distorted because of temporary variations arising from the input of (2-3′) animals after a heavy hatchling recruitment year as after the "dry wets" of 1978-1979, 1981-1982 and 1982-1983. This variation appears to soon disappear once the animals reach the ≥(3-4′) size classes.

Figure 6 demonstrates vividly the process of dynamic change which we have come to associate with *C. porosus* populations. Any influx of large and/or (3-6′) animals usually occurs in the May-early September period and any exclusion of such animals occurs largely during the breeding season around October. It is in this latter period that many large and (3-6′) animals appear to join the ranks of the missing — presumed dead. Aggressiveness between animals of all size classes, whether mating or otherwise, appears to reach a peak during the breeding season.

What can one say about the trend in the number of (3-6′) animals sighted on the Liverpool-Tomkinson Rivers System during the surveys of the past 8 years? One does not require any esoteric trend analysis to be carried out to see that there has been but little overall change. We started with some 130 (3-6′) animals in July 1976 and ended up with 174 in July, and 142 in October, 1983 with substantial variations in between. There were 140 (3-6′) animals sighted during the October 1977 survey. The three substantial increases, one in May 1977 and the two in June 1982 and July 1983, following the "dry wets" of 1981-1982 and 1982-1983 when the animals were concentrated onto the tidal waterways, had disappeared by October 1983. We are unable to say whether the "dry wet" instigated increases consist purely of animals originally recruited on the Liverpool-Tomkinson System or whether animals recruited originally in such places as the Arafura Swamp are included. We believe the former to largely be the case.

Following the "dry wet" of 1978-1979 the number of large animals sighted increased spectacularly, from the 40 sighted on the July 1976 and September 1978 surveys to 74 on the July 1979 one. However by the October survey of that year the number had dropped to 58 and then remained closely the same for the 1980 and 1981 surveys; the October 1981 survey revealed 54 large animals. Following the "dry wet" of 1981-1982 there was an influx of large animals again but not quite to the same degree as in 1979; the June 1982 survey revealed 67 large animals and the October one, 69. Unsurprisingly and as discussed previously, there was a decrease from 69 to 54, instead of an increase in the number of large animals sighted on the Liverpool-Tomkinson System on the July 1983 survey. This was followed by a further decrease of 9 large animals; 45 were sighted on the October 1983 survey.

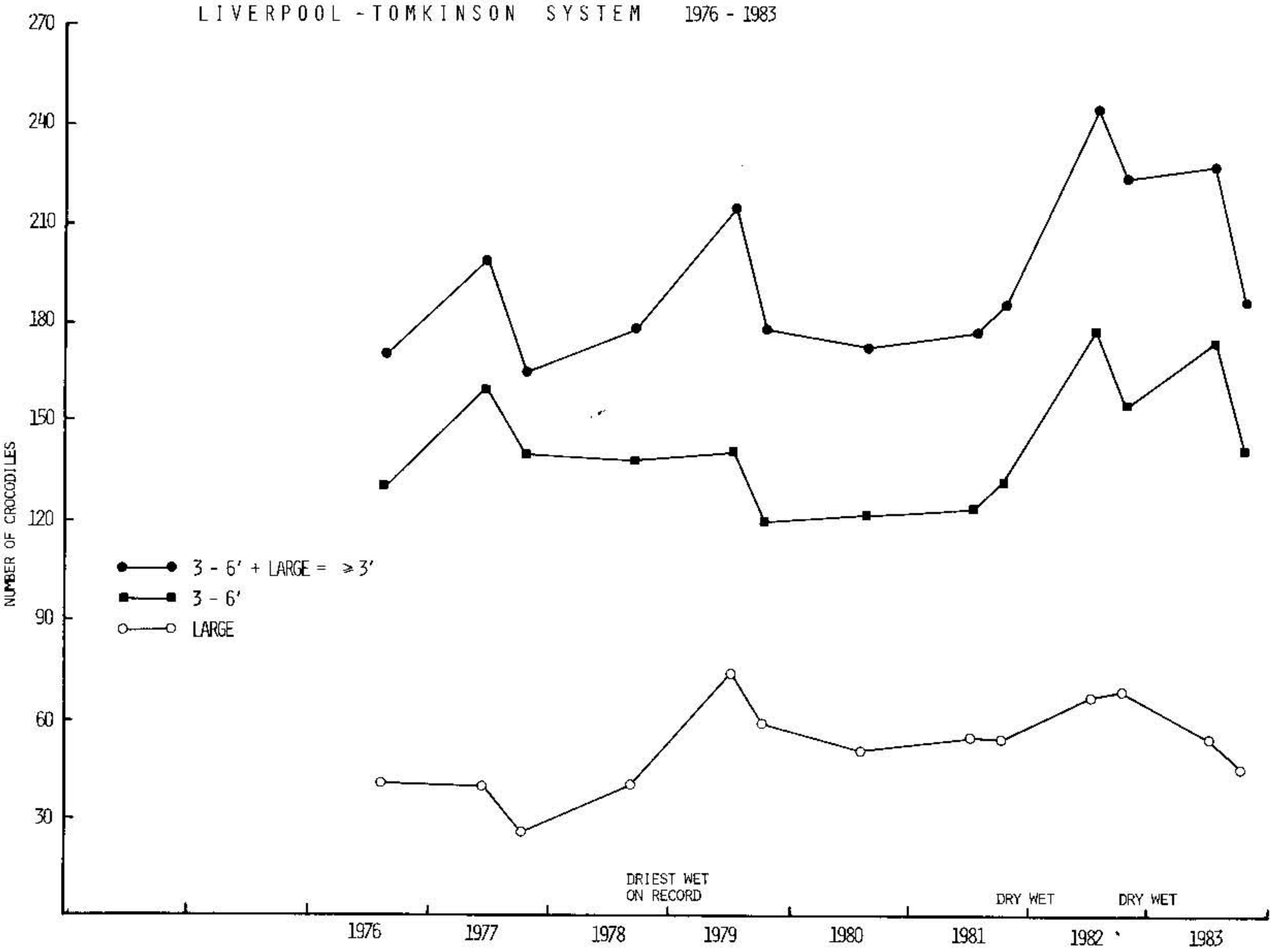


Fig. 6
A plot of the number of (3-6′), large (≥ 6′) and their sum, (3-6′) plus large (or (≥ 3′)) animals for the 13 surveys carried out on the Liverpool-Tomkinson Rivers System during the eight years 1976 to 1983. Table 5 was used.

Comparing equivalent survey seasons, July 1976 with July 1983 yields an increase of 44 (3-6′) and 14 large animals and comparing October 1977 with October 1983 surveys yields an increase of 2 (3-6′) animals only, and 20 large ones. OBVIOUSLY THE EXCLUSIONS AND/OR LOSSES OF ANIMALS IN ALL SIZE CLASSES HAVE TO DATE NEARLY EQUALLED THE INPUT. It should be stressed that the large size classes are included; that they also suffer substantial exclusion and/or losses for we know from our recapture work that some (3-6′) animals do enter the large size class and yet the overall number of large animals sighted increases marginally only. However the evidence does indicate that some 14 to 20 additional large animals are in the process of successfully establishing a territory in the Liverpool-Tomkinson System.

We have calculated rough estimates for the exclusion and losses of animals previously (for instance Chapter 6 Monograph 1, St Lucia 1982). These estimates can now be recalculated for the Liverpool-Tomkinson System using data from surveys made over the past 8 years. One can obtain an estimate for the maximum average percentage of hatchlings which survive to the (2-3′) stage by taking for each year the maximum number of hatchlings sighted during the surveys of that year and doing the same for the (2-3′) animals for each succeeding year and dividing the two figures. The maximum average percentage of hatchlings over the past 8 years which reach the (2-3′) class is thus found to be (256/699) or 37% on the Liverpool-Tomkinson System.

A broad estimate for the minimum percentage of (3-6′) crocodiles which are excluded and/or lost from the System may be obtained by noting (Table 5) that 130 (3-6′) and 40 large animals were sighted during the July 1976 survey and that the October 1983 survey revealed 45 large crocodiles only. Each of the (3-6′) animals of 1976 would, if they survived, be in the large size class by 1983 and hence the minimum percentage which have been excluded and/or lost (minimum because we have assumed that all the increase originated from the 130) by October 1983 is (130-5)/130 or 96%. It is more useful however to compare surveys made in equivalent periods. The Table below gives the minimum exclusion and/or loss percentage for various important cases.

However one views the matter, the exclusions and/or losses are very high. If one assumes that the "dry wet" of 1981-1982 had concentrated back into the Liverpool-Tomkinson practically all of the surviving large animals originally recruited there — and none originating from elsewhere — then 69 to 79% becomes the estimate for the missing — presumed dead (3-6′) animals.

Surveys Used	**(3-6′)**	**Large (≥6′)**	**Minimum % of (3-6′) animals excluded and/or lost**
July 1976 October 1983	130	40 45	(130-5)/130 or 96%
July 1976 July 1983	130	40 54	(130-14)/130 or 89%
July 1976 June 1982	130	40 67	(130-27)/130 or 79%
October 1977 October 1983	140	25 45	(140-20)/140 or 86%
October 1977 October 1982	140	25 69	(140-44)/140 or 69%

Part 2

BLYTH-CADELL RIVERS SYSTEM, JULY 15-18 AND OCTOBER 26-29, 1983 SURVEYS

2.1 General

The eighteenth and nineteenth general surveys of the Blyth-Cadell System (Figs. 1 and 3) were made in July and October 1983. These surveys have been carried out over a span of 10 years and are in addition to the 204 calibration surveys which we made of two 10 km sections of the waterway (Monograph 1). It is no exaggeration to state that we are rather well acquainted with this remote and excellent tidal waterway which is quite different from the Liverpool-Tomkinson System to the west of it. We were fortunate to have been able to concentrate our study, of the dynamics of *C. porosus* populations, on these two different major tidal waterways. However, the cost of the study in human terms, in such a remote area of Australia has been beyond imagination — aside from the grisly financial aspect. It is unlikely to be repeated.

Our July 1983 survey of the Blyth-Cadell System was in some regards more important than usual. It was following on two consecutive "dry wets", discussed elsewhere in this paper and our October 1982 survey had indicated that some 28 large animals had been excluded from the System between the June and October surveys of last year. Would we find an increase in the number of large animals sighted? Had some of the excluded animals returned? And if they had returned, where had they returned from? If they hadn't returned, then what had happened to them; where were they, if still alive? What about the (3-6′) subadults, would the number sighted be up or down and how would they be distributed throughout the System? And how would the number sighted relate to the two consecutive "dry wets" and tie in with the number of (3-6′) and large animals sighted in the other waterways surveyed in June-July 1983? What about hatchling recruitment and survivorship on the Blyth-Cadell after two consecutive "dry wets", would it be up, down or remain essentially steady? Our July survey would provide answers and/or leads to most of these questions.

2.2 July 1983 Survey (Tables 1, 2, 3, 4, 7 and 8)

On the matter of the 28 missing large animals from the Blyth-Cadell in October 1982; note that there had been an influx of 28 large animals between the October 1981 and the June 1982 survey (Table 2). It is now apparent that the influx was triggered by the intervening "dry wet" of 1981-1982, when falling water levels in swamps, both large and small, simply forced the crocodiles back into the tidal waterways — perhaps back to the same tidal waterways from which they were originally recruited. The same events had transpired in 1979 after the "dry wet" of 1978-1979; we were thus witnessing a replay of the 1979 events after the "dry wet" of 1981-1982. The results of the many surveys carried out, specially those of 1979 and 1982, left no doubt that both large and (3-6′) animals were entering and leaving the Blyth-Cadell System via the mouth of the Blyth River. We now believe that the influx of 35 (3-6′) and 32 large animals — and specially those animals in size classes ≥(5-6′), note specially the >7′ animals, Table 1 — sighted in June 1979 and the influx of 28 large and 36 (3-6′) animals — specially those animals in size classes ≥(4-5′) — sighted on the Blyth-Cadell during the June 1982 survey were mostly crocodiles forced out of the Arafura Swamp (Figs. 1 and 4) some 130 km by sea and river to the east, which had been acting as a rearing stockyard for them, and that these animals may have originally been excluded from the Blyth-Cadell System on which they had been recruited. By the October 1982 survey, 28 large animals were missing from the System, practically all of them from the downstream sections and they must have travelled eastward for we did not sight an increased number of large crocodiles in the waterways surveyed to the west of the Blyth-Cadell or in the alternative habitat surveyed (Table 8). These animals were probably on their way back to the Arafura Swamp and other minor freshwater complexes via the Milingimbi Complex of tidal waterways. However, a second "dry wet" intervened and it is likely that the crocodiles remained in the Milingimbi Complex and Glyde River waiting for the usual wet season to raise the water levels in the Arafura Swamp and other small swamps. If this is so, there would be nothing to trigger an influx in 1983 of subadults, both small and large, into the Blyth-Cadell System from the hypersaline Milingimbi Complex: "dry wets" could be expected to have little direct effect upon animals frequenting the hypersaline tidal waterways. On this basis, one would not expect to find a major increase in the number of (3-6′) and large animals sighted on the Blyth-Cadell System during the July 1983 survey. On the other hand, if the crocodiles did return to the Arafura Swamp over the "dry wet" of 1982-1983, then one might expect an influx of the animals again excluded from it. However, the results of our June-July 1983 surveys of the Liverpool-Tomkinson (Table 2) and of the waterways of Junction and Rolling Bays (Table 5) showed no major influx of crocodiles into these systems. Furthermore the large animals sighted on the Liverpool mainstream and sidecreeks near its mouth, during the October 1982 survey, appeared, because of their distribution near the mouth, to be on their way out of the waterway. This was confirmed by the results of our July 1983 survey, when a decrease of 15 large animals was found on the Liverpool-Tomkinson System. Hence if there was a substantial increase in the number of large animals sighted on the Blyth-Cadell on the July 1983 survey then the most likely source of these animals would have to be from those 15 large animals excluded from the Liverpool-Tomkinson System. These animals would normally encounter the Blyth River mouth on their way back to the Arafura Swamp and hence might attempt to enter it. As can be seen from the results in Table 4 this appears to have been the case for 11 additional large animals were sighted. One could thus expect that the October 1983 survey would reveal that most of this increase had disappeared as it is unlikely that any of these additional animals would be allowed to remain in the Blyth-Cadell System, specially if they had originally been recruited on the Liverpool-Tomkinson.

Following the "driest wet" on record of 1978-1979, we fully expected to find increased hatchling recruitment on the Blyth-Cadell in 1979. However, we were surprised to find that the number of hatchlings sighted on the System during the June 1979 survey was only 123 (86 on the Blyth, 37 on the Cadell), compared to 173 (137 on the Blyth, 36 on the Cadell) sighted during the June 1978 survey (Table 4), which followed a normal wet season with its substantial flooding of the upstream nesting sections of the waterway. This was in contrast to what happened on the Tomkinson River (Table 5) where 260 hatchlings were sighted during the July 1979 survey, compared to only 17 sighted on the September 1978 one.

Thus already in 1979 it was evident that even though heavy flooding of nesting habitat almost invariably led to the catastrophic loss of riverside nests laid down during the January-March period, non-flooding did not necessarily indicate that increased hatchling recruitment would follow (page 333 Monograph 1). It was obvious that flooding or non-flooding of nests was only one of a number of important factors involved in hatchling recruitment.

This matter has been brought more sharply into focus by the results of our June-July 1983 surveys. In the Section on the Liverpool-Tomkinson System, we discuss the surprising result of sighting only 91 hatchlings on the Tomkinson during the July 1983 survey as compared to 178 hatchlings during the June 1982 one (Table 5) and possible reasons for this result. The wet season of 1982-1983 had been a "dry wet" as had been the one of 1981-1982 and there had been only minor flooding on the upstream nesting sections of the waterway during both of the wet seasons. Study of Table 4 for the Blyth-Cadell System makes matters appear even more complex. On the Blyth River mainstream a record 146 hatchlings were sighted and yet on the Cadell River only 9 were seen. What happened? Why the sudden drop on the Cadell River and the sudden increase on the Blyth mainstream? We are unable to answer these questions satisfactorily at present but believe that the level of available food and the condition factors of the animals may well be involved in determining whether they nest early or late in the wet season and whether they nest once or twice or even at all during it.

As shown in Table 2, the number of small crocodiles sighted, increased from 197 in November 1982 to 258 in July 1983. However this increase, significant at the 95% level, consisted of 55 (2-3′) and only 6 (3-6′) animals. One notes in Table 1 that the 111 hatchlings sighted in November 1982 appear to have yielded 98 (2-3′) animals by July 1983. On the basis of hatchling survivorship studies made on the Blyth-Cadell System (Table 8.4.1 Monograph 1) one would have expected about 70% of the hatchlings to have survived and hence to have only sighted some 78 rather than 98 (2-3′) animals. On the basis of our model, one might expect to soon find a substantial decrease in the number of small animals sighted. However in view of the record hatchling recruitment on the Blyth mainstream during 1983, following high hatchling recruitment in 1982, the number of small and (3-6′) animals could be temporarily exaggerated even further by the resultant (2-3′) animals. However, the important size classes to watch are the large and (3-6′) ones.

A study of the distributional pattern of the (3-6′) animals on the Blyth-Cadell System (Table 4) is of interest and again highlights further the dynamicism of the situation. Though the number of (3-6′) animals sighted on the June and November 1982 and July 1983 surveys remained essentially constant, 163, 154 and 160 respectively, their distribution on the waterway varied greatly from survey to survey. This is further delineated in the Table below, where we have also included the distribution of large animals. The km0-20 section is called the mouth section of the Blyth and contains all of the major sidecreeks. The Cadell River joins the Blyth at km19.1. On June and July surveys one normally sights a higher density of (3-6′) and large animals on the mouth section of the Blyth River than on October or November surveys when the animals have been either forced out of the waterway or further upstream. On the km20-49.8 section, we found during the July 1983 survey some 23 (3-6′) animals missing since the November 1982 survey. However, on surveying the mouth section of the Blyth River 14 additional (3-6′) animals were sighted and on the Cadell River 14 additional ones. This matter simply highlights again the danger of drawing conclusions about *C. porosus* populations for a whole waterway from results gained on only a part of it.

Size Classes	(3-6′)				**Large (≥ 6′)**			
Blyth River	**June 82**	**Nov 82**	**July 83**	**Oct 83**	**June 82**	**Nov 82**	**July 83**	**Oct 83**
km0-20	52	36	50	41	29	12	24	14
km20-49.8	42	57	34	43	12	13	11	9
Sidecreeks	13	9	10	10	6	3	2	2
Cadell River	56	52	66	57	20	11	13	10
Totals	163	154	160	151	67	39	50	35

2.3 October 1983 survey

This survey provided additional evidence for very considerable movement of animals between the various components of the river system. Examination of the Table above shows that on the Cadell River, the October survey revealed 9 (3-6′) animals less than on the July 1983 one. From Table 4 one can show that 16 (2-3′) animals were missing also. On the Blyth km20-49.8 section precisely 16 (2-3′) and 9 (3-6′) additional animals were sighted. The above Table highlights again the redistribution and/or exclusion of animals in the (3-6′) and large size classes which takes place between the June-July and October-November surveys. It also shows that the influx and exclusion of animals occurs largely via the mouth section of the Blyth River. However, as discussed in the Section on Alternative Habitat, a small number of (3-6′) and large animals appear to be forced to take haven in alternative habitat during the breeding season. For instance, an additional 3 large and 2 (3-6′) animals were sighted on the extreme upstream section of the Blyth River during the October survey and probably include the missing 2 large animals from the km20-49.8 section. The same phenomenon was noted in the October 1982 surveys.

Tables 1, 2, 3, 4, 7 and 8 contain the results of our final survey of the Blyth-Cadell Rivers System. The results contained no surprises in relation to the (3-6′) and large size classes and followed the apparent pattern for October-November surveys. The consistency of this pattern in 1982 and 1983 is indeed striking. Overall there was a decrease of 9 (3-6′) and 15 large animals since the July 1983 survey. The 9 (3-6′) crocodiles and 10 large animals were missing from the mouth section of the Blyth River. Recall that 12 additional large animals had been sighted on the mouth section of the Blyth during the July 1983 survey. Furthermore, it had been postulated that this increase may have included some of the 15 large animals which had been excluded from the Liverpool-Tomkinson System — that these animals were probably on their way back to the Arafura Swamp, not having been successful in establishing a territory for themselves on this occasion. We predicted that if this was so, then it was highly likely that the animals would also be excluded from the Blyth River by October. Our survey results support this contention and the missing 9 (3-6′) and 10 large animals are either missing — presumed dead or on their way back to the Arafura Swamp via the Milingimbi Complex. Our October 1983 surveys, however, did not reveal any additional large animals in Crab, Anamayirra or Beach Creeks (in fact there was a decrease) to the west of the Blyth River mouth (Fig. 3 and Table 8) and no additional (3-6′) or large animals, since the June survey, in Ngandadauda Creek and the Glyde River to the east of the Blyth River (Fig. 4 and Table 1).

In the discussion of the Liverpool-Tomkinson results we referred to the surprisingly heavy hatchling losses (121 to 63) and very low (2-3′) losses (83 to 77), between the July and October 1983 surveys. Precisely the same thing occurred on the Blyth-Cadell System. The number of hatchlings sighted decreased from 157 to 73 (a fall of 54% compared to the fall of 30% for 1978 given on page 391 Monograph 1) and the number of (2-3′) animals decreased from 98 to 95 only. Even allowing for errors in size class estimation, these are startling results. Why the specially heavy hatchling losses during the June-October 1983 period following the second consecutive "dry wet"? Why the exceedingly low losses of (2-3′) animals occurring at the same time? Are they somehow related? Why the very low hatchling losses between November 1982 and July 1983? We are unable to answer these questions.

2.4 A ten year overview

In Figure 7 we have plotted, using Tables 3 and 4, the number of (3-6′), large and their sum (3-6′) plus large (or (≥ 3′)) animals sighted on the 19 general surveys of the Blyth-Cadell Rivers System over the past 10 years. The plot reveals in a dramatic fashion the picture of dynamic change to which we have referred so often, specially when discussing the (3-6′) and large animals. Specially note the dramatic drop between the September and October 1977 surveys. One has the picture of a couple of hundred (3-6′) animals which are being added to year after year from the recruitment of hatchlings several years earlier and yet the number of (3-6′) animals sighted remaining constant or decreasing. The number of (3-6′) animals sighted on the tidal waterway during the surveys of a given year is at a maximum during the May-early September period, the non-breeding season when aggressiveness between animals of all size classes is at a minimum, and is usually at a minimum during the breeding season around the October period, when aggressiveness between the animals is at a maximum. The constant battle which goes on for the establishment of a territory leads to the exclusion, influx and heavy losses of the (3-6′) animals. But matters do not rest here for one sees essentially the same thing happening with the large animals, many of which are still not sexually mature. However, as seen in Fig. 7, some of these animals are successful in establishing a territory and holding it, for the number of large animals sighted is increasing, the major jump coming after the "dry wet" of 1978-1979 when some 32 large animals were forced out of the drying freshwater complexes and into the tidal waterway. These animals then had little choice but to fight for territory. Apparently some succeeded. All of this appears to be superimposed upon a base, made up of some 15 to 20% of the (≥ 3′) animals sighted which appear to be successful in establishing a territory in the waterway without being excluded in the first instance. For example, we have just recaptured (on the Liverpool-Tomkinson) 2 large animals which were captured and marked as hatchlings in 1973 and 1975 and one of these animals was recaptured at the original capture site and the other only 1.8 km away from its original capture site. Two other animals captured originally in 1974 were recaught in 1980 and 1981 only 0.8 km and 1.5 km respectively from their original capture sites. Of course we cannot say where these animals had been in the intervening years. It appears that on the Blyth-Cadell, there has been a decrease, between 1975 and 1983, in the number of (3-6′) animals which could hold a territory on the System (we do not use the 1974 figures except in special cases because the figures of that year include both captures and sightings of animals missed). Whereas in November 1975 the figure was 183 (3-6′) animals, in October 1983 it was down to 151. This is opposite to what appears to be happening with the large animals. In November 1975 the number of large animals sighted was 14, in October 1983 it was 35 or an increase of 21 over the 9 years, or if one compares the September 1976 and July 1983 numbers, the increase is 24. It appears as if there were a set number of territories or slots in the river system and the increasing of this number results in the loss of a very high fraction of the animals trying to secure these territories.

In the Section on the Liverpool-Tomkinson, we calculated the maximum

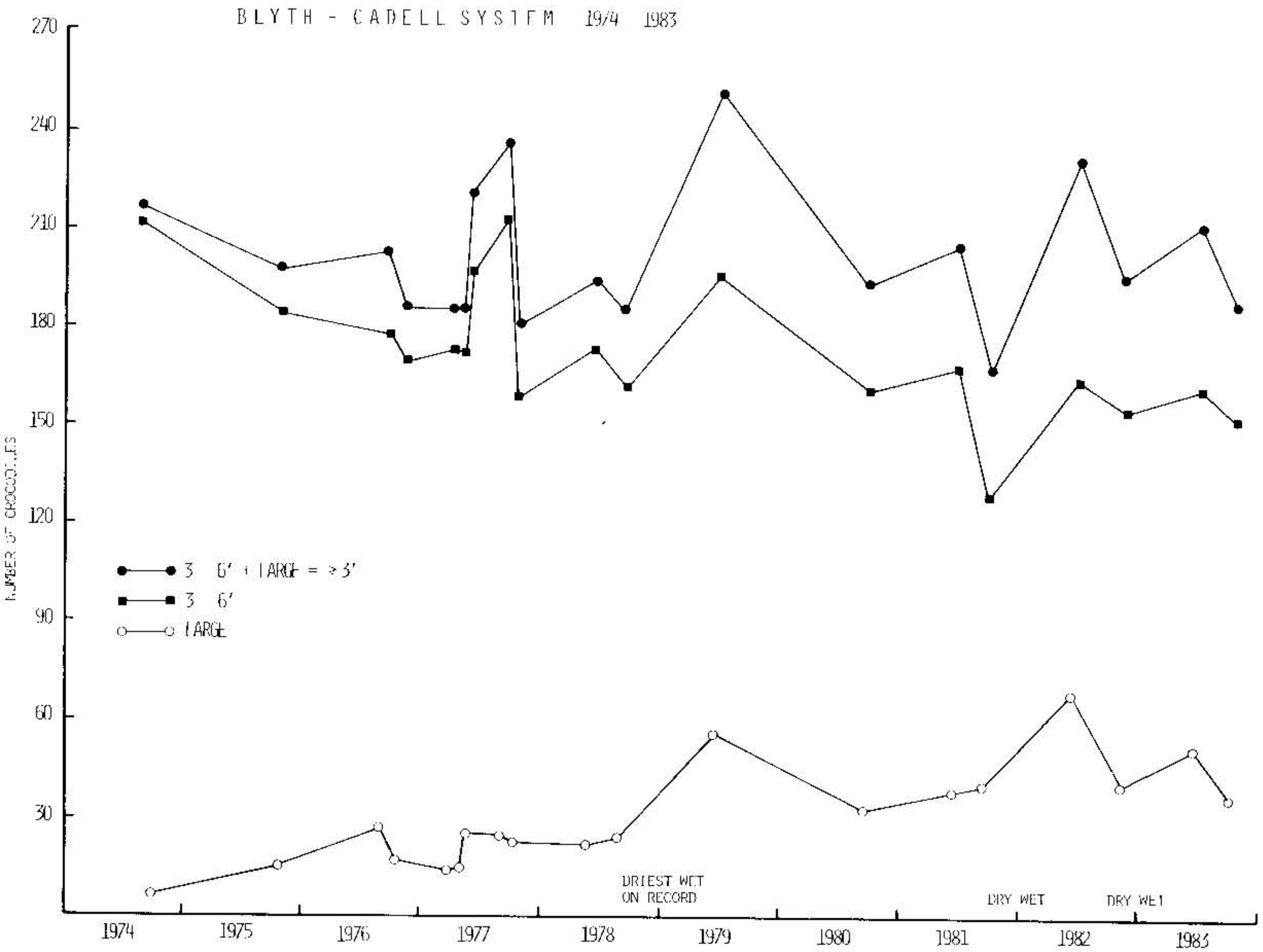


Fig. 7
A plot of the number of (3-6'), large (≥6') and their sum, (3-6') plus large (or (≥3')) animals for the 19 surveys carried out on the Blyth-Cadell Rivers System during the ten years 1974 to 1983. Table 4 was used.

average percentage of hatchlings which survive to the (2-3′) stage and found the figure to be 37%. Doing the same for the Blyth-Cadell, for the years between 1974 and 1983, yields a figure of 709/960 or 74%. Why the difference by a factor of 2? Could it be related to the fact that the number of large animals in the Liverpool-Tomkinson was generally greater than in the Blyth-Cadell over the period? But then why does the number of (3-6′) animals sighted in the Blyth-Cadell appear to have gone down between 1975 and 1983 and yet on the Liverpool-Tomkinson it appears to be about steady? Again we are unable to answer these difficult "why" questions and leave them to future generations!

As for the Liverpool-Tomkinson we can give a Table showing various broad estimates for the minimum exclusion and/or loss percentages for the (3-6′) animals.

Surveys Used	**(3-6′)**	**Large (≥ 6′)**	**Minimum % of (3-6′) animals excluded and/or lost**
November 1975 October 1983	183	14 35	(183-21)/183 or 89%
September 1976 June 1982	177	26 67	(177-41)/177 or 77%
June 1977 June 1982	196	25 67	(196-42)/196 or 79%
November 1975 November 1982	183	14 39	(183-25)/183 or 86%
October 1977 October 1983	158	22 35	(158-13)/158 or 92%

From the above Table one sees that for the Blyth-Cadell the minimum exclusion and/or loss percentage is very high also, generally in excess of 80%. Again, if one assumes that the "dry wet" of 1981-1982 had concentrated back into the Blyth-Cadell, nearly all of the surviving large animals originally recruited there — and none originating from elsewhere — then 77 to 79% becomes the estimate for the missing — presumed dead (3-6′) animals.

Part 3

THE TIDAL WATERWAYS OF ROLLING AND JUNCTION BAYS, JUNE 18-21 AND OCTOBER 1-4, 1983 SURVEYS

The summary results from the reduced June and October 1983 survey data for the four tidal waterways of Rolling and Junction Bays (Fig. 1) are shown in updated Tables 1 and 6.

The fact that the 1982-1983 wet season was again a "dry wet" with negligible flooding (following on that of the 1981-1982 "dry wet") is perhaps reflected in increased hatchling recruitment, specially on Nungbulgarri Creek where 34 hatchlings were sighted during the June survey; the maximum number sighted on previous surveys was 10. These hatchlings were concentrated mostly between km5 and 13; no obvious creches were sighted and it is likely that these hatchlings resulted from only one or two relatively successful nests. Only 15 hatchlings were sighted on the October survey.

Hatchling recruitment on the Goomadeer River in June was 24, much the same as that found on June-July surveys after previous "dry wet" seasons, 1979 (29H), 1982 (18H) and occurred on the same sections of the waterway. On the October survey, 33 hatchlings were sighted indicating that there may have been an additional input from one or more late nests.

Four hatchlings were sighted in TYPE 3 Majarie Creek in June, where sporadic nesting is believed to occur (page 61 Monograph 5). No hatchlings were sighted on the October survey. No hatchlings were sighted on TYPE 3 Wurugoij Creek on either the June or October surveys. Thus overall, 62 hatchlings were sighted on the 4 waterways of Junction and Rolling Bays during our June survey and 48 on the October one. These numbers are to be compared with the previous maximum number of 39 hatchlings sighted during the July 1979 survey following the "dry wet" of 1978-1979.

The 57 (3-6′) animals sighted on the overall systems both during the June and October 1983 surveys are to be compared with the 51 and 61 sighted during the June and October 1982 and 56 and 60 on the June and October 1981 surveys, respectively. Thus there has been little overall change in the number of (3-6′) animals sighted during the last 6 surveys. As may be seen in Table 6 there has been only little change since the August 1975 survey when 46 (3-6′) animals were sighted. The low figure of 33 for 1976 is probably accounted for by the historic floods of the 1975-1976 wet season when the sea penetrated several kilometres inland. Many of the smaller animals would have been swept away and dispersed at the time. The number of (3-6′) animals sighted during 1977 increased to 40 and on the July 1979 survey, 66 were sighted. There is now little doubt that this relatively high number is accounted for by the "driest wet" on record, of 1978-1979, when animals in associated freshwater complexes were forced, by falling water levels, to re-enter the tidal systems. As pointed out in the DISCUSSION, we now believe some of the increase may have been derived from the Arafura Swamp (however a substantial number could also have been forced out of swamps near the Goomadeer River) and that a few of these animals may have returned there by the time of the June 1981 survey. Study of Table 1 shows that nearly all of the animals concerned were in size classes ≥(4-5′) and that as would be expected from our model not many animals in the (3-4′) size class were involved.

The situation in relation to the large animals is somewhat different. There was a major influx of large animals after the record "dry wet" of 1978-1979 and the most likely sources are the minor swamps of the Goomadeer and the Arafura Swamp. As expected, the number of large animals sighted dropped between the July 1979 and June 1981 surveys, from 33 to 22 in June 1981 and then to 12 only on the October 1981 survey. Again we believe that some of these animals may have returned to the Arafura Swamp and the larger fraction to the other associated freshwater complexes from which they came.

Following the "dry wet" of 1981-1982, there was an influx of large animals into the tidal waterways of Rolling and Junction Bays again; the number sighted increasing from 12 to 29 between the October 1981 and June 1982 surveys. The number sighted then dropped marginally to 24 for the October 1982 survey and to 21 for the June 1983 one. The October 1983 survey revealed 26 large animals; the 5 additional large animals could include the missing 5 large animals from Anamayirra, Crab and Beach Creeks (Table 8) or animals from the Liverpool-Tomkinson System. Thus it appears that few if any of the 17 additional large animals sighted on the June 1982 survey had returned by October 1983 to the area from which they came. This is in keeping with the fact that the wet season of 1982-1983 was again a "dry wet" and hence the animals would not have been able to return to the area from which they were forced to leave originally because of falling water levels.

Our results show that there can be considerable adjustment between the 4 waterways, in the number of animals sighted on them. Note the decrease from 8 large animals sighted on Nungbulgarri Creek during the October 1982 survey to only 2 large animals sighted during the June 1983 survey and the increase from 12 non-hatchlings sighted in Majarie Creek in October 1982 to 20 sighted during the June survey.

The survey results for the 4 waterways of Junction and Rolling Bays over the past 9 years (Table 6) appear to be in keeping with those for the overall waterways of our Maningrida monitoring area (Table 7), that is a steady, or marginally increasing, number of (3-6′) animals accompanied by an apparent increase in the number of large animals sighted. Comparing the August 1975 survey results with those of June 1983 (see Section on the Liverpool-Tomkinson as to why not October 1983), one finds that the increase in the number of (3-6′) animals was 11 only and the increase in large animals was 9 — a relatively large increase — however note that on the October 1981 survey only 12 large animals were sighted as in 1975 (but the 1975 survey was made in August). The ratio of (3-6′) to large animals appears to be decreasing but there are substantial fluctuations, aggravated because of the relatively small numbers involved and the inclusion of Majarie and Wurugoij Creeks, both TYPE 3 systems.

Part 4

ALTERNATIVE HABITAT

4.1 Anamayirra and Beach Creeks, June 27-28 and October 10-11, 1983 surveys

A helicopter was used for ferrying the survey boat and staff to these two hypersaline coastal creeks (Fig. 3). When Beach Creek (∼2.2 km) was surveyed during 1982, 6 crocodiles, 3 (3-6′) and 3 large were sighted on the July survey and 3 (5-6′) animals on the October one (Table 8). The survey of June 27, 1983 revealed 7 crocodiles, 6 (3-6′) and one large animal, thus the number sighted on the June 1983 survey was back to almost the same number sighted on the July 1982 one. Note however that the size structure of the animals sighted was different, indicating that some animals may have left the creek and others had entered it. Further evidence for considerable movement of animals (albeit, the numbers involved are small) into and out of the waterway was gained from the October 10, 1983 survey when the number sighted had dropped back to 2 (3-6′) animals, almost the same again as the number sighted on the October 1982 survey. That the animals are moving in and out is also indicated by the fact that nearly all sightings are in the first 800 metres.

The survey of Anamayirra Creek (∼7.3 km) on June 28, 1983 resulted in the sighting of 16 crocodiles — exactly the same number that was sighted during the previous two surveys of 1982 — quite a remarkable coincidence. The size structure of the animals was 9 (3-6′) and 7 large in July, 11 (3-6′) and 5 large in October 1982, and 10 (3-6′) and 6 large in June 1983. Our survey of October 11, 1983 revealed 8 crocodiles only, 5 (3-6′) and 3 large animals.

Thus 13 animals are missing from the two creeks, 9 (3-6′) and 4 large, since our June survey. What happened to them?

4.2 Toms Creek, June 1 and October 13, 1983 surveys

We made our first systematic survey of Toms Creek (Fig. 2), a hypersaline coastal waterway with a surveyable length of 8.9 km, in 1976 and then annually thereafter until 1979 (St Lucia 1982). Of the five previous surveys, no survey revealed more than 2 non-hatchlings, until our resurvey in July 1983 when 6 animals, 5 (3-6′) and one large one were sighted (Table 8). On the October 1983 survey 4 crocodiles were sighted, a (2-3′), (4-5′) and 2 (6-7′) animals. Thus Toms Creek is evidently frequented by a small number of itinerant animals, moving in and out of the Liverpool-Tomkinson System.

4.3 Crab Creek, June 25 and October 20, 1983 surveys

This 3 km hypersaline coastal creek (Fig. 3) was surveyed in November 1981 and again in October 1982. Two large crocodiles (EO >6′, >7′) were sighted on the first survey and one crocodile (EO >6′), during the second one (Table 8). The survey of June 1983 again revealed 2 crocodiles (EO >6′, 6-7′) and on the October one we sighted 2 animals (5-6′, EO >6′). Thus as far as *C. porosus* are concerned, Crab Creek appears unimportant; it provides a temporary haven for several (3-6′) and large animals only. Whether these are animals which were excluded from the Blyth or the Liverpool Systems we are unable to say, however the latter is the more likely.

4.4 Cadell Big and Cadell Gardens Billabongs, June-July and October 1983 surveys

A helicopter is used to gain access to the 4 km long Cadell Big Billabong, ferrying survey boat and staff. The billabong (Fig. 3) was first systematically surveyed on

July 9, 1982 when 5 *C. porosus* were sighted, 3 EO, one >7′ and a (3-4′) animal (Table 8). On the June 30, 1983 survey only 3 crocodiles were sighted, one EO >6′, one (8-9′) and one (9-10′). The October 9, 1983 survey revealed 3 animals again, a (6-7′), (7-8′) and (EO >6′).

Survey of Cadell Gardens Billabong on the night of July 10, 1983 yielded 3 crocodiles as it did on the October 1982 survey. We sighted 2 (4-5′) and one (EO >6′) animal. On the survey of October 22, 1983 we sighted 3 animals again, a (4-5′), a (5-6′) and a (EO >6′).

It is evident that the Cadell billabongs normally only contain small numbers of (3-6′) and large animals excluded from the Cadell River. These numbers are in keeping with the observation that the available food supply in these billabongs is quite limited. Sporadic nesting does occur, for in 1973 a number of hatchlings were caught in Cadell Gardens Billabong by aboriginals.

4.5 Extreme upstream section of Blyth River km49.8-59 and billabong km60.6-64.6, July 11-12 and October 23-24, 1983 surveys

The extreme upstream sections of the Blyth River (Fig. 3) were resurveyed on the nights of July 11 and 12. The results of the survey are shown in Table 8. Note how the number of (3-6′) and large animals sighted (12) in October 1982 had increased from the number sighted during the previous June 1982 survey (4) and how again on the present July 1983 survey the number of (3-6′) and large crocodiles sighted dropped from 12 to 3. Whereas during the October 1982 survey 3 large crocodiles were sighted in the billabong between km60.6-64.6, during the present survey none were sighted.

As pointed out in the St Lucia 1982 paper such variation is predicted by our model and provides further support for our contention that sub-adults are being excluded by the larger animals — specially during the breeding season. If the animals are not excluded completely from the waterway, then as in the present instance they are forced into less desirable habitat such as the extreme upstream section of the waterway. From km55 to km59 the river is very rocky. With the breeding season over, the animals appear to again return to the main sections of the breeding system. Further support for this view was provided by the results of the October 1983 survey when the number of (3-6′) and large animals sighted had increased by 2 and 3 respectively. Again no crocodiles were sighted on the billabong between km60.6-64.6.

4.6 Upstream Liverpool River, km60-66.4, June 29 and October 8, 1983 surveys

The sandy and snag-ridden terminal section, km60-66.4, of the Liverpool River mainstream, which was not normally surveyed during previous surveys, was surveyed on three occasions during 1982 and 1983 and the results for these surveys are shown in Table 8. A small number of (3-6′) and large animals frequent this section of the mainstream and it is to be noted that the number of large animals sighted was larger for both of the October surveys than for the July one.

4.7 General

Some 75% of our survey effort during 1982 and 1983 was spent gaining the information shown in Table 8, for those years. However we believed it was important to survey every bit of habitat we could gain entry to, using boats, vehicles and a helicopter, in order to eliminate the various possibilities as to where the large number of apparently missing crocodiles could be. As may be seen in Table 8, the alternative habitat does provide some important rearing stockyards for both large and small animals, but the number of animals involved is small compared to the hundreds missing. The October 1983 survey yielded 24 (3-6′) and 28 large animals compared to 48 (3-6′) and 25 large animals sighted during the July 1983 one. Reference to Table 7, shows that of all the (3-6′) and large animals sighted during the October 1983 survey, some 5% of the (3-6′) and 25% of the large animals were sighted in the alternative habitat.

Part 5

NGANDADAUDA CREEK, JUNE 26 AND OCTOBER 12, 1983 SURVEYS

This important hypersaline creek (Figs. 1 and 4) was first surveyed on September 8, 1975 and again on June 24, 1979 when the University of Sydney's research vessel was used to gain entrance to the Milingimbi Complex of tidal waterways (Monograph 9). For logistic reasons, we were unable to resurvey Ngandadauda Creek until June of 1983 at which time a helicopter was used to ferry our survey boat and crew to this TYPE 3 coastal creek which has a navigable length of 20.9 km, and a sidecreek at km9.7 with a navigable length of some 3 km. This survey very nearly cost the lives of two men when a strong wind gust caught the punt which was hanging under the helicopter, and blew it upwards, striking the Bell Jet Ranger's stabilizer fin and missing the rear rotor blade by inches. The punt was jettisoned from a height of 80 metres and the helicopter was able to safely return to Maningrida for repair. We surveyed Ngandadauda Creek the following night using a different boat.

It was most important that we resurveyed the creek this year both in June and October. Following two consecutive "dry wets", our model would suggest that the creek should be acting as a haven for a substantial number of both (3-6′) and large animals excluded from the Blyth River and excluded or forced out from the Glyde River-Arafura Swamp. Thus, it could be acting as a haven for some of the 28 large animals which had left the Blyth River by the time of our November 1982 survey (Table 2) — probably on their way back to the Arafura Swamp from which they had been excluded or forced out during the previous "dry wet" of 1981-1982. However another "dry wet" intervened and the animals would essentially be "caught" in the Milingimbi Complex and the Glyde River until the wet season of 1983-1984. It is likely that some of the animals on their way back to the Arafura Swamp had been recruited on the Blyth-Cadell System originally.

The survey on the night of June 26, 1983 fulfilled our expectations; 30 crocodiles were sighted, 20 (3-6′) and 10 large animals. However note from Table 1 that of the 30 animals sighted 13 were EO, suggesting that these animals were exceedingly wary and hence that a high fraction of them had probably entered the creek only recently. These results are to be compared with those of September 1975 when 3 hatchlings, 2 (2-3′), 9 (3-6′) and 5 large animals were sighted and with those of the June 1979 survey, following the record "dry wet" of 1978-1979, when 10 (3-6′) and 11 large animals were observed (Tables 9.22 and 9.23 Monograph 9 and present Table 1).

Ngandadauda Creek was resurveyed for the second time during 1983 on the night of October 12. On this occasion 21 crocodiles were sighted, 14 (4-6′) and 7 large; the number of EO crocodiles sighted dropped from 13 on the June survey to 2 only on this one, suggesting strongly that most of these animals which had entered the waterway by June 1983 had either been excluded again or joined the class "missing — presumed dead".

The fact that no additional crocodiles in the (3-6′) and large size classes were sighted during the October survey of the Glyde and Blyth-Cadell and Liverpool-Tomkinson Systems provides support for the latter. The crocodiles missing were from the mouth and upstream sections of the waterway only.

The results of the two latest surveys support further our contention that Ngandadauda Creek, which is a TYPE 3 waterway, is largely frequented by animals coming from other waterways, such as the Blyth-Cadell System and the Glyde River-Arafura Swamp, which act both as breeding and rearing systems. The creek acts as a temporary haven and/or rearing stockyard for sub-adults excluded or forced out from other systems, like those above, until the animals are able to return (pages 39, 40, 122-125 Monograph 9).

We record here two important observations made during our last survey. The measured salinity some 4 hours after low water of Ngandadauda Creek at km20.9, the terminal survey point, was 83‰. This is to be compared with the measurement made at high tide on Creek C of the Adelaide River in September 1979 (pages 375-377 Monograph 1) of 85‰. Furthermore a (4-5′) *C. porosus* was sighted at km20.5 on Ngandadauda Creek where the measured salinity was 78‰. We have never before sighted a crocodile in waters as hypersaline as this. The previous record was for a (7-8′) animal sighted on Creek C of the Adelaide River; the measured high tide salinity was 61‰ and the extrapolated low tide value was 71.5‰ (same reference as above).

In the early monographs (Monographs 3, 5, 6 and 7) of the series of 17, we stated repeatedly that our results indicated that *C. porosus* appears to tolerate hypersaline conditions poorly and that crocodiles tended to leave highly hypersaline waterways. We were perplexed by this matter for a number of years. However by 1979 numerous additional observations showed that *C. porosus* in all size classes are able to tolerate very high salinities, but probably for short periods of time only and that the time period may be size dependent (page 380 Monograph 1). Since that date Taplin and Grigg discovered lingual salt glands in both *C. porosus* and *C. johnstoni* thus providing a method of getting rid of excess salt. In addition we now have a much clearer understanding of the dynamics of *C. porosus* populations and of the itinerant crocodiles, mostly sub-adults, populating the hypersaline TYPE 3 waterways. Exclusion of some 80% of the sub-adult crocodiles from TYPE 1 tidal waterways and their associated freshwater complexes appears to be the dominant factor involved in the populating of TYPE 3 waterways. Itinerant animals are more likely to be excluded from TYPE 1 and/or TYPE 3 waterways during the September-November period, the breeding season, when crocodile interactions between all size classes appear to reach a maximum (page 457 Monograph 1). This also happens to be the period when salinities increase rapidly in the hypersaline TYPE 3 waterways. A (4-5′) crocodile staying in water of 83‰ salinity must be paying some metabolic penalty; a penalty he is forced to pay to stay in the creek.

Part 6

GLYDE RIVER-ARAFURA SWAMP

The results from the survey of Nganoadauda Creek on the night of June 26 dictated that we resurvey the Glyde River and also make an aerial helicopter survey of the Arafura Swamp (Figs. 1, 4 and 5). It appeared crucial that we do so and resurvey in October, if we were to obtain a more comprehensive picture of what was happening to the (3-6′) and large animals on the northern Arnhem Land coast, following two "dry wet" seasons. This meant re-arranging our 1983 survey schedule and complicating further the already complicated logistics of our survey programme. The Glyde River and the Arafura Swamp are some 150 km, by very rough bush track, east of Maningrida. Flying in survey gear by helicopter would simply be prohibitively expensive and vehicular access had to be made. We did so and were reminded of our *C. porosus* research 12 years earlier when vehicular access to the tidal waterways was the only method available to us. Often when we had arrived at the waterway, with gear devastated by the rough bush tracks, we were so grateful that the arrival seemed a great achievement in itself. By the time the gear and vehicles were repaired, there was little time left for the research, which was the reason we had originally come. Our July 1983 expedition to Nungalala at White Star Landing and the Glyde Crossing on the Glyde went off "smoothly", perhaps because of 12 additional years of experience of working under Arnhem Land conditions. The October surveys were made from camps at the Glyde Crossing and at the large billabongs at Old Arafura.

6.1 July 7-8, 1983 survey

Following the "driest wet" on record of 1978-1979, when many crocodiles had been forced out of the Arafura Swamp, we sighted during the July 1979 survey of the Glyde River 36 (3-6′) and 19 large animals compared to 17 (3-6′) and 11 large during the September 1975 survey. Following the two "dry wets" of 1981-1982 and 1982-1983, again we expected to sight a substantial number of (3-6′) and large crocodiles in the Glyde River, specially on both the mouth and extreme upstream sections. And so it turned out.

As may be deduced from Table 1, 73 (3-6′), of which at least 35 were in the (3-4′) size class, and 31 large animals were sighted. Furthermore there were 19 animals sighted on the km 0-5 mouth section and the majority of these were large; 15 of the animals were sighted between km0 and 2, strongly indicating that they were either entering or leaving the river (in fact the October survey indicates they were entering the system). Three pairs of these large crocodiles were sighted interacting; that is, one was in the water directly facing one up on the bank. On the terminal km40-45.9 section of the river, 3 hatchlings, one (2-3′), 11 (3-6′) — most of which were in the (3-4′) size class — and 5 large animals were sighted. However on our helicopter aerial survey of the same section of the river, during the day of July 2, we sighted 7 large (some very large, >13′, which one rarely ever sees at night because of their wariness, probably going back to the days of shooting) crocodiles on the last 2 km of the surveyable section of the river, that is from km43.9 to 45.9. It is highly probable that most of these animals had been forced out of the Arafura Swamp, because of the low water levels following on two consecutive "dry wets". During the July 1979 survey of the Glyde we also observed a high density of crocodiles on the mouth and upstream terminal sections (Fig. 9.59 Monograph 9), however the overall number of animals concerned was less than that sighted during the present survey.

The fact that the number of large animals sighted during the July 1983 survey of the Glyde River was considerably higher than the number sighted in July 1979 (31 versus 19) is not surprising. The July 1979 survey followed on immediately after the record "dry wet" of 1978-1979 and the crocodiles which had been forced out of the Arafura Swamp were spread throughout the tidal waterways from Arnhem Bay in the east to the King River in the west (Fig. 1, also see DISCUSSION). On the other hand, the July 1983 survey followed on two consecutive "dry wets". Examination of Table 7 shows that after the 1981-1982 "dry wet" there had been by July 1982 a major influx of 58 large animals into the monitored waterways of the Maningrida area, from 105 to 163. Since most of these additional large animals had been forced out of the Arafura Swamp via the Glyde River, one could expect, as in 1979, the number of large animals to have increased in the Glyde River also, over that in the previous normal year. By the time of the October 1982 survey, 31 of the additional 58 large animals had been excluded or were missing from the waterways of the Maningrida area. Some of the 31 animals were probably in the class of missing — presumed dead, while the remainder were on their way back to the Arafura Swamp via the Milingimbi Complex of waterways. But the second "dry wet" of 1982-1983 intervened and it is likely these animals remained in the Glyde River and in the other waterways of the Milingimbi Complex over the wet season. Thus the Glyde River in July 1983 could be expected to contain not only its share of the large animals originally excluded but also a share of the returning animals. On this basis too, one would not necessarily expect an increase in the number of large animals sighted on the Glyde River during the October 1983 survey, for the animals had already returned. An explanation along similar lines can be given also for the increased number of (3-6′) animals seen in July 1983. The possibility of many further animals being excluded into the river from the swamp after July is considered very small, because of the drying up by July of the channel connecting the river to the swamp.

Two interesting points arise from a study of the size structure of the animals sighted. The Glyde River has good breeding habitat (so does the Arafura Swamp when the water levels are up) and yet after a "dry wet" season, when there could be little or no loss of nests due to flooding, only 5 hatchlings were sighted during the survey. Surely there must have been more? Could they have been cannibalized by the increased number of large crocodiles? And where did the 35 (3-4′) animals, shown in Table 1, come from? Did they arise from normal recruitment on the Glyde? If they did, then there must have been an excellent nesting year over the wet season of 1980-1981, which we know had heavy flooding. Hence it is likely that most of these (3-4′) crocodiles came from elsewhere — perhaps from the Arafura Swamp and/or the Blyth-Cadell System? The Arafura Swamp must be the more likely source for a majority of these (3-4′) animals.

We wish to emphasize again what we have been saying about the increase in the number of crocodiles sighted on the Glyde River, during the July 1983 survey. The increase has not arisen from a major population increase since 1975, but again, as in 1979, predominantly consists of animals which were already present in the freshwater swamps and which, because of the "dry wet", were concentrated into the tidal waterways.

We report here an observation made on July 8 on the Glyde River at km35.9. A (8-9′) dead crocodile was sighted midstream floating with belly up and the front half of the body missing. Suddenly the corpse appeared to dive at which time we sighted another (9-10′) crocodile pulling at it, apparently in an endeavour to tear a piece off. Considering the concentration of large crocodiles on the Glyde, at this time, it is likely that the crocodile was killed by another one and that we were witnessing another case of cannibalism.

We carried out a daytime aerial helicopter survey of the Arafura Swamp (Fig. 5) on July 2, 1983. Water levels in the swamp were low and with the exception of areas near old river courses, much of the swamp area at present could not provide habitat suitable for crocodiles. Practically all of the old river courses were completely covered by a heavy matting of water hyacinths. However, a number of deep billabongs along the old river courses still had areas of open water. These areas could be expected to hold concentrations of *C. porosus* which had not been forced out of the swamp and into the Glyde River. We sighted a dead (9-10′) crocodile with a rear foot missing floating on its back in an old Goyder River bed and one (8-9′) animal in a large deep waterhole, also part of an old river bed.

Surprisingly, only one probable old nest was sighted. It appears that little nesting took place during the "dry wet" and one may ask why. Bird life was very scarce and consisted mainly of magpie geese.

6.2 October 6-8, 1983 survey

The resurvey of the Glyde River on the night of October 6 revealed 91 *C. porosus* (Table 1), 3 (2-3′), 58 (3-6′) and 30 large animals. The 5 hatchlings sighted on the July survey were missing as were 6 (2-3′), 13 (3-4′) and 4 (4-5′) animals. The number of large animals sighted remained essentially constant, 31 having been sighted in July. The ratio of (3-6′) to large animals decreased from 2.4 in July to 1.9 for the October survey. These numbers are consistent with the predictions which could be made on the basis of the population dynamics model outlined in the INTRODUCTION. It is to be noted that, as predicted previously, there was no influx, since the July 1983 survey, of animals returning from the Milingimbi Complex to the Arafura Swamp.

The distribution along the river of the 91 animals sighted differed considerably from the July survey when 11 large animals were sighted on the km0-5 mouth section of the river. On the present survey only 6 large animals were sighted on this section, however the number of large animals on the upstream sections above km35 increased from 7 in July to 13 on the October survey. This further supports our view that some of the animals which had been on the km0-5 section in July were moving back to the swamp. By October they were waiting on the upstream sections to re-enter the Arafura Swamp during the forthcoming wet season.

It seems reasonable that the animals which had been forced to leave the Arafura Swamp first were those which had been excluded originally from systems such as the Blyth-Cadell. One could expect animals hatched and reared in the Arafura Swamp to be the ones concentrated into the few remaining large billabongs there. The excluded animals could be expected to try to establish territories in the system from which they had been excluded originally, however in trying to do so, some undoubtedly join the ranks of the missing — presumed dead. Others could still be on their way back, but the matter is very complex to unravel indeed.

Some 5 hours of helicopter flying time were used on October 6 and 7 for carrying out an intensive aerial survey of the Arafura Swamp. The swamp water level had dropped further since the July survey and there was a mere trickle of freshwater out of the swamp into the Glyde River. Downstream of the Glyde River Crossing at km45.9, the river was almost totally drained of water for several km at low tide. Only a few inches of water were seen to trickle between the high exposed mud banks. Whereas the salinity in July was 24‰ at km0 and 1‰ at km20, during the October survey it was measured to be 34‰ at km0 and 20‰ at km20. In fact the salinity at km40 was still 5‰.

As during the July aerial survey, no definite old nests were sighted, indicating that very little nesting occurred in the swamp during the "dry wets" of 1981-1982 and 1982-1983. Old nests would have been easily spotted had there been any. The failure to nest during the "dry wet" is puzzling. As will be seen shortly, there were some 32 large animals concentrated into the large billabong at Old Arafura and it is surrounded by some excellent nesting habitat. Why was there essentially no nesting?

Twelve large crocodiles were sighted from the helicopter during the daytime survey (including one very large animal, ≥14′, in Old Arafura Billabong), 10 in the open water billabongs and 2 trapped in old river courses, heavily matted with water hyacinths.

The large and strategically situated billabong at Old Arafura (Fig. 5) was surveyed on the night of October 7. This billabong, which has a length of some 4.5 km, had some 2 km of open water; the remainder was matted very heavily with water hyacinths. Even the open area of the billabong was fringed by a heavy matting of hyacinths. This billabong joins the Goyder and Glyde Rivers and could be expected to contain animals concentrated into it from elsewhere in the Arafura Swamp and which had not left via the Glyde River. Animals entering or leaving the swamp would normally have to pass through it. Thus we expected to sight a high concentration of animals. We were not disappointed, sighting 70 animals, the highest concentration sighted by us during our 12 years of research on the waterways of northern Australia. We sighted 22 (2-3′), 16 (3-6′) and 32 (≥6′) animals — a spectacular sight. No hatchlings were sighted. All the animals were in or near the edge of the water hyacinths; some of the large animals scrambled frantically through the matting into the open water when the survey boat approached the edge of the matting. Interestingly, all except 4 of the 22 (2-3′) animals were concentrated in the northern half of the billabong and this portion of the billabong contained only a few larger animals. We sighted 4 pairs of large animals in the southern half of the billabong, all of which were within a radius of 5 metres. At least 3 other pairs were sighted. These might have been mating pairs. Only one crocodile was sighted out in the matting extending over the remainder of the billabong at the southern and northern ends. Our spotlight would have picked up any eye shine to a distance of some 300 metres.

Old Arafura Billabong was first surveyed by one of the authors (HM) in July 1972, at which time the daytime survey revealed one very large *C. porosus* >14′ and another animal (10-11′). The nighttime boat spotlight survey revealed 4 animals, the >14′ animal sighted during the day, 2 other large and one (5-6′). An attempt was made to capture the >14′ animal, however we were unable to get closer than 50′ to it. Probably the same animal was sighted during the course of an aerial survey of the billabong in July 1972 and again during the helicopter survey discussed above. Water hyacinths covered much of the billabong, and specially at the northern and southern ends, in 1972 also. However the mats were not as thick then as at present and they floated freely over the surface of it, pushed by the wind. Our records show that progress could be made through the matting using a 12′ fibreglass dinghy and small outboard motor. This would not be possible in October 1983. It should be noted that the wet season of 1971-1972 was not a "dry wet" and so there would not have been the concentrating process that we have discussed.

How many non-hatchling *C. porosus* did the Arafura Swamp still contain in October 1983? We can perhaps give an informed estimate based upon the results of our spotlight survey of the strategically situated major billabong in the swamp — the Old Arafura Billabong. Taking into consideration the remaining few open water billabongs and their situation, the almost total heavy cover of the old river beds with a matting of hyacinths and the low water level of the swamp, the number probably falls somewhere around 200 with 400 being a very generous upper limit.

The almost total absence of old nests makes one wonder just how much breeding does take place in the Arafura Swamp and what fraction of the animals are subadult itinerants from elsewhere. There is little doubt that some nesting does take place as evidenced by the 22 (2-3′) animals sighted in the Old Arafura Billabong. Apparently the adult *C. porosus* of the Arafura Swamp nest mainly during normal or heavy wet seasons and only rarely during "dry wet" ones.

Part 7

DISCUSSION

7.1 "Dry wet" seasons

When Monographs 9 to 11 were written in 1979, we had not yet completed resurveying the tidal waterways of the Northern Territory coast west of Maningrida and were not aware that the substantial increase in the number of non-hatchling *C. porosus* sighted during the 1979 surveys, as compared to the number sighted on the 1975 ones, was in fact a general phenomenon on the tidal waterways of the Northern Territory coast and appeared to be connected with a special event — the "driest wet" on record. Furthermore, when the 1979 surveys were completed, we interpreted the statistically significant (at the 95% level) increase in the number of non-hatchling *C. porosus* sighted, as indicating a slow but important recovery on certain major sections of the northern Australian coast. When one analyses the substantial amount of additional survey data we have gathered in the intervening 4 years, it appears that that interpretation may have been overly optimistic at that time (Tables 1 to 7) and that the additional animals sighted were already present in 1978 and perhaps earlier, but were scattered throughout various associated freshwater complexes. All that the "driest wet" did was to concentrate these animals onto the tidal waterways. As soon as another usual wet came, many of the animals apparently returned from whence they came.

In "Addendum August, 1981" pages 440-446 of Monograph 1, we discussed in some detail the influx of large *C. porosus* into the tidal waterways in 1979, which in some cases was accompanied by an increase (Blyth-Cadell) and in some cases by a decrease (East and South Alligator) in the number of (3-6′) animals sighted. Comparison of data obtained on surveys during 1978 and again during 1979, for a number of major tidal systems (Adelaide, Blyth-Cadell, Liverpool-Tomkinson, East Alligator, South Alligator, West Alligator, Wildman) established that the major influx of animals took place between the 1978 and 1979 surveys. Furthermore, consideration of the data following the completion of the 1981 surveys, indicated that the 1979 influx may have been due to the "driest wet" on record and that the number of (3-6′) crocodiles sighted on subsequent surveys had returned to almost pre-1979 levels, whereas the number of large animals sighted remained at a higher level than previously (Update Table 6.2.31, page 14 Monograph 1). This Table (present Table 2), which was further updated after our June and October 1982 surveys (Appendix, St Lucia 1982), also provided some evidence that the ratio of small, and (3-6′), to large animals was decreasing on the Blyth-Cadell and Liverpool-Tomkinson Rivers Systems, though there were substantial fluctuations in the ratio. There was evidence that an increase in the number of large *C. porosus* sighted on a tidal waterway (often accompanied by an increase in (3-6′) animals) was usually followed by an eventual decrease in the number of small and/or (3-6′) animals counted. Furthermore our data indicated that the exclusion of sub-adults, both in the (3-6′) and large size classes coincides with the breeding season which commences around the September-October period. All of these observations and conclusions were in keeping with our model and might well be incorporated into it. However, there were a number of troublesome points which remained to be resolved. We quote from the St Lucia 1982 paper:

"We suggested that the common factor, which may have been connected with this general influx of animals, was the exceedingly dry wet season of 1978-1979 and the severe drought conditions which prevailed until the wet season of 1979-1980. Such conditions might be expected to force any itinerant animals in swamp areas and semipermanent waterholes back into the tidal waterways. However we pointed out that there are a number of worrisome points about this, firstly there are very few swamp areas in the vicinity of the Blyth-Cadell System (certainly not enough to hold the number of animals involved) and secondly if the sub-adults were returning from non-TYPE 1 tidal waterways elsewhere (for instance the Milingimbi Complex, see Monograph 9) then why should a very dry wet season and severe drought conditions trigger the return of sub-adults to TYPE 1 systems from non-TYPE 1 systems. In addition there were indications of an increase, rather than a decrease, in the number of non-hatchlings sighted in TYPE 3 systems in August 1979 — see the results for Majarie and Wurugoij Creeks, Table 1. Finally, how does one account for the decrease in the number of large crocodiles (from 74 to 58) spotted on the Liverpool-Tomkinson System during the October 1979 survey (Table 2); where did they disappear to? The missing crocodiles could not have returned to the freshwater swamps and/or billabongs from which it was postulated they had come, for these were even drier in October than in June and July. One is thus tempted to dismiss the 'drying up swamp and billabong' explanation for 1979. However, the 1981-1982 wet season along the northern Arnhem Land coastline was again a dry one and again there has been an influx of large animals into the Goomadeer (from 3 to 14), Blyth-Cadell (from 39 to 67) and Liverpool-Tomkinson (from 54 to 67) Systems — see the results for the June 1982 surveys in Tables 1 and 2. The increase in the number of large animals sighted on the Liverpool-Tomkinson System was accompanied by a major increase of small (from 166 to 207, significant at the 95% level) and (3-6') (from 133 to 178) animals, whereas on the Blyth-Cadell it was accompanied by an increase of (3-6') animals (from 126 to 163) only. The number of small animals remained constant.

In June 1979 the increase in the number of large animals sighted (from 23 to 55) on the Blyth-Cadell System was accompanied by a significant increase at the 95% level (from 221 to 287) in the number of small, and an increase (from 161 to 196) in the number of (3-6') animals sighted. However, on the Liverpool-Tomkinson System this was not so — both the number of small and (3-6') animals remained essentially constant.

Thus we ask what role, if any, do the dry wet seasons play in determining the influx of small and specially large C. porosus onto the main sections of the tidal waterways.

It is to be noted from Table 2 that on the second survey of the Liverpool-Tomkinson System in 1979, namely the October survey, the number of large animals spotted had decreased (from 74 to 58), but still was at a considerably higher level than for the September 1978 survey when only 40 large animals were spotted. The number of small animals sighted had also decreased, but not significantly — from 152 to 136. For the Blyth-Cadell System there was a similar occurrence, however the next survey, after the June 1979 one, could not be made until October 1980; the drop in the number of small animals was from 287 to 249, just missing being significant at the 95% level."

The results of the 1980 and 1981 surveys (Tables 1 to 7) indicated that the number of animals on the tidal waterways in the Maningrida monitoring area remained fairly static except for the further exclusion, between the July and October

1981 surveys, of 40 animals in the (3-6′) size classes from the Blyth-Cadell System (Table 2). Then came the "dry wet" of 1981-1982 and again the influx, referred to above, of (3-6′) and large animals into the Liverpool-Tomkinson and Blyth-Cadell Rivers Systems. The distribution of the animals sighted left little doubt that for the Blyth-Cadell System, the animals were entering and leaving the system largely through the mouth of the Blyth River. You could see the animals on the mouth sections of the waterway in both June 1979 and June 1982 — a spectacular and fascinating sight. In our St Lucia 1982 paper we wrote:

"As is evident from our discussion, consideration of the survey results for the Blyth-Cadell System can be indicative only as to where the fluctuating numbers of small and large crocodiles disappear to and return from. Most of these large C. porosus *are in the (6-8′) size class and thus are sexually immature or just sexually mature animals for it is known that females are often sexually mature when they reach the (6-7′) size class (page 339 Monograph 1, also personal communication from Dr Gordon Grigg). The evidence suggests strongly that most of these large crocodiles and a substantial fraction of the excluded small crocodiles leave and re-enter the Blyth-Cadell System through the mouth of the Blyth River. Those that leave, go out to sea and are probably lost or they travel along the coastline until they reach another tidal waterway to which they gain entrance.*

To the east of the Blyth River mouth, the closest tidal waterways are those discussed in Monograph 9, Ngandadauda, Bennett, Darbitla, Djigagila and Djabura Creeks, all TYPE 3 or 2-3 waterways, and which provide excellent rearing stockyards for sub-adult and just mature C. porosus, *referred to in our model. However to reach the first of these waterways, Ngandadauda Creek, necessitates a sea journey of some 36 km and the rounding of Cape Stewart. This creek is also joined to Creek B on the Blyth River by an open paperbark swamp and crocodiles could move from one to the other during the height of the wet season (page 39 Monograph 9). There is a very small but distinct channel joining the two creeks.*

When last surveyed in June 1979, 39 large and 44 (3-6′) animals were sighted in the creeks above and since they are all TYPE 3 or 2-3 waterways, nearly all the animals sighted must have been derived from elsewhere. The Blyth-Cadell System is probably one of the sources for these crocodiles."

On pages 39, 40, 106, 124 and 125 of Monograph 9 we also discussed the probable source(s) of the major portion of those crocodiles frequenting Ngandadauda Creek and the remainder of the Milingimbi Complex, which consists of TYPE 2-TYPE 3 waterways. Excluding the small number of animals which are derived from within the Complex itself and from scattered semipermanent freshwater billabongs and small swamps bordering it, the two major and nearest sources are the Blyth-Cadell Rivers System and the Glyde River System which drains the Arafura Swamp. Our 1979 survey results strongly suggested that the Glyde River was acting as a channel for *C. porosus* entering and leaving the Arafura Swamp. On page 106 of Monograph 9 we stated:

"Examination of Tables 9.43 and 9.44 indicates that at least one half of the crocodiles in size classes ≥(5-6′) may have been derived from crocodiles moving into the river mainstream from elsewhere. Since the nearest TYPE 1 river systems are the Blyth River in Boucaut Bay to the west and the Kalarwoi River in Buckingham Bay to the east (Fig. 9.1), it is highly unlikely that crocodiles from those rivers would enter the TYPE 1 Glyde River. In fact as we shall see in the Discussion of the overall Castlereagh Bay and Hutchinson Strait results, it is highly likely that some of the crocodiles in the ≥(4-5′) size classes spotted in the other river and creek systems in the Bay and Strait were derived

from and through the Glyde River. This reasoning leads one to conclude that substantial numbers of crocodiles in size classes ≥(4-5') are moving out of the Arafura Swamp into (and some out of) the Glyde River. Furthermore a fraction of the crocodiles in these size classes recruited from within the river itself are probably also excluded from the river proper. This would be in full accord with the picture we have developed of the dynamics of the populations of C. porosus *(Monographs 1, 10 and 11).*

That substantial numbers of C. porosus *in size classes between (4-6') are probably leaving the river, and some in larger size classes entering it, is supported by our sighting of 12 animals in these size classes between km0 and 1.2 (Fig. 9.59). We have surveyed most navigable tidal rivers and creeks in the Northern Territory and this is the first occasion on which we have sighted such a concentration of C.* porosus *at a river mouth.*

It is to be noted that the density of non-hatchlings sighted during the 1975 survey was 0.61/km, whereas during the 1979 survey it was 1.39/km. The increase in the number of non-hatchling crocodiles is highly significant (Table 9.45). Not only is the Glyde River with its excellent nesting habitat helping to repopulate itself but the Arafura Swamp is helping as well. The Woolen River, Hutchinson Strait and the Milingimbi Creek complex are undoubtedly recipients of some of these crocodiles. The Arafura Swamp is probably functioning both as a rearing stockyard and as a breeding system.''

And on page 124 of Monograph 9, where we discussed the increased number of non-hatchling crocodiles sighted during the 1979 surveys of the Milingimbi Complex, and again discussed possible source(s) of these crocodiles, we wrote:

''As discussed previously, the increase observed on the Glyde River can be accounted for by recruitment on the river and by crocodiles entering the fast flowing upstream sections of the river from the Arafura Swamp, where certain parts may act as rearing stockyards and others as breeding areas. Some of these crocodiles probably dispersed from the Glyde River to the other river and creek systems surveyed. However, it is most improbable that crocodiles from the Arafura Swamp and the Glyde River could account for the total increase in the number of non-hatchling crocodiles sighted, specially those in size classes ≥(4-5'). Using Tables 9.24, 9.25, 9.40, 9.41A, 9.43, 9.44, 9.53 and 9.54 and making due allowance for the EO classes (and subtracting the 7 crocodiles spotted on the additional 35.4 km of Bennett Creek which was surveyed in 1979 and not in 1975), we find the following accounting for crocodiles in size classes ≥(4-5'), where we show the number of crocodiles in the 2-3' and 3-4' size classes in brackets:

	1975	**1979**
Milingimbi area	*29 (14)*	*63 (15)*
Glyde River	*19 (9)*	*38 (26)*
Woolen River	*16 (10)*	*27 (10)*
Hutchinson Strait	*11 (8)*	*26 (12)*
Total	*75 (41)*	*154 (63)*

Thus there was an increase of at least 79 crocodiles sighted in size classes ≥(4-5'), this is more than a doubling in numbers.

Reference to Fig. 9.1 indicates that the Blyth-Cadell Rivers System from which 80% of crocodiles sighted in the (2-5') size classes during the 1974 survey were missing by 1979 (Monograph 1), and the Arnhem Bay Rivers (Monograph 11) from which some 88% were missing, are the likely candidates from which at least a portion of these crocodiles came.''

Further analysis of our extensive survey data obtained since 1979 and specially that of the June and October surveys of 1982 and 1983, which included the survey and resurvey of all major and minor alternative habitat (St Lucia 1982 and Table 8) we could gain entrance to, suggests strongly that a substantial fraction of the INCREASED NUMBER of crocodiles sighted, not only on the Milingimbi Complex in 1979 and on Ngandadauda Creek and the Glyde River in 1983, but also on the Blyth-Cadell and Liverpool-Tomkinson Rivers during the 1979, 1982 resurveys, were animals RETURNING from the Arafura Swamp. Examination of Table 8, showing the number of animals sighted in alternative habitat, available for animals leaving the TYPE 1 Blyth-Cadell System (Fig. 3), indicates that even though this habitat is frequented by some animals excluded from the System, a substantial fraction of the animals must move eastward, rather than westward, along the coast and move into the TYPE 2-TYPE 3 waterways of the Milingimbi Complex and the Arafura Swamp prior to returning from there to the System. In 1976, a 12′ male *C. porosus* which had been caught in 1975 at km49.9 on the Tomkinson River and had a transmitter fitted was sighted at the mouth of Darbitla Creek in the Milingimbi Complex, roughly ten months later. In June 1983, a (5-6′) animal was sighted stationary in the water some 1 km from shore and some 5 km east of the Blyth River mouth. Yet we do know from our mark-capture-recapture studies of 1973-1975 that some of the sub-adults from the Blyth River do move westward also, for we recaptured a (3-4′) animal south of Bat Island in the Liverpool River (Fig. 2) which had been marked in the Blyth River. However the fraction of the animals excluded from the Blyth River which move westward and frequent alternative habitat such as Anamayirra, Beach and Crab Creeks (Fig. 3), rather than moving eastward, is unknown. Perhaps this habitat is utilized more by animals excluded from the Liverpool-Tomkinson System, but we are really unable to say. The results given in Table 8 show that the number of crocodiles frequenting these small hypersaline coastal waterways is relatively small.

A further important result comes from our resurvey of Ngandadauda Creek in June 1983. This TYPE 3 creek was first surveyed in September 1975 when 9 (3-6′) and 5 large animals were sighted in it; on the resurvey of June 1979, 10 (3-6′) and 11 large animals were sighted, indicating an influx of 6 large animals (pages 39 and 40 Monograph 9). During the June 1983 resurvey, 20 (3-6′) and 10 large animals were seen, indicating that there had been an influx of (3-6′) and probably some different large animals into this TYPE 3 waterway — most likely of animals moving between the Blyth River and Arafura Swamp. On the October 1983 survey 14 (4-6′) and 7 large animals were sighted, indicating a loss of 9 animals. As discussed in the Section on Ngandadauda Creek, it is reasonable to assume that on this occasion many of these should be classified as missing — presumed dead.

The situation in relation to the Liverpool-Tomkinson System appears to be somewhat different from that of the Blyth-Cadell System. There is considerable alternative habitat available for sub-adults excluded from the Liverpool and Tomkinson Rivers proper (St Lucia 1982). For instance, Morngarrie, Mungardobolo, Gudjerama and Toms Creek, which are part of the Liverpool-Tomkinson System are each TYPE 2-3 creeks and provide excellent non-TYPE 1 habitat for animals excluded — without them having to leave the System. Our results for these creeks show that there is a flow of both small and large animals into and out of them. There is other alternative habitat in addition, such as the extreme upstream sections of the Liverpool and Tomkinson mainstreams (Table 8), which we discussed at some length in the St Lucia 1982 paper and in which we presented evidence for the upstream terminal sections of the Tomkinson River acting as excellent rearing stockyards for large and specially small animals. Also there are numerous small permanent and semipermanent swamps and billabongs and tiny creeks associated with the System in which sub-adult crocodiles could hide. In addition there are the waterways of Rolling and Junction Bays (Fig. 1) which appear to be frequented by animals from the Liverpool-Tomkinson System (page 75 Monograph 7) as well as Crab, Anamayirra and Beach Creek (Fig. 3) which act as rearing stockyards also. Thus there appears to be little difficulty in accounting for a substantial fraction of the variation in the number of (3-6′) animals sighted on the Liverpool-Tomkinson System.

It is not possible to do so as easily for the substantial variations in the number of large animals sighted during the 1979, 1982 and 1983 surveys (Table 2). A study of the distribution and variation in the number of large animals sighted on each individual survey section, for all surveys, suggests (but certainly does not prove) that perhaps one-half of the increase of 34 large animals sighted in June 1979 may be attributed to animals returning from the extreme terminal sections of the Tomkinson River and the unsurveyable terminal swamp and billabong sections of Maragulidban Creek and perhaps of the other small creeks as well. However, the distribution of the remainder of the animals on the downstream sections of the Liverpool River and the downstream creeks suggests that the remainder of the increase may have been derived from outside the Liverpool-Tomkinson System. This is specially so for the apparent increase of 13 large animals sighted during the June 1982 survey; an increase of 11 large animals was sighted on the mouth sections of the Liverpool River. Rolling and Junction Bay waterways were not responsible for the increase sighted in June 1979 and 1982, for there were increases in the number of large animals sighted on those surveys as well (Tables 6 and 7). Similar remarks apply to the decreases. Furthermore the same applies to the Blyth-Cadell System and hence one is forced to assume that some of the animals returned from or to a substantial rearing- stockyard and breeding system — the Arafura Swamp.

The perplexing question of what happened to the apparent 16 missing large crocodiles from the Liverpool-Tomkinson System in October 1979 must be considered again. If these animals were excluded by the time of the October 1979 survey, they certainly could not have returned to swamp habitat — including the Arafura — for such habitat was even more dried up in October than in June. Thus we are forced to surmise that these large crocodiles excluded from the Liverpool-Tomkinson System probably entered the Milingimbi Complex of tidal waterways and returned to the Arafura Swamp when the wet season of 1979-1980 arrived. The same probably occurred with the 23 large animals excluded from the Blyth-Cadell System by the time of the October 1980 survey. It is to be stressed that we have no direct proof of this — we cannot survey such large complexes continuously.

We thus now believe that our original contention (Monograph 9) was correct. The only reasonable explanation we are able to give, which is in accord with the observations made during the 1979, 1982 and 1983 surveys following "dry wet" seasons, is that the Arafura Swamp is acting both as a breeding system (during normal wet season periods) and as a rearing stockyard of varying extent, for sub-adult crocodiles from Arnhem Bay in the east to the King River in the west (Fig. 1). The Blyth-Cadell System is a very important component of this. During a severe "dry wet" season as in 1978-1979, the water levels in small and large swamps fall drastically and crocodiles inhabiting these have no choice but to leave. They can only return to the tidal waterways, both TYPE 1 and non-TYPE 1, and this they do — as they did in 1979 and 1982. Many animals frequenting the alternative freshwater habitat must have come from TYPE 1 tidal breeding systems and hence, as the swamps dry, some of the sub-adult animals probably return to the tidal system from whence they originally came, the others apparently have to frequent non-TYPE 1 tidal systems — even though temporarily — until they can go back to the swamp rearing stockyard or a TYPE 1 system. Some of the returning large animals appear successful in establishing a territory for themselves (and perhaps a few of the (3-6′) animals also): the others appear to be excluded yet again — and specially the (3-6′) and sub-adult large animals — on the commencement of the breeding season. When the next "dry wet" arrives [if there has been the usual wet season(s) in between so that the animals could have returned to the swamp(s)] large and sometimes (3-6′) animals again are excluded from the swamps and the degree of the process must depend upon just how "dry" the wet season is — upon how much the swamp water levels fall. The whole process is superimposed upon the normal exclusion and re-entry of animals which takes place in usual years and which accounts for most of the sub-adults sighted in non-TYPE 1 systems. Thus, whether "dry wet" seasons are the proximal factor involved or not, they are certainly associated with the major influxes of large and sometimes (3-6′) animals sighted on the tidal waterways during surveys made in June-July, after a "dry wet". Thus "dry wets" appear to play a very important role in the dynamics of *C. porosus* populations.

An interesting possibility which follows from the above picture or model is that *C. porosus* may be able to "sense" how drastic the drop in freshwater levels will be, for the influx of sub-adults has already occurred before the June surveys — perhaps before the water level, which forces the animal to leave, is reached.

A matter which becomes somewhat clearer on the above picture is why the influx of large animals is sometimes accompanied by an influx of (3-6′) animals and sometimes not (see Table A.1 on page 422, Monograph 1 and Table 2). Though there probably is an interplay of a complex set of factors, it is reasonable to assume that large animals require higher water levels than small animals and hence in some years and from some swamps only the larger animals are forced to leave. In addition, the number of large and/or adult animals in the tidal waterway may also be a factor involved (St Lucia 1982) — and perhaps tending to prevent the (3-6′) animals from remaining in the waterway over the dry season (see Table 2, July 1979 survey of the Liverpool-Tomkinson System).

7.2 An overview for the monitored waterways in the Maningrida area

In Fig. 8 we have plotted using Table 7, the number of (3-6′), large and their sum, (3-6′) plus large (or (≥3′)) animals sighted on surveys over the past 8 years of the Liverpool-Tomkinson, Blyth-Cadell and the 4 waterways of Rolling and Junction Bays. The waterways of Rolling and Junction Bays could not be surveyed every time the Blyth-Cadell and Liverpool-Tomkinson were, thus resulting in a number of incomplete totals. These cases are referred to in the caption of Table 7 and certain corrections are suggested.

Unsurprisingly the graph shown in Fig. 8, largely mirrors those shown in Figs. 6 and 7 for the Liverpool-Tomkinson and Blyth-Cadell respectively. We refer the reader to the Overview Sections for each of those Systems, for essentially the same broad general remarks can be made here as were made there. The number of large crocodiles sighted on the overall Systems during the surveys of 1976 was 83 and the number of (3-6′) animals was 340. The number of both (3-6′) and large crocodiles sighted then essentially held steady or even declined slightly until June-July 1979 when there was a dramatic jump following the "driest wet" on record of 1978-1979. By the time of the June-July 1981 surveys the number of (3-6′) animals sighted was back to almost the same figure as in 1976 (347 versus 340) whereas the number of large crocodiles remained at a higher level, 113 versus 83. Obviously a number of the returning large animals were being successful in establishing a territory for themselves, probably in the very waterways from which they had been excluded, but many of their less successful rivals were joining the ranks of the missing — presumed dead in the process. Then came the two "dry wets" of 1981-1982 and 1982-1983. Again there was an influx, this time of 72 (3-6′) and 58 large animals; 392 (3-6′) and 163 large animals (amazingly the number for 1979 had been 162) were sighted. Again a substantial fraction of the increase, specially for large animals could

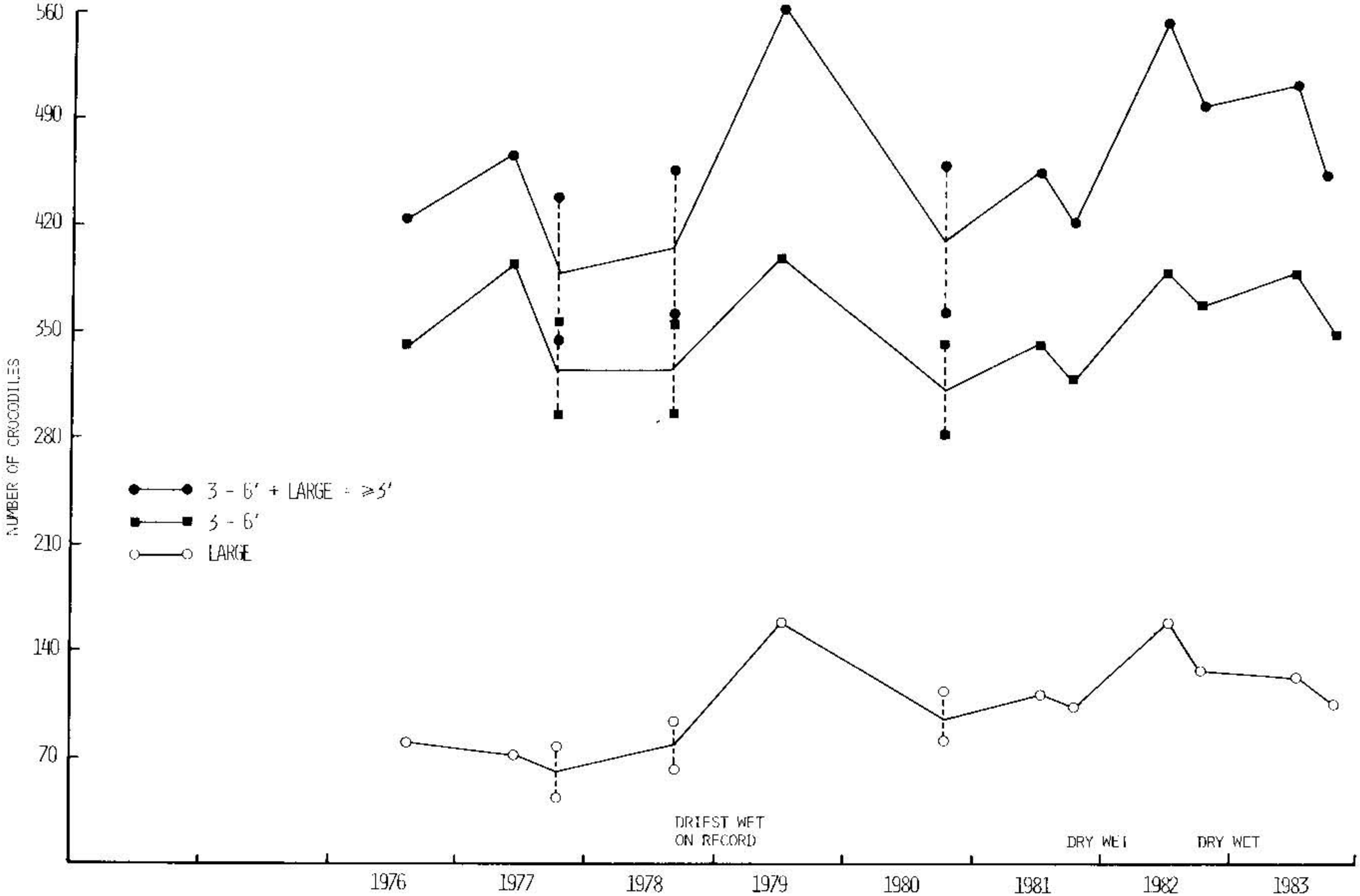


Fig. 8
A plot of the number of (3-6'), large (≥6') and their sum, (3-6') plus large (or (≥3')) animals for surveys carried out on the Liverpool-Tomkinson, Blyth-Cadell and Rolling and Junction Bays Rivers Systems during the eight years 1976 to 1983. For those years in which the waterways of Rolling and Junction Bays were not surveyed, we have plotted the numbers shown in Table 7 and the maximum figures also, but have drawn the line through the average value only.

only have been derived from animals excluded from the Arafura Swamp. By the time of the June-July 1983 surveys the number of large animals sighted had dropped to 125 whereas the number of (3-6′) animals remained almost constant (392 versus 391). Then came the expected drop in numbers for the October 1983 survey when 350 (3-6′) and 106 large animals were spotted.

Obviously only a relatively small number of additional (3-6′) animals may have been successful in establishing a territory for themselves during the 8 year period; it is as if there were a fairly definite number of slots or territories on the waterways for the (3-6′) animals and the number and size of these slots can vary depending upon a complex set of factors of which food supply is one. Of course the (3-6′) animals utilizing these in 1983 were not the same animals which filled those slots in 1976. Superimposed upon this is the increasingly aggressive behaviour of the animals as the October-November period approaches and the more aggressive behaviour of the large animals towards the (3-6′) ones during the breeding season.

The picture for the large animals is along the same lines. Comparing the surveys of July-September 1976 with those of June-July 1983 indicates that an additional (125-83) = 42 large animals had or were well on the way to establishing a territory for themselves. Study of Tables 4, 5 and 6 reveals that, as expected, those territories were in the TYPE 1 waterways. On the other hand, since only 106 large animals were sighted during the October 1983 survey, it is apparent that a number of large animals which held a territory in the July 1983 period could not do so once the breeding season commenced. Again one must realize that one is viewing a highly dynamic situation: a large animal may be successful in holding a territory for only a limited period. Even the largest animals may eventually be deposed by younger and more aggressive ones. This continual battle for the eventual right to breed is documented for many species. The losses involved during this process in the case of *C. porosus* are startlingly high.

What determines the carrying capacity of a tidal waterway in relation to *C. porosus*? This is a complex matter. Obviously the availability of food, nesting habitat, basking habitat and many other factors are involved. The results presented in Tables 1 to 8 and the above discussion of them make one wonder whether the tidal waterways which we have been monitoring in the Maningrida area have already almost reached their maximum carrying capacity under present day conditions. Or is it that the dynamics of the population is such that a major sustained increase in the number of (3-6′) and large crocodiles, and the change in population structure from a dominance in the numbers of (3-6′) to a major dominance in the number of large animals [ratio of $(3\text{-}6')/L \ll 1$] present, is inherently a slow and very long term process. During this period, there is an exceedingly severe sorting out process resulting in only a small fraction of highly successful animals surviving. Our results and population dynamics model based on them, provide strong evidence to support this latter view. The fact that *C. porosus* has been on earth for some millions of years and is superbly adapted to its environment provides further support for it.

The above views imply that we do not believe that the tidal waterways in the Maningrida area have reached their maximum carrying capacity and furthermore that we believe that population numbers of 40 to 200 years ago were far greater than they are today. Of course we are in a "no win" situation in trying to prove this for no systematic survey work, that we have heard about, was ever carried out or recorded for *C. porosus* in northern Australia. However the reports of early explorers such as Phillip Parker King, Lort Slokes, Cadell (see Monographs 4, 12 and 17) and many others, of perhaps less repute, leave no doubt whatever in our minds that *C. porosus* numbers were vastly greater in the past then they are at present. No reliable statistics are available, but it is evident that tens of thousands of animals were taken for their skins during the 1950s and 1960s and there was a small but viable industry during this period, based on crocodiles. That could not be true today. We must also give strong credence to reports to us by individuals such as Hugh Roberts (former manager of our Maningrida Research Facility and pilot of the University's research airplane) who was a pilot during the 1939-1945 war and flew numerous patrols along the northern Arnhem Land coastline. He and his co-pilot saw hundreds of large crocodiles lying on the beaches along the coastline and used them for machine gun target practice. This was recorded in letters to his now wife, Maidie. Today you can fly for days and see no crocodile on a coastal beach. The fact that mostly large crocodiles were sighted is easily understandable. On the basis of our model, one can well imagine that as the ratio of large to (3-6′) animals increases along with a major increase in the number of large animals, the increasing competition for good habitat would lead to the exclusion of big numbers of large animals. Life would also be very tough and relatively short — even more so than today — for most of the (3-6′) animals.

As we did for the Liverpool-Tomkinson and Blyth-Cadell Systems, we calculate for the overall waterways monitored in the Maningrida area, the maximum average percentage over the past 8 years, of hatchlings which survive to the (2-3′) stage and find it to be 824/1594 or 52%. The broad estimates for the minimum exclusion and/or loss percentages for the (3-6′) animals are shown below and are obtained using Table 7. Thus for the overall waterways we have been monitoring the minimum exclusion and/or loss percentage is a very high 88%. Again if we assume that the "dry wet" of 1981-1982 had concentrated back into our monitored waterways nearly all of the surviving large animals originally recruited there — and none originating from elsewhere — then 76% becomes the estimate for the missing — presumed dead (3-6′) animals.

7.3 Recovery of the *C. porosus* population

On the basis of the results above, it is small wonder that the population of *C. porosus* appears to be recovering at a very slow rate and that it may take many decades to recover — if ever. In fact, one may ask legitimately whether the population is already below a critical level, from which it cannot recover. We do not believe this is so, but it is one possibility suggested by the results. One thing that continually impresses us is the smallness of the numbers we are dealing with. The variations we are talking about are measured in tens, not hundreds or thousands.

The results of the ten years of systematic and carefully recorded surveys speak for themselves. It is no exaggeration to state that no one is more surprised by them than we are but we have finally reconciled ourselves to them. In 1972 when the ban on the export of crocodile skins and products was imposed by the Australian Government at the request of one of us (HM) and commercial hunting

Surveys Used	(3-6′)	Large (≥6′)	Minimum % of (3-6′) animals excluded and/or lost
July/Sept 1976	340	83	(340-42)/340 or 88%
July 1983		125	
July/Sept 1976	340	83	(340-80)/340 or 76%
June/July 1982		163	

ground to a halt — more because of the paucity of crocodiles than because of the ban — we felt very confident that given a decade or so of protection, Australia could again look forward to a substantial crocodile skin industry. We were further encouraged during the 1970s by the apparent very rapid recovery in alligator populations in the southern states of U.S.A. During that period it was claimed by the relevant wildlife authority that the alligator numbers had increased from some 450,000 to 750,000. An alligator skin industry started up again in the U.S.A. We, along with many other individuals, hoped and in fact believed, that the same would happen with *C. porosus*. But alligators are not saltwater crocodiles; they may appear to be superficially the same but in fact they are very different. *C. porosus* appears to be its own worst enemy.

Perhaps a further reason for the apparent differing recovery rates of alligators and saltwater crocodiles relates to the nature and amount of the habitat available to be utilized. In the southern states, of the U.S.A. there are evidently still substantial areas of swamp habitat available for alligators and the alligators appear to be thriving in it. We have stressed the importance of swamp habitat for *C. porosus* in the present paper and elsewhere (Monographs 1, 2, 4, 9 and 14) and pointed out that the very high loss factors for (3-6′) and large crocodiles on the tidal waterways could be expected to be considerably lower for animals inhabiting swamps (see especially page 445 Monograph 1 and page 98 Monograph 14). The fact remains however, that even though in recent history there was little swamp habitat available in northern Australia, much of what there was has been destroyed by feral water buffaloes. Examples of serious destruction may be seen in areas around the Adelaide, Mary, and Alligator Rivers Region, areas which contain some of the best and most important TYPE 1 river systems in northern Australia. The remaining areas in the Daly, Finniss, Reynolds and Moyle Rivers region (Monograph 3) and the Arafura Swamp thus take on added importance.

The laudable steps being taken by the Australian Government to include most of the waterways in the Alligator Rivers Region in a large national park (Kakadu) is leading to closer management of the feral water buffalo population there and hopefully may lead to the eventual recovery of the swamp habitat. This matter may be of major importance for the recovery of the *C. porosus* population in the park and surrounding areas. In Table A.1 page 442 of Monograph 1 we show the number of (3-6′) and large animals sighted during surveys made of the Adelaide River and rivers of the Alligator Region during 1978 and 1979 and one notes that the ratio of (3-6′) to large animals was already less than one on Murgenella Creek and on the South Alligator and Wildman Rivers. Of course it must be recalled that the 1979 survey was carried out after the record "dry wet" season of 1978-1979 and hence many of the animals had been forced out of the swamps and into the tidal waterways. However, this evidence along with that presented in this paper indicates that as the *C. porosus* population recovers and increases, there will be many more large than (3-6′) animals.

How many non-hatchling — but more importantly (3-6′) and large — saltwater crocodiles are there remaining in Australia? Our estimate for 1979 was a maximum of 15,500, but as discussed elsewhere in this paper, this estimate was based on numbers obtained in a year when most of the crocodiles were concentrated into the tidal waterways and could well be too high. Our present results indicate that there is no reason to increase this estimate for 1983, although we must check to see whether the results gained for the waterways monitored in the Maningrida area are generally applicable to waterways elsewhere in northern Australia.

It should be apparent that the present wild *C. porosus* population could not support a commercial skin industry based on indiscriminate shooting. If every saltwater crocodile in northern Australia was shot today, and the skins brought an average of $100 per skin, the total value would only be around $1.5 million. This is considerably less than the money spent over the past 12 years to gain the scientific information presented in our 17 Monographs and numerous papers.

7.4 Management of the *C. porosus* population

What are the management implications of our results? We are not management authorities, but are aware that a multitude of factors — some of them political — must be taken into consideration. For example, for reasons based on public safety, Australian society could decide that all waterways utilized for business and/or pleasure or which had settlements near them, should be cleared of *C. porosus* and that *C. porosus* should be allowed to exist and perhaps recover, only in a number of designated parks and/or reserves used for scientific and/or tourism purposes. Such a decision would result in the removal of *C. porosus* from many of the waterways in northern Australia and could have far reaching ecological consequences, many of which probably could not be foreseen beforehand. Based on examples from elsewhere in the world, the removal of a predator from the top of a complex food chain cannot occur without some major consequences. The Australian people would have to decide whether the unhindered enjoyment of the waterways of northern Australia is worth the risk of possibly disastrous consequences to the whole ecology of the waterways. The fishing industry is one group that readily springs to mind as a possible sufferer.

Or it might be decided to encourage the establishment of a commercial *C. porosus* skin industry based upon the wild population. Since at least 70% of the (3-6′) animals are lost — and these are the most valuable ones commercially — one is tempted to believe that their removal beforehand would yield a valuable resource without harming it. But one must proceed with extreme caution before embarking upon such an enterprise. Undoubtedly the exclusion and/or loss of some 80% of the (3-6′) animals is an integral part of the vital process of sorting out the successful from the less successful, of sorting out the stronger and more dominant component of the population. Removing a given fraction of the population might very well remove the stronger component and thus over the long term set the population on a declining course. We simply do not know. On page 15 of Monograph 1, we proposed in 1981 a critical experiment to test the effect of removing a given fraction of the (3-6′) *C. porosus* population and proposed that some 25 to 40% of the (3-6′) animals be removed annually for a period of 4 to 5 years from the downstream sections of the Adelaide River to see what effect if any this had upon the population in that river. For the experiment to be meaningful, one had to monitor the population changes on another set of control tidal waterways in which the *C. porosus* population remained untouched. The University of Sydney financed the costly monitoring of a control group of waterways for 4 years and this work has now been completed successfully. Though the proposed experiment had very important ramifications for the management and ranching of the *C. porosus* resource, no financial support had been forthcoming, from relevant authorities, for the other half of it. The opportunity has now been lost, thus ensuring that decisions made in relation to ranching will perforce be made on a much weaker scientific base.

We have already discussed in Monograph 1 (pages 437 to 439 and 445 to 446) various other management implications arising from our results. These relate to control of feral water buffaloes, prohibition of net fishing in rivers, establishment of marine or other parks and the release of hatchlings. We do not repeat these here but perhaps it is worthwhile to emphasize one apparent important issue again, an issue which is of great and fundamental importance. This relates to allowing net fishing upstream of and near the mouths of rivers. Our results show that over 80% of the (3-6′) animals are excluded from TYPE 1 waterways and that this exclusion also involves large animals; that there is great and continuing movement of these animals into and out of the river systems. Allowance of net fishing in or at the mouths of rivers, specially the TYPE 1 waterways is certain to remove an important component of the large animals and could well ensure that the population in those waterways never recovers or even declines further. Undoubtedly economic and political considerations are involved in arriving at a reasonable compromise in relation to this very important matter. We have no desire whatever to become involved in argumentation about it. However we would suggest that at the very minimum, all net fishing be definitely phased out over a period of 2 years in rivers included in national parks.

Most people are not aware that net fishing is still being permitted in the East Alligator River up to Coopers Creek and that relatively large numbers of crocodiles are still being drowned in that river annually.

This river forms the backbone of Kakadu National Park, one of Australia's most important national parks. More importantly, Stage Two of Kakadu National Park has just been announced by the Australian Government and most of the important tidal waterways in the Alligator Rivers Region will now be included in the park. These waterways constitute the largest and probably the most important group of TYPE 1 breeding systems in Australia and they are associated with large freshwater swamps which, as discussed elsewhere in this paper, are of great importance. These tidal waterways should all now be monitored annually, systematically, carefully and completely as we did in 1977, 1978 and 1979 — and net fishing in them totally prohibited.

We now end this paper *with our own view on the long term future of* C. porosus *outside of national parks in Australia: Considering the present greedy nature of society,*

IT HASN'T ANY . . .!

And even in the rivers of the national parks, unless net fishing is prohibited in them, the future for *C. porosus* is grim.

ACKNOWLEDGEMENTS

The authors thank the University of Sydney and its Science Foundation for Physics for their great financial support over so many years. Kayama Sinba from the Papua New Guinea Crocodile Project spent one month participating in our final programme of surveys from Maningrida in order to learn our techniques. It was a pleasure to have him with us. Our thanks also go to Doug Martyn and Colin Wiles, the pilots of the helicopters used for the July and October 1983 surveys respectively, of alternative habitat.

Our thanks also to Kim Mawhinnew, HM's secretary, for typing (and retyping!) the manuscript and Tables.

REFERENCES

Refer to page 2 for complete list of Monographs and Reports.

5.

MONOGRAPH 1

Additional data, 1980-1983 for The Blyth-Cadell Rivers

TABLE 18.1.1
BLYTH RIVER, OCTOBER 4-5, 1980

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION IV	IVIW	OM	IM	SWOE	MS	OBSERVED FEEDING
HATCHLING	86			3		83		3
2-3 *(0.6-0.9)*	42			4	1	37		
3-4 *(0.9-1.2)*	50	1		9		40		1
4-5 *(1.2-1.5)*	34	4		4	1	20	5	1
5-6 *(1.5-1.8)*	15			4		11		1
6-7 *(1.8-2.1)*	7					4	3	
>7 *(>2.1)*	4	2				1	1	
EO<6 *(<1.8)*	9					9		
EO>6 *(>1.8)*	8			1		5	2	
EO	12					9	3	
TOTAL	267	7	—	25	2	219	14	6

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 18.1.1
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Blyth River, October 4-5, 1980. Total distance surveyed was 63.5 km, mainstream 49.8 and the six sidecreeks 13.7 km.

TABLE 18.1.2
CADELL RIVER, OCTOBER 4, 1980

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION IV	IVIW	OM	IM	SWOE	MS	OBSERVED FEEDING
HATCHLING	33			5		28		
2-3 *(0.6-0.9)*	47			5		40	2	
3-4 *(0.9-1.2)*	21	1				20		
4-5 *(1.2-1.5)*	14	1		4		9		
5-6 *(1.5-1.8)*	7			1		6		
6-7 *(1.8-2.1)*	2					2		
>7 *(>2.1)*								
EO<6 *(<1.8)*	2					1	1	
EO>6 *(>1.8)*								
EO	7	3				4		
TOTAL	133	5	—	15	—	110	3	—

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 18.1.2
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Cadell River, October 4, 1980. Total distance surveyed was 29.4 km.

TABLE 18.1.3
BLYTH RIVER KM49.8-59 AND BILLABONG KM60.6-64.6, OCTOBER 13-14, 1980

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

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 18.1.3
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Blyth River km49.8-59 and billabong km60.6-64.6, October 13-14, 1980. No crocodiles were sighted in the billabong km60.6-64.6. The river cannot normally be surveyed by boat between km59-60.6.

TABLE 18.1.4
BLYTH RIVER, JULY 9-12, 1981

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	50			1		47	2	2
2-3 (0.6-0.9)	50			1		49		2
3-4 (0.9-1.2)	56			7		49		1
4-5 (1.2-1.5)	33			5	1	27		2
5-6 (1.5-1.8)	17					16	1	
6-7 (1.8-2.1)	10			1		8	1	
>7 (>2.1)	6					6		
EO<6 (<1.8)	6					6		
EO>6 (>1.8)	2					2		
EO	19	1				16	2	
TOTAL	249	1		15	1	226	6	7

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 18.1.4
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Blyth River, July 9-12, 1981. Total distance surveyed was 61.9 km, mainstream 49.8 and the six sidecreeks 12.1 km.

TABLE 18.1.5
CADELL RIVER, JULY 11, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	26					26		
2-3 *(0.6-0.9)*	36			4		32		1
3-4 *(0.9-1.2)*	28			2		26		
4-5 *(1.2-1.5)*	10					9	1	2
5-6 *(1.5-1.8)*	7				1	6		
6-7 *(1.8-2.1)*	1					1		
>7 *(>2.1)*	3					3		
EO<6 *(<1.8)*								
EO>6 *(>1.8)*								
EO	6	2				4		
TOTAL	117	2	—	6	1	107	1	3

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 18.1.5
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Cadell River, July 11, 1981. Total distance surveyed was 28.2 km.

TABLE 18.1.6
BLYTH RIVER, OCTOBER 19-21, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	40			2		38		1
2-3 *(0.6-0.9)*	53			9	2	42		2
3-4 *(0.9-1.2)*	36			3	4	28	1	
4-5 *(1.2-1.5)*	22	4		1	5	10	2	1
5-6 *(1.5-1.8)*	17	1		4	1	8	3	
6-7 *(1.8-2.1)*	11			2	1	7	1	1
>7 *(>2.1)*	7			2		4	1	
EO<6 *(<1.8)*	9	1				8		
EO>6 *(>1.8)*	5					3	2	
EO	10	5				4	1	
TOTAL	210	11	—	23	13	152	11	5

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 18.1.6
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Blyth River, October 19-21, 1981. Total distance surveyed was 61.7 km, mainstream 49.8 and the six sidecreeks 11.9 km.

TABLE 18.1.7
CADELL RIVER, OCTOBER 18, 1981

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	32			2		30		1
2-3 (0.6-0.9)	24			4	2	18		
3-4 (0.9-1.2)	24	3		5	8	8		1
4-5 (1.2-1.5)	10				2	8		
5-6 (1.5-1.8)	3			2		1		1
6-7 (1.8-2.1)	5			2		3		
>7 (>2.1)								
EO<6 (<1.8)	3					3		
EO>6 (>1.8)	3					1	2	
EO	1	1						
TOTAL	105	4	—	15	12	72	2	3

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 18.1.7
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Cadell River, October 18, 1981. Total distance surveyed was 28.2 km.

TABLE 18.1.8
BLYTH RIVER, JUNE 26-28, 1982

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	85			1		82	2	1
2-3 (0.6-0.9)	25			2		23		
3-4 (0.9-1.2)	35	3		5	4	21	2	1
4-5 (1.2-1.5)	31	2		5	2	22		
5-6 (1.5-1.8)	24			8		15	1	1
6-7 (1.8-2.1)	17	2		3	1	11		3
>7 (>2.1)	13			7		5	1	1
EO<6 (<1.8)	10			1		9		
EO>6 (>1.8)	17					12	5	
EO	7	2				5		
TOTAL	264	9	—	32	7	205	11	7

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 18.1.8
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Blyth River, June 26-28, 1982. Total distance surveyed was 62.2 km, mainstream 49.8 and the six sidecreeks 12.4 km.

TABLE 18.1.9
CADELL RIVER, JUNE 25, 1982

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	51					51		
2-3 *(0.6-0.9)*	17			3	1	13		1
3-4 *(0.9-1.2)*	24			1	1	22		
4-5 *(1.2-1.5)*	18	1		1	2	14		
5-6 *(1.5-1.8)*	7			1		6		
6-7 *(1.8-2.1)*	5					5		
>7 *(>2.1)*	7			1		6		
EO<6 *(<1.8)*	2					2		
EO>6 *(>1.8)*	6					1	5	
EO	7	1		1		5		
TOTAL	144	2	—	8	4	125	5	1

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 18.1.9
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Cadell River, June 25, 1982. Total distance surveyed was 29.7 km.

TABLE 18.1.10
BLYTH RIVER KM49.8-59, JULY 12, 1982

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

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 18.1.10
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Blyth River km49.8-59, July 12, 1982.

TABLE 18.1.11
BLYTH RIVER, NOVEMBER 7-8, 1982

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	55			2		53		1
2-3 *(0.6-0.9)*	23			1		22		1
3-4 *(0.9-1.2)*	39	3		7	2	25	2	
4-5 *(1.2-1.5)*	31	1		6	5	18	1	
5-6 *(1.5-1.8)*	21	2		1	5	9	4	
6-7 *(1.8-2.1)*	11			1		10		
>7 *(>2.1)*	6				2	4		
EO<6 *(<1.8)*	5					5		
EO>6 *(>1.8)*	16					12	4	
EO	2					2		
TOTAL	209	6	—	18	14	160	11	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 18.1.11
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Blyth River, November 7-8, 1982. Total distance surveyed was 62.8 km, mainstream 49.8 and the six sidecreeks 13 km.

TABLE 18.1.12
CADELL RIVER, NOVEMBER 6, 1982

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	56					56		
2-3 *(0.6-0.9)*	20			6	2	12		1
3-4 *(0.9-1.2)*	27			5	7	14	1	
4-5 *(1.2-1.5)*	15	1		3	2	8	1	1
5-6 *(1.5-1.8)*	7			1		6		
6-7 *(1.8-2.1)*	4			1		3		
>7 *(>2.1)*	4			1		3		
EO<6 *(<1.8)*	1					1		
EO>6 *(>1.8)*	2					1	1	
EO	2					2		
TOTAL	138	1	—	17	11	106	3	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 18.1.12
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Cadell River, November 6, 1982. Total distance surveyed was 29.7 km.

TABLE 18.1.13
BLYTH RIVER KM49.8-59 AND BILLABONG KM60.6-64.6, NOVEMBER 2-3, 1982

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	5					5		
2-3 (0.6-0.9)	2					2		
3-4 (0.9-1.2)	1					1		
4-5 (1.2-1.5)	1					1		
5-6 (1.5-1.8)								
6-7 (1.8-2.1)	1					1		
>7 (>2.1)	2					2		
EO<6 (<1.8)								
EO>6 (>1.8)	6					4	2	
EO	1					1		
TOTAL	19	—	—	—	—	17	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 18.1.13
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Blyth River km49.8-59 and billabong km60.6-64.6, November 2-3, 1982. Two large crocodiles were sighted in the billabong and one EO>6 was actually sighted just downstream of the Blyth crossing at km59.8. These three crocodiles are included in the table.

TABLE 18.1.14
BLYTH RIVER, JULY 16-18, 1983

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	148			2		145	1	2
2-3 (0.6-0.9)	43			7	1	35		
3-4 (0.9-1.2)	26			4		21	1	
4-5 (1.2-1.5)	27			9		17	1	1
5-6 (1.5-1.8)	25			3		21	1	2
6-7 (1.8-2.1)	14			4		9	1	
>7 (>2.1)	6			2		3	1	
EO<6 (<1.8)	12			1		11		
EO>6 (>1.8)	16			1		12	3	
EO	5	1		1		3		
TOTAL	322	1	—	34	1	277	9	5

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 18.1.14
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Blyth River, July 16-18, 1983. Total distance surveyed was 62.1 km, mainstream 49.8 and the six sidecreeks 12.3 km.

TABLE 18.1.15
CADELL RIVER, JULY 15, 1983

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	9					9		
2-3 *(0.6-0.9)*	55			2		53		
3-4 *(0.9-1.2)*	35			4	1	29	1	
4-5 *(1.2-1.5)*	21					20	1	
5-6 *(1.5-1.8)*	5				1	4		
6-7 *(1.8-2.1)*	5					5		
>7 *(>2.1)*	3					3		
EO<6 *(<1.8)*	6				1	4	1	
EO>6 *(>1.8)*	3					2	1	
EO	1					1		
TOTAL	143	—	—	6	3	130	4	—

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 18.1.15
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Cadell River, July 15, 1983. Total distance surveyed was 29.7 km.

TABLE 18.1.16
BLYTH RIVER KM49.8-59 AND BILLABONG KM60.6-64.6, JULY 11-12, 1983

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

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 18.1.16
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Blyth River km49.8-59 and billabong km60.6-64.6, July 11-12, 1983. No crocodiles were sighted in the billabong.

TABLE 18.1.17
BLYTH RIVER, OCTOBER 27-29, 1983

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	70			2		66	2	3
2-3 *(0.6-0.9)*	56			2	1	53		2
3-4 *(0.9-1.2)*	33			7	6	19	1	
4-5 *(1.2-1.5)*	33	1		6	8	16	2	
5-6 *(1.5-1.8)*	20			1	3	15	1	
6-7 *(1.8-2.1)*	7			1		6		
>7 *(>2.1)*	9			1		6	2	
EO<6 *(<1.8)*	5					5		
EO>6 *(>1.8)*	9					7	2	
EO	3					3		
TOTAL	245	1	—	20	18	196	10	5

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 18.1.17
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Blyth River, October 27-29, 1983. Total distance surveyed was 63.1 km, mainstream 49.8 and the six sidecreeks 13.3 km.

TABLE 18.1.18
CADELL RIVER, OCTOBER 26, 1983

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)*	39			3		36		2
3-4 *(0.9-1.2)*	36			4	2	30		1
4-5 *(1.2-1.5)*	12				1	10	1	2
5-6 *(1.5-1.8)*	4					4		
6-7 *(1.8-2.1)*	4					4		
>7 *(>2.1)*	1			1				
EO<6 *(<1.8)*	5					5		
EO>6 *(>1.8)*	4					2	2	
EO	1	1						
TOTAL	109	1	—	8	3	94	3	5

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 18.1.18
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Cadell River, October 26, 1983. Total distance surveyed was 29.7 km.

TABLE 18.1.19
BLYTH RIVER KM49.8-59 AND BILLABONG KM60.6-64.6, OCTOBER 23-24, 1983

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 *(0.6-0.9)*	4					4		
3-4 *(0.9-1.2)*	1					1		1
4-5 *(1.2-1.5)*	1					1		
5-6 *(1.5-1.8)*	1					1		
6-7 *(1.8-2.1)*								
>7 *(>2.1)*	2					1	1	
EO<6 *(<1.8)*	1					1		
EO>6 *(>1.8)*	2					1	1	
EO								
TOTAL	12					10	2	1

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 18.1.19
Crocodylus porosus numbers, size structure and situation, sighted in river during general night spotlight survey of Blyth River km49.8-59 and billabong km60.6-64.6, October 23-24, 1983. No crocodiles were sighted in the billabong.

TABLE 18.1.20

Number of hatchlings, small (2-6′) and large (≥6′) crocodiles sighted on the sidecreeks of the Blyth River during the general night spotlight surveys of 1980-1983. Subscripts refer to the number of (2-3′) animals which are included in the number shown. When fractions of a crocodile are shown, this is because the EO crocodiles sighted are divided half and half between the (3-6′) and large size classes. Also shown is the distance surveyed on each creek, for each survey.

	KM	H	S	L	KM	H	S	L	KM	H	S	L	KM	H	S	L	KM	H	S	L	KM	H	S	L	KM	H	S	L
	OCTOBER 1980				JULY 1981				OCTOBER 1981				JUNE 1982				NOVEMBER 1982				JULY 1983				OCTOBER 1983			
Creek at km1.0	1.7	—	2.5	0.5	1.3	—	4	—	1.5	—	0.5	0.5	1.6	—	1	—	1.7	—	0.5	0.5	1.7	—	2	—	1.7	—	2	1
Creek B at km3.5	4.6	—	1_1	—	3.5	1	4.5	0.5	3.5	—	4.5	0.5	4.1	—	5.5	1.5	3.5	—	1	—	3.5	—	2	—	3.5	—	1	—
Creek C at km6.8	0.4	—	1	2	0.8	—	3	2	0.5	—	1	—	1.2	—	0.5	2.5	1.2	—	1	1	1.0	—	—	—	1.1	—	2	—
Creek D at km8.3	0.7	—	1	—	0.7	—	2_1	—	0.7	1	0.5	0.5	0.7	—	1_1	—	0.7	—	1.5	0.5	0.6	—	1	—	0.7	—	1	—
Creek F at km10.0	3.3	—	6_1	1	3.3	1	4.5_1	0.5	3.0	1	2_1	1	2.7	1	2	1	2.9	—	0.5	0.5	3.3	—	3	1	3.3	—	2.5	0.5
Creek G at km12.3	3.0	—	5_2	—	2.5	—	7_1	—	2.7	1	4	—	2.1	—	4	1	3.0	—	4.5	0.5	2.2	2	2	1	3.0	—	2	—
TOTALS	13.7	—	16.5_4	3.5	12.1	2	25_3	3	11.9	3	12.5_1	2.5	12.4	1	14_1	6	13.0	—	9	3	12.3	2	10	2	13.3	—	10.5	1.5

TABLE 18.1.21

An extension of Table 6.2.27 in Monograph 1. It shows the number of *C. porosus* sighted in the 1980-1983 general night spotlight surveys on the Cadell River survey sections. Subscripts refer to the number of hatchlings observed in the number spotted. Non-hatchling number is shown in brackets; density shown is the number of non-hatchling crocodiles sighted per km surveyed.

DATE KM	4 OCT 80	11 JULY 81	18 OCT 81	25 JUNE 82	6 NOV 82	15 JULY 83	26 OCT 83
19.1-24	31_3	34_4	20	33_3	22_1	30_3	19
24-29.1	21_5	19_5	20_{10}	24_1	18_6	30_2	19_3
29.1-33.3	21_6	17	18_5	16_1	18_3	20_1	25
33.3-38	23_6	21_3	15_6	12_2	20_{10}	20_3	12
38-41.5	22_8	7_1	18_8	15_7	19_{10}	17	10
41.5-45	12_5	17_{13}	13_2	36_{33}	28_{21}	16	17
45-48.8	3	2	1_1	8_4	13_5	10	7
TOTALS	133_{33} (100)	117_{26} (91)	105_{32} (73)	144_{51} (93)	138_{56} (82)	143_9 (134)	109_3 (106)
Density	3.40	3.23	2.59	3.13	2.76	4.51	3.57

TABLE 18.1.22

An extension of Table 6.2.28 in Monograph 1. It shows the number of *C. porosus* sighted in the 1980-1983 general night spotlight surveys on the Blyth River survey sections. Subscripts refer to the number of hatchlings observed in the number spotted. River sections are shown grouped and subtotals given for easy reference. Non-hatchling number is shown in brackets; density shown is the number of non-hatchling crocodiles sighted per km surveyed.

	DATE KM	4 OCT 80		9 JULY 81		19 OCT 81		26 JUNE 82		7 NOV 82		16 JULY 83		27 OCT 83	
DOWNSTREAM	0-3.5	4		15		6		15		6		11		7	
	3.5-6.8	9	28	5	33_1	5	20	6	37	7	15	6	33_1	10	23
	6.8-10	15		13_1		9		16		2		16_1		6	
	10-12.3	15	25_1	11	19	7	10	10	20	7	16	11	24	9	19_1
	12.3-15	10_1		8		3		10		9		13		10_1	
			53_1		52_1		30		57		31		57_1		42_1
MID-SALT	15-20	26_4		20_3		15		32_6		21_1		33_8		21_3	
	20-25	40_{13}	156_{69}	35_8	115_{24}	28_5	120_{23}	35_{10}	138_{60}	35_{12}	127_{43}	52_{31}	179_{95}	36_{15}	141_{45}
	25-30	43_{22}		30_1		36_1		26_{11}		33_7		46_{27}		48_{17}	
	30-35	47_{30}		30_{12}		41_{17}		45_{33}		38_{23}		48_{29}		36_{10}	
			209_{70}		167_{25}		150_{23}		195_{60}		158_{43}		236_{96}		183_{46}
FRESH	35-40	19_7		25_{12}		21_5		14_6		20_9		35_{25}		31_{15}	
	40-45	14_7	38_{16}	21_{11}	52_{23}	18_9	42_{14}	22_{12}	48_{24}	12_3	39_{12}	27_{16}	72_{50}	15_8	50_{24}
	45-49.8	5_2		6		3		12_6		7		10_9		4_1	
	Creeks A	3		4		1		1		1		2		3	
	B	1		6_1		5		7		1		2		1	
	C	3	20	5	30_2	1	18_3	3	21_1	2	12	0	14_2	2	12
	D	1		2		2_1		1		2		1		1	
	F	7		6_1		4_1		4_1		1		4		3	
	G	5		7		5_1		5		5		5_2		2	
	TOTALS	267_{86}	(181)	249_{50}	(199)	210_{40}	(170)	264_{85}	(179)	209_{55}	(154)	322_{148}	(174)	245_{70}	(175)
	Density	2.85		3.21		2.76		2.88		2.45		2.80		2.77	

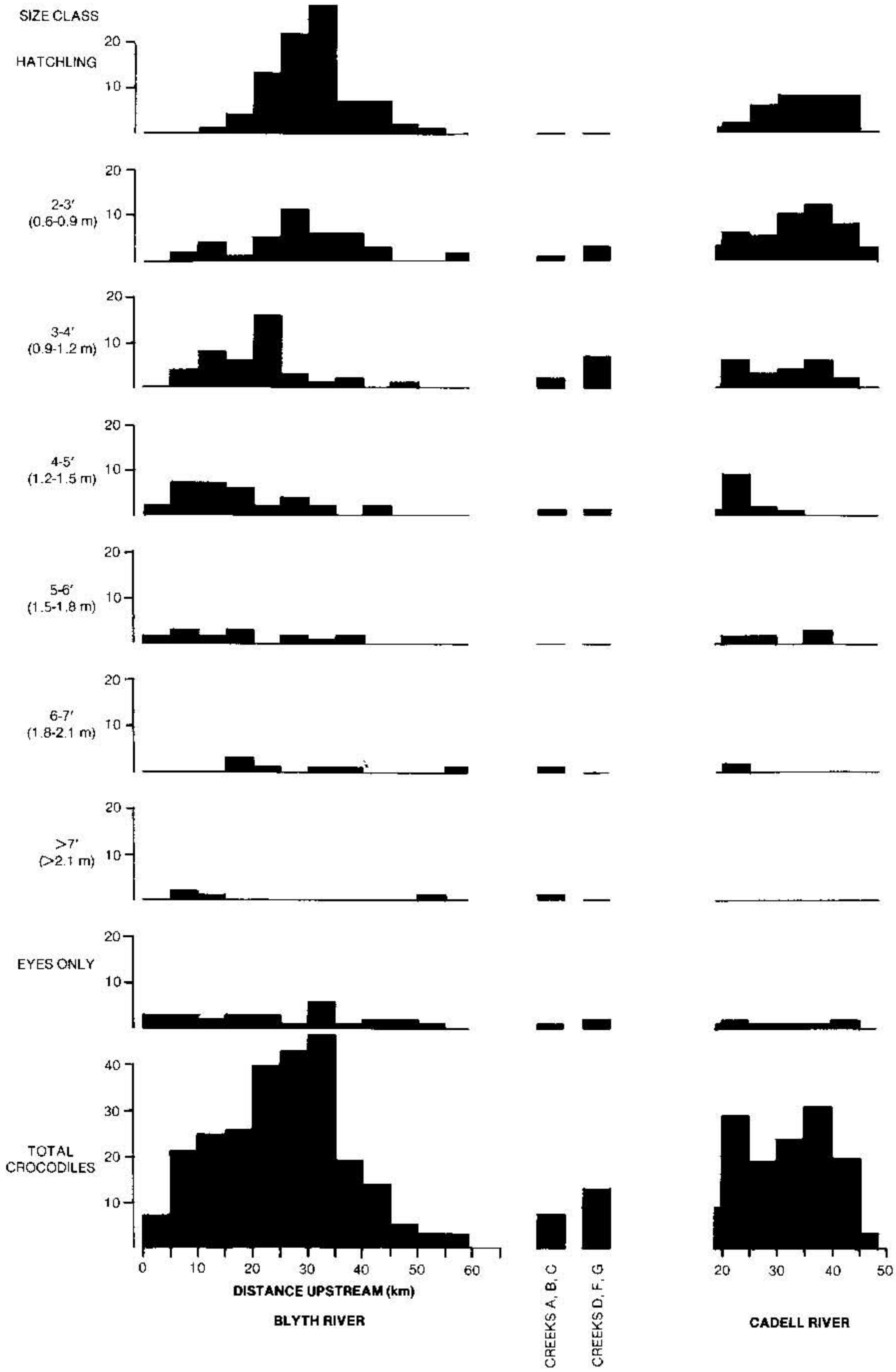


Fig. 18.1.1
Distributional pattern of *Crocodylus porosus* in the Blyth-Cadell Rivers System during October 4-5, 1980. The Cadell River enters the Blyth River at km19.1.

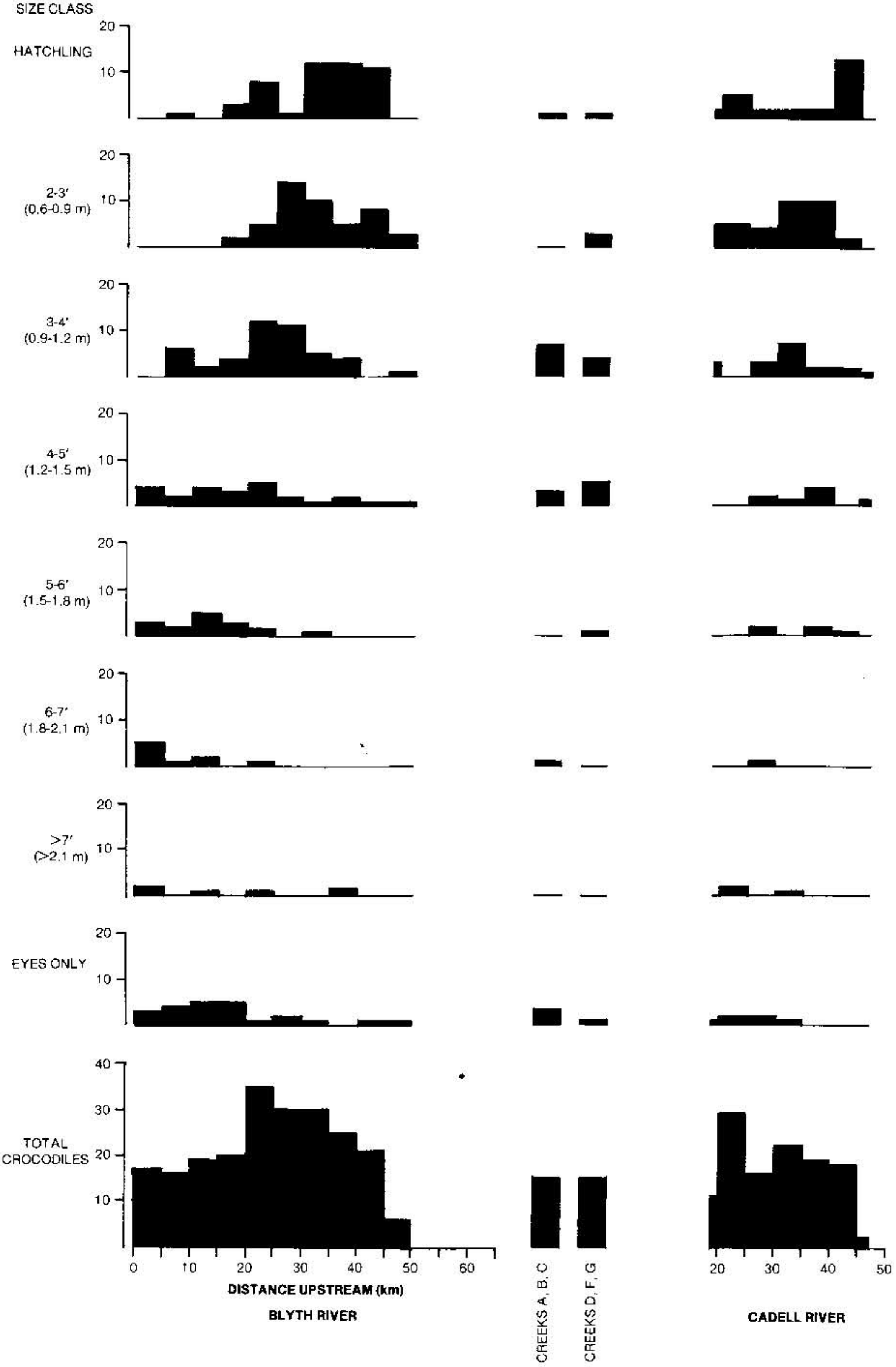


Fig. 18.1.2
Distributional pattern of *Crocodylus porosus* in the Blyth-Cadell Rivers System during July 9-12, 1981.

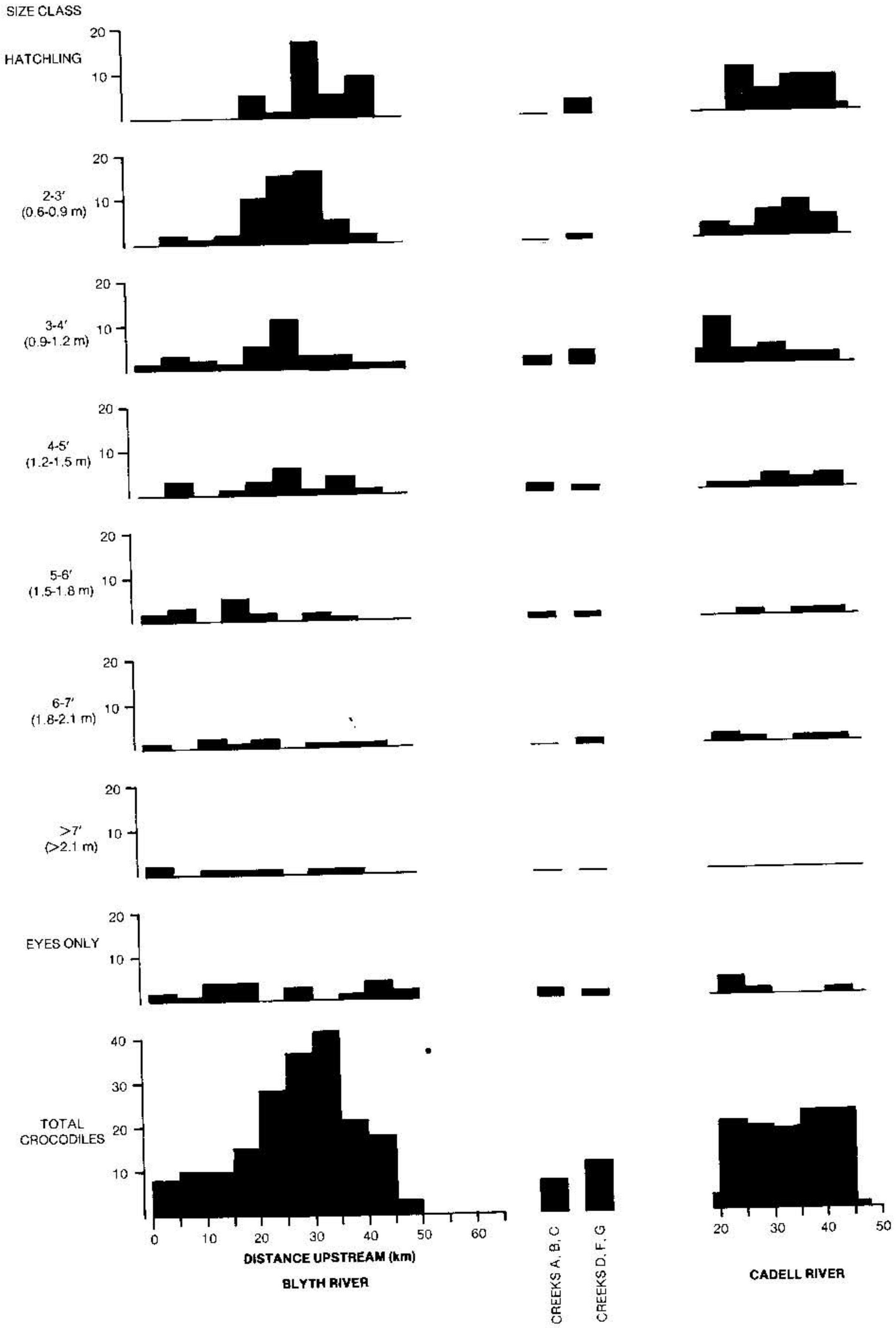


Fig. 18.1.3
Distributional pattern of *Crocodylus porosus* in the Blyth-Cadell Rivers System during October 18-21, 1981.

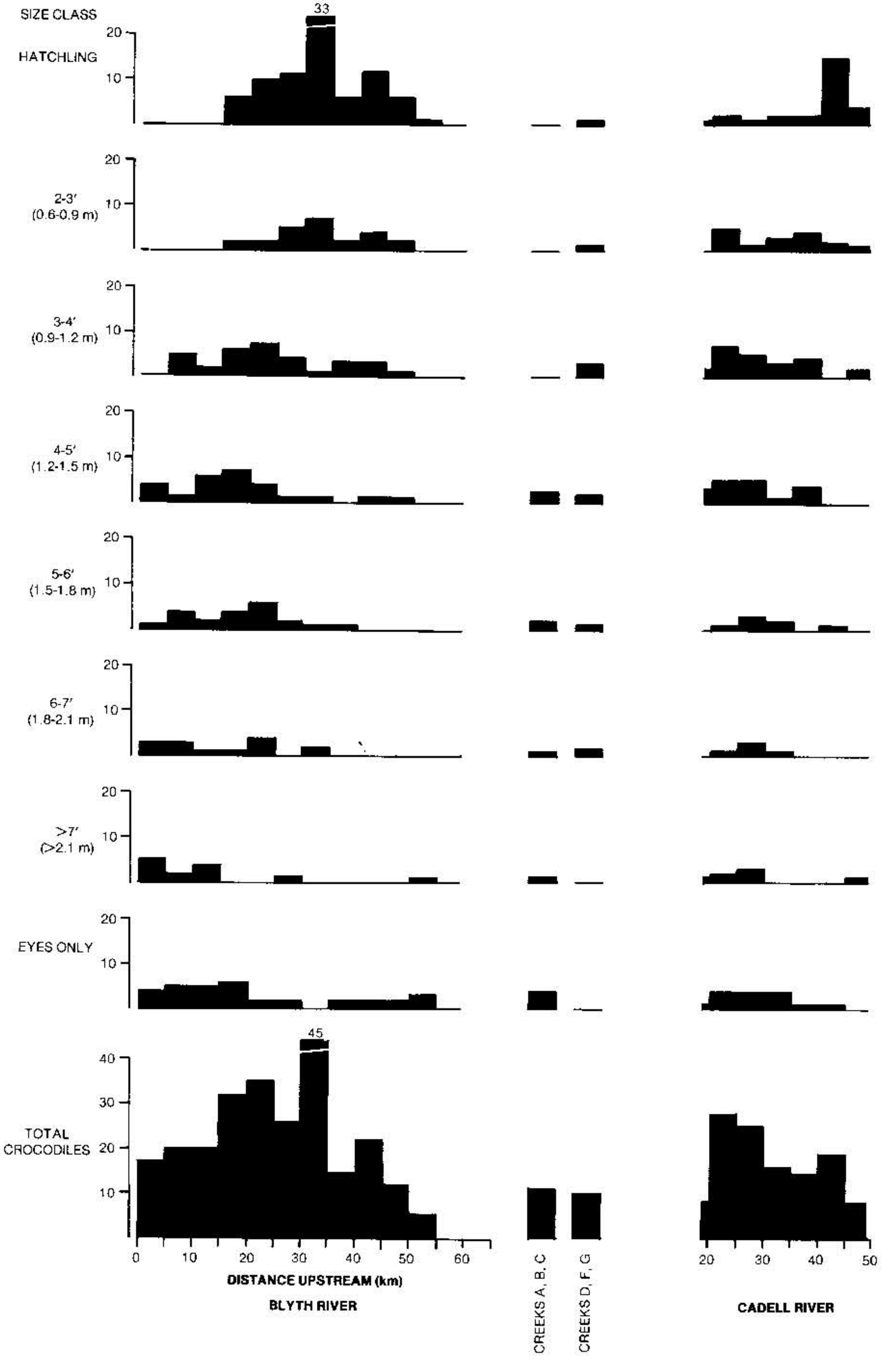


Fig. 18.1.4
Distributional pattern of *Crocodylus porosus* in the Blyth-Cadell Rivers System during June 25-28, 1982.

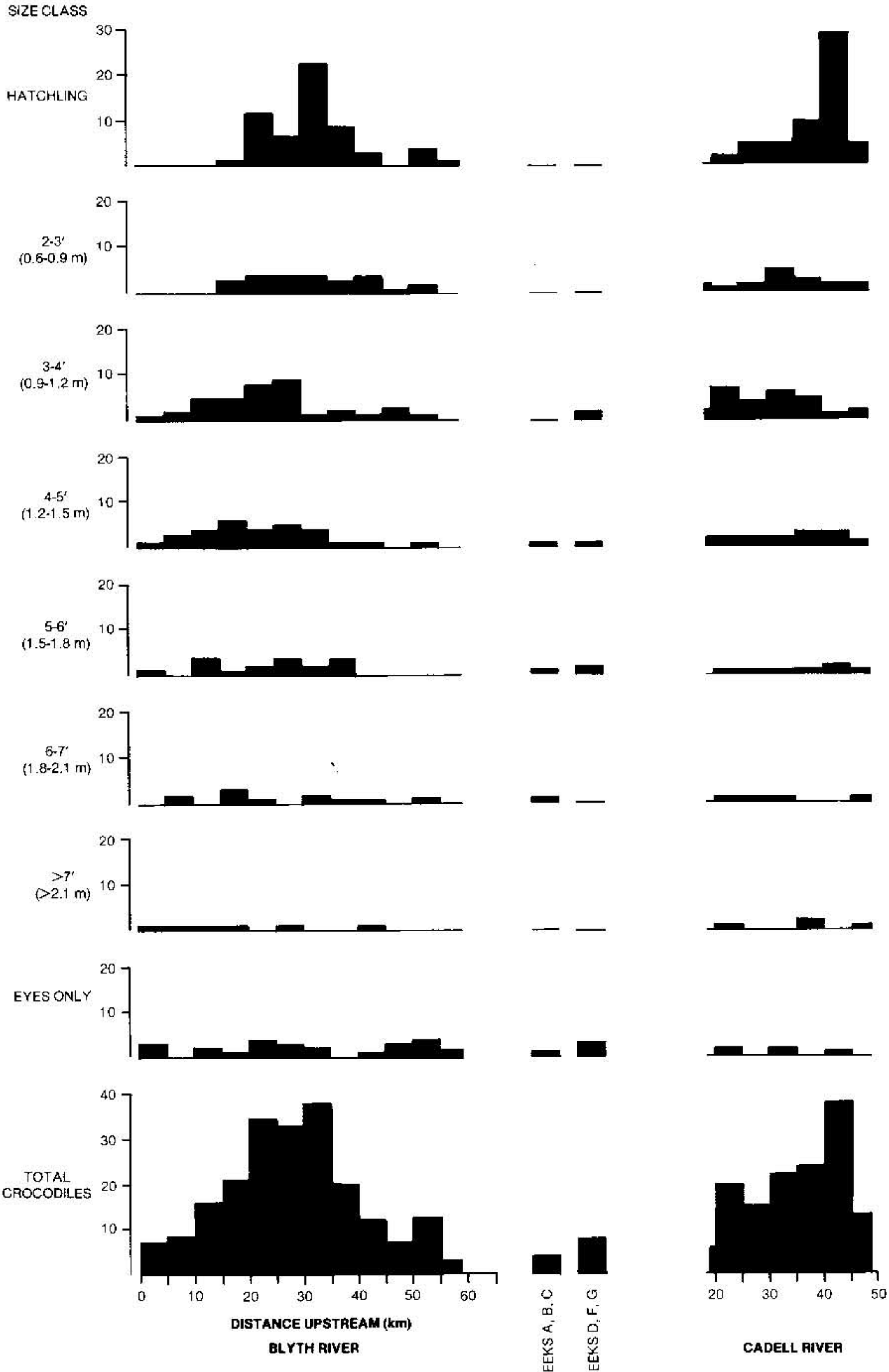


Fig. 18.1.5
Distributional pattern of *Crocodylus porosus* in the Blyth-Cadell Rivers System during November 6-8, 1982.

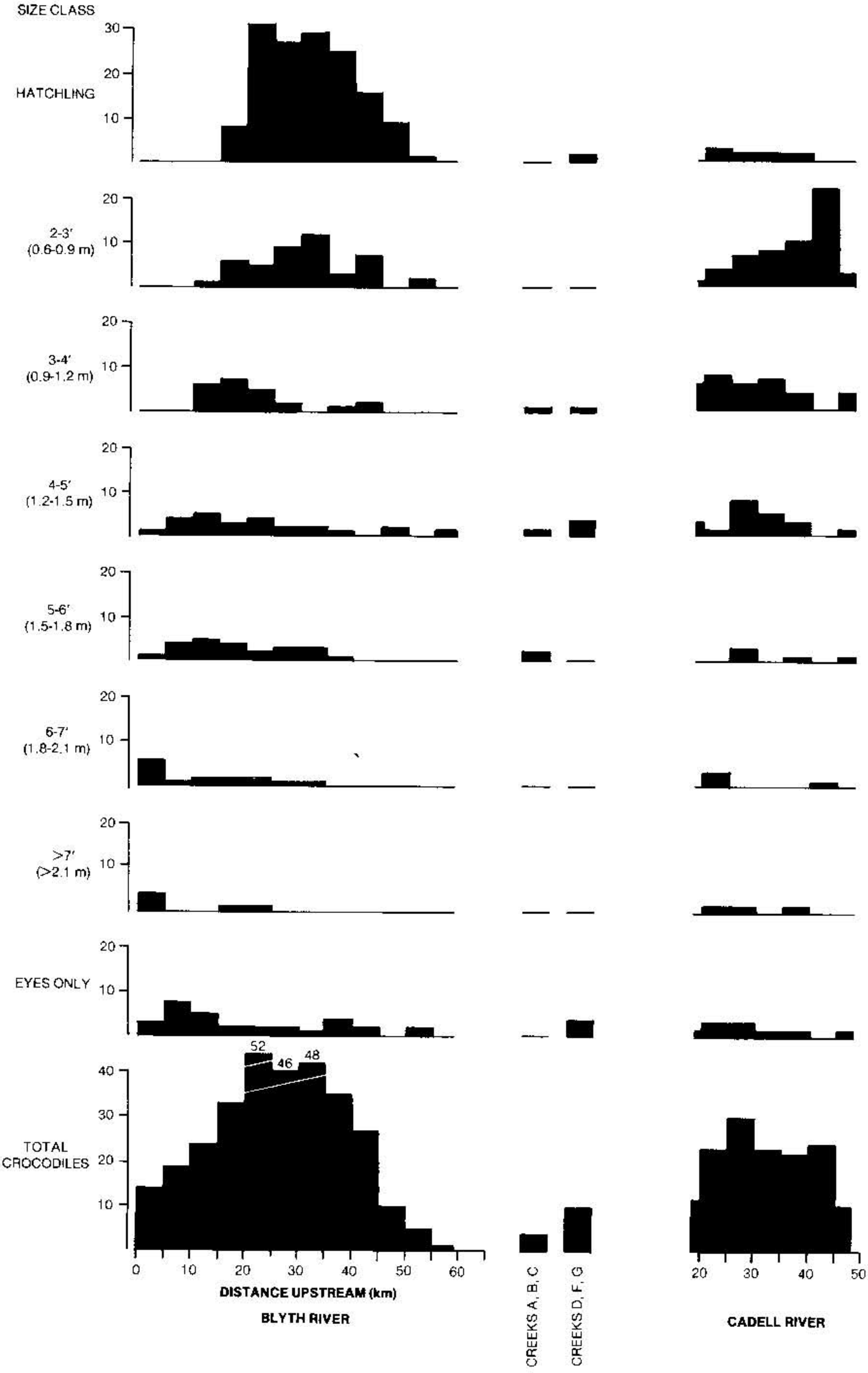


Fig. 18.1.6
Distributional pattern of *Crocodylus porosus* in the Blyth-Cadell Rivers System during July 15-18, 1983.

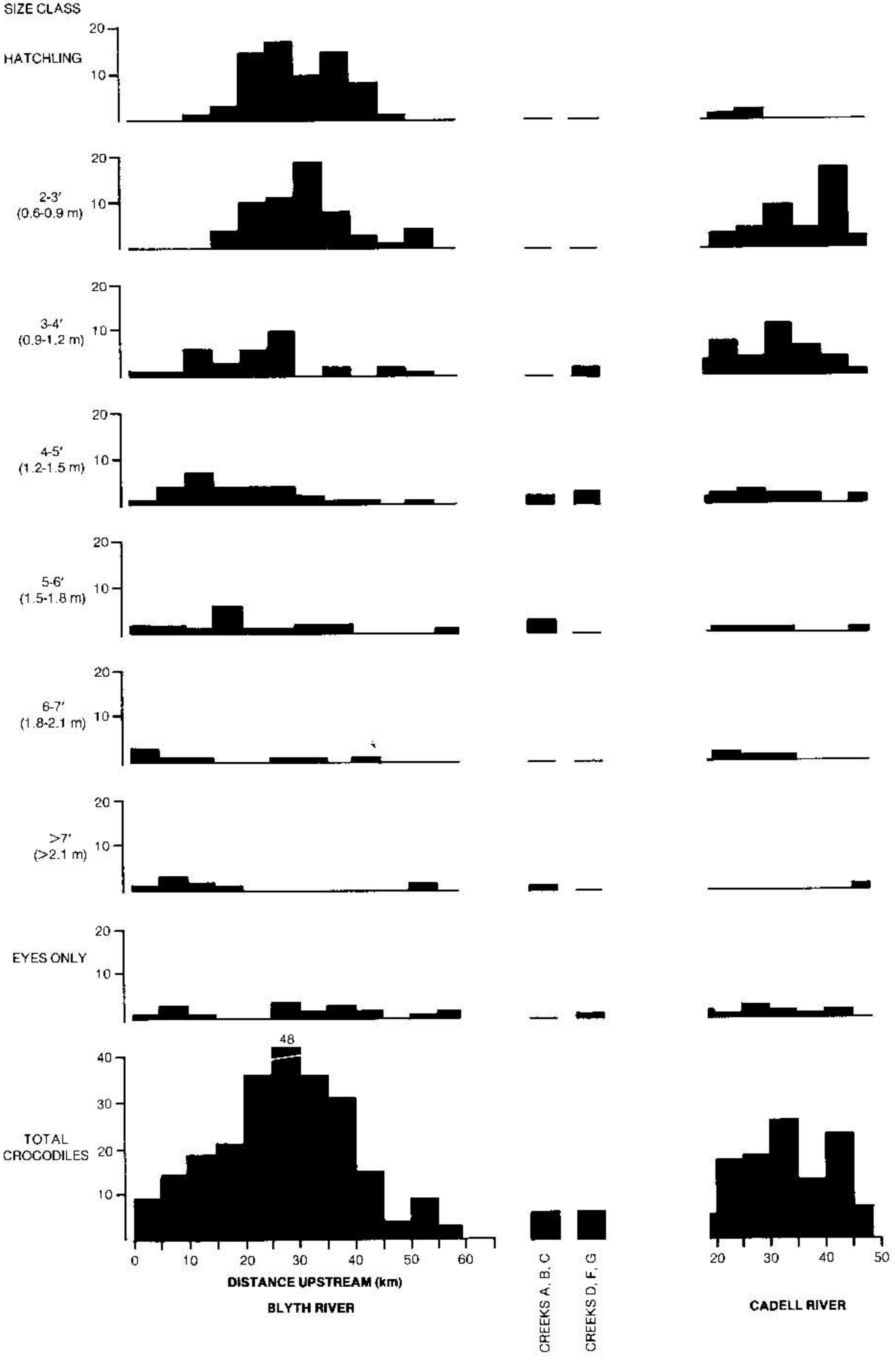


Fig. 18.1.7
Distributional pattern of *Crocodylus porosus* in the Blyth-Cadell Rivers System during October 26-29, 1983.

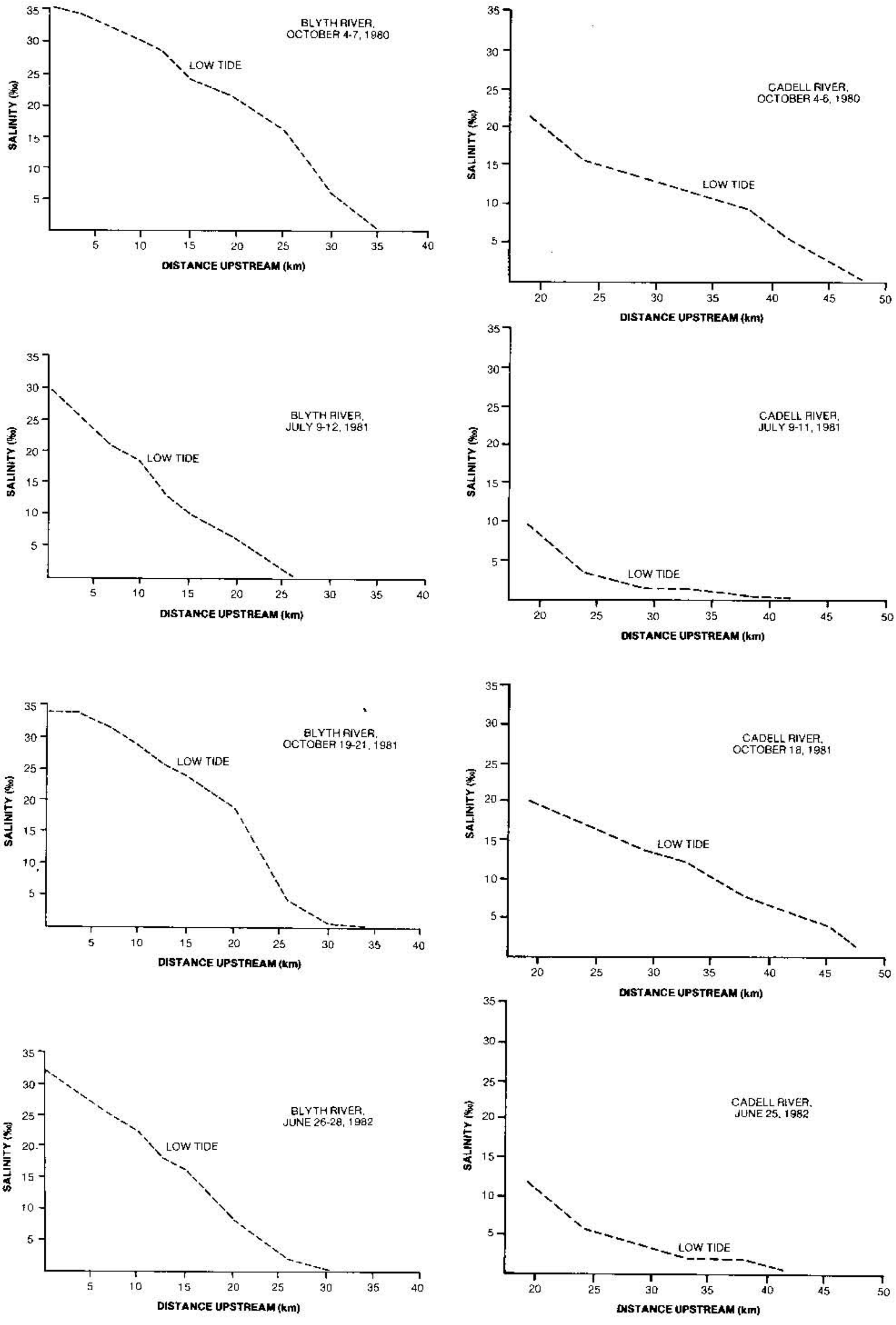


Fig. 18.1.8
Low tide salinity measurements on the Blyth-Cadell Rivers during October 1980, July 1981, October 1981 and June 1982.

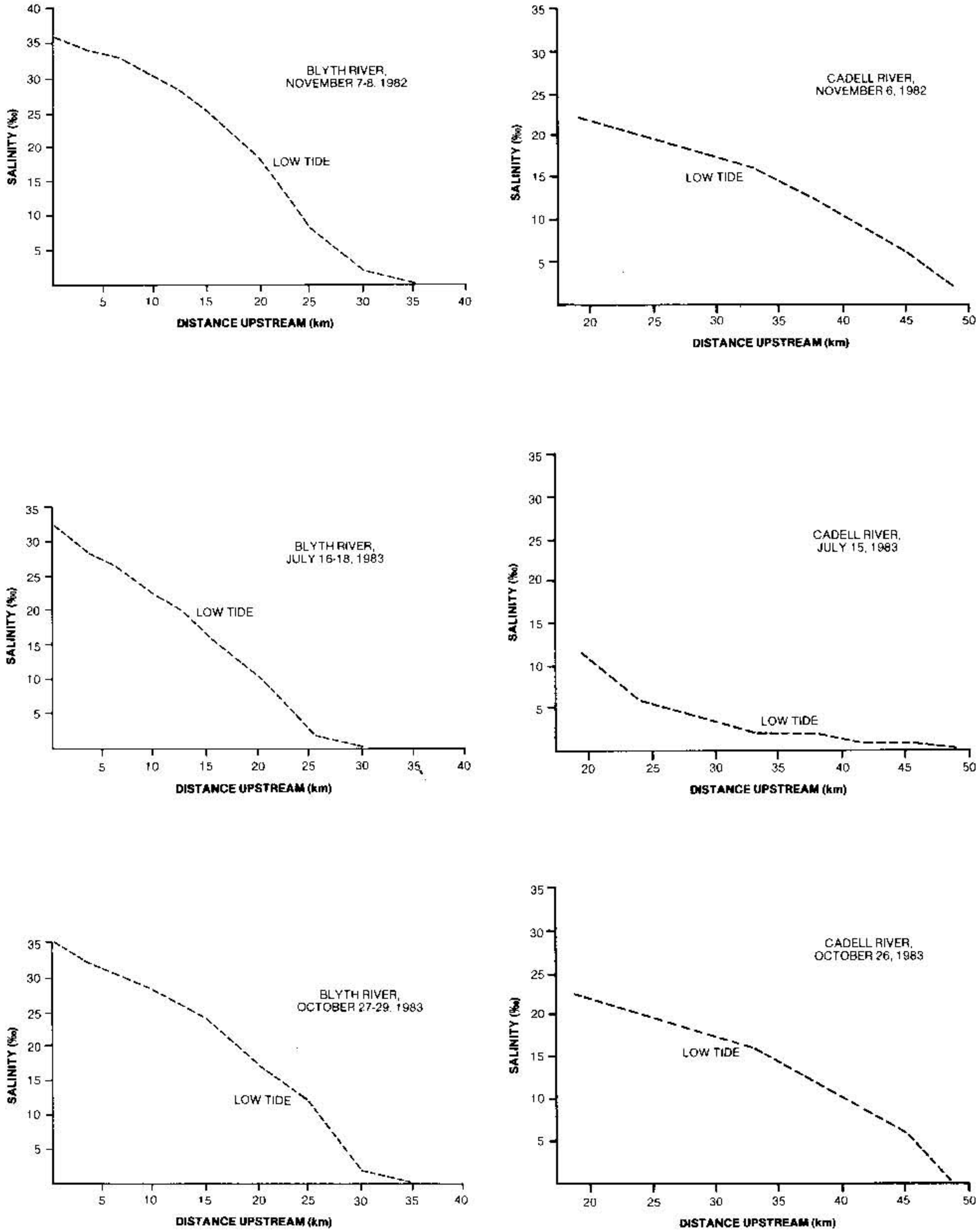


Fig. 18.1.9
Low tide salinity measurements on the Blyth-Cadell Rivers during November 1982, July 1983 and October 1983.

6.

MONOGRAPH 3

Additional data, 1979 for The Adelaide River

TABLE 18.3.1
ADELAIDE RIVER MAINSTREAM, SEPTEMBER 12-15, 1979

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	36	1				35		
2-3 *(0.6-0.9)*	8					8		1
3-4 *(0.9-1.2)*	40			5	1	34		
4-5 *(1.2-1.5)*	61	1	1	13	6	39	1	
5-6 *(1.5-1.8)*	48	2	3	9	5	28	1	
6-7 *(1.8-2.1)*	30		1	5	3	21		
>7 *(>2.1)*	52			5	4	35	8	
EO<6 *(<1.8)*	7					7		
EO>6 *(>1.8)*	3					2	1	
EO	10	1				8	1	
TOTAL	295	5	5	37	19	217	12	1

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 18.3.1
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Adelaide River mainstream, September 12-15, 1979.

TABLE 18.3.2
ADELAIDE RIVER SALTWATER CREEKS, SEPTEMBER 11-14, 1979

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	16					16		
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*	4				2	2		
4-5 *(1.2-1.5)*	11			2	3	6		
5-6 *(1.5-1.8)*	9			1	1	7		
6-7 *(1.8-2.1)*	12			1	2	8	1	
>7 *(>2.1)*	10			1		9		
EO<6 *(<1.8)*								
EO>6 *(>1.8)*	2					1	1	
EO	1						1	
TOTAL	65	—	—	5	8	49	3	—

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 18.3.2
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the saltwater creeks of the Adelaide River, September 11-14, 1979.

TABLE 18.3.3
ADELAIDE RIVER FRESHWATER CREEKS, SEPTEMBER 11-14, 1979

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	1			1				
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*	2			1		1		
4-5 *(1.2-1.5)*	3			1		2		
5-6 *(1.5-1.8)*	1	1						
6-7 *(1.8-2.1)*	5					5		
>7 *(>2.1)*	2					1	1	
EO<6 *(<1.8)*								
EO>6 *(>1.8)*								
EO								
TOTAL	14	1	—	3	—	9	1	—

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 18.3.3
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the freshwater creeks of the Adelaide River, September 11-14, 1979.

TABLE 18.3.4
ADELAIDE RIVER SYSTEM, SEPTEMBER 11-16, 1979

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	53	1		1		51		
2-3 *(0.6-0.9)*	8					8		1
3-4 *(0.9-1.2)*	46			6	3	37		
4-5 *(1.2-1.5)*	75	1	1	16	9	47	1	
5-6 *(1.5-1.8)*	58	3	3	10	6	35	1	
6-7 *(1.8-2.1)*	47		1	6	5	34	1	
>7 *(>2.1)*	64			6	4	45	9	
EO<6 *(<1.8)*	7					7		
EO>6 *(>1.8)*	5					3	2	
EO	11	1				8	2	
TOTAL	374	6	5	45	27	275	16	1

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 18.3.4
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Adelaide River System, September 11-16, 1979.

TABLE 18.3.5
ADELAIDE RIVER (*C. JOHNSTONI*), SEPTEMBER 12, 1979

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*	5			1		4		
4-5 *(1.2-1.5)*	3			1		2		
5-6 *(1.5-1.8)*	5		1	3		1		
6-7 *(1.8-2.1)*	2			2				
>7 *(>2.1)*	1			1				
EO<6 *(<1.8)*								
EO>6 *(>1.8)*								
EO	19*	1*	1*	2*		10*	5*	
TOTAL	35	1	2	10	—	17	5	—

* UNIDENTIFIED

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 18.3.5
Crocodylus johnstoni numbers, size structure and situation, sighted during the general night spotlight survey of the Adelaide River mainstream, September 12, 1979. Included are those crocodiles which could not be positively identified (only those sections where *C. johnstoni* were sighted) as *C. porosus* or *C. johnstoni*.

TABLE 18.3.6

The surveyable portions of the Adelaide River System at or near low water.

	Sept. 1979
Adelaide River mainstream	117.0 km
"Saltwater" creeks:	(101.8)
Creek system at km1.0 (A)	24.0
Creek at km5.2 (B)	2.6
Wiltshire Creek at km5.7	26.5
Creek system at km8.0 (C)	20.0
Creek system at km11.2 (D)	16.5
Melacca Creek at km16.3	2.3
Creek at km18.5 (E)	0.6
Creek system at km19.5 (F)	9.3
"Freshwater" creeks:	(12.8)
Creek at km31.6 (G)	1.8
Marrakai Creek at km82.1	3.9
Creek at km89 (H)	1.0
Beatrice Creek at km94.5	3.2
Creek at km102.5 (J)	2.9
TOTAL	231.6 km

TABLE 18.3.7

Tidal times and (heights) in metres at Darwin and at the vessel's anchorages at positions shown in the Adelaide River, September 1979. Also shown are the tidal time delays in minutes between the standard port and vessel's anchorage.

DAY	TIDE	DARWIN	DELAY	ANCHORAGE
Wednesday September 12 Moonage Day 21	LW	0348 (2.1)	+322	*km79.7* 0910 (9.74)
	HW	0935 (6.4)	+280	1415 (12.44)
	LW	1616 (1.4)	+339	2155 (9.70)
	HW	2228 (6.3)	—	—
Thursday September 13 Moonage Day 22	HW		+312	0330 (11.98)
	LW	0430 (2.7)	+315	0945 (9.6)
	HW	1009 (5.8)	+276	1445 (11.5)
	LW	1702 (1.9)	+338	2240 (9.7)
	HW	2319 (5.7)	—	—
Friday September 14 Moonage Day 23	HW	—	+326	0445 (11.2)
	LW	0522 (3.3)	+303	1025 (9.6)
	HW	—	—	*Creek at km31.7*
	LW	1758 (2.4)	+217	2135 (11.27)
Saturday September 15 Moonage Day 24	HW	0025 (5.2)	+235	0420 (13.25)
	LW	0631 (3.7)	+234	1025 (12.04)
				Creek at km5.2
	HW	1149 (4.7)	+106	1335 (9.76)
	LW	1920 (2.8)	+130	2130 (5.63)
Sunday September 16 Moonage Day 25	HW	0219 (5.1)	+131	0430 (8.07)
	LW	0822 (3.7)	+128	1030 (6.15)
	HW	1409 (4.4)	+126	1615 (7.5)
	LW	2108 (2.6)	+127	2315 (6.55)
Monday September 17 Moonage Day 26	HW	0356 (5.4)	+129	0605 (9.8)

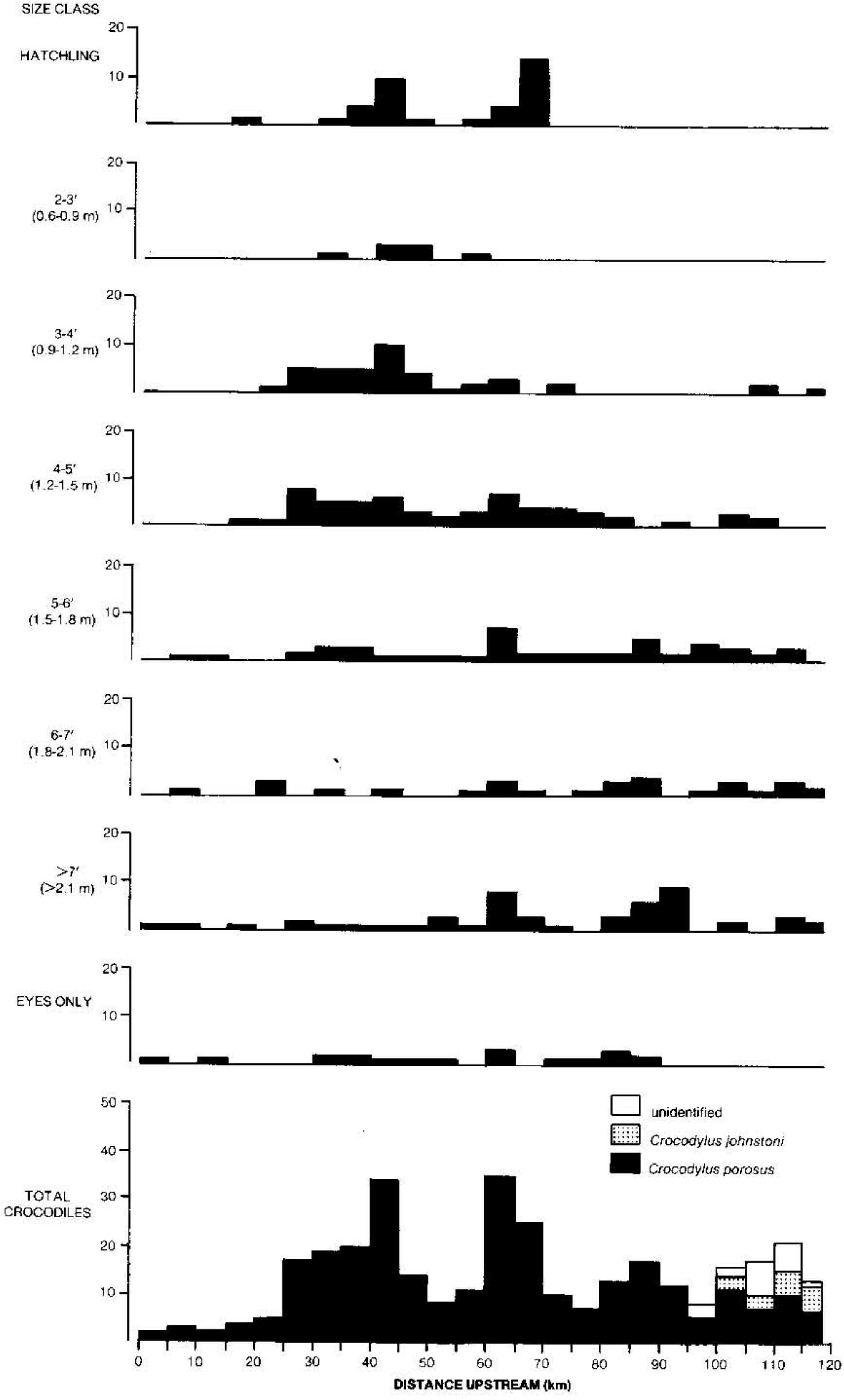


Fig. 18.3.1
Distributional pattern of *Crocodylus porosus* on the mainstream of the Adelaide River, September 11-15, 1979.

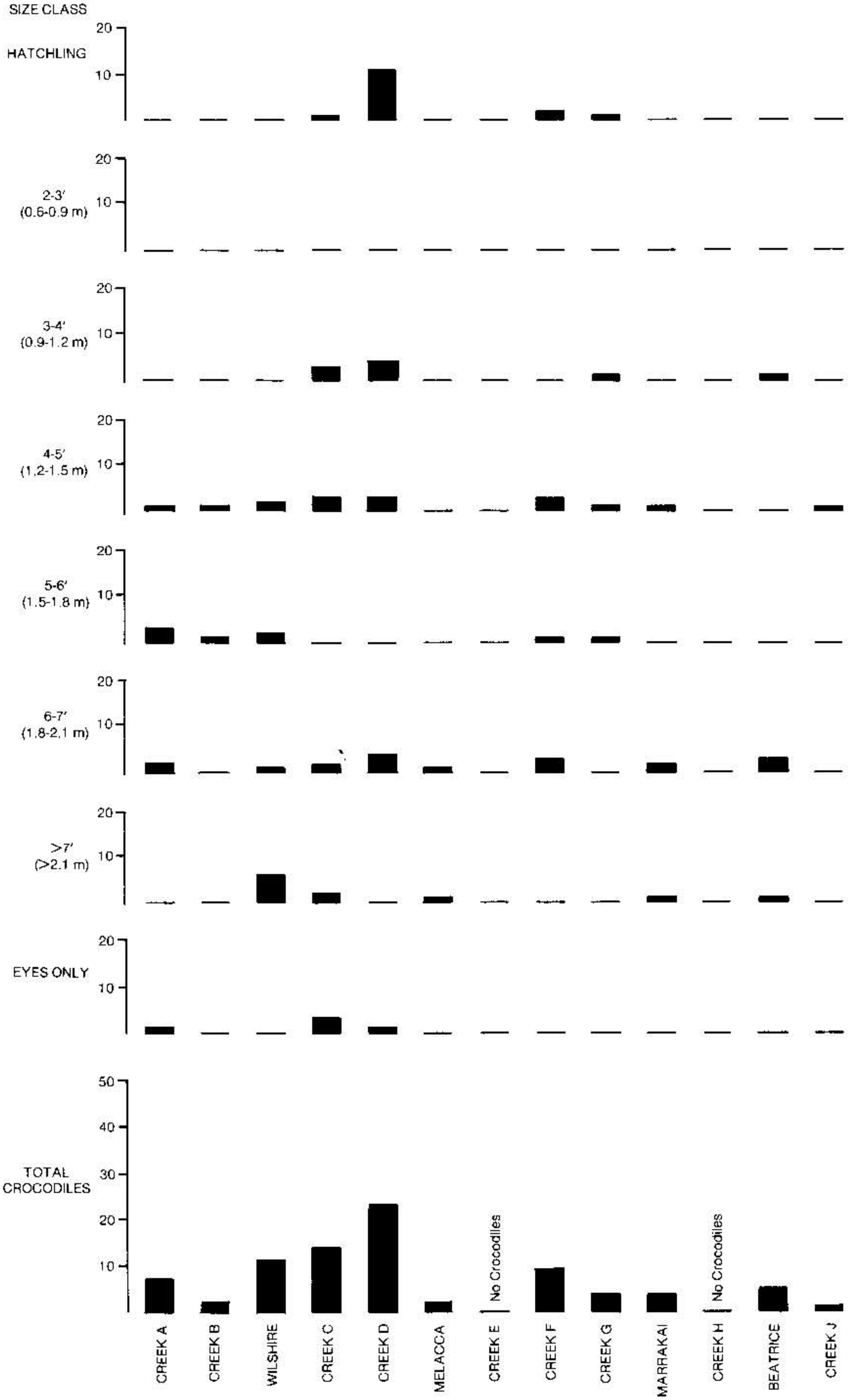


Fig. 18.3.2
Distributional pattern of *Crocodylus porosus* on the sidecreeks of the Adelaide River, September 11-14, 1979.

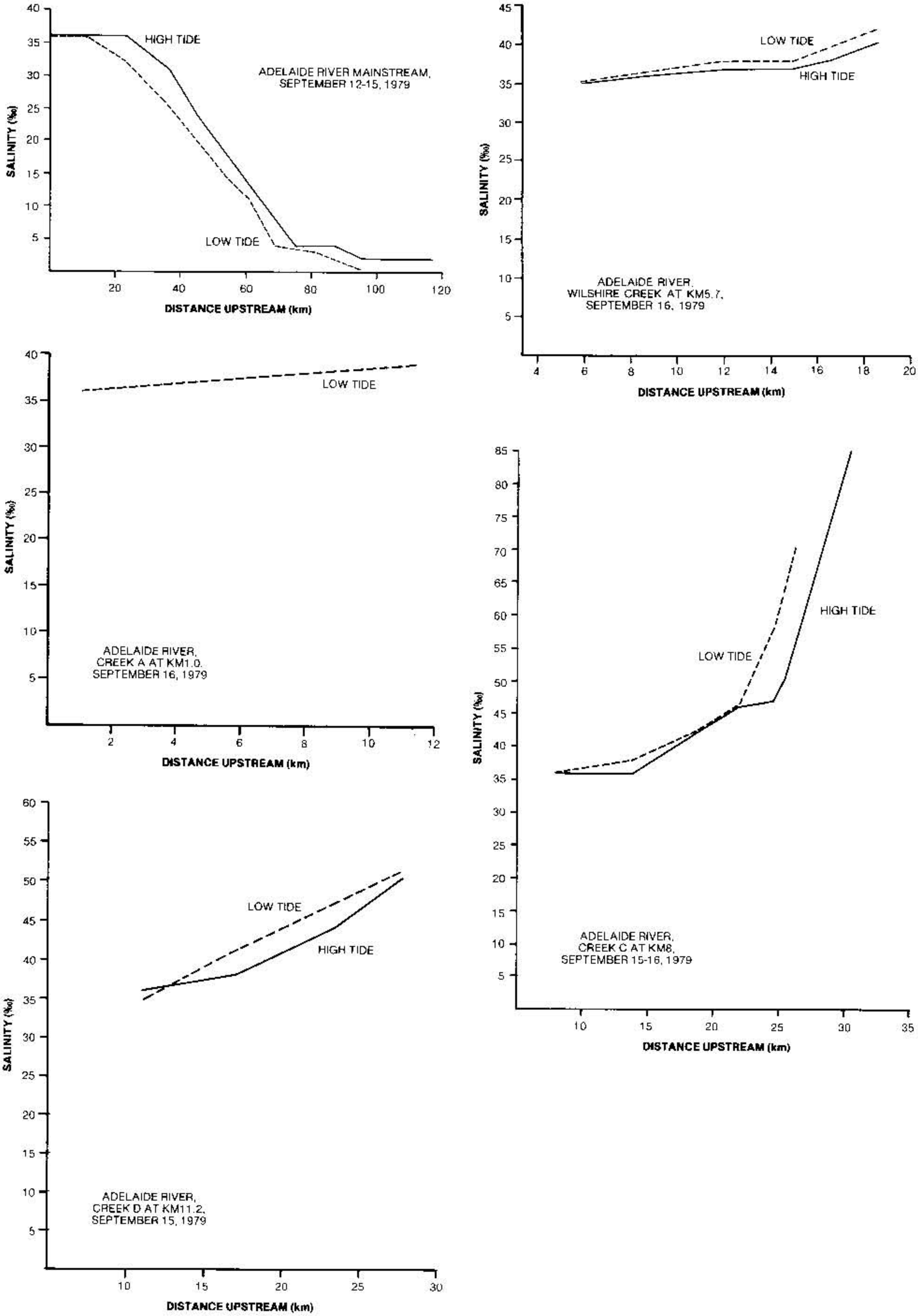


Fig. 18.3.3
Adelaide River mainstream, Wilshire Creek at km5.7, sidecreeks A at km1.0, C at km8.0 and D at km11.2, high and low tide salinities, September 12-16, 1979. Also see Figs 7.3.21 and 7.3.22, Monograph 1.

7.

MONOGRAPH 5

Additional data, 1979-1983 for The Goomadeer and King Rivers Wurugoij, Majarie and All Night Creeks

TABLE 18.5.1
GOOMADEER RIVER MAINSTREAM, JULY 30, 1979

SIZE IN FEET (*metres*)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	28			3		25		
2-3 (*0.6-0.9*)	13			1		12		
3-4 (*0.9-1.2*)	4			2	1	1		
4-5 (*1.2-1.5*)	13			6		7		
5-6 (*1.5-1.8*)	6	1		3		2		
6-7 (*1.8-2.1*)	5	1				3	1	
>7 (*>2.1*)	1					1		
EO<6 (*<1.8*)	1					1		
EO>6 (*>1.8*)	2					2		
EO	4					1	3	
TOTAL	77	2	—	15	1	55	4	—

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 18.5.1
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Goomadeer River mainstream, July 30, 1979. The total distance surveyed was 39.8 km

'TABLE 18.5.2
SIDECREEKS OF GOOMADEER RIVER, JULY 30, 1979

SIZE IN FEET (*metres*)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	1					1		
2-3 (*0.6-0.9*)	1					1		
3-4 (*0.9-1.2*)	3					2	1	
4-5 (*1.2-1.5*)	1						1	
5-6 (*1.5-1.8*)	4			1		3		
6-7 (*1.8-2.1*)	1			1				
>7 (*>2.1*)								
EO<6 (*<1.8*)	1					1		
EO>6 (*>1.8*)	1					1		
EO								
TOTAL	13	—	—	2	—	9	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 18.5.2
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Goomadeer River sidecreeks, July 30, 1979. The total distance surveyed was 5.5 km.

TABLE 18.5.3
OVERALL GOOMADEER RIVER, JULY 30, 1979

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	29			3		26		
2-3 *(0.6-0.9)*	14			1		13		
3-4 *(0.9-1.2)*	7			2	1	3	1	
4-5 *(1.2-1.5)*	14			6		7	1	
5-6 *(1.5-1.8)*	10	1		4		5		
6-7 *(1.8-2.1)*	6	1		1		3	1	
>7 *(>2.1)*	1					1		
EO<6 *(<1.8)*	2					2		
EO>6 *(>1.8)*	3					3		
EO	4					1	3	
TOTAL	90	2	—	17	1	64	6	—

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 18.5.3
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Goomadeer River System, July 30, 1979. The total distance surveyed was 45.3 km.

TABLE 18.5.4
GOOMADEER RIVER MAINSTREAM, JUNE 26, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	5					5		
2-3 *(0.6-0.9)*	4					4		
3-4 *(0.9-1.2)*	9	1				7	1	
4-5 *(1.2-1.5)*	8					7	1	
5-6 *(1.5-1.8)*	3					2	1	
6-7 *(1.8-2.1)*	3					3		
>7 *(>2.1)*	1					1		
EO<6 *(<1.8)*								
EO>6 *(>1.8)*	3					3		
EO								
TOTAL	36	1	—	—	—	32	3	—

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 18.5.4
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Goomadeer River mainstream, June 26, 1981. The total distance surveyed was 39.8 km.

TABLE 18.5.5
SIDECREEKS OF GOOMADEER RIVER, JUNE 26, 1981

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

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 18.5.5
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Goomadeer sidecreeks, June 26, 1981. The total distance surveyed was 5.2 km.

TABLE 18.5.6
OVERALL GOOMADEER RIVER, JUNE 26, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	6			1		5		
2-3 *(0.6-0.9)*	5					5		
3-4 *(0.9-1.2)*	11	1				9	1	
4-5 *(1.2-1.5)*	8					7	1	
5-6 *(1.5-1.8)*	4					3	1	
6-7 *(1.8-2.1)*	3					3		
>7 *(>2.1)*	1					1		
EO<6 *(<1.8)*	1					1		
EO>6 *(>1.8)*	3					3		
EO	1					1		
TOTAL	43	1	—	1	—	38	3	—

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 18.5.6
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Goomadeer River System, June 26, 1981. The total distance surveyed was 45 km.

TABLE 18.5.7
GOOMADEER RIVER MAINSTREAM, OCTOBER 8, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION IV	IVIW	OM	IM	SWOE	MS	OBSERVED FEEDING
HATCHLING	17			1		16		
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*	4			1		3		
4-5 *(1.2-1.5)*	5	1				4		
5-6 *(1.5-1.8)*	1					1		
6-7 *(1.8-2.1)*								
>7 *(>2.1)*								
EO<6 *(<1.8)*	2					2		
EO>6 *(>1.8)*	1						1	
EO	1					1		
TOTAL	31	1	—	2	—	27	1	—

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 18.5.7
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Goomadeer River mainstream, October 8, 1981. The total distance surveyed was 39.8 km.

TABLE 18.5.8
SIDECREEKS OF GOOMADEER RIVER, OCTOBER 8, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION IV	IVIW	OM	IM	SWOE	MS	OBSERVED FEEDING
HATCHLING								
2-3 *(0.6-0.9)*	3					3		
3-4 *(0.9-1.2)*	9			5		3	1	
4-5 *(1.2-1.5)*	1				1			
5-6 *(1.5-1.8)*								
6-7 *(1.8-2.1)*								
>7 *(>2.1)*								
EO<6 *(<1.8)*	1	1						
EO>6 *(>1.8)*								
EO								
TOTAL	14	1	—	5	1	6	1	—

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 18.5.8
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Goomadeer River sidecreeks, October 8, 1981. The total distance surveyed was 5.2 km.

TABLE 18.5.9
OVERALL GOOMADEER RIVER, OCTOBER 8, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	17			1		16		
2-3 *(0.6-0.9)*	3					3		
3-4 *(0.9-1.2)*	13			6		6	1	
4-5 *(1.2-1.5)*	6	1			1	4		
5-6 *(1.5-1.8)*	1					1		
6-7 *(1.8-2.1)*								
>7 *(>2.1)*								
EO<6 *(<1.8)*	3	1				2		
EO>6 *(>1.8)*	1						1	
EO	1					1		
TOTAL	45	2	—	7	1	33	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 18.5.9
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Goomadeer River System, October 8, 1981. The total distance surveyed was 45 km.

TABLE 18.5.10
GOOMADEER RIVER MAINSTREAM, JUNE 14, 1982

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	18			1		17		
2-3 *(0.6-0.9)*	5					5		
3-4 *(0.9-1.2)*	10	1		2		6	1	
4-5 *(1.2-1.5)*	4					4		
5-6 *(1.5-1.8)*	1					1		
6-7 *(1.8-2.1)*	4					3	1	
>7 *(>2.1)*	4					4		
EO<6 *(<1.8)*	1					1		
EO>6 *(>1.8)*	4					3	1	
EO	1						1	
TOTAL	52	1	—	3	—	44	4	—

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 18.5.10
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Goomadeer River mainstream, June 14, 1982. The total distance surveyed was 39.8 km.

TABLE 18.5.11
SIDECREEKS OF GOOMADEER RIVER, JUNE 14, 1982

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

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 18.5.11
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Goomadeer River sidecreeks, June 14, 1982. The total distance surveyed was 5.5 km.

TABLE 18.5.12
OVERALL GOOMADEER RIVER, JUNE 14, 1982

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	18			1		17		
2-3 *(0.6-0.9)*	5					5		
3-4 *(0.9-1.2)*	12	1		2		8	1	
4-5 *(1.2-1.5)*	5			1		4		
5-6 *(1.5-1.8)*	2					2		
6-7 *(1.8-2.1)*	4					3	1	
>7 *(>2.1)*	4					4		
EO<6 *(<1.8)*	5					5		
EO>6 *(>1.8)*	4					3	1	
EO	2					1	1	
TOTAL	61	1	—	4	—	52	4	—

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 18.5.12
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Goomadeer River System, June 14, 1982. The total distance surveyed was 45.3 km.

TABLE 18.5.13
GOOMADEER RIVER MAINSTREAM, OCTOBER 11, 1982

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	9			1		8		
2-3 *(0.6-0.9)*	7					7		
3-4 *(0.9-1.2)*	6			1		5		
4-5 *(1.2-1.5)*	9			2		7		
5-6 *(1.5-1.8)*	3					1	2	
6-7 *(1.8-2.1)*	3					3		
>7 *(>2.1)*	3					1	2	
EO<6 *(<1.8)*	1					1		
EO>6 *(>1.8)*	3					2	1	
EO								
TOTAL	44	—	—	4	—	35	5	—

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 18.5.13
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Goomadeer River mainstream, October 11, 1982. The total distance surveyed was 39.8 km.

TABLE 18.5.14
SIDECREEKS OF GOOMADEER RIVER, OCTOBER 11, 1982

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

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 18.5.14
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Goomadeer River sidecreeks, October 11, 1982. The total distance surveyed was 5.5 km.

TABLE 18.5.15
OVERALL GOOMADEER RIVER, OCTOBER 11, 1982

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	9			1		8		
2-3 *(0.6-0.9)*	7					7		
3-4 *(0.9-1.2)*	9			2		7		
4-5 *(1.2-1.5)*	11			4		7		
5-6 *(1.5-1.8)*	5					3	2	
6-7 *(1.8-2.1)*	4					4		
>7 *(>2.1)*	3					1	2	
EO<6 *(<1.8)*	3					3		
EO>6 *(>1.8)*	3					2	1	
EO								
TOTAL	54	—	—	7	—	42	5	—

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 18.5.15
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Goomadeer River System, October 11, 1982. The total distance surveyed was 45.3 km.

TABLE 18.5.16
GOOMADEER RIVER MAINSTREAM, JUNE 19, 1983

SIZE IN FEET *(metres)*	*NUMBER* OF CROCS	*SITUATION*						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	23					23		
2-3 *(0.6-0.9)*	4					4		
3-4 *(0.9-1.2)*	6					6		
4-5 *(1.2-1.5)*	4					4		
5-6 *(1.5-1.8)*	3					3		
6-7 *(1.8-2.1)*	2					2		
>7 *(>2.1)*	3					2	1	
EO<6 *(<1.8)*	2					2		
EO>6 *(>1.8)*	5					2	3	
EO	2					2		
TOTAL	54	—	—	—	—	50	4	—

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 18.5.16
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Goomadeer River mainstream, June 19, 1983. The total distance surveyed was 39.8 km.

TABLE 18.5.17
SIDECREEKS OF GOOMADEER RIVER, JUNE 19, 1983

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

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 18.5.17
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Goomadeer River sidecreeks, June 19, 1983. The total distance surveyed was 5.5 km.

TABLE 18.5.18
OVERALL GOOMADEER RIVER, JUNE 19, 1983

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	24					24		
2-3 (0.6-0.9)	5					5		
3-4 (0.9-1.2)	6					6		
4-5 (1.2-1.5)	8			2		6		
5-6 (1.5-1.8)	3					3		
6-7 (1.8-2.1)	3					3		
>7 (>2.1)	4					3	1	
EO<6 (<1.8)	2					2		
EO>6 (>1.8)	6					2	4	
EO	2					2		
TOTAL	63	—	—	2	—	56	5	—

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 18.5.18
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Goomadeer River System, June 19, 1983. The total distance surveyed was 45.3 km.

TABLE 18.5.19
GOOMADEER RIVER MAINSTREAM, OCTOBER 1, 1983

SIZE IN FEET (*metres*)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	33			4		29		
2-3 (*0.6-0.9*)	7			3		4		1
3-4 (*0.9-1.2*)	5					5		
4-5 (*1.2-1.5*)	6					6		
5-6 (*1.5-1.8*)	4					4		
6-7 (*1.8-2.1*)	4					4		
>7 (*>2.1*)	2					1	1	
EO<6 (*<1.8*)	3					3		
EO>6 (*>1.8*)	3					2	1	
EO	1					1		
TOTAL	68	—	—	7	—	59	2	1

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 18.5.19
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Goomadeer River mainstream, October 1, 1983. The total distance surveyed was 39.8 km.

TABLE 18.5.20
SIDECREEKS OF GOOMADEER RIVER, OCTOBER 1, 1983

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

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 18.5.20
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Goomadeer River sidecreeks, October 1, 1983. The total distance surveyed was 5.5 km.

TABLE 18.5.21
OVERALL GOOMADEER RIVER, OCTOBER 1, 1983

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	33			4		29		
2-3 *(0.6-0.9)*	8			3		5		1
3-4 *(0.9-1.2)*	5					5		
4-5 *(1.2-1.5)*	8			2		6		
5-6 *(1.5-1.8)*	5					5		
6-7 *(1.8-2.1)*	4					4		
>7 *(>2.1)*	3					2	1	
EO<6 *(<1.8)*	3					3		
EO>6 *(>1.8)*	3					2	1	
EO	1					1		
TOTAL	73	—	—	9	—	62	2	1

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 18.5.21
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Goomadeer River System, October 1, 1983. The total distance surveyed was 45.3 km.

TABLE 18.5.22
MAJARIE CREEK MAINSTREAM, JULY 28, 1979

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

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 18.5.22
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Majarie Creek mainstream, July 28, 1979. The total distance surveyed was 13.8 km.

TABLE 18.5.23
SIDECREEKS OF MAJARIE CREEK, JULY 28, 1979

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

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 18.5.23
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the sidecreeks of Majarie Creek, July 28, 1979. The total distance surveyed was 10.3 km.

TABLE 18.5.24
OVERALL MAJARIE CREEK, JULY 28, 1979

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*	1					1		
4-5 *(1.2-1.5)*	7			1		6		
5-6 *(1.5-1.8)*	4					4		
6-7 *(1.8-2.1)*	1					1		
>7 *(>2.1)*	3					3		
EO<6 *(<1.8)*								
EO>6 *(>1.8)*								
EO	2					1	1	
TOTAL	18	—	—	1	—	16	1	—

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 18.5.24
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Majarie Creek System, July 28, 1979. The total distance surveyed was 24.1 km.

TABLE 18.5.25
MAJARIE CREEK MAINSTREAM, JUNE 29, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*	1					1		
4-5 *(1.2-1.5)*	2					2		
5-6 *(1.5-1.8)*	4					4		
6-7 *(1.8-2.1)*	2					2		
>7 *(>2.1)*	1					1		
EO<6 *(<1.8)*								
EO>6 *(>1.8)*	2					2		
EO	1					1		
TOTAL	13	—	—	—	—	13	—	—

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 18.5.25
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Majarie Creek mainstream, June 29, 1981. The total distance surveyed was 13.0 km.

TABLE 18.5.26
SIDECREEKS OF MAJARIE CREEK, JUNE 28-29, 1981

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

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 18.5.26
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the sidecreeks of Majarie Creek, June 28-29, 1981. The total distance surveyed was 8.2 km.

TABLE 18.5.27
OVERALL MAJARIE CREEK, JUNE 28-29, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*	2					2		
4-5 *(1.2-1.5)*	2					2		
5-6 *(1.5-1.8)*	4					4		
6-7 *(1.8-2.1)*	2					2		
>7 *(>2.1)*	3					2	1	
EO<6 *(<1.8)*								
EO>6 *(>1.8)*	3					3		
EO	3					1	2	
TOTAL	19	—	—	—	—	16	3	—

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 18.5.27
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Majarie Creek System, June 28-29, 1981. The total distance surveyed was 21.2 km.

TABLE 18.5.28
MAJARIE CREEK MAINSTREAM, OCTOBER 10, 1981

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

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 18.5.28
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Majarie Creek mainstream, October 10, 1981. The total distance surveyed was 13.8 km.

TABLE 18.5.29
SIDECREEKS OF MAJARIE CREEK, OCTOBER 10, 1981

SIZE IN FEET (*metres*)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 (*0.6-0.9*)								
3-4 (*0.9-1.2*)	2					2		
4-5 (*1.2-1.5*)	2					2		
5-6 (*1.5-1.8*)	1					1		
6-7 (*1.8-2.1*)	1						1	
>7 (*>2.1*)								
EO<6 (*<1.8*)								
EO>6 (*>1.8*)	2					2		
EO	2					2		
TOTAL	10	—	—	—	—	9	1	—

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 18.5.29
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the sidecreeks of Majarie Creek, October 10, 1981. The total distance surveyed was 8.2 km.

TABLE 18.5.30
OVERALL MAJARIE CREEK, OCTOBER 10, 1981

SIZE IN FEET (*metres*)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 (*0.6-0.9*)								
3-4 (*0.9-1.2*)	3					3		
4-5 (*1.2-1.5*)	4					4		
5-6 (*1.5-1.8*)	2					2		
6-7 (*1.8-2.1*)	1						1	
>7 (*>2.1*)								
EO<6 (*<1.8*)								
EO>6 (*>1.8*)	3					3		
EO	4					4		
TOTAL	17	—	—	—	—	16	1	—

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 18.5.30
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Majarie Creek System, October 10, 1981. The total distance surveyed was 22 km.

TABLE 18.5.31
MAJARIE CREEK MAINSTREAM, JUNE 16, 1982

SIZE IN FEET *(metres)*	**NUMBER OF CROCS**	**SITUATION**						**OBSERVED FEEDING**
		IV	**IVIW**	**OM**	**IM**	**SWOE**	**MS**	
HATCHLING	1					1		
2-3 *(0.6-0.9)*	1			1				
3-4 *(0.9-1.2)*	1					1		
4-5 *(1.2-1.5)*	1					1		
5-6 *(1.5-1.8)*	2					2		
6-7 *(1.8-2.1)*								
>7 *(>2.1)*	2					2		
EO<6 *(<1.8)*								
EO>6 *(>1.8)*	3					1	2	
EO	1					1		
TOTAL	12	—	—	1	—	9	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 18.5.31
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Majarie Creek mainstream, June 16, 1982. The total distance surveyed was 13.8 km.

TABLE 18.5.32
SIDECREEKS OF MAJARIE CREEK, JUNE 16, 1982

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

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 18.5.32
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the sidecreeks of Majarie Creek, June 16, 1982. The total distance surveyed was 10.0 km.

TABLE 18.5.33
OVERALL MAJARIE CREEK, JUNE 16, 1982

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	2					2		
2-3 *(0.6-0.9)*	1			1				
3-4 *(0.9-1.2)*	1					1		
4-5 *(1.2-1.5)*	2					2		
5-6 *(1.5-1.8)*	2					2		
6-7 *(1.8-2.1)*	1			1				
>7 *(>2.1)*	3					3		
EO<6 *(<1.8)*								
EO>6 *(>1.8)*	4					2	2	
EO	1					1		
TOTAL	17	—	—	2	—	13	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 18.5.33
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Majarie Creek System, June 16, 1982. The total distance surveyed was 23.8 km.

TABLE 18.5.34
MAJARIE CREEK MAINSTREAM, OCTOBER 13, 1982

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

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 18.5.34
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Majarie Creek mainstream, October 13, 1982. The total distance surveyed was 13.8 km.

TABLE 18.5.35
SIDECREEKS OF MAJARIE CREEK, OCTOBER 13, 1982

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*								
4-5 *(1.2-1.5)*	3			1		2		
5-6 *(1.5-1.8)*	1						1	
6-7 *(1.8-2.1)*	1						1	
>7 *(>2.1)*	1					1		
EO<6 *(<1.8)*								
EO>6 *(>1.8)*								
EO	1					1		
TOTAL	7	—	—	1	—	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 18.5.35
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the sidecreeks of Majarie Creek, October 13, 1982. The total distance surveyed was 9.5 km.

TABLE 18.5.36
OVERALL MAJARIE CREEK, OCTOBER 13, 1982

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

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 18.5.36
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Majarie Creek System, October 13, 1982. The total distance surveyed was 23.3 km.

TABLE 18.5.37
MAJARIE CREEK MAINSTREAM, JUNE 20, 1983

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	3			1		2		
2-3 (0.6-0.9)								
3-4 (0.9-1.2)	1					1		
4-5 (1.2-1.5)	2			1		1		
5-6 (1.5-1.8)	2					2		
6-7 (1.8-2.1)	2					1	1	
>7 (>2.1)								
EO<6 (<1.8)								
EO>6 (>1.8)	3					3		
EO								
TOTAL	13	—	—	2	—	10	1	—

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 18.5.37
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Majarie Creek mainstream, June 20, 1983. The total distance surveyed was 13.8 km.

TABLE 18.5.38
SIDECREEKS OF MAJARIE CREEK, JUNE 20, 1983

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	1					1		
2-3 (0.6-0.9)								
3-4 (0.9-1.2)	3			1		2		
4-5 (1.2-1.5)	2					1	1	
5-6 (1.5-1.8)	3					3		
6-7 (1.8-2.1)								
>7 (>2.1)								
EO<6 (<1.8)								
EO>6 (>1.8)	1					1		
EO	1						1	
TOTAL	11	—	—	1	—	8	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 18.5.38
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the sidecreeks of Majarie Creek, June 20, 1983. The total distance surveyed was 10.3 km.

TABLE 18.5.39
OVERALL MAJARIE CREEK, JUNE 20, 1983

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	4			1		3		
2-3 (0.6-0.9)								
3-4 (0.9-1.2)	4			1		3		
4-5 (1.2-1.5)	4			1		2	1	
5-6 (1.5-1.8)	5					5		
6-7 (1.8-2.1)	2					1	1	
>7 (>2.1)								
EO<6 (<1.8)								
EO>6 (>1.8)	4					4		
EO	1						1	
TOTAL	24	—	—	3	—	18	3	—

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 18.5.39
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Majarie Creek System, June 20, 1983. The total distance surveyed was 24.1 km.

TABLE 18.5.40
MAJARIE CREEK MAINSTREAM, OCTOBER 3, 1983

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

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 18.5.40
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Majarie Creek mainstream, October 3, 1983. The total distance surveyed was 13.8 km.

TABLE 18.5.41
SIDECREEKS OF MAJARIE CREEK, OCTOBER 3, 1983

SIZE IN FEET *(metres)*	**NUMBER OF CROCS**	**SITUATION**						**OBSERVED FEEDING**
		IV	**IVIW**	**OM**	**IM**	**SWOE**	**MS**	
HATCHLING								
2-3 *(0.6-0.9)*	1					1		
3-4 *(0.9-1.2)*	2			1		1		
4-5 *(1.2-1.5)*	1					1		
5-6 *(1.5-1.8)*	6			1		4	1	
6-7 *(1.8-2.1)*	3					3		
>7 *(>2.1)*	1					1		
EO<6 *(<1.8)*								
EO>6 *(>1.8)*								
EO								
TOTAL	14	—	—	2	—	11	1	—

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 18.5.41
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the sidecreeks of Majarie Creek, October 3, 1983. The total distance surveyed was 10.3 km.

TABLE 18.5.42
OVERALL MAJARIE CREEK, OCTOBER 3, 1983

SIZE IN FEET *(metres)*	**NUMBER OF CROCS**	**SITUATION**						**OBSERVED FEEDING**
		IV	**IVIW**	**OM**	**IM**	**SWOE**	**MS**	
HATCHLING								
2-3 *(0.6-0.9)*	1					1		
3-4 *(0.9-1.2)*	4			1		3		
4-5 *(1.2-1.5)*	1					1		
5-6 *(1.5-1.8)*	6			1		4	1	
6-7 *(1.8-2.1)*	3					3		
>7 *(>2.1)*	1					1		
EO<6 *(<1.8)*								
EO>6 *(>1.8)*	2			1		1		
EO	1					1		
TOTAL	19	—	—	3	—	15	1	—

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 18.5.42
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Majarie Creek System, October 3, 1983. The total distance surveyed was 24.1 km.

TABLE 18.5.43
WURUGOIJ CREEK MAINSTREAM, JULY 29, 1979

SIZE IN FEET (*metres*)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 (*0.6-0.9*)								
3-4 (*0.9-1.2*)								
4-5 (*1.2-1.5*)								
5-6 (*1.5-1.8*)	2					1	1	
6-7 (*1.8-2.1*)	1					1		
>7 (*>2.1*)	3					2	1	
EO<6 (*<1.8*)								
EO>6 (*>1.8*)								
EO	1			1				
TOTAL	7	—	—	1	—	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 18.5.43
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Wurugoij Creek mainstream, July 29, 1979. Total distance surveyed was 9.2 km.

TABLE 18.5.44
SIDECREEKS OF WURUGOIJ CREEK, JULY 29, 1979

SIZE IN FEET (*metres*)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 (*0.6-0.9*)								
3-4 (*0.9-1.2*)								
4-5 (*1.2-1.5*)								
5-6 (*1.5-1.8*)								
6-7 (*1.8-2.1*)	1					1		
>7 (*>2.1*)	1					1		
EO<6 (*<1.8*)								
EO>6 (*>1.8*)								
EO								
TOTAL	2	—	—	—	—	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 18.5.44
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the sidecreeks of Wurugoij Creek, July 29, 1979. Total distance surveyed was 7.2 km.

TABLE 18.5.45
OVERALL WURUGOIJ CREEK, JULY 29, 1979

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*								
4-5 *(1.2-1.5)*								
5-6 *(1.5-1.8)*	2					1	1	
6-7 *(1.8-2.1)*	2					2		
>7 *(>2.1)*	4					3	1	
EO<6 *(<1.8)*								
EO>6 *(>1.8)*								
EO	1			1				
TOTAL	9	—	—	1	—	6	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 18.5.45
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Wurugoij Creek System, July 29, 1979. Total distance surveyed was 16.4 km.

TABLE 18.5.46
WURUGOIJ CREEK MAINSTREAM, JUNE 27, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*	1					1		
4-5 *(1.2-1.5)*	1						1	
5-6 *(1.5-1.8)*	1						1	
6-7 *(1.8-2.1)*	1					1		
>7 *(>2.1)*	1					1		
EO<6 *(<1.8)*								
EO>6 *(>1.8)*								
EO								
TOTAL	5	—	—	—	—	3	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 18.5.46
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Wurugoij Creek mainstream, June 27, 1981. Total distance surveyed was 9.2 km.

TABLE 18.5.47
SIDECREEKS OF WURUGOIJ CREEK, JUNE 27, 1981

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

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 18.5.47
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the sidecreeks of Wurugoij Creek, June 27, 1981. Total distance surveyed was 7.2 km.

TABLE 18.5.48
OVERALL WURUGOIJ CREEK, JUNE 27, 1981

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

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 18.5.48
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Wurugoij Creek System, June 27, 1981. Total distance surveyed was 16.4 km.

TABLE 18.5.49
WURUGOIJ CREEK MAINSTREAM, OCTOBER 9, 1981

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

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 18.5.49
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Wurugoij Creek mainstream, October 9, 1981. Total distance surveyed was 9.2 km.

TABLE 18.5.50
SIDECREEKS OF WURUGOIJ CREEK, OCTOBER 9, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 *(0.6-0.9)*	1					1		
3-4 *(0.9-1.2)*								
4-5 *(1.2-1.5)*								
5-6 *(1.5-1.8)*								
6-7 *(1.8-2.1)*								
>7 *(>2.1)*								
EO<6 *(<1.8)*								
EO>6 *(>1.8)*								
EO	1					1		
TOTAL	2	—	—	—	—	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 18.5.50
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the sidecreeks of Wurugoij Creek, October 9, 1981. Total distance surveyed was 7.2 km.

TABLE 18.5.51
OVERALL WURUGOIJ CREEK, OCTOBER 9, 1981

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

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 18.5.51
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Wurugoij Creek System, October 9, 1981. The total distance surveyed was 16.4 km.

TABLE 18.5.52
WURUGOIJ CREEK MAINSTREAM, JUNE 15, 1982

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

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 18.5.52
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Wurugoij Creek mainstream, June 15, 1982. The total distance surveyed was 9.0 km.

TABLE 18.5.53
SIDECREEKS OF WURUGOIJ CREEK, JUNE 15, 1982

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*								
4-5 *(1.2-1.5)*								
5-6 *(1.5-1.8)*	1					1		
6-7 *(1.8-2.1)*								
>7 *(>2.1)*								
EO<6 *(<1.8)*								
EO>6 *(>1.8)*								
EO	1					1		
TOTAL	2	—	—	—	—	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 18.5.53
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the sidecreeks of Wurugoij Creek, June 15, 1982. The total distance surveyed was 7.2 km.

`TABLE 18.5.54
OVERALL WURUGOIJ CREEK, JUNE 15, 1982

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

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 18.5.54
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Wurugoij Creek System, June 15, 1982. The total distance surveyed was 16.2 km.

TABLE 18.5.55
WURUGOIJ CREEK MAINSTREAM, OCTOBER 12, 1982

SIZE IN FEET (*metres*)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	1					1		
2-3 (*0.6-0.9*)								
3-4 (*0.9-1.2*)								
4-5 (*1.2-1.5*)	1					1		
5-6 (*1.5-1.8*)	1			1				
6-7 (*1.8-2.1*)	1						1	
>7 (*>2.1*)	1						1	
EO<6 (*<1.8*)	1					1		
EO>6 (*>1.8*)								
EO								
TOTAL	6	—	—	1	—	3	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 18.5.55
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Wurugoij Creek mainstream, October 12, 1982. The total distance surveyed was 9.2 km.

TABLE 18.5.56
SIDECREEKS OF WURUGOIJ CREEK, OCTOBER 12, 1982

SIZE IN FEET (*metres*)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 (*0.6-0.9*)								
3-4 (*0.9-1.2*)								
4-5 (*1.2-1.5*)	1					1		
5-6 (*1.5-1.8*)	1					1		
6-7 (*1.8-2.1*)								
>7 (*>2.1*)								
EO<6 (*<1.8*)								
EO>6 (*>1.8*)								
EO								
TOTAL	2	—	—	—	—	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 18.5.56
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the sidecreeks of Wurugoij Creek, October 12, 1982. The total distance surveyed was 7.2 km.

TABLE 18.5.57
OVERALL WURUGOIJ CREEK, OCTOBER 12, 1982

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	1					1		
2-3 (0.6-0.9)								
3-4 (0.9-1.2)								
4-5 (1.2-1.5)	2					2		
5-6 (1.5-1.8)	2			1		1		
6-7 (1.8-2.1)	1						1	
>7 (>2.1)	1						1	
EO<6 (<1.8)	1					1		
EO>6 (>1.8)								
EO								
TOTAL	8	—	—	1	—	5	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 18.5.57
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Wurugoij Creek System, October 12, 1982. The total distance surveyed was 16.4 km.

TABLE 18.5.58
WURUGOIJ CREEK MAINSTREAM, JUNE 19, 1983

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

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 18.5.58
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Wurugoij Creek mainstream, June 19, 1983. The total distance surveyed was 9.2 km.

TABLE 18.5.59
SIDECREEKS OF WURUGOIJ CREEK, JUNE 19, 1983

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

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 18.5.59
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the sidecreeks of Wurugoij Creek, June 19, 1983. The total distance surveyed was 7.2 km.

TABLE 18.5.60
OVERALL WURUGOIJ CREEK, JUNE 19, 1983

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

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 18.5.60
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Wurugoij Creek System, June 19, 1983. The total distance surveyed was 16.4 km.

TABLE 18.5.61
WURUGOIJ CREEK MAINSTREAM, OCTOBER 2, 1983

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

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 18.5.61
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Wurugoij Creek mainstream, October 2, 1983. The total distance surveyed was 9.2 km.

TABLE 18.5.62
SIDECREEKS OF WURUGOIJ CREEK, OCTOBER 2, 1983

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

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 18.5.62
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the sidecreeks of Wurugoij Creek, October 2, 1983. The total distance surveyed was 7.2 km.

TABLE 18.5.63
OVERALL WURUGOIJ CREEK, OCTOBER 2, 1983

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

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 18.5.63
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Wurugoij Creek System, October 2, 1983. The total distance surveyed was 16.4 km.

TABLE 18.5.64
OVERALL ALL NIGHT CREEK, JULY 25, 1979

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

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 18.5.64
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of overall All Night Creek, July 25, 1979. The total distance surveyed was 9.1 km; Mainstream 7.6 and Sidecreek C, 1.5 km.

TABLE 18.5.65
KING RIVER MAINSTREAM, JULY 24, 1979

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)								
3-4 (0.9-1.2)	8					8		
4-5 (1.2-1.5)	6					6		
5-6 (1.5-1.8)	6					6		
6-7 (1.8-2.1)	2					1	1	
>7 (>2.1)	3					3		
EO<6 (<1.8)								
EO>6 (>1.8)	3					3		
EO	3					3		
TOTAL	34	—	—	—	—	33	1	—

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 18.5.65
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the King River mainstream, July 24, 1979. Total distance surveyed was 28.1 km.

TABLE 18.5.66
SIDECREEKS OF KING RIVER, JULY 24, 1979

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 (0.6-0.9)								
3-4 (0.9-1.2)	3					3		
4-5 (1.2-1.5)	4			1		2	1	
5-6 (1.5-1.8)	3					3		
6-7 (1.8-2.1)								
>7 (>2.1)	2					2		
EO<6 (<1.8)	1					1		
EO>6 (>1.8)	1						1	
EO								
TOTAL	14	—	—	1	—	11	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 18.5.66
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the sidecreeks of King River, July 24, 1979. Total distance surveyed was 20.4 km; Creeks A, B, E and F, 13 km; and Creeks J, K, L and N, 7.4 km.

TABLE 18.5.67
OVERALL KING RIVER, JULY 24, 1979

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)*								
3-4 *(0.9-1.2)*	11					11		
4-5 *(1.2-1.5)*	10			1		8	1	
5-6 *(1.5-1.8)*	9					9		
6-7 *(1.8-2.1)*	2					1	1	
>7 *(>2.1)*	5					5		
EO<6 *(<1.8)*	1					1		
EO>6 *(>1.8)*	4					3	1	
EO	3					3		
TOTAL	48	—	—	1	—	44	3	—

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 18.5.67
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the King River System, July 24, 1979. Total distance surveyed was 48.5 km; Mainstream 28.1; Creeks A, B, E and F, 13 km; and Creeks J, K, L and N, 7.4 km.

TABLE 18.5.68

Tidal times and (heights) in metres at Gove, Darwin and at the vessel's anchorages at positions shown, July 1979. Also shown are the tidal time delays in minutes between the standard port and vessel's anchorage.

DAY	TIDE	GOVE	DELAY	DARWIN	DELAY	ANCHORAGE
Tuesday						
July 24						
Moonage						*King River km5.5*
Day 00	HW	2100 (2.64)	−130	1832 (5.9)	+18	1850 (4.9)
Wednesday	LW	0338 (0.45)	−118	0100 (1.1)	+40	0140 (2.4)
July 25	HW	1008 (2.51)	−118	0716 (6.8)	+54	0810 (4.5)
Moonage						*All Night Creek*
Day 01	LW	1601 (1.17)	−131	1326 (2.2)	+24	1350 (4.7)
	HW	2140 (2.65)	−120	1909 (6.1)	+31	1940 (6.4)
Thursday	LW	0415 (0.45)	−120	0133 (1.1)	+42	0215 (3.9)
July 26						
Moonage						
Day 02						
Saturday	LW	0521 (0.53)	—	0277 (1.4)	—	*Junction Bay km1.6*
						NE off Majarie
July 28	HW	1143 (2.56)	−108	0844 (6.7)	+71	0955 (3.7)
Moonage	LW	1741 (1.02)	−111	1458 (2.0)	+52	1550 (1.8)
Day 04	HW	2324 (2.59)	−114	2044 (6.1)	+46	2130 (4.0)
Sunday	LW	0551 (0.59)	−121	0251 (1.6)	+59	0350 (1.4)
July 29	HW	1211 (2.56)	−109	0911 (6.5)	+71	1022 (3.9)
Moonage	LW	1813 (0.99)	−108	1527 (2.1)	+58	1625 (2.0)
Day 05	HW	2357 (2.53)	−112	2118 (5.9)	+47	2205 (4.2)
Monday	LW	0631 (0.67)	−116	0315 (1.9)	+80	0435 (1.7)
July 30						*Goomadeer F*
						km4.5
Moonage	HW	1238 (2.56)	−112	0935 (6.3)	+71	1046 (5
Day 06	LW	1848 (0.96)	− 93	1557 (2.2)	+78	1715 (
	HW	—	—	2155 (5.7)	+60	2255 (
Tuesday	HW	0031 (2.44)	− 96	—	—	—
July 31	LW	0652 (0.76)	−112	1343 (2.3)	+87	0510
Moonage						
Day 07						

APPENDIX

From: The Master,
RV *The Harry Messel*
To: Professor H Messel
Subject: Voyage Report: King River, All Night Creek, Majarie and Wurugoij Creeks and Goomadeer River
Date: July 24-31, 1979

July 24. The ship arrived in the King River from Maningrida via South Goulburn Island at 1730hrs and came to anchor at km5.5 close seaward of the unnamed island. Both survey boats carried out daylight surveys followed by night spotting surveys. The surveys were completed that night.

July 25. Boats were hoisted and the ship proceeded at 0905hrs. Anchorage with shelter from the NE wind and sea was found close inshore bearing 245°T distant 4.5 miles from Cuthbert Point. Boat 1 left the ship at 1700hrs for All Night Creek and returned at dawn July 26, having completed the survey.

July 26. The anchor was weighed at 0630hrs and the ship proceeded to South West Bay, South Goulburn Island to replenish fuel supplies from the barge *Fourcroy*.

July 27, 0500hrs. After completion of fuelling, course was set for Junction Bay with a strong wind warning current. By 0630hrs, the wind had increased to 30 knots and seas were rough. The ship returned to Mullet Bay, North Goulburn Island for sheltered anchorage. By 1815 hours the wind had dropped. The ship proceeded to Junction Bay, anchoring in the south-east corner of the bay at 0125hrs, July 28.

July 28. The wind had again reached 25 to 30 knots by 0945hrs and anchorage was shifted as close as possible to the south shore of the bay, where both boats were lowered. The boats with their survey crews went off prepared for an all night stay in their respective creeks. Boat 1, Majarie Creek, and Boat 2, Wurugoij Creek. During the day, Boat 2 reported gearbox failure which could not be corrected. Boat 1 finished her survey returning to the ship at dawn.

July 29. At 0800hrs, Boat 1 proceeded to tow Boat 2 and met the ship off Wurugoij Creek at 1210hrs. A fresh survey crew took Boat 1 back into the creek for the night survey whilst Boat 2 was hoisted for repair. The ship returned to the sheltered anchorage. Boat 1 returned to ship at 2100hrs, having completed the survey. By this time, Boat 2 had been repaired and tested.

July 30, 0735hrs. The ship weighed and proceeded to the Goomadeer River. Boat 1, with portable echo sounder, was lowered at 0815hrs to check the bar and channel; the ship following her into the river, anchoring at km4.5 at 0925hrs. The two boats completed their surveys on the evening low tide.

July 31, 0900hrs. After hoisting both boats, the ship weighed and proceeded out of the river and set course for Van Diemen Gulf.

Commander S R Schofield
(RAN Retd)
Master

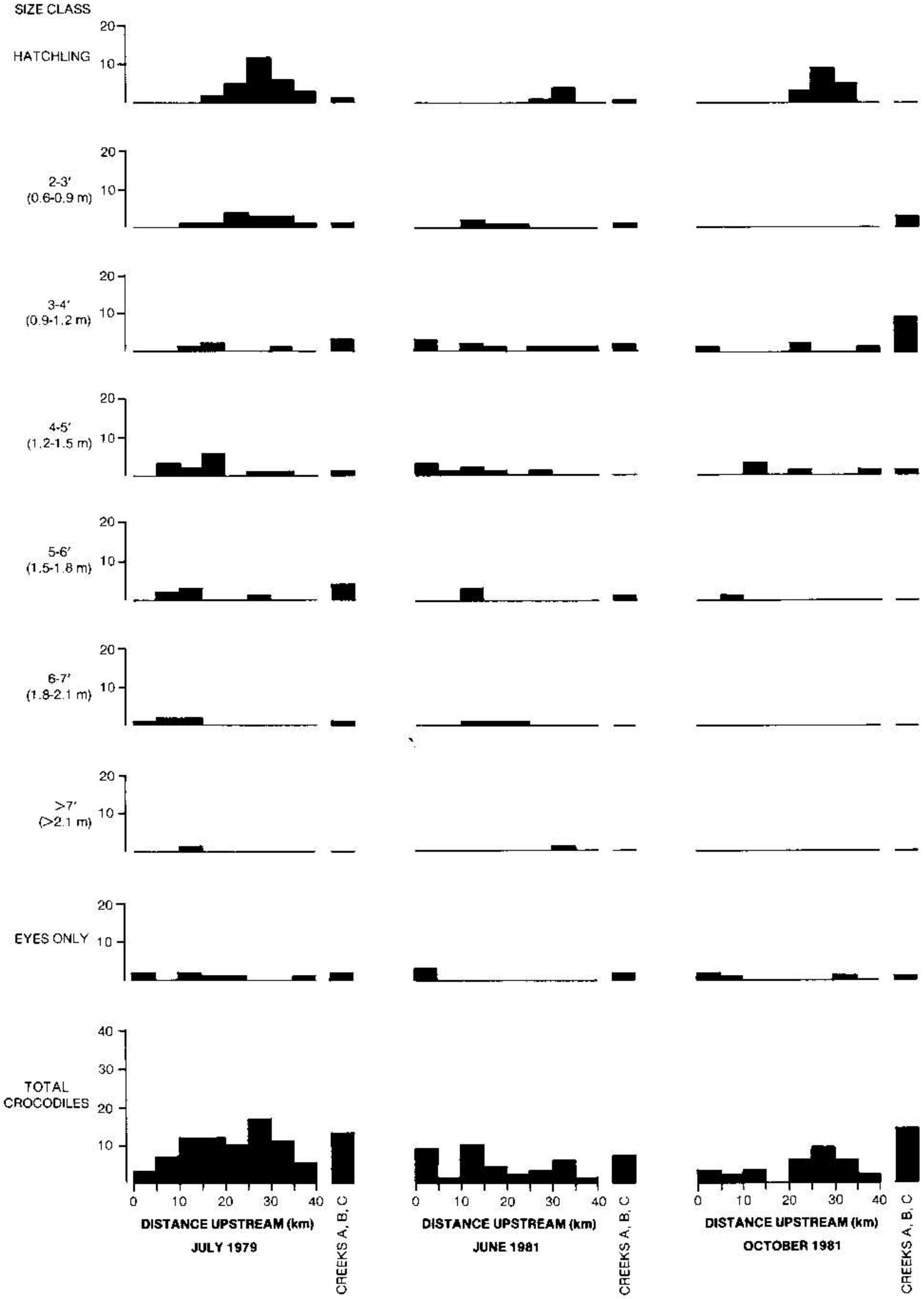


Fig. 18.5.1
Distributional pattern of *Crocodylus porosus* on the Goomadeer River System in July, 1979 and June and October, 1981.

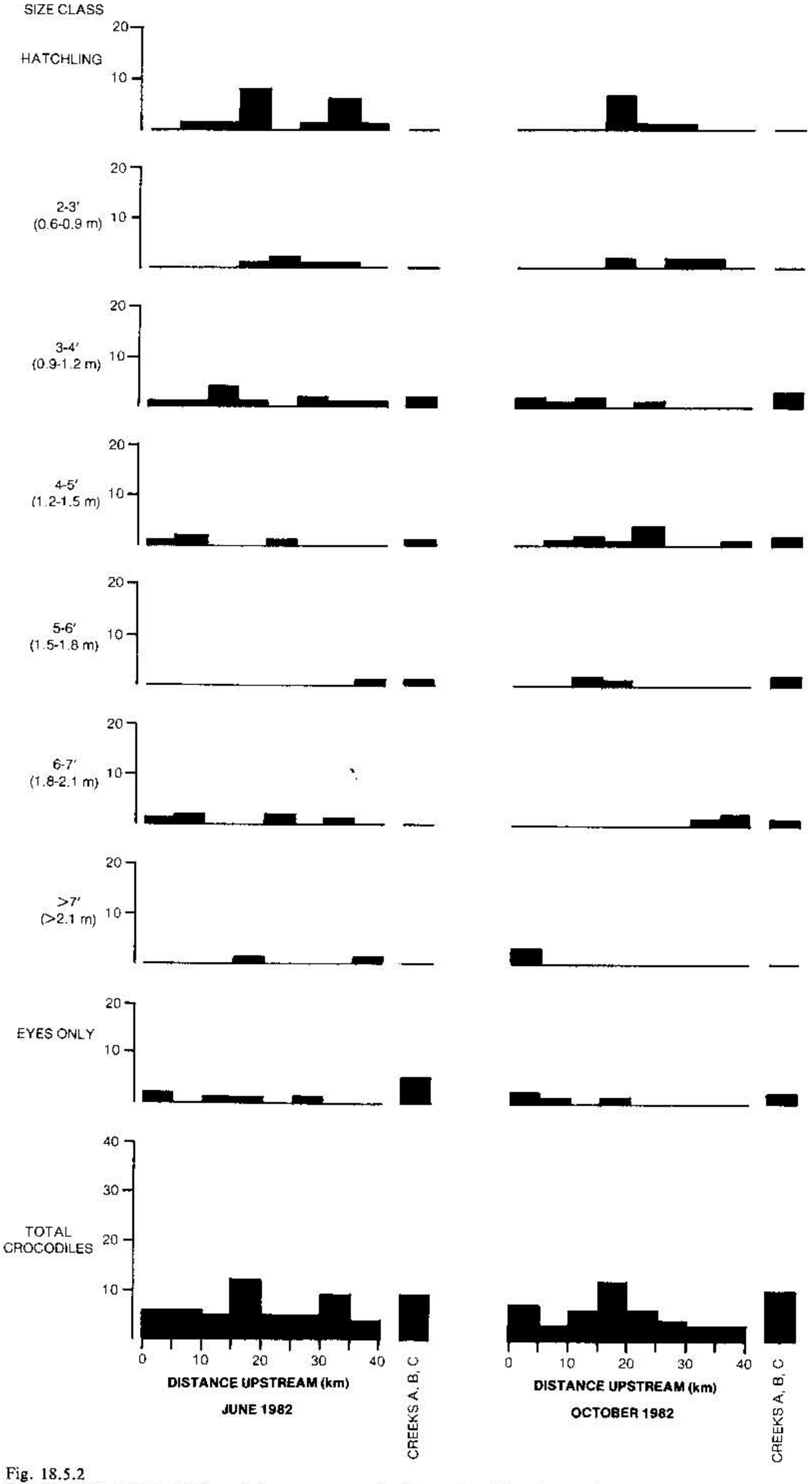


Fig. 18.5.2
Distributional pattern of *Crocodylus porosus* on the Goomadeer River System in June and October, 1982.

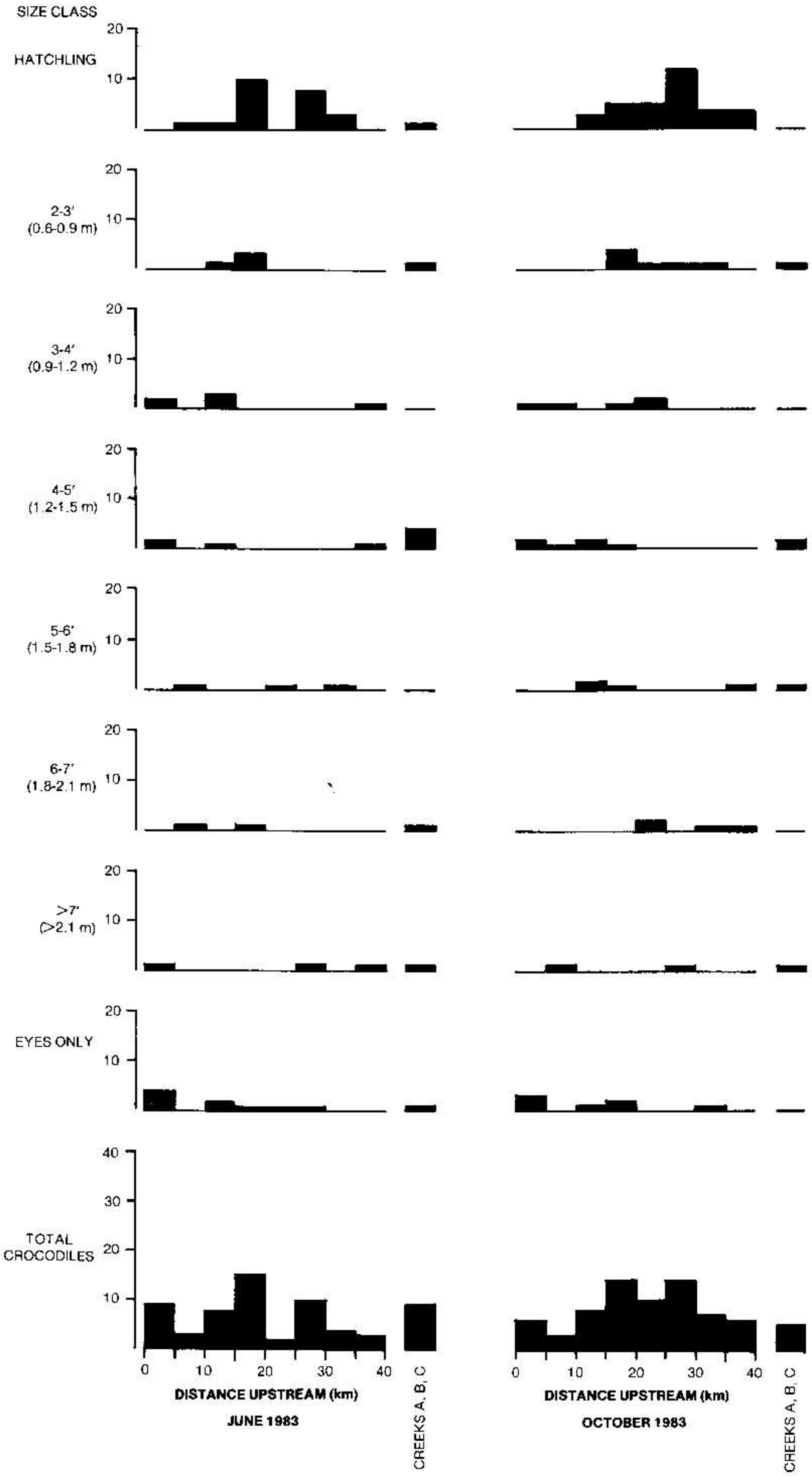


Fig. 18.5.3
Distributional pattern of *Crocodylus porosus* on the Goomadeer River System in June and October, 1983.

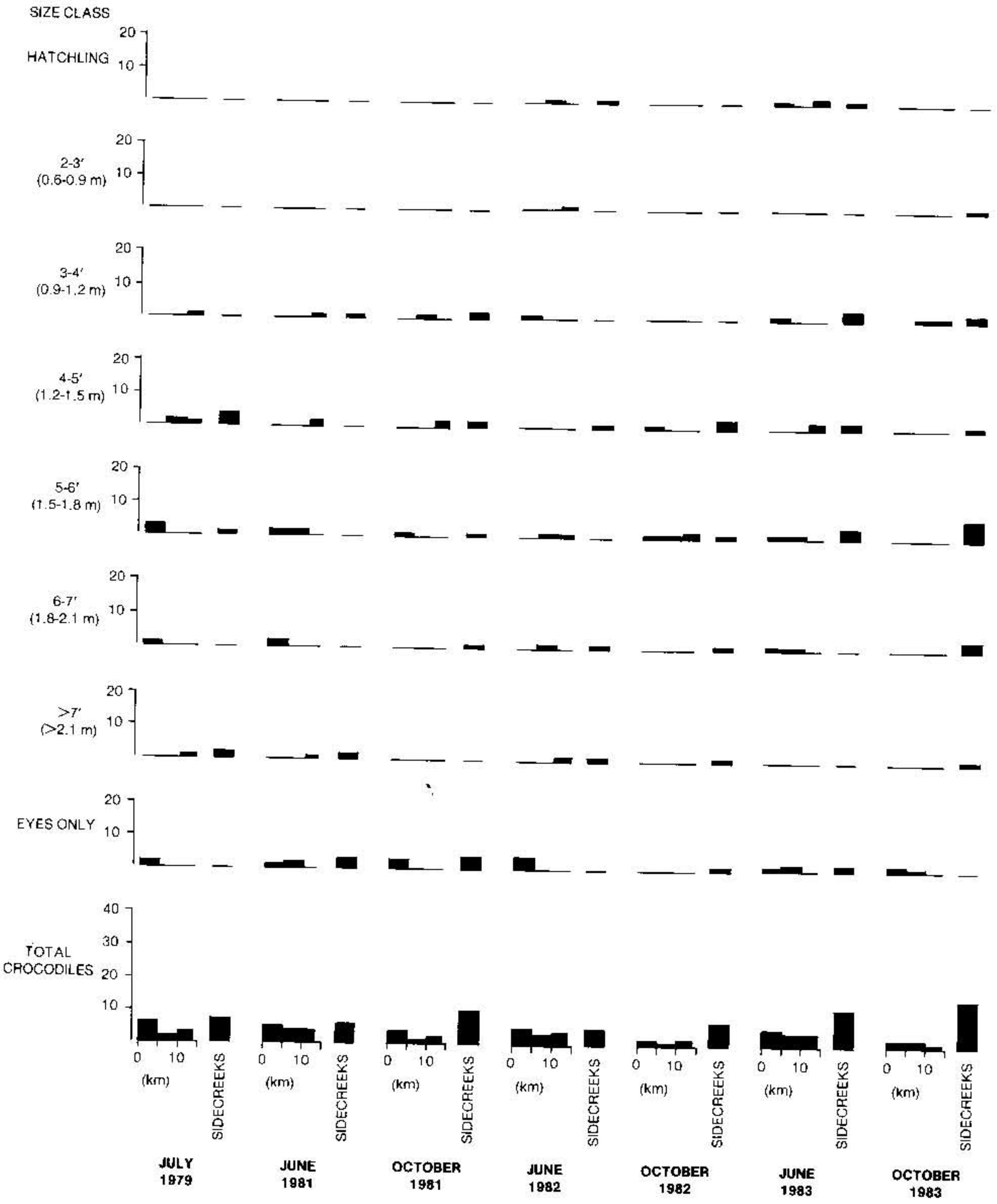


Fig. 18.5.4
Distributional pattern of *Crocodylus porosus* on Majarie Creek from July 1979 to October 1983.

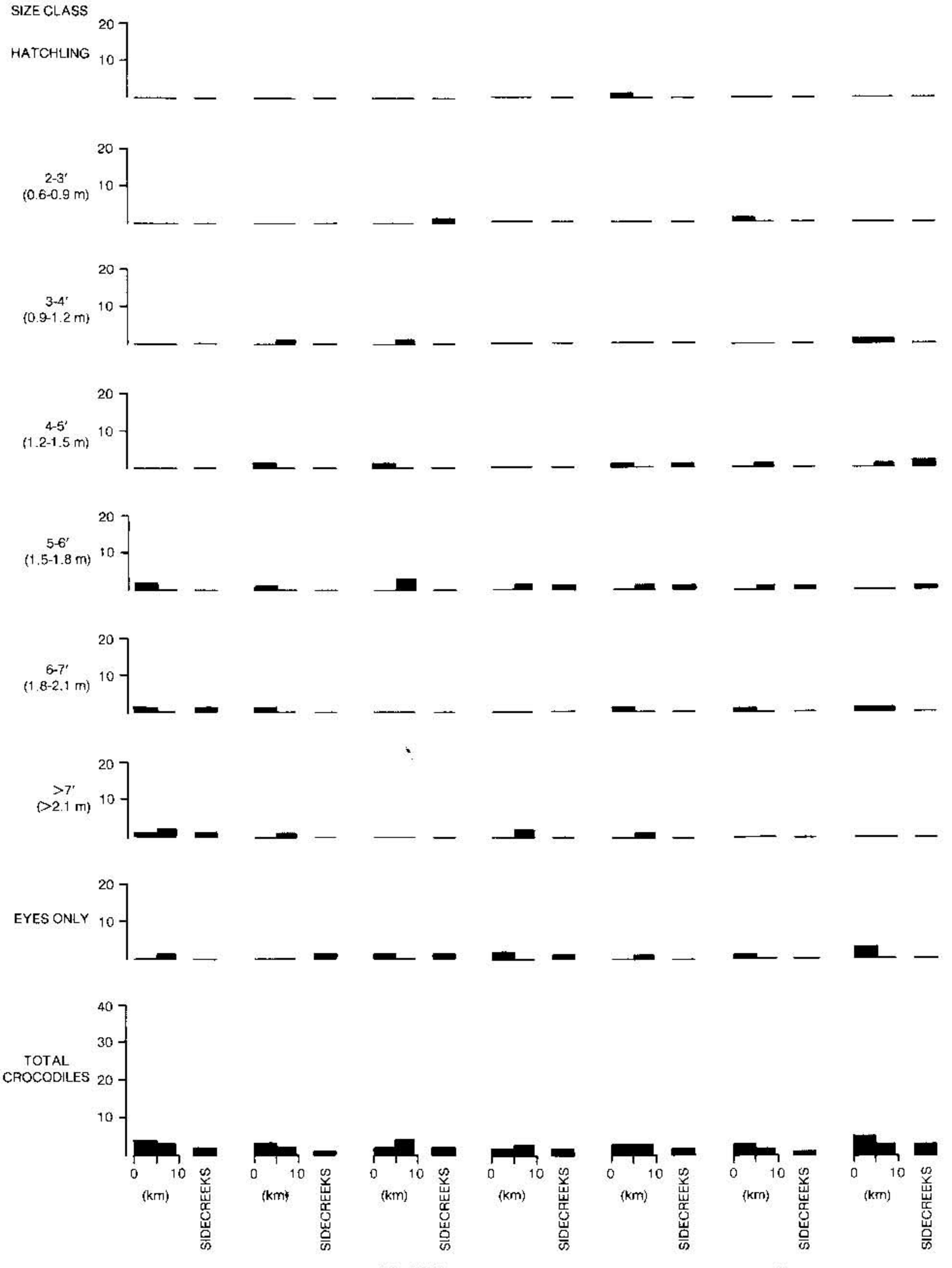


Fig. 18.5.5
Distributional pattern of *Crocodylus porosus* on Wurugoij Creek from July 1979 to October 1983.

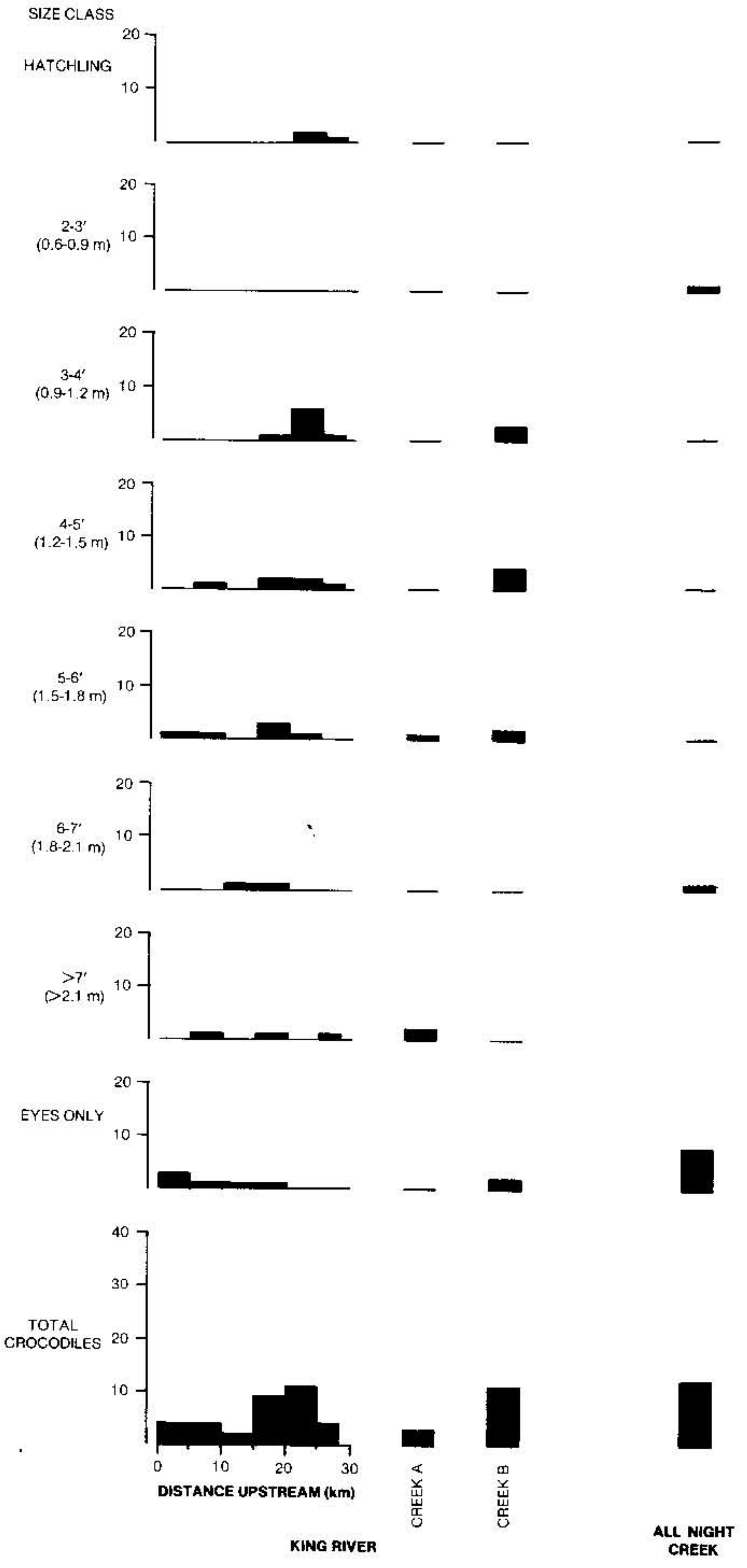


Fig. 18.5.6
Distributional pattern of *Crocodylus porosus* on the King River System and All Night Creek in July, 1979.

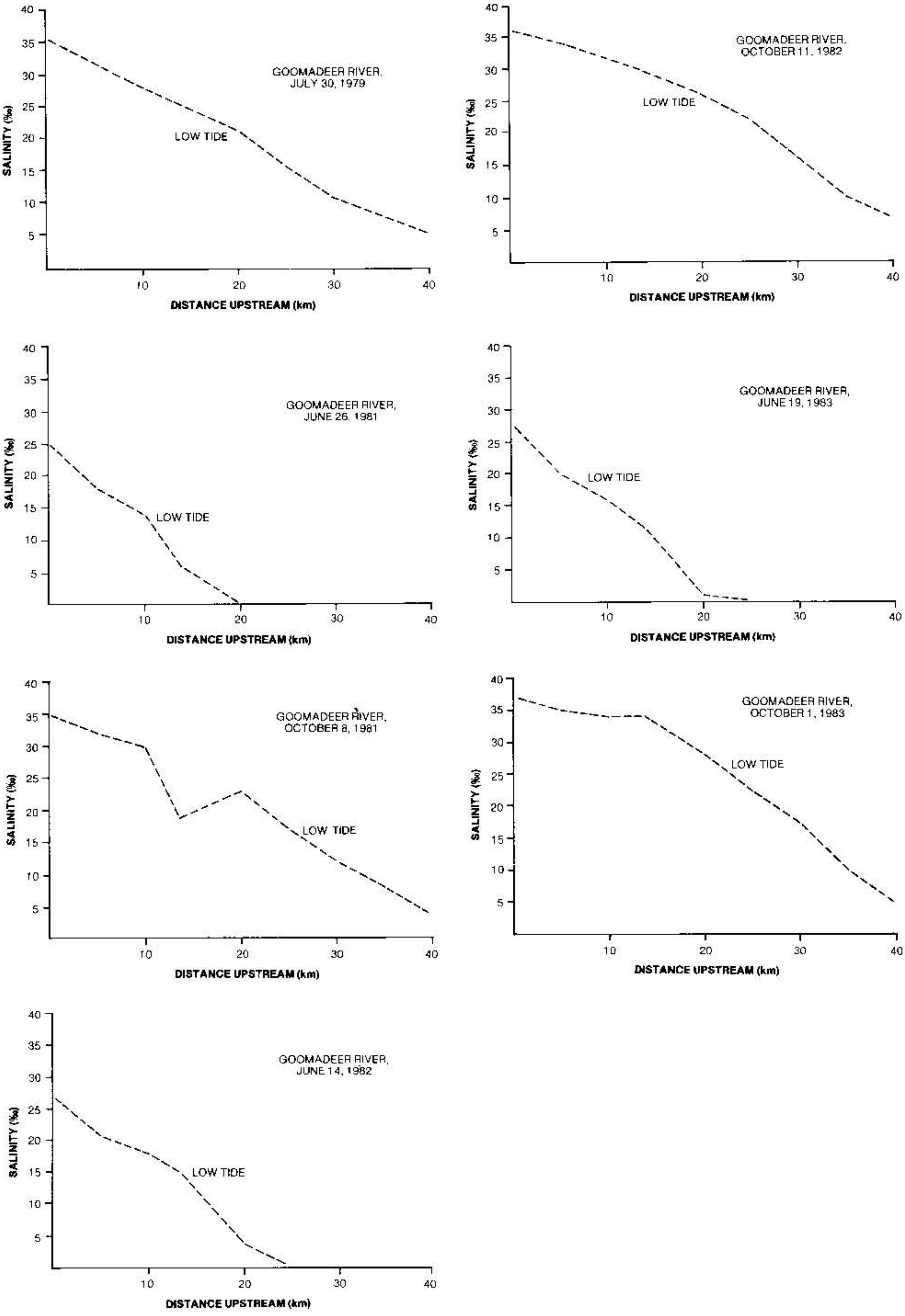


Fig. 18.5.7
Goomadeer River, low tide salinities for 1979, 1981-1983.

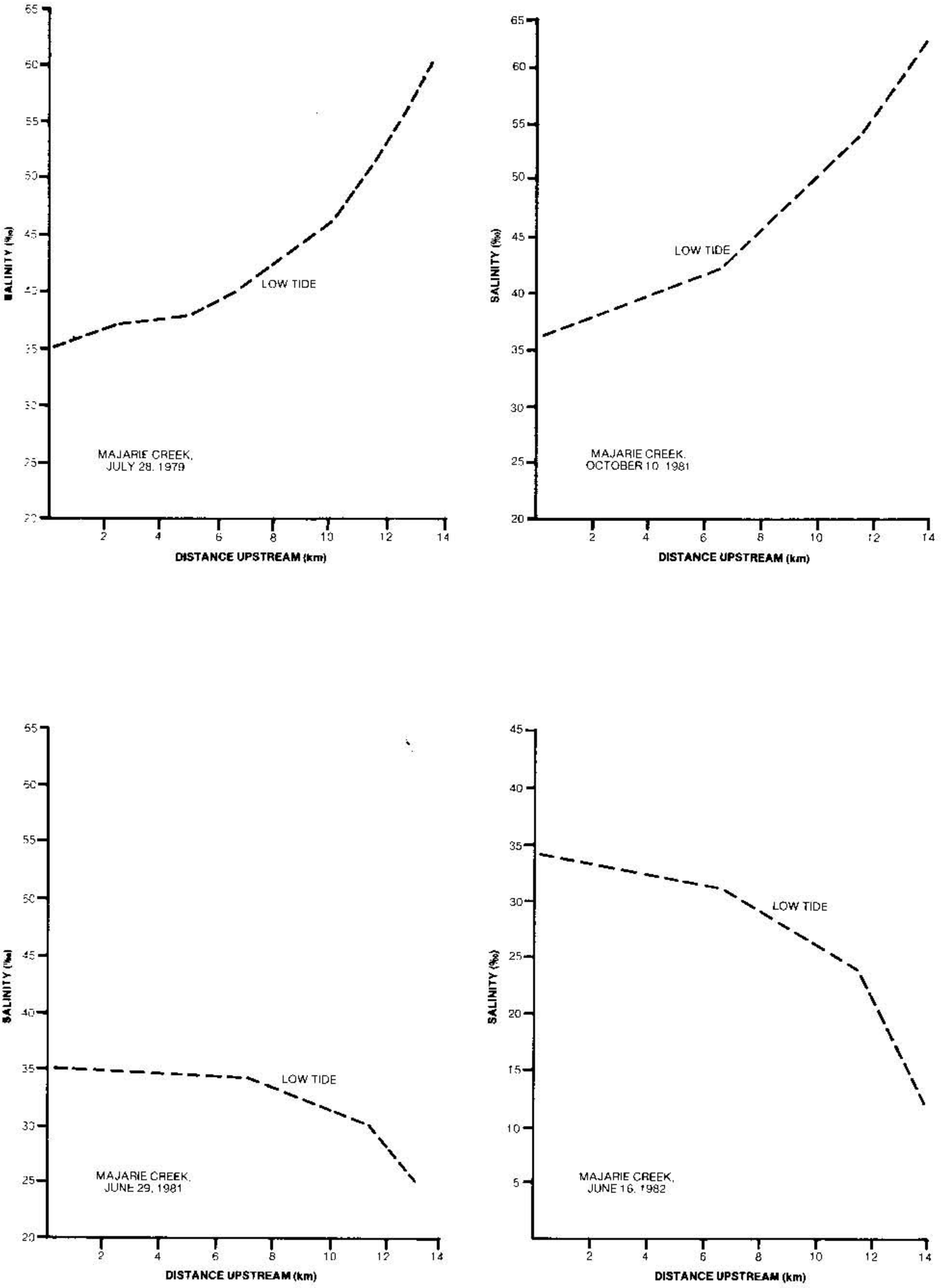
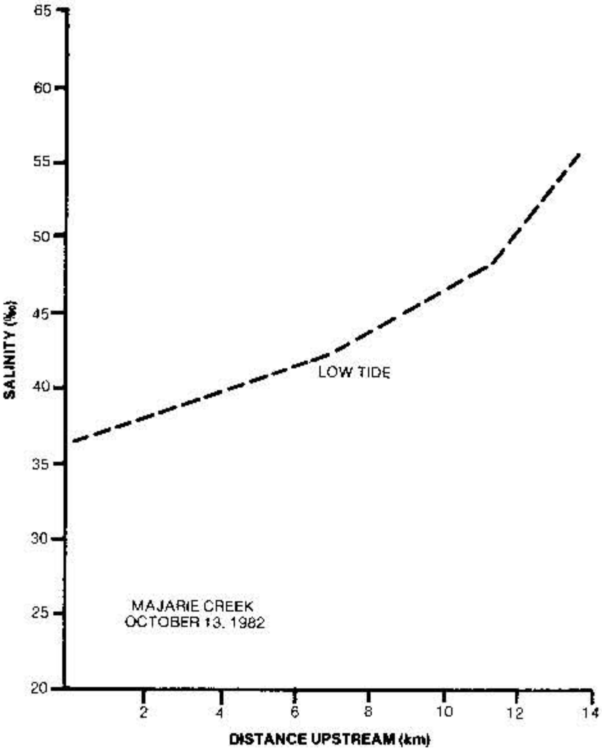
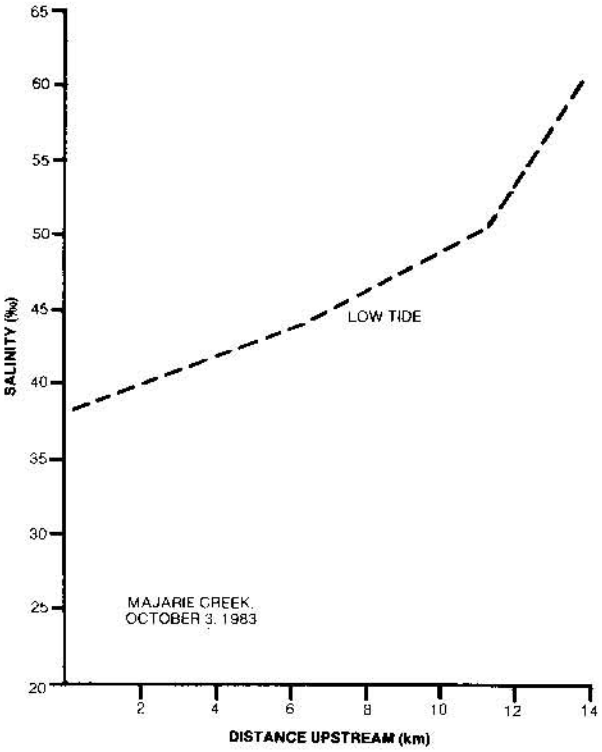


Fig. 18.5.8
Majarie Creek mainstream, low tide salinities for 1979, 1981-1983.





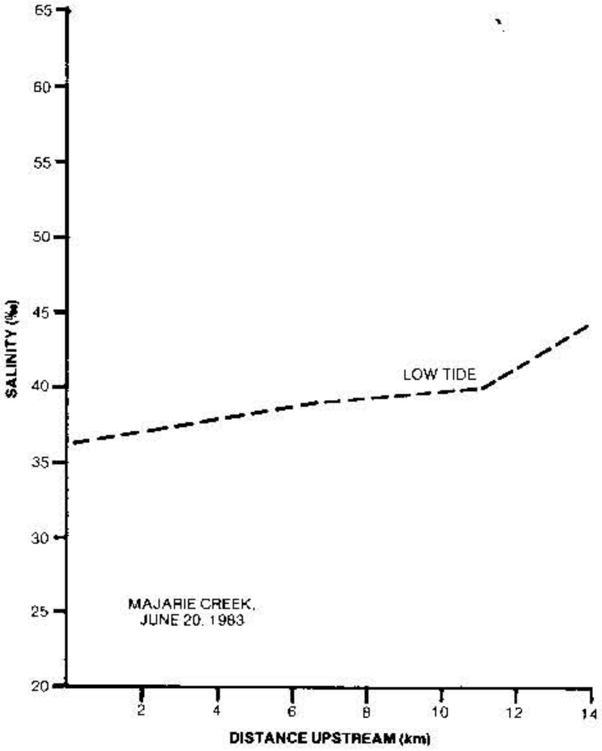


Fig. 18.5.8 continued

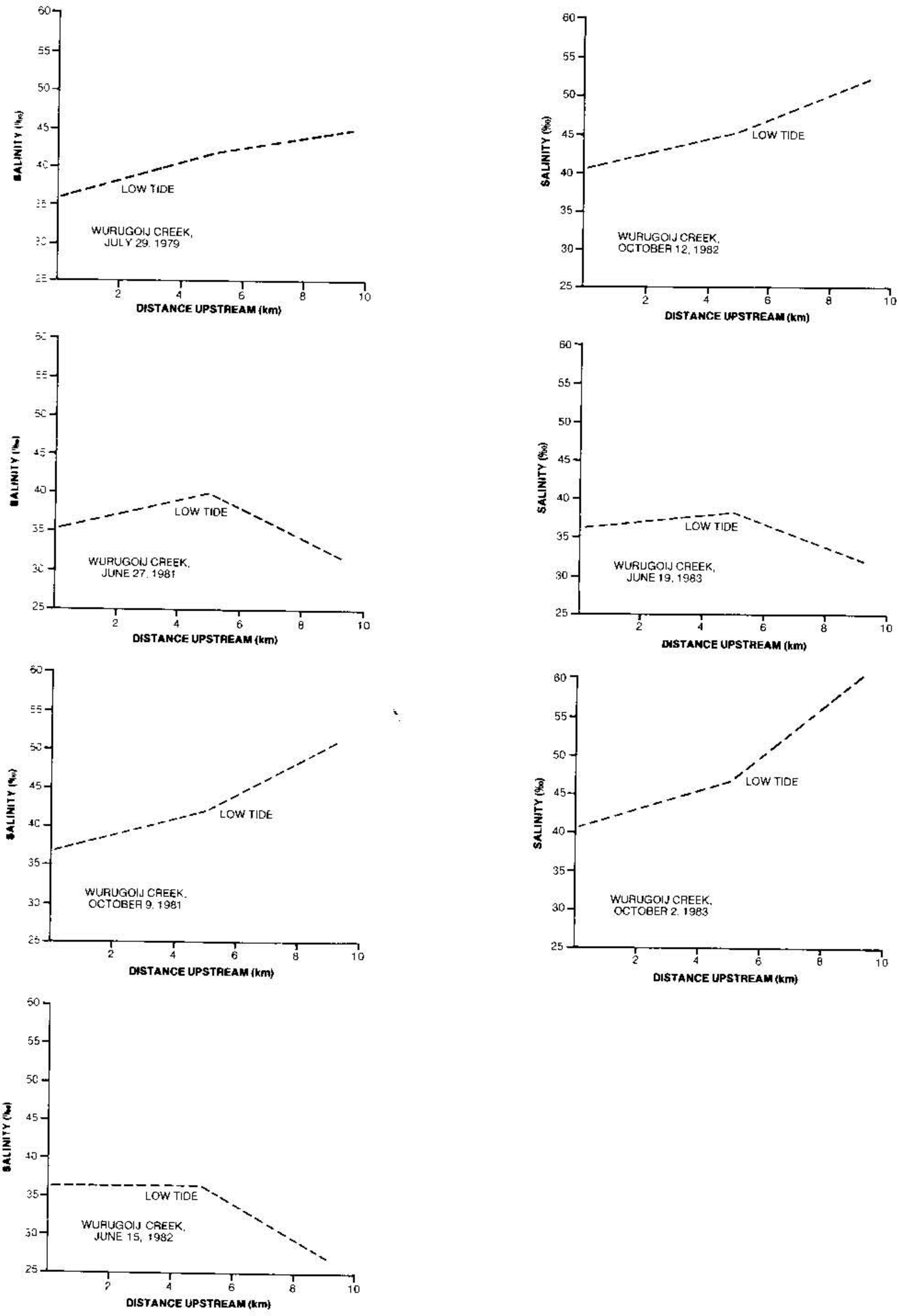


Fig. 18.5.9
Wurugoij Creek mainstream, low tide salinities for 1979, 1981-1983.

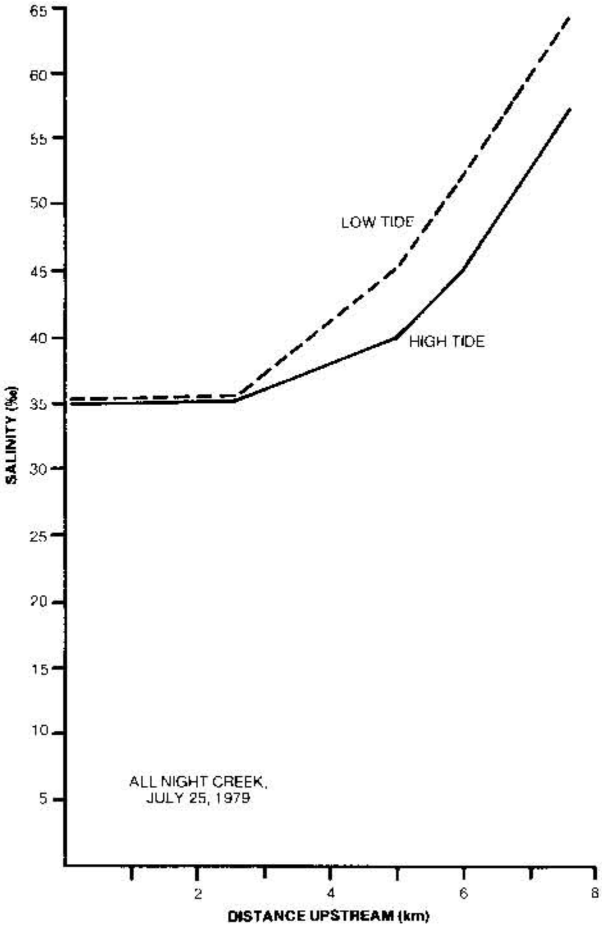


Fig. 18.5.10
All Night Creek mainstream, low and high tide salinities for July 1979.

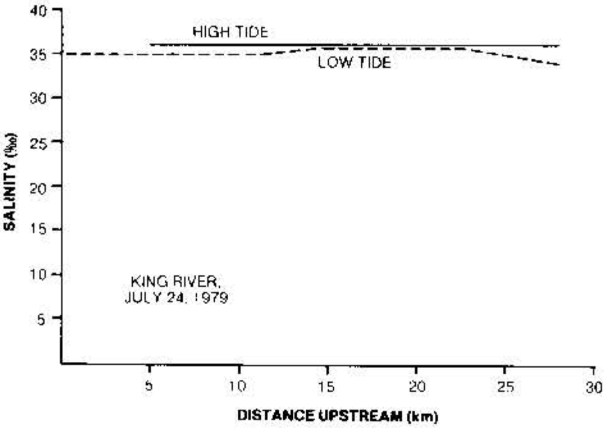


Fig. 18.5.11
King River mainstream, low and high tide salinities for July 1979.

8.

MONOGRAPH 6

Additional data, 1979 for The Johnston River, Andranangoo, Bath, Dongau and Tinganoo Creeks

TABLE 18.6.1
OVERALL ANDRANANGOO CREEK, OCTOBER 14-15, 1979

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	4					4		1
2-3 (0.6-0.9)	1						1	
3-4 (0.9-1.2)	3					2	1	
4-5 (1.2-1.5)	9			1		6	2	
5-6 (1.5-1.8)	7					6	1	
6-7 (1.8-2.1)	6					5	1	
>7 (>2.1)	10		1			9		
EO<6 (<1.8)	4					3	1	
EO>6 (>1.8)	6					5	1	
EO	6					5	1	
TOTAL	56	—	1	1	—	45	9	1

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 18.6.1
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of overall Andranangoo Creek, October 14-15, 1979. The total distance surveyed was 48.4 km, mainstream 45 and the two sidecreeks 3.4 km.

TABLE 18.6.2
OVERALL DONGAU CREEK, OCTOBER 11, 1979

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 (0.6-0.9)								
3-4 (0.9-1.2)								
4-5 (1.2-1.5)	3					3		
5-6 (1.5-1.8)	3					2	1	
6-7 (1.8-2.1)	2					2		
>7 (>2.1)	5					5		
EO<6 (<1.8)								
EO>6 (>1.8)	1					1		
EO	1					1		
TOTAL	15	—	—	—	—	14	1	—

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 18.6.2
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of overall Dongau Creek, October 11, 1979. The total distance surveyed was 22.4 km, mainstream 19.3 and the two sidecreeks 3.1 km.

TABLE 18.6.3
OVERALL TINGANOO CREEK, OCTOBER 10, 1979

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

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 18.6.3
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of overall Tinganoo Creek, October 10, 1979. The total distance surveyed was 14.5 km, mainstream 6.3 and the five sidecreeks 8.2 km.

TABLE 18.6.4
JOHNSTON RIVER MAINSTREAM, OCTOBER 12, 1979

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*								
4-5 *(1.2-1.5)*	1					1		
5-6 *(1.5-1.8)*	4					4		
6-7 *(1.8-2.1)*	4					4		
>7 *(>2.1)*	1					1		
EO<6 *(<1.8)*								
EO>6 *(>1.8)*	1			1				
EO	3					3		
TOTAL	14	—	—	1	—	13	—	—

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 18.6.4
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Johnston River mainstream, October 12, 1979. The total distance surveyed was 36.3 km.

TABLE 18.6.5
SIDECREEKS OF JOHNSTON RIVER, OCTOBER 12-13, 1979

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

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 18.6.5
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the sidecreeks of the Johnston River, excluding Bath Creek, October 12-13, 1979. The total distance surveyed was 53.5 km. See Table 18.6.8 for a breakdown of the distances surveyed.

TABLE 18.6.6
BATH CREEK, OCTOBER 13, 1979

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

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 18.6.6
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of Bath Creek, October 13, 1979. The total distance surveyed was 14.5 km.

TABLE 18.6.7
OVERALL JOHNSTON RIVER SYSTEM, OCTOBER 12-13, 1979

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 *(0.6-0.9)*	1					1		
3-4 *(0.9-1.2)*	2					2		
4-5 *(1.2-1.5)*	2					2		
5-6 *(1.5-1.8)*	6					6		
6-7 *(1.8-2.1)*	5					5		
>7 *(>2.1)*	3		1	2				
EO<6 *(<1.8)*	1		1					
EO>6 *(>1.8)*	2					1	1	
EO	3					3		
TOTAL	25	—	2	2	—	20	1	—

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 18.6.7
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Johnston River System, October 12-13, 1979. The total distance surveyed was 104.3 km, mainstream 36.3, Bath Creek 14.5 and the other sidecreeks 53.5 km.

TABLE 18.6.8

Distances surveyed on the overall Johnston River System, October 12-13, 1979.

Johnston River	km
Mainstream	36.3
Creek B at km8.7	3.7
Creek C at km10.2	5.0
and its Sidecreek at km12.5	2.4
Creek D at km12.5	2.0
Creek E at km12.5	3.0
Creek F at km12.7	not done
Creek G at km16.0	11.2
and its Sidecreeks at km20.1	0.8
at km24.8	0.7
Creek H at km17.9	3.9
Creek J at km17.7	1.6
Creek K at km18.5	1.3
Creek L at km22.2	6.1
Creek M at km22.2	2.3
Creek N at km22.9	3.1
Creek O at km24.6	3.4
Creek P at km24.8	not done
Creek Q at km26.4	not done
Creek R at km30.7	0.7
Channel A at km0	2.3
TOTAL	89.8
Bath Creek at km5.5	14.5

TABLE 18.6.9

Tidal times and (heights) in metres at Darwin and at the vessel's anchorages at positions shown, October 1979. Also shown are the tidal time delays in minutes between the standard port and vessel's anchorage.

DAY	TIDE	DARWIN	DELAY	ANCHORAGE
Wednesday	LW	0249 (1.9)		
October 10	HW	0830 (6.8)		*Tinganoo Bay*
Moonage	LW	1505 (0.8)	−35	1430
Day 19	HW	2122 (7.1)	−32	2050
Thursday	LW	0325 (2.3)	−45	0240
October 11	HW	0901 (6.3)		*Quanipiri Bay*
Moonage	LW	1541 (1.3)	−71	1430 (3.6)
Day 20	HW	2202 (6.5)	−92	2030 (5.0)
Friday	LW	0406 (2.8)	−81	0245 (4.8)
October 12	HW	0934 (5.7)		*Brenton Bay*
Moonage	LW	1620 (1.9)	−80	1500 (3.95)
Day 21	HW	2247 (5.9)	−107	2100 (4.85)
Saturday	LW	0454 (3.3)	−144	0230 (4.00)
October 13	HW	1010 (5.1)	−100	0830 (4.65)
Moonage	LW	1709 (2.6)	−99	1530 (3.70)
Day 22	HW	2344 (5.4)	−134	2130 (4.80)
Sunday	LW	0600 (3.6)	−150	0330 (4.40)
October 14	HW	1106 (4.6)		*Andranangoo Ck*
Moonage	LW	1827 (3.1)	−147	1600 (6.00)
Day 23	HW			2130 (7.10)
Monday	HW	0119 (5.1)	−229	
October 15	LW	0755 (3.7)	−235	0400 (6.70)
Moonage	HW	1344 (4.3)	−254	0930 (7.00)
Day 24	LW	2025 (3.2)	−145	1800 (6.30)
Tuesday	HW	0312 (5.3)		(missed)
October 16	LW	0943 (3.3)	−223	0600 (6.60)
Moonage	HW	1555 (4.8)	−220	1215 (7.00)
Day 25	LW	2148 (3.0)	−153	1915 (6.15)

APPENDIX

NOTES ON SURVEYS OF ASSOCIATED C. POROSUS HABITAT ON MELVILLE ISLAND

Brenton Bay Swamp, October 12, 1979
(Page 48 Monograph 6)

Bill Green and HM walked into the swamp, and it was in almost the same state as when HM first saw it in October 1972. The main swamp was dry and lovely to walk on and there were numerous dried out slides of some 4 to 6 different sized crocodiles. These were plainly visible on the dried-out swamp mud, criss-crossing the swamp. There were several shallow patches of water at the south-east extremity of the swamp.

On the western side, the swamp was bordered by high green sedge and Bill quickly found a very fresh slide (only hours or minutes old) heading into a 4 m long water hole — the same one HM had found in 1972 with a (9-10′) croc in it. We probed the fresh and much used hole, but the croc had left. We followed the track for some 100 metres through the dense sedge. The track was deep and very well defined. In many places the crocodile had tunneled through the sedge. We had no firearms with us and it would have been unwise to proceed further into the dense sedge without them. We saw 2 black and 1 burdekin duck only.

Pulloloo Bay Lagoons, October 10, 1979
(Page 54 Monograph 6)

Surveyed by H Messel, Bill Green, Sandra Bourne. 1400-1600 hours, LLW at 1430 hours. Weather was calm, the water blue, the beach was well exposed at low water and easy to walk upon.

There were numerous turtle nests. There were fewer signs of dingoes raiding turtle nests than previously.

South Lagoon

Measured salinity 6‰ and water temperature was 38.8°C. There were a number of fresh crocodile tracks leading to and from the lagoon, made by an (8-9′) and a (11-12′) crocodile. Probably a breeding pair.

North Lagoon

Measured salinity 16‰ and there was a fresh track of a (9-10′) croc leading into the lagoon. Because the salinities were relatively low, it appears that there had been some recent rain, though the levels of both lagoons were low.

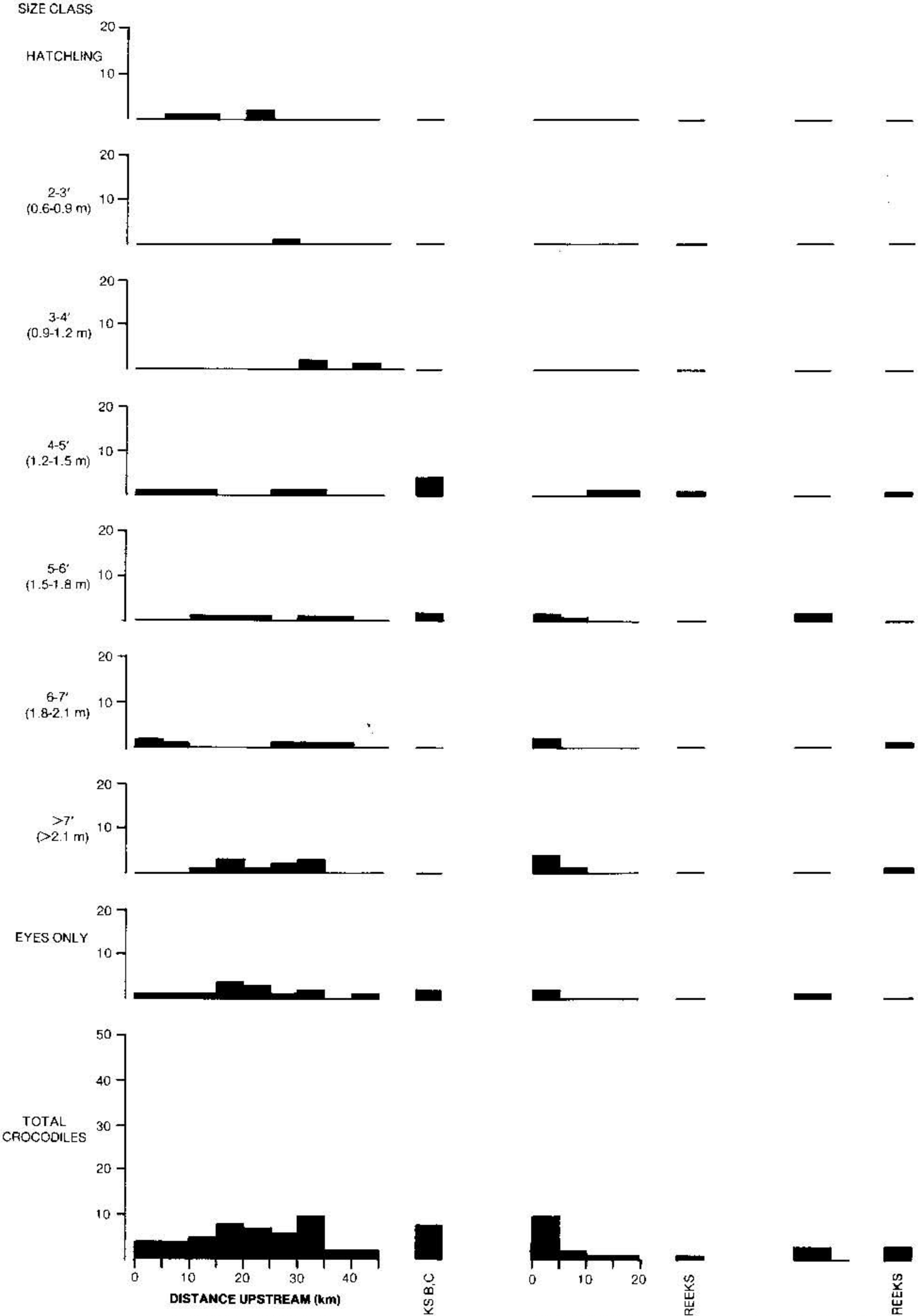


Fig. 18.6.1
Distributional pattern of *Crocodylus porosus* on Andranangoo, Dongau and Tinganoo Creeks in October, 1979.

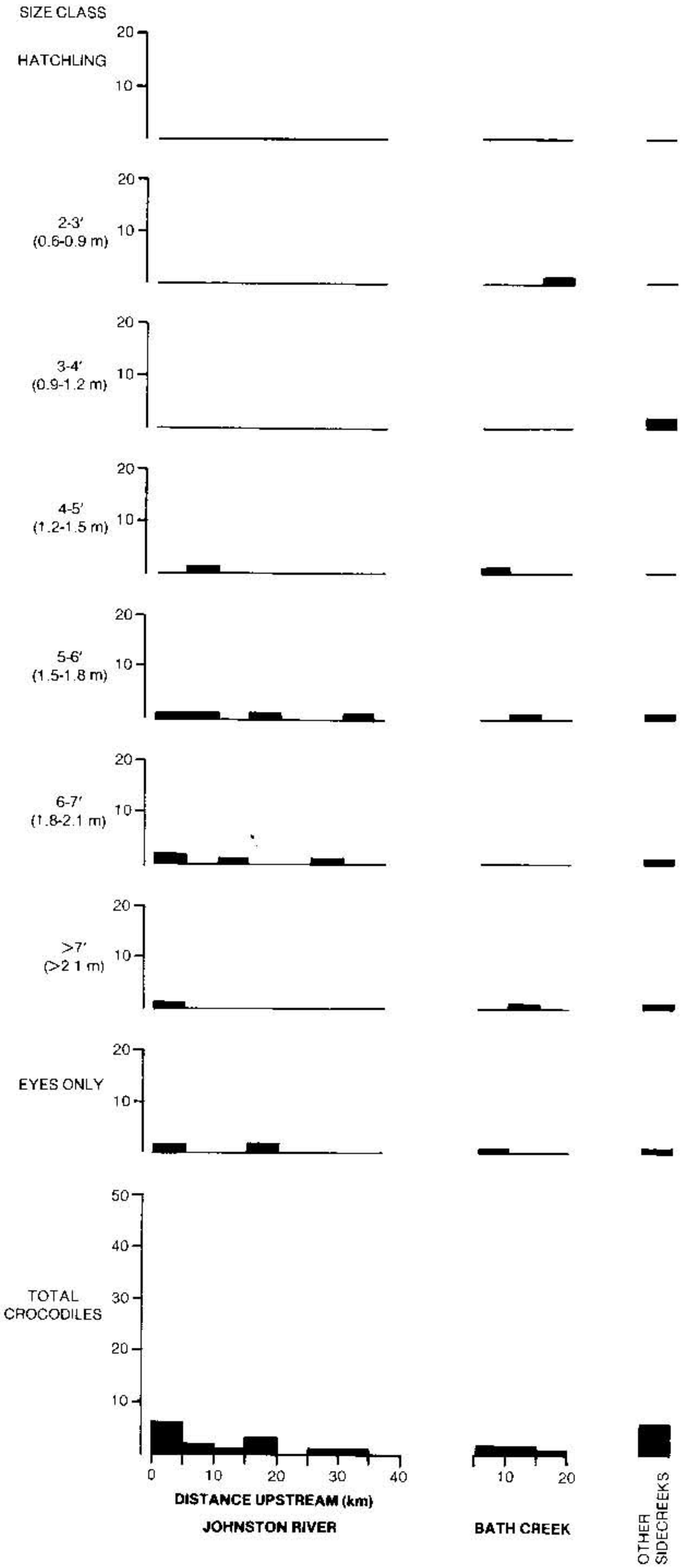


Fig. 18.6.2
Distributional pattern of *Crocodylus porosus* on the Johnston River System, including Bath Creek in October, 1979.

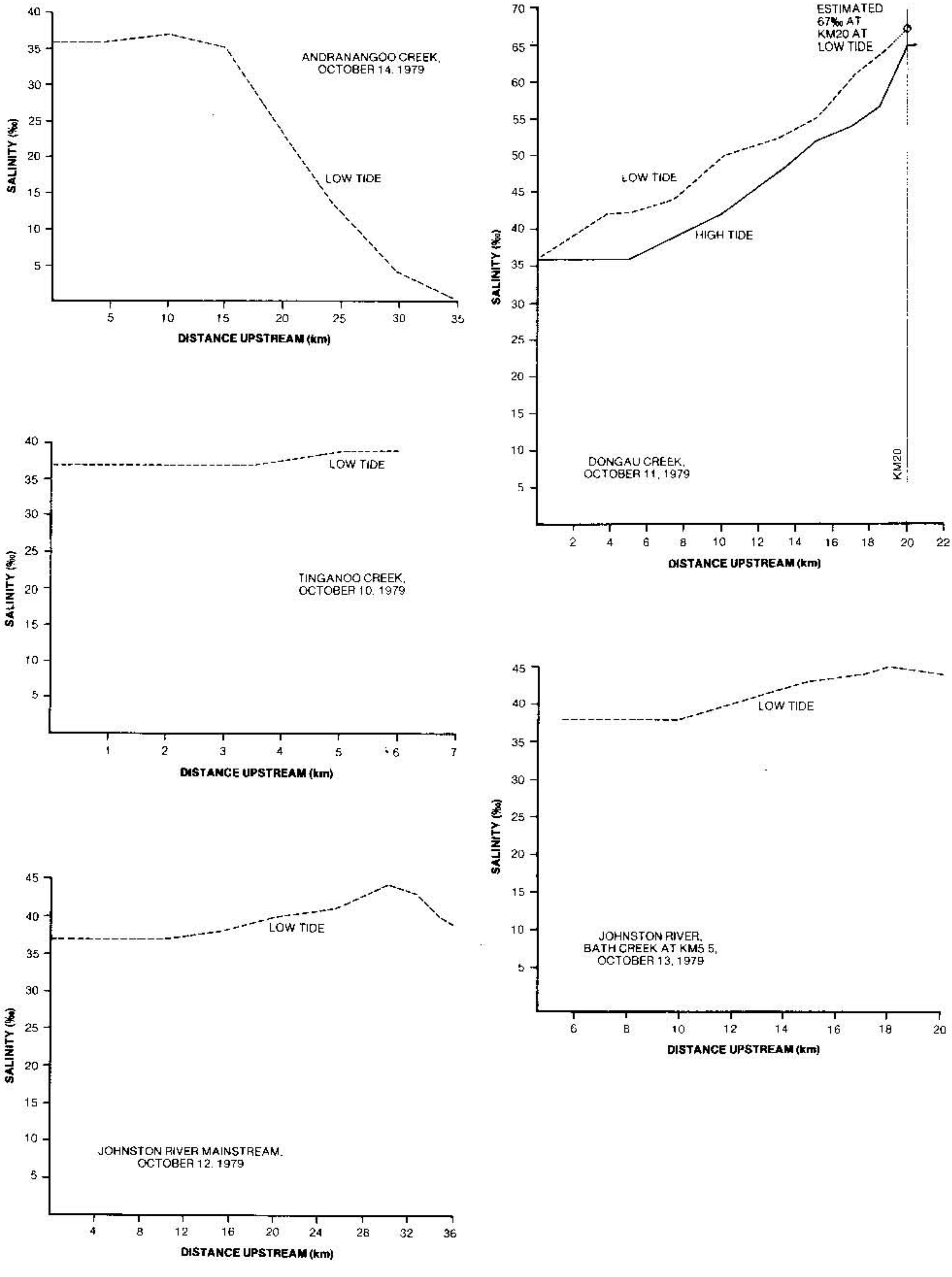


Fig. 18.6.3
Andranangoo, Dongau and Tinganoo Creeks, Johnston River and Bath Creek, low tide salinities in October, 1979.

9.

MONOGRAPH 7

Additional data, 1979-1983 for The Liverpool-Tomkinson Rivers and Nungbulgarri Creek

TABLE 18.7.1

Survey distances on the various components of the Liverpool-Tomkinson Rivers System for night spotlight surveys carried out between 1979-1983. All distances are shown in km. Note that for the July 1979 survey, Toms Creek (8.9 km) was surveyed and included in the creeks, increasing the distance surveyed to 150.0 km. Toms Creek was also surveyed in 1982 and 1983 but was not included in the overall Liverpool-Tomkinson System. Instead the results appear under alternative habitat, Table 8 in the population dynamics paper.

	1979		**1980**	**1981**		**1982**		**1983**	
	July	**Oct**	**Oct**	**July**	**Oct**	**June**	**Oct**	**July**	**Oct**
Liverpool M'stream	57.0	57.0	57.0	57.0	57.0	57.0	57.0	57.0	57.0
Tomkinson River	56.7	56.7	56.2	56.7	56.7	56.7	56.7	56.7	56.7
Gudjerama Creek	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Morngarrie Creek	2.9	2.9	2.9	2.4	2.9	2.9	2.9	2.9	2.9
Mungardobolo Creek	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
Maragulidban Creek	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
Atlas Creek	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TOTALS	141.1	141.1	140.6	140.6	141.1	141.1	141.1	141.1	141.1

TABLE 18.7.2
LIVERPOOL RIVER MAINSTREAM, JULY 16-17, 1979

SIZE IN FEET *(metres)*	**NUMBER OF CROCS**	**SITUATION**						**OBSERVED FEEDING**
		IV	**IVIW**	**OM**	**IM**	**SWOE**	**MS**	
HATCHLING	24					24		
2-3 *(0.6-0.9)*	4				1	3		
3-4 *(0.9-1.2)*	21	2		4		15		
4-5 *(1.2-1.5)*	14	1			1	10	2	
5-6 *(1.5-1.8)*	15			3		12		
6-7 *(1.8-2.1)*	11			1		9	1	
>7 *(>2.1)*	9			3		5	1	
EO<6 *(<1.8)*	4			1		3		
EO>6 *(>1.8)*	4					4		
EO	10	1		1		7	1	
TOTAL	116	4	—	13	2	92	5	—

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 18.7.2
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Liverpool River mainstream, July 16-17, 1979.

TABLE 18.7.3
OVERALL LIVERPOOL RIVER CREEKS, JULY 16-21, 1979

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	5					5		
2-3 *(0.6-0.9)*	4					4		
3-4 *(0.9-1.2)*	5			2		3		
4-5 *(1.2-1.5)*	7	1		1	1	4		
5-6 *(1.5-1.8)*	5			1		3	1	
6-7 *(1.8-2.1)*	9		2			7		
>7 *(>2.1)*	9		1	1	1	6		
EO<6 *(<1.8)*	3					3		
EO>6 *(>1.8)*	1					1		
EO	2					1	1	
TOTAL	50	1	3	5	2	37	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 18.7.3
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool River creeks, July 16-21, 1979. Note that one hatchling and 2 (>7') animals are included, which were sighted on Toms Creek (8.9 km). Total distance surveyed was 36.3 km.

TABLE 18.7.4
TOMKINSON RIVER, JULY 15, 1979

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	260		5	16		236	3	5
2-3 *(0.6-0.9)*	3			1		2		
3-4 *(0.9-1.2)*	13			1	3	9		
4-5 *(1.2-1.5)*	22	1		2	2	17		
5-6 *(1.5-1.8)*	14	1			4	9		
6-7 *(1.8-2.1)*	9	1	1			7		
>7 *(>2.1)*	2			1		1		
EO<6 *(<1.8)*	4					4		
EO>6 *(>1.8)*	4					4		
EO	18					14	4	
TOTAL	349	3	6	21	9	303	7	5

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 18.7.4
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Tomkinson River, July 15, 1979.

TABLE 18.7.5
OVERALL LIVERPOOL-TOMKINSON SYSTEM, JULY 15-21, 1979

SIZE IN FEET (*metres*)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	289		5	16		265	3	5
2-3 *(0.6-0.9)*	11			1	1	9		
3-4 *(0.9-1.2)*	39	2		7	3	27		
4-5 *(1.2-1.5)*	43	3		3	4	31	2	
5-6 *(1.5-1.8)*	34	1		4	4	24	1	
6-7 *(1.8-2.1)*	29	1	3	1		23	1	
>7 *(>2.1)*	20		1	5	1	12	1	
EO<6 *(<1.8)*	11			1		10		
EO>6 *(>1.8)*	9					9		
EO	30	1		1		22	6	
TOTAL	515	8	9	39	13	432	14	5

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 18.7.5
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool-Tomkinson System, July 15-21, 1979.

TABLE 18.7.6
LIVERPOOL RIVER MAINSTREAM, OCTOBER 19-20, 1979

SIZE IN FEET (*metres*)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	17			1		16		1
2-3 *(0.6-0.9)*	12					12		1
3-4 *(0.9-1.2)*	17			1		16		
4-5 *(1.2-1.5)*	11			2		6	3	
5-6 *(1.5-1.8)*	13	1		2	3	7		
6-7 *(1.8-2.1)*	8	1		1		5	1	
>7 *(>2.1)*	14	2				8	4	
EO<6 *(<1.8)*	1					1		
EO>6 *(>1.8)*	1					1		
EO	18			1		13	4	
TOTAL	112	4	—	8	3	85	12	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 18.7.6
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Liverpool River mainstream, October 19-20, 1979.

TABLE 18.7.7
OVERALL LIVERPOOL RIVER CREEKS, OCTOBER 19-20, 1979

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	2					2		
2-3 *(0.6-0.9)*	1					1		
3-4 *(0.9-1.2)*	7	1				6		
4-5 *(1.2-1.5)*	6			1		5		
5-6 *(1.5-1.8)*	6	1			1	3	1	
6-7 *(1.8-2.1)*	1			1				
>7 *(>2.1)*	3	1			1	1		
EO<6 *(<1.8)*								
EO>6 *(>1.8)*								
EO	2					1	1	
TOTAL	28	3	—	2	2	19	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 18.7.7
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool River creeks, October 19-20, 1979. Total distance surveyed was 27.4 km.

TABLE 18.7.8
TOMKINSON RIVER, OCTOBER 20, 1979

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	142			12		129	1	1
2-3 *(0.6-0.9)*	3					3		
3-4 *(0.9-1.2)*	12			2		9	1	
4-5 *(1.2-1.5)*	20			3	2	13	2	
5-6 *(1.5-1.8)*	10			2	2	4	2	
6-7 *(1.8-2.1)*	8	1		2		5		
>7 *(>2.1)*	6					6		
EO<6 *(<1.8)*	3	1				2		
EO>6 *(>1.8)*	1					1		
EO	10					7	3	
TOTAL	215	2	—	21	4	179	9	1

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 18.7.8
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Tomkinson River, October 20, 1979.

TABLE 18.7.9
OVERALL LIVERPOOL-TOMKINSON SYSTEM, OCTOBER 19-20, 1979

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	161			13		147	1	2
2-3 *(0.6-0.9)*	16					16		1
3-4 *(0.9-1.2)*	36	1		3		31	1	
4-5 *(1.2-1.5)*	37			6	2	24	5	
5-6 *(1.5-1.8)*	29	2		4	6	14	3	
6-7 *(1.8-2.1)*	17	2		4		10	1	
>7 *(>2.1)*	23	3			1	15	4	
EO<6 *(<1.8)*	4	1				3		
EO>6 *(>1.8)*	2					2		
EO	30			1		20	9	
TOTAL	355	9	—	31	9	282	24	3

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 18.7.9
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool-Tomkinson System, October 19-20, 1979.

TABLE 18.7.10
LIVERPOOL RIVER MAINSTREAM, OCTOBER 16-18, 1980

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	28			1		27		
2-3 *(0.6-0.9)*	10			2		8		
3-4 *(0.9-1.2)*	11			1		10		
4-5 *(1.2-1.5)*	15	2		1	1	10	1	
5-6 *(1.5-1.8)*	13	1				10	2	
6-7 *(1.8-2.1)*	5					5		
>7 *(>2.1)*	8			1		7		
EO<6 *(<1.8)*	4					4		
EO>6 *(>1.8)*	10					9	1	
EO	10	1				9		
TOTAL	114	4	—	6	1	99	4	—

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 18.7.10
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Liverpool River mainstream, October 16-18, 1980.

TABLE 18.7.11
OVERALL LIVERPOOL RIVER CREEKS, OCTOBER 15-18, 1980

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	17			1		16		
2-3 *(0.6-0.9)*	2			1		1		
3-4 *(0.9-1.2)*	8			4	1	3		
4-5 *(1.2-1.5)*	9			2	1	6		
5-6 *(1.5-1.8)*	2			1		1		
6-7 *(1.8-2.1)*	1			1				
>7 *(>2.1)*	1					1		
EO<6 *(<1.8)*	3					2	1	
EO>6 *(>1.8)*	4					3	1	
EO	2					2		
TOTAL	49	—	—	10	2	35	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 18.7.11
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool River creeks, October 15-18, 1980. Total distance surveyed was 27.4 km.

TABLE 18.7.12
TOMKINSON RIVER, OCTOBER 17, 1980

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	26			1		25		
2-3 *(0.6-0.9)*	39			14	1	24		1
3-4 *(0.9-1.2)*	18	2		4	2	6	4	
4-5 *(1.2-1.5)*	8			1		7		
5-6 *(1.5-1.8)*	14			3		10	1	
6-7 *(1.8-2.1)*	6			1		5		
>7 *(>2.1)*	5					4	1	
EO<6 *(<1.8)*	4					4		
EO>6 *(>1.8)*	2					1	1	
EO	10	1				8	1	
TOTAL	132	3	—	24	3	94	8	1

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 18.7.12
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Tomkinson River, October 17, 1980.

TABLE 18.7.13
OVERALL LIVERPOOL-TOMKINSON SYSTEM, OCTOBER 15-18, 1980

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	71			3		68		
2-3 *(0.6-0.9)*	51			17	1	33		1
3-4 *(0.9-1.2)*	37	2		9	3	19	4	
4-5 *(1.2-1.5)*	32	2		4	2	23	1	
5-6 *(1.5-1.8)*	29	1		4		21	3	
6-7 *(1.8-2.1)*	12			2		10		
>7 *(>2.1)*	14			1		12	1	
EO<6 *(<1.8)*	11					10	1	
EO>6 *(>1.8)*	16					13	3	
EO	22	2				19	1	
TOTAL	295	7	—	40	6	228	14	1

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 18.7.13
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool-Tomkinson System, October 15-18, 1980.

TABLE 18.7.14
LIVERPOOL RIVER MAINSTREAM, JULY 2-3, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	8					7	1	
2-3 *(0.6-0.9)*	28			7	2	18	1	
3-4 *(0.9-1.2)*	20	1		2		16	1	
4-5 *(1.2-1.5)*	9			1		8		
5-6 *(1.5-1.8)*	8			1		7		
6-7 *(1.8-2.1)*	7			1		6		
>7 *(>2.1)*	6					6		
EO<6 *(<1.8)*	6					6		
EO>6 *(>1.8)*	4					4		
EO	10			1		7	2	
TOTAL	106	1	—	13	2	85	5	—

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 18.7.14
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Liverpool River mainstream, July 2-3, 1981.

TABLE 18.7.15
OVERALL LIVERPOOL RIVER CREEKS, JULY 2-7, 1981

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	1					1		
2-3 (0.6-0.9)	5			1		4		
3-4 (0.9-1.2)	5			2		2	1	
4-5 (1.2-1.5)	5					5		
5-6 (1.5-1.8)	5					5		
6-7 (1.8-2.1)								
>7 (>2.1)	4					3	1	
EO<6 (<1.8)	3					3		
EO>6 (>1.8)	1						1	
EO	3					2	1	
TOTAL	32	—	—	3	—	25	4	—

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 18.7.15
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool River creeks, July 2-7, 1981. Total distance surveyed was 26.9 km.

'TABLE 18.7.16
TOMKINSON RIVER, JULY 6, 1981

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	17					17		
2-3 (0.6-0.9)	19			1	1	17		
3-4 (0.9-1.2)	23			6	1	16		
4-5 (1.2-1.5)	15			2		11	2	1
5-6 (1.5-1.8)	10			1		8	1	
6-7 (1.8-2.1)	8					8		
>7 (>2.1)	5					3	2	
EO<6 (<1.8)								
EO>6 (>1.8)	10					6	4	
EO	11		2			6	3	
TOTAL	118	—	2	10	2	92	12	1

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 18.7.16
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Tomkinson River, July 6, 1981.

TABLE 18.7.17
OVERALL LIVERPOOL-TOMKINSON SYSTEM, JULY 2-7, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	26					25	1	
2-3 *(0.6-0.9)*	52			9	3	39	1	
3-4 *(0.9-1.2)*	48	1		10	1	34	2	
4-5 *(1.2-1.5)*	29			3		24	2	1
5-6 *(1.5-1.8)*	23			2		20	1	
6-7 *(1.8-2.1)*	15			1		14		
>7 *(>2.1)*	15					12	3	
EO<6 *(<1.8)*	9					9		
EO>6 *(>1.8)*	15					10	5	
EO	24		2	1		15	6	
TOTAL	256	1	2	26	4	202	21	1

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 18.7.17
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool-Tomkinson System, July 2-7, 1981.

TABLE 18.7.18
LIVERPOOL RIVER MAINSTREAM, OCTOBER 13-14, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	2					2		
2-3 *(0.6-0.9)*	20				3	17		
3-4 *(0.9-1.2)*	22	1		3	4	14		
4-5 *(1.2-1.5)*	14			1	1	10	2	
5-6 *(1.5-1.8)*	8					8		
6-7 *(1.8-2.1)*	4	1				3		
>7 *(>2.1)*	5					4	1	
EO<6 *(<1.8)*	11					10	1	
EO>6 *(>1.8)*	6					6		
EO	3	1				2		
TOTAL	95	3	—	4	8	76	4	—

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 18.7.18
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Liverpool River mainstream, October 13-14, 1981.

TABLE 18.7.19
OVERALL LIVERPOOL RIVER CREEKS, OCTOBER 5-14, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	2					2		
2-3 *(0.6-0.9)*	4			1	1	2		
3-4 *(0.9-1.2)*	11	2		5	1	2	1	
4-5 *(1.2-1.5)*	4			2		1	1	
5-6 *(1.5-1.8)*	3			1		2		
6-7 *(1.8-2.1)*	2					2		
>7 *(>2.1)*	2					2		
EO<6 *(<1.8)*	3					3		
EO>6 *(>1.8)*	4			1		2	1	
EO	2					2		
TOTAL	37	2	—	10	2	20	3	—

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 18.7.19
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool River creeks, October 5-14, 1981. Total distance surveyed was 27.4 km.

TABLE 18.7.20
TOMKINSON RIVER, OCTOBER 6, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	30					29	1	
2-3 *(0.6-0.9)*	9				1	8		
3-4 *(0.9-1.2)*	17			5	1	10	1	
4-5 *(1.2-1.5)*	16			1	3	10	2	
5-6 *(1.5-1.8)*	12			2	1	8	1	
6-7 *(1.8-2.1)*	8	1		2		5		
>7 *(>2.1)*	7			1		5	1	
EO<6 *(<1.8)*	6	2		1		3		
EO>6 *(>1.8)*	12			1		3	8	
EO	5	1				4		
TOTAL	122	4	—	13	6	85	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 18.7.20
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Tomkinson River, October 6, 1981.

TABLE 18.7.21
OVERALL LIVERPOOL-TOMKINSON SYSTEM, OCTOBER 5-14, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	34					33	1	
2-3 *(0.6-0.9)*	33			1	5	27		
3-4 *(0.9-1.2)*	50	3		13	6	26	2	
4-5 *(1.2-1.5)*	34			4	4	21	5	
5-6 *(1.5-1.8)*	23			3	1	18	1	
6-7 *(1.8-2.1)*	14	2		2		10		
>7 *(>2.1)*	14			1		11	2	
EO<6 *(<1.8)*	20	2		1		16	1	
EO>6 *(>1.8)*	22			2		11	9	
EO	10	2				8		
TOTAL	254	9	—	27	16	181	21	—

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 18.7.21
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool-Tomkinson System, October 5-14, 1981.

TABLE 18.7.22
LIVERPOOL RIVER MAINSTREAM, JUNE 19-20, 1982

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	7					7		
2-3 *(0.6-0.9)*	7			2		5		
3-4 *(0.9-1.2)*	23			2		21		1
4-5 *(1.2-1.5)*	14				1	13		
5-6 *(1.5-1.8)*	13					13		1
6-7 *(1.8-2.1)*	11			1		9	1	
>7 *(>2.1)*	10	1		2		6	1	
EO<6 *(<1.8)*	6					6		
EO>6 *(>1.8)*	8					7	1	
EO	4					3	1	
TOTAL	103	1	—	7	1	90	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 18.7.22
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Liverpool River mainstream, June 19-20, 1982.

TABLE 18.7.23
OVERALL LIVERPOOL RIVER CREEKS, JUNE 12-20, 1982

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	8					8		
2-3 *(0.6-0.9)*	2					2		
3-4 *(0.9-1.2)*	14			2		12		
4-5 *(1.2-1.5)*	7	1		2		4		
5-6 *(1.5-1.8)*	8			1		7		
6-7 *(1.8-2.1)*	2					2		
>7 *(>2.1)*	3					3		
EO<6 *(<1.8)*	3					3		
EO>6 *(>1.8)*	4					3	1	
EO	3					2	1	
TOTAL	54	1	—	5	—	46	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 18.7.23
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool River creeks, June 12-20, 1982. Total distance surveyed was 27.4 km.

TABLE 18.7.24
TOMKINSON RIVER, JUNE 22-23, 1982

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	178			2		175	1	
2-3 *(0.6-0.9)*	20			1	1	18		
3-4 *(0.9-1.2)*	27			2	1	24		
4-5 *(1.2-1.5)*	29	1		3		21	4	
5-6 *(1.5-1.8)*	16			1		13	2	
6-7 *(1.8-2.1)*	10					8	2	1
>7 *(>2.1)*	4					3	1	
EO<6 *(<1.8)*	6					5	1	
EO>6 *(>1.8)*	11					7	4	
EO	9					8	1	
TOTAL	310	1	—	9	2	282	16	1

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 18.7.24
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Tomkinson River, June 22-23, 1982.

TABLE 18.7.25
OVERALL LIVERPOOL-TOMKINSON SYSTEM, JUNE 12-23, 1982

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	193			2		190	1	
2-3 *(0.6-0.9)*	29			3	1	25		
3-4 *(0.9-1.2)*	64			6	1	57		1
4-5 *(1.2-1.5)*	50	2		5	1	38	4	
5-6 *(1.5-1.8)*	37			2		33	2	1
6-7 *(1.8-2.1)*	23			1		19	3	1
>7 *(>2.1)*	17	1		2		12	2	
EO<6 *(<1.8)*	15					14	1	
EO>6 *(>1.8)*	23					17	6	
EO	16					13	3	
TOTAL	467	3	—	21	3	418	22	3

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 18.7.25
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool-Tomkinson System, June 12-23, 1982.

TABLE 18.7.26
LIVERPOOL RIVER MAINSTREAM, OCTOBER 16-18, 1982

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	6					6		
2-3 *(0.6-0.9)*	4					4		
3-4 *(0.9-1.2)*	26			3		22	1	
4-5 *(1.2-1.5)*	29			2		27		
5-6 *(1.5-1.8)*	13					13		
6-7 *(1.8-2.1)*	9				1	7	1	
>7 *(>2.1)*	7					7		
EO<6 *(<1.8)*	6					6		
EO>6 *(>1.8)*	9					7	2	
EO	6					4	2	
TOTAL	115	—	—	5	1	103	6	—

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 18.7.26
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Liverpool River mainstream, October 16-18, 1982.

TABLE 18.7.27
OVERALL LIVERPOOL RIVER CREEKS, OCTOBER 16-24, 1982

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)*	4					4		
3-4 *(0.9-1.2)*	7	1				6		
4-5 *(1.2-1.5)*	8	1		2	1	4		
5-6 *(1.5-1.8)*	4	1			1	2		
6-7 *(1.8-2.1)*	4	1		1		2		
>7 *(>2.1)*	5					5		
EO<6 *(<1.8)*	6	1		1		4		
EO>6 *(>1.8)*	10					8	2	
EO	2					2		
TOTAL	53	5	—	4	2	40	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 18.7.27
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool River creeks, October 16-24, 1982. Total distance surveyed was 27.4 km.

TABLE 18.7.28
TOMKINSON RIVER, OCTOBER 22-NOVEMBER 1, 1982

SIZE IN FEET *(metres)*	**NUMBER OF CROCS**	**SITUATION**						**OBSERVED FEEDING**
		IV	**IVIW**	**OM**	**IM**	**SWOE**	**MS**	
HATCHLING	135			3		132		3
2-3 *(0.6-0.9)*	8			1		7		
3-4 *(0.9-1.2)*	15	2		4		8	1	
4-5 *(1.2-1.5)*	14	1		3		8	2	
5-6 *(1.5-1.8)*	8					8		1
6-7 *(1.8-2.1)*	8					7	1	
>7 *(>2.1)*	5				1	3	1	
EO<6 *(<1.8)*	3					3		
EO>6 *(>1.8)*	14					8	6	
EO	6					5	1	
TOTAL	216	3	—	11	1	189	12	4

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 18.7.28
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Tomkinson River, October 22-November 1, 1982.

TABLE 18.7.29
OVERALL LIVERPOOL-TOMKINSON SYSTEM, OCTOBER 16-NOVEMBER 1, 1982

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	144			3		141		3
2-3 *(0.6-0.9)*	16			1		15		
3-4 *(0.9-1.2)*	48	3		7		36	2	
4-5 *(1.2-1.5)*	51	2		7	1	39	2	
5-6 *(1.5-1.8)*	25	1			1	23		1
6-7 *(1.8-2.1)*	21	1		1	1	16	2	
>7 *(>2.1)*	17				1	15	1	
EO<6 *(<1.8)*	15	1		1		13		
EO>6 *(>1.8)*	33					23	10	
EO	14					11	3	
TOTAL	384	8	—	20	4	332	20	4

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 18.7.29
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool-Tomkinson System, October 16-November 1, 1982.

TABLE 18.7.30
LIVERPOOL RIVER MAINSTREAM, JULY 5-6, 1983

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	27			2		25		
2-3 *(0.6-0.9)*	7					7		
3-4 *(0.9-1.2)*	25					25		2
4-5 *(1.2-1.5)*	22			2		20		
5-6 *(1.5-1.8)*	12					11	1	
6-7 *(1.8-2.1)*	7					7		
>7 *(>2.1)*	5			1		3	1	
EO<6 *(<1.8)*	7					7		
EO>6 *(>1.8)*	6					6		
EO	3					3		
TOTAL	121	—	—	5	—	114	2	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 18.7.30
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Liverpool River mainstream, July 5-6, 1983.

TABLE 18.7.31
OVERALL LIVERPOOL RIVER CREEKS, JULY 1-6, 1983

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)	2					2		
3-4 (0.9-1.2)	10			2		8		
4-5 (1.2-1.5)	16	1		1		14		
5-6 (1.5-1.8)	6			1		5		
6-7 (1.8-2.1)	5			1		4		
>7 (>2.1)	2					1	1	
EO<6 (<1.8)	1					1		
EO>6 (>1.8)	6					6		
EO								
TOTAL	51	1	—	5	—	44	1	—

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 18.7.31
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool River creeks, July 1-6, 1983. Total distance surveyed was 27.4 km.

TABLE 18.7.32
TOMKINSON RIVER, JULY 3-4, 1983

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	91			1		90		4
2-3 (0.6-0.9)	74			9		64	1	
3-4 (0.9-1.2)	29			3		26		3
4-5 (1.2-1.5)	18					15	3	
5-6 (1.5-1.8)	14					13	1	
6-7 (1.8-2.1)	5					4	1	
>7 (>2.1)	8			1		6	1	
EO<6 (<1.8)	14	1				12	1	
EO>6 (>1.8)	4					1	3	
EO	3					3		
TOTAL	260	1	—	14	—	234	11	7

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 18.7.32
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Tomkinson River, July 3-4, 1983.

TABLE 18.7.33
OVERALL LIVERPOOL-TOMKINSON SYSTEM, JULY 1-6, 1983

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	121			3		118		4
2-3 *(0.6-0.9)*	83			9		73	1	
3-4 *(0.9-1.2)*	64			5		59		5
4-5 *(1.2-1.5)*	56	1		3		49	3	
5-6 *(1.5-1.8)*	32			1		29	2	
6-7 *(1.8-2.1)*	17			1		15	1	
>7 *(>2.1)*	15			2		10	3	
EO<6 *(<1.8)*	22	1				20	1	
EO>6 *(>1.8)*	16					13	3	
EO	6					6		
TOTAL	432	2	—	24	—	392	14	9

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 18.7.33
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool-Tomkinson System, July 1-6, 1983.

TABLE 18.7.34
LIVERPOOL RIVER MAINSTREAM, OCTOBER 17-18, 1983

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	21			2		19		
2-3 *(0.6-0.9)*	6			1		5		
3-4 *(0.9-1.2)*	22			1	3	18		
4-5 *(1.2-1.5)*	18			1	1	16		
5-6 *(1.5-1.8)*	13			2	1	9	1	
6-7 *(1.8-2.1)*	4					4		
>7 *(>2.1)*	4					3	1	
EO<6 *(<1.8)*	2					2		
EO>6 *(>1.8)*	13			1		10	2	
EO	7					6	1	
TOTAL	110	—	—	8	5	92	5	—

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 18.7.34
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Liverpool River mainstream, October 17-18, 1983.

TABLE 18.7.35
OVERALL LIVERPOOL RIVER CREEKS, OCTOBER 13-18, 1983

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	2					2		
2-3 *(0.6-0.9)*	3					3		
3-4 *(0.9-1.2)*	5			1		4		
4-5 *(1.2-1.5)*	9	2				7		
5-6 *(1.5-1.8)*	8	1				7		
6-7 *(1.8-2.1)*	1					1		
>7 *(>2.1)*	5	1		1		3		
EO<6 *(<1.8)*								
EO>6 *(>1.8)*	4					2	2	
EO	2	1				1		
TOTAL	39	5	—	2	—	30	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 18.7.35
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool River creeks, October 13-18, 1983. Total distance surveyed was 27.4 km.

TABLE 18.7.36
TOMKINSON RIVER, OCTOBER 14-16, 1983

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	40			4		36		3
2-3 *(0.6-0.9)*	68			17		51		2
3-4 *(0.9-1.2)*	20			3		17		
4-5 *(1.2-1.5)*	12			2		7	3	
5-6 *(1.5-1.8)*	13			1		10	2	
6-7 *(1.8-2.1)*	3					2	1	
>7 *(>2.1)*	5			1		3	1	
EO<6 *(<1.8)*	4					4		
EO>6 *(>1.8)*	11					8	3	
EO	2					2		
TOTAL	178	—	—	28	—	140	10	5

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 18.7.36
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Tomkinson River, October 14-16, 1983.

TABLE 18.7.37
OVERALL LIVERPOOL-TOMKINSON SYSTEM, OCTOBER 13-18, 1983

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	63			6		57		3
2-3 (0.6-0.9)	77			18		59		2
3-4 (0.9-1.2)	47			5	3	39		
4-5 (1.2-1.5)	39	2		3	1	30	3	
5-6 (1.5-1.8)	34	1		3	1	26	3	
6-7 (1.8-2.1)	8					7	1	
>7 (>2.1)	14	1		2		9	2	
EO<6 (<1.8)	6					6		
EO>6 (>1.8)	28			1		20	7	
EO	11	1				9	1	
TOTAL	327	5	—	38	5	262	17	5

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 18.7.37
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the overall Liverpool-Tomkinson System, October 13-18, 1983.

TABLE 18.7.38
UPSTREAM LIVERPOOL RIVER, KM60-66.4, OCTOBER 26, 1982

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

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 18.7.38
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the upstream Liverpool River km60-66.4, October 26, 1982.

TABLE 18.7.39
UPSTREAM LIVERPOOL RIVER, KM60-66.4, JUNE 29, 1983

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

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 18.7.39
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the upstream Liverpool River km60-66.4, June 29, 1983.

TABLE 18.7.40
UPSTREAM LIVERPOOL RIVER, KM60-66.4, OCTOBER 8, 1983

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

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 18.7.40
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the upstream Liverpool River km60-66.4, October 8, 1983.

TABLE 18.7.41
UPSTREAM TOMKINSON RIVER, KM73.7-81.3, JUNE 23 AND JULY 2, 1982

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*	1					1		
4-5 *(1.2-1.5)*	7					7		
5-6 *(1.5-1.8)*	5			1		4		
6-7 *(1.8-2.1)*	5					5		
>7 *(>2.1)*	3					3		
EO<6 *(<1.8)*	3					3		
EO>6 *(>1.8)*	8					8		
EO								
TOTAL	32	—	—	1	—	31	—	—

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 18.7.41
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the upstream Tomkinson River km73.7-81.3, June 23 and July 2, 1982.

TABLE 18.7.42
UPSTREAM TOMKINSON RIVER, KM73.7-81.3, NOVEMBER 1, 1982

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*	1					1		
4-5 *(1.2-1.5)*	3					3		
5-6 *(1.5-1.8)*	1					1		
6-7 *(1.8-2.1)*	5					5		
>7 *(>2.1)*	2					2		
EO<6 *(<1.8)*								
EO>6 *(>1.8)*	11					6	5	
EO	1					1		
TOTAL	24	—	—	—	—	19	5	—

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 18.7.42
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the upstream Tomkinson River km73.7-81.3, November 1, 1982.

TABLE 18.7.43
UPSTREAM TOMKINSON RIVER, KM73.7-81.3, JULY 4, 1983

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	2					2		
2-3 (0.6-0.9)	1					1		
3-4 (0.9-1.2)	2					2		
4-5 (1.2-1.5)	4					4		
5-6 (1.5-1.8)	9					9		
6-7 (1.8-2.1)	3					3		
>7 (>2.1)	3					2	1	
EO<6 (<1.8)	1					1		
EO>6 (>1.8)	4					4		
EO								
TOTAL	29	—	—	—	—	28	1	—

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 18.7.43
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the upstream Tomkinson River km73.7-81.3, July 4, 1983.

TABLE 18.7.44
UPSTREAM TOMKINSON RIVER, KM73.7-81.3, OCTOBER 14 AND 19, 1983

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 (0.6-0.9)								
3-4 (0.9-1.2)	1					1		
4-5 (1.2-1.5)	1					1		
5-6 (1.5-1.8)	4					4		
6-7 (1.8-2.1)	1					1		
>7 (>2.1)	5					4	1	
EO<6 (<1.8)	1					1		
EO>6 (>1.8)	3					3		
EO	1					1		
TOTAL	17	—	—	—	—	16	1	—

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 18.7.44
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the upstream Tomkinson River km73.7-81.3, October 14 and 19, 1983.

TABLE 18.7.45

Number of hatchlings, small (2-6′) and large (≥6′) crocodiles sighted on the Liverpool River creeks during the general night spotlight surveys of 1979-1983. A subscript refers to the number of (2-3′) animals which are included in the number shown. Note that Toms Creek is omitted here from the July 1979 survey when one hatchling and 2 (>7′) animals were sighted. When fractions of a crocodile are shown, this is because the EO crocodiles sighted are divided half and half between the (3-6′) and large size classes.

	H	S	L	H	S	L	H	S	L	H	S	L	H	S	L	H	S	L	H	S	L	H	S	L	H	S	L
	JULY 1979			OCTOBER 1979			OCTOBER 1980			JULY 1981			OCTOBER 1981			JUNE 1982			OCTOBER 1982			JULY 1983			OCTOBER 1983		
Gudjerama	—	5.5	2.5	—	3	—	—	6.5	0.5	—	6	3	—	8	3	1	8	1	—	10	6	—	5.5_1	2.5	—	6.5_1	5.5
Morngarrie	2	4_4	2	1	3_1	1	4	2.5_1	1.5	—	3_2	—	1	3_1	—	3	4_1	1	1	3_1	1	3	6_1	—	2	2_1	—
Mungardobolo	1	8.5	5.5	—	7	2	9	10.5	1.5	1	6.5_2	0.5	1	11_3	1	—	17.5_1	2.5	—	12.5_3	3.5	—	16.5	2.5	—	11_1	1
Maragulidban	1	6	9	1	7.5	0.5	4	5.5_1	2.5	—	8_1	3	—	4	4	4	5	5	2	5	7	—	8.5	5.5	—	7.5	1.5
Atlas	—	—	—	—	0.5	1.5	—	0.5	0.5	—	—	1	—	0.5	0.5	—	1.5	0.5	—	1.5	0.5	—	1	—	—	1	1
TOTALS	4	24_4	19	2	21_1	5	17	25.5_2	6.5	1	23.5_5	7.5	2	26.5_4	8.5	8	36_2	10	3	32_4	18	3	37.5_2	10.5	2	28_3	9

TABLE 18.7.46
NUNGBULGARRI CREEK, JULY 19, 1979

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	10			1		8	1	
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*	4					4		
4-5 *(1.2-1.5)*	4		1			3		
5-6 *(1.5-1.8)*	6					6		
6-7 *(1.8-2.1)*	5					5		
>7 *(>2.1)*	2			1		1		
EO<6 *(<1.8)*	2					2		
EO>6 *(>1.8)*	1					1		
EO	1					1		
TOTAL	35	—	1	2	—	31	1	—

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 18.7.46
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of Nungbulgarri Creek, July 19, 1979. Total distance surveyed was 14.8 km.

TABLE 18.7.47
NUNGBULGARRI CREEK, JUNE 30, 1981

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	2			1		1		
2-3 *(0.6-0.9)*	4					4		
3-4 *(0.9-1.2)*	10			1		9		
4-5 *(1.2-1.5)*	4					4		
5-6 *(1.5-1.8)*								
6-7 *(1.8-2.1)*	1					1		
>7 *(>2.1)*								
EO<6 *(<1.8)*								
EO>6 *(>1.8)*	2					1	1	
EO	4					4		
TOTAL	27	—	—	2	—	24	1	—

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 18.7.47
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of Nungbulgarri Creek, June 30, 1981. Total distance surveyed was 14.8 km.

TABLE 18.7.48
NUNGBULGARRI CREEK, OCTOBER 11, 1981

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 *(0.6-0.9)*	2					2		
3-4 *(0.9-1.2)*	12	5			1	6		
4-5 *(1.2-1.5)*	4	1				2	1	
5-6 *(1.5-1.8)*	2					1	1	
6-7 *(1.8-2.1)*								
>7 *(>2.1)*								
EO<6 *(<1.8)*	2	1		1				
EO>6 *(>1.8)*	2			1			1	
EO	1						1	
TOTAL	25	7	—	2	1	11	4	—

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 18.7.48
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of Nungbulgarri Creek, October 11, 1981. Total distance surveyed was 14.8 km.

TABLE 18.7.49
NUNGBULGARRI CREEK, JUNE 17, 1982

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 *(0.6-0.9)*	2					2		
3-4 *(0.9-1.2)*	8			1		7		1
4-5 *(1.2-1.5)*	4			1		3		
5-6 *(1.5-1.8)*	3					3		1
6-7 *(1.8-2.1)*	1						1	
>7 *(>2.1)*	1						1	
EO<6 *(<1.8)*	1					1		
EO>6 *(>1.8)*	1					1		
EO	2					2		
TOTAL	23	—	—	2	—	19	2	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 18.7.49
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of Nungbulgarri Creek, June 17, 1982. Total distance surveyed was 14.8 km.

TABLE 18.7.50
NUNGBULGARRI CREEK, OCTOBER 14, 1982

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING								
2-3 (0.6-0.9)	1					1		
3-4 (0.9-1.2)	9				1	8		
4-5 (1.2-1.5)	8	1			1	6		
5-6 (1.5-1.8)	2				1	1		
6-7 (1.8-2.1)	2				1	1		
>7 (>2.1)	4				1	2	1	
EO<6 (<1.8)	1					1		
EO>6 (>1.8)	1					1		
EO	1					1		
TOTAL	29	1	–	–	5	22	1	–

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 18.7.50
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of Nungbulgarri Creek, October 14, 1982. Total distance surveyed was 14.4 km.

TABLE 18.7.51
NUNGBULGARRI CREEK, JUNE 21, 1983

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	34					34		
2-3 (0.6-0.9)	2					2		
3-4 (0.9-1.2)	6			1		5		
4-5 (1.2-1.5)	5			1		3	1	
5-6 (1.5-1.8)	5					4	1	
6-7 (1.8-2.1)								
>7 (>2.1)								
EO<6 (<1.8)	1					1		
EO>6 (>1.8)	1						1	
EO	1	1						
TOTAL	55	1	–	2	–	49	3	–

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 18.7.51
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of Nungbulgarri Creek, June 21, 1983. Total distance surveyed was 14.4 km.

TABLE 18.7.52
NUNGBULGARRI CREEK, OCTOBER 4, 1983

SIZE IN FEET *(metres)*	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	15			2		13		
2-3 *(0.6-0.9)*	1					1		
3-4 *(0.9-1.2)*	5			1		2	2	
4-5 *(1.2-1.5)*	4			2		2		
5-6 *(1.5-1.8)*	6			4			2	
6-7 *(1.8-2.1)*	1			1				
>7 *(>2.1)*	1					1		
EO<6 *(<1.8)*	1					1		
EO>6 *(>1.8)*	2			1		1		
EO	2			1		1		
TOTAL	38	—	—	12	—	22	4	—

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 18.7.52
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of Nungbulgarri Creek, October 4, 1983. Total distance surveyed was 14.4 km.

TABLE 18.7.53

Tidal times and (heights) in metres at Gove, Darwin and at the vessel's anchorages at positions shown, July, 1979. Also shown are the tidal time delays in minutes between the standard port and vessel's anchorage.

DAY	TIDE	GOVE	DELAY	DARWIN	DELAY	ANCHORAGE
						Liverpool River km11
Saturday	LW	0553 (0.23)	− 73	0300 (0.8)	+ 100	0440 (1.9)
July 14	HW	1209 (2.82)	− 79	0922 (7.2)	+ 88	1050 (5.3)
Moonage	LW	1809 (0.79)	− 69	1542 (1.7)	+ 78	1700 (2.6)
Day 20	HW			2128 (6.3)	+ 86	2255 (5.5)
Sunday	HW	0002 (3.00)	− 67			
July 15	LW	0638 (0.35)	− 78	0343 (1.3)	+ 97	0520 (2.0)
Moonage	HW	1253 (2.78)	− 83	1002 (6.9)	+ 88	1130 (5.2)
Day 21	LW	1857 (0.76)	− 69	1631 (1.8)	+ 77	1748 (2.6)
	HW			2220 (5.9)	+ 82	2342 (5.4)
Monday	HW	0052 (2.86)	− 70			
July 16	LW	0725 (0.52)	− 80	0431 (1.9)	+ 94	0605 (2.2)
Moonage	HW	1338 (2.72)	− 83	1004 (6.4)	+ 91	1215 (5.2)
Day 22	LW	1947 (0.75)	− 67	1723 (2.0)	+ 77	1840 (2.6)
	HW			2318 (5.5)	+ 82	
Tuesday	HW	0146 (2.66)	− 66			0040 (5.1)
July 17	LW	0814 (0.71)	− 79	0525 (2.5)	+ 90	0655 (2.6)
Moonage	HW	1428 (2.65)	− 88	1132 (6.0)	+ 88	1300 (5.1)
Day 23	LW	2044 (0.76)	− 64	1824 (2.1)	+ 76	1940 (2.3)
Wednesday	HW	0250 (2.45)	− 65	0027 (5.3)	+ 78	0145 (4.6)
July 18	LW	0907 (0.92)	− 72	0628 (3.0)	+ 87	0755 (2.4)
Moonage	HW	1523 (2.58)	− 90	1225 (5.6)	+ 88	1353 (5.1)
Day 24	LW	2148 (0.77)	− 63	1930 (2.1)	+ 75	2045 (2.3)
Thursday	HW	0406 (2.29)	− 71	0148 (5.2)	+ 67	0255 (4.5)
July 19	LW	1007 (1.10)	− 60	0740 (3.3)	+ 87	0907 (2.4)
Moonage						*Rolling Bay*
Day 25	HW	1624 (2.54)	− 84	1331 (5.3)	+ 89	1500 (3.3)
	LW	2259 (0.74)	− 59	2043 (2.0)	+ 77	2200 (1.1)

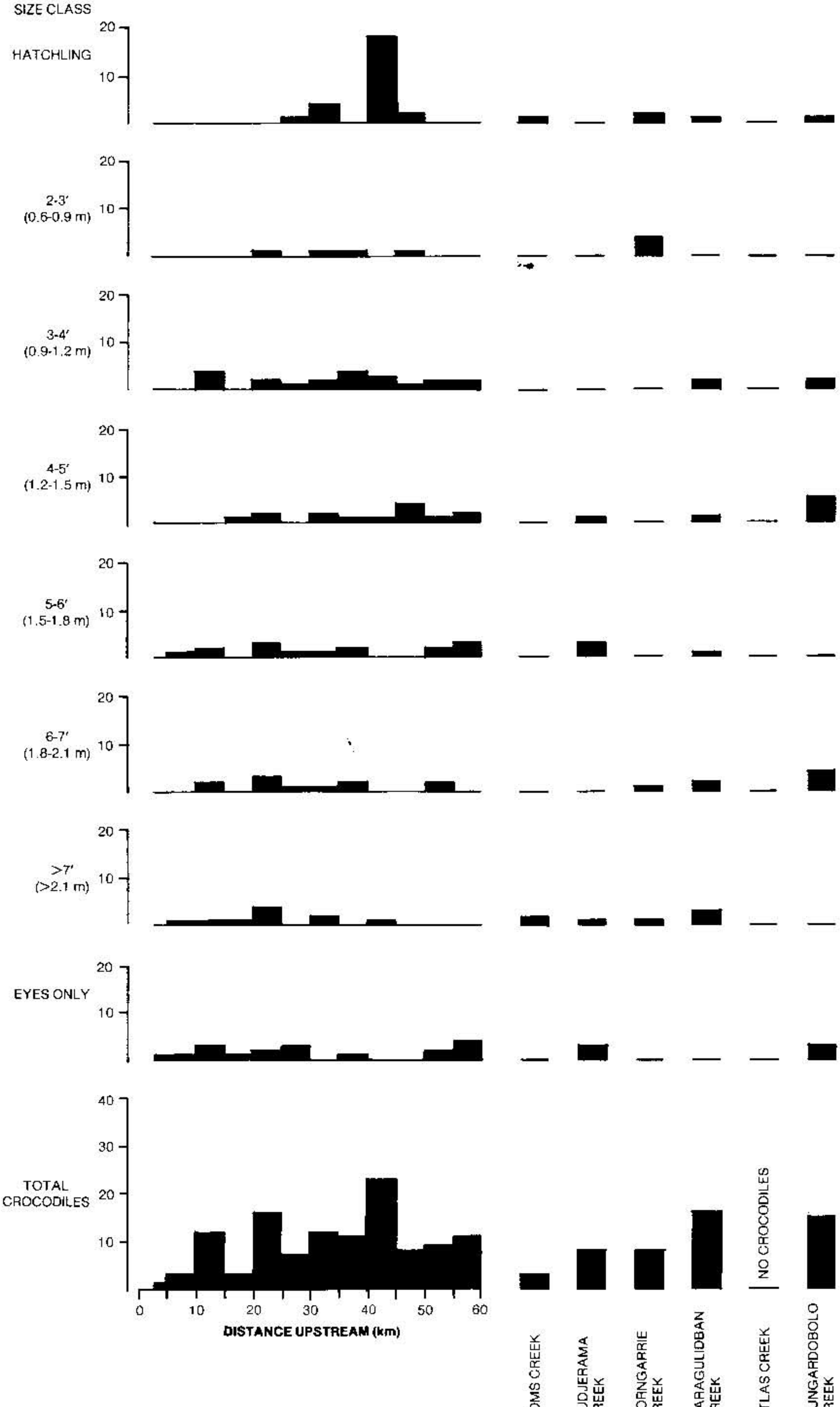


Fig. 18.7.1
Distributional pattern of *Crocodylus porosus* on the Liverpool River and its creeks in July, 1979.

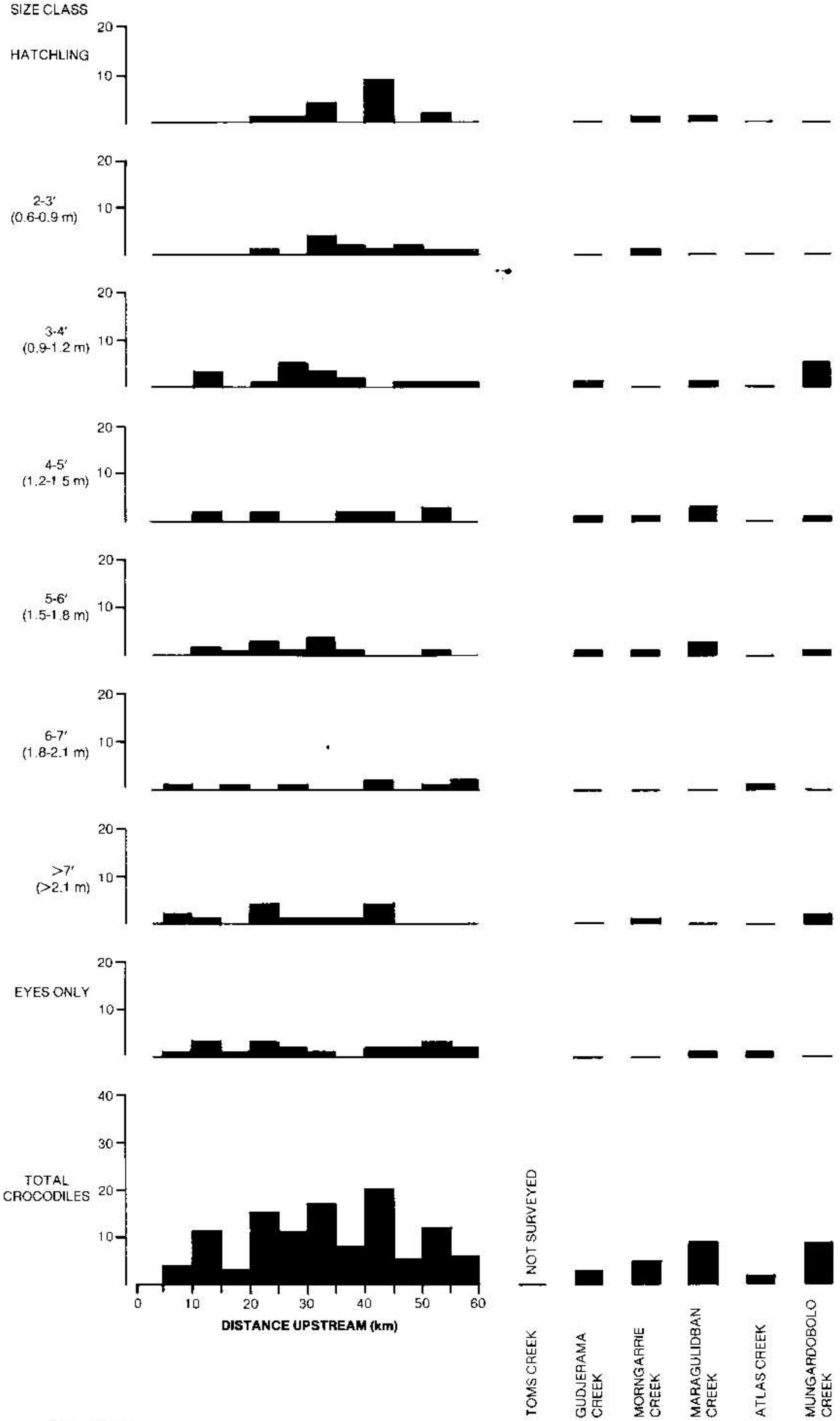


Fig. 18.7.2
Distributional pattern of *Crocodylus porosus* on the Liverpool River and its creeks in October, 1979.

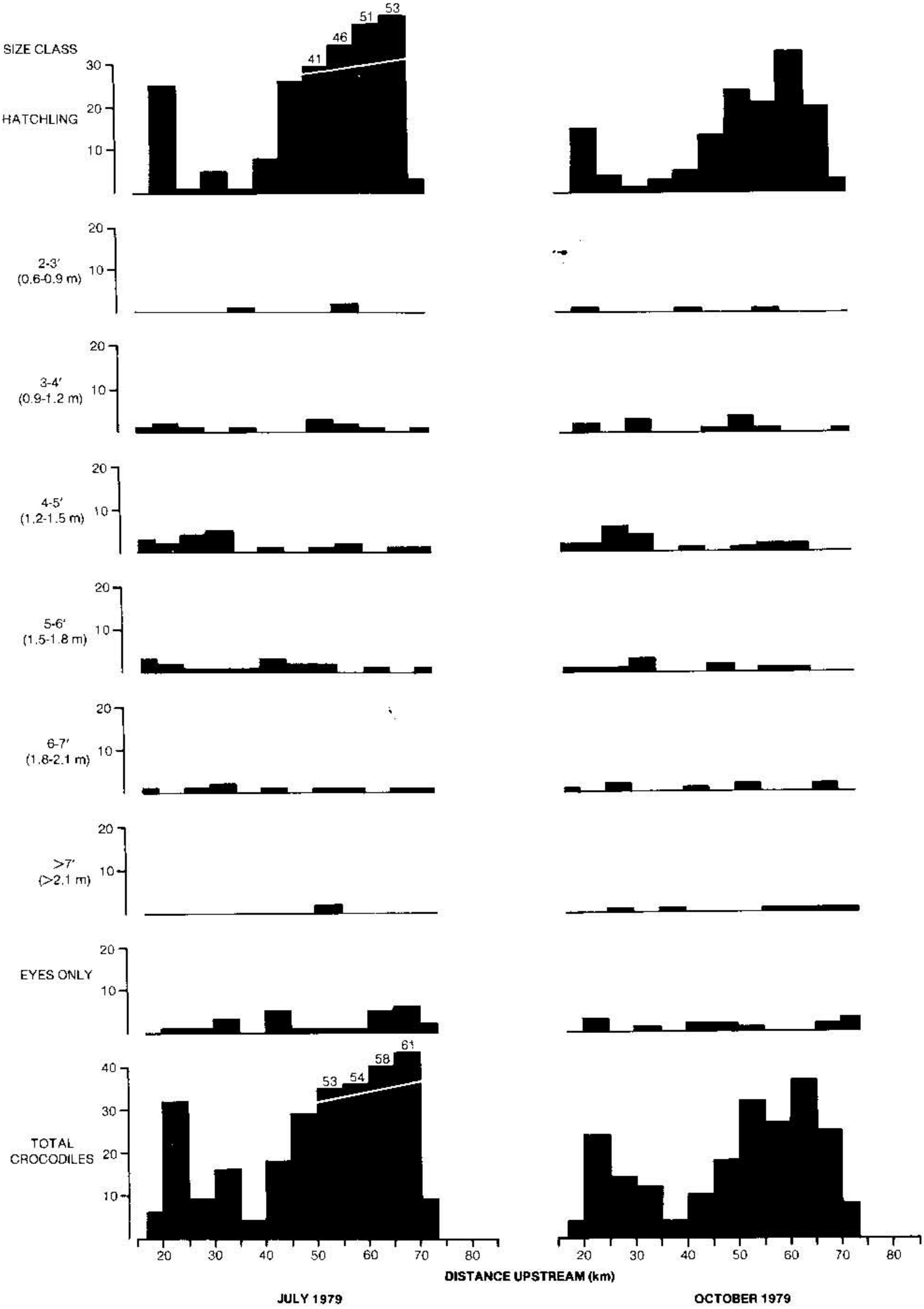


Fig. 18.7.3
Distributional pattern of *Crocodylus porosus* on the Tomkinson River in July and October, 1979.

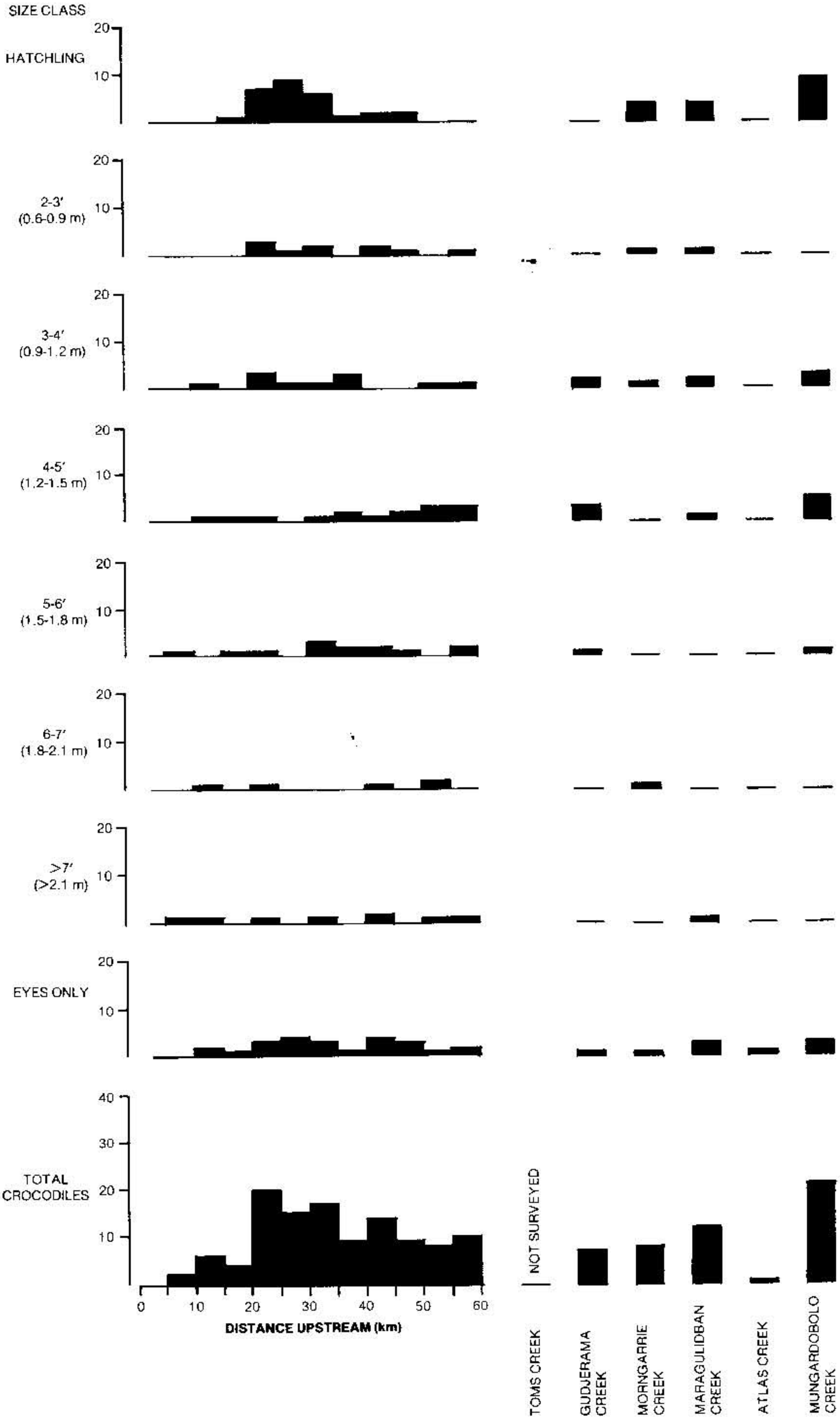


Fig. 18.7.4
Distributional pattern of *Crocodylus porosus* on the Liverpool River and its creeks in October, 1980.

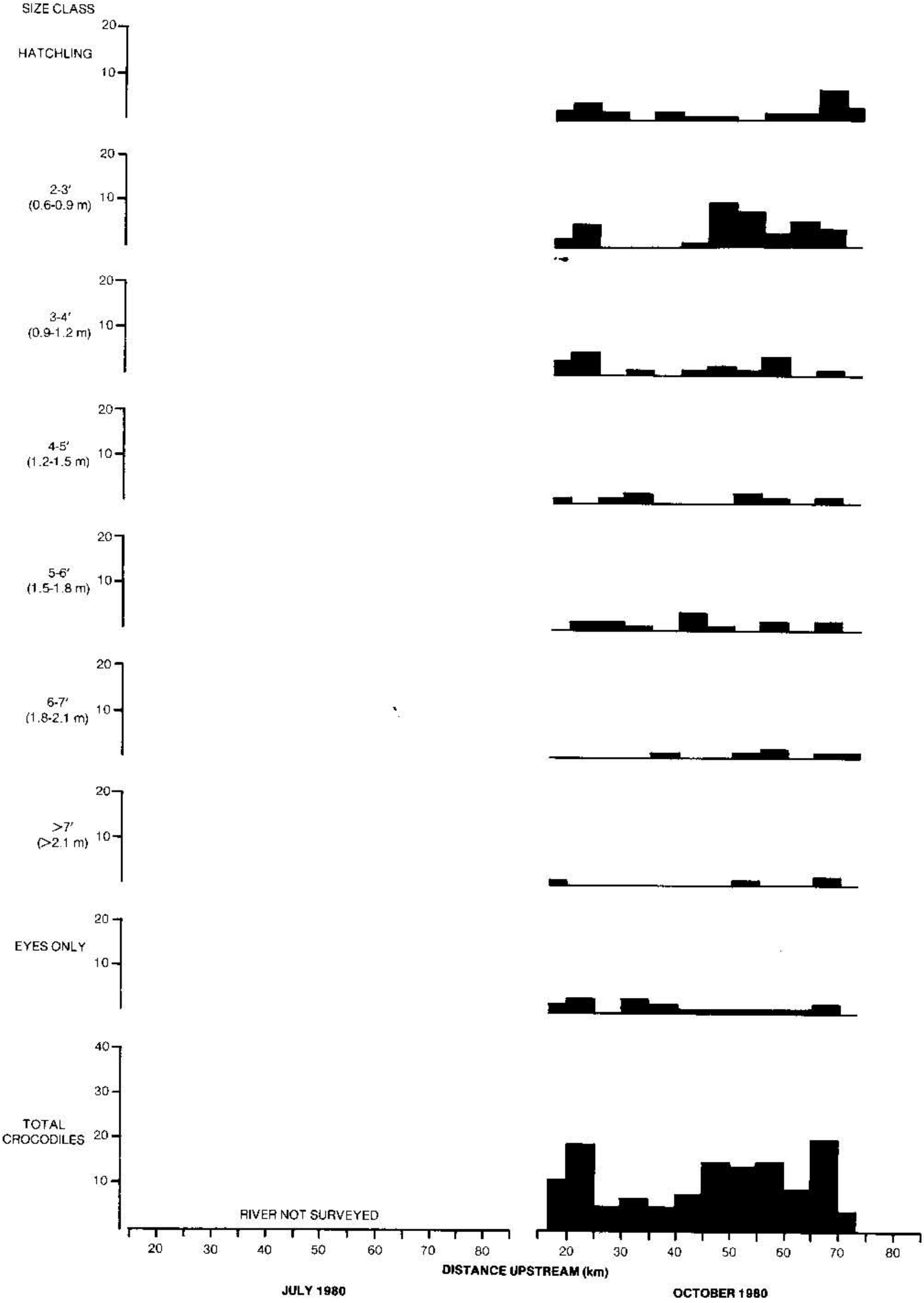


Fig. 18.7.5
Distributional pattern of *Crocodylus porosus* on the Tomkinson River in October, 1980.

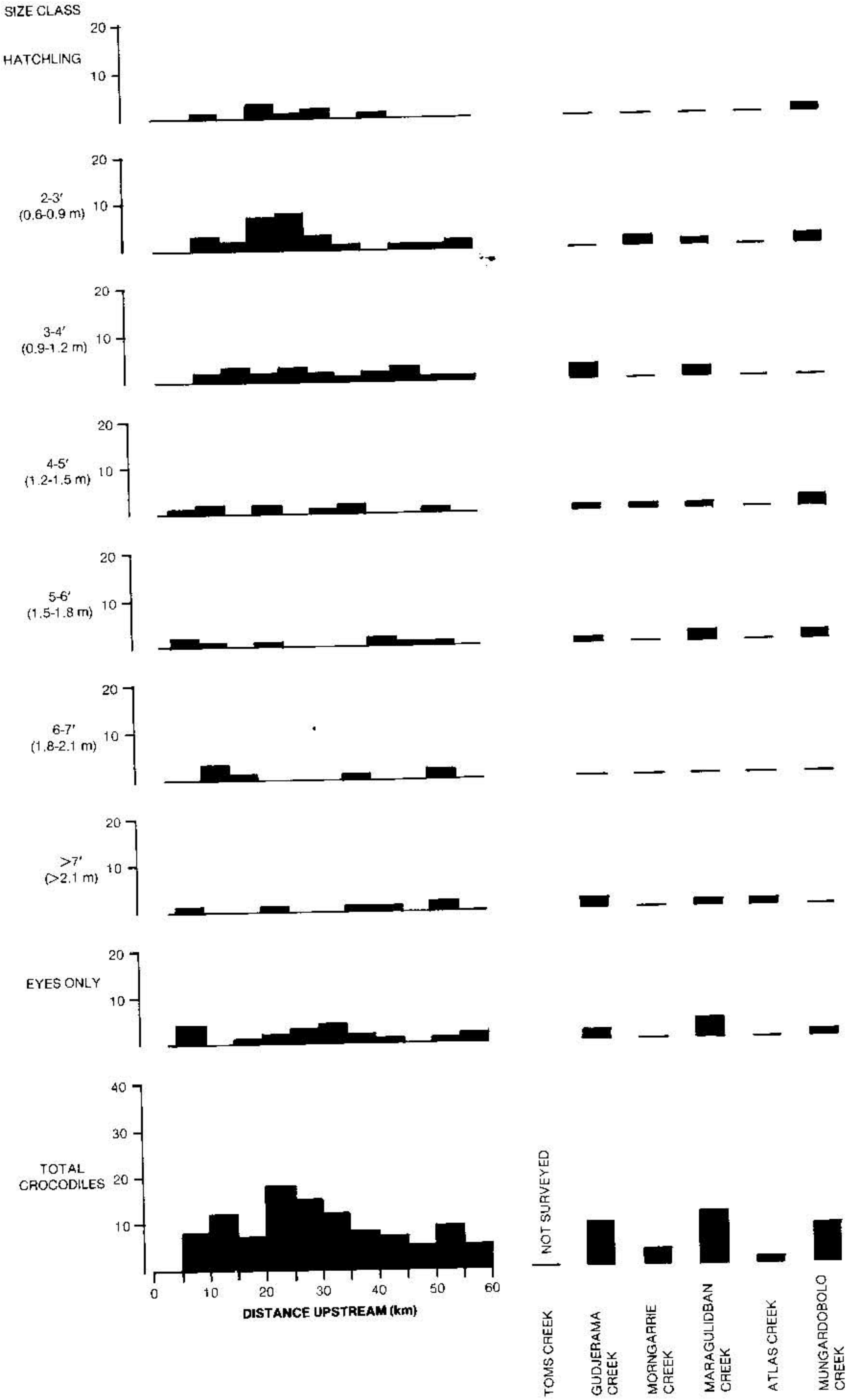


Fig. 18.7.6
Distributional pattern of *Crocodylus porosus* on the Liverpool River and its creeks in July, 1981.

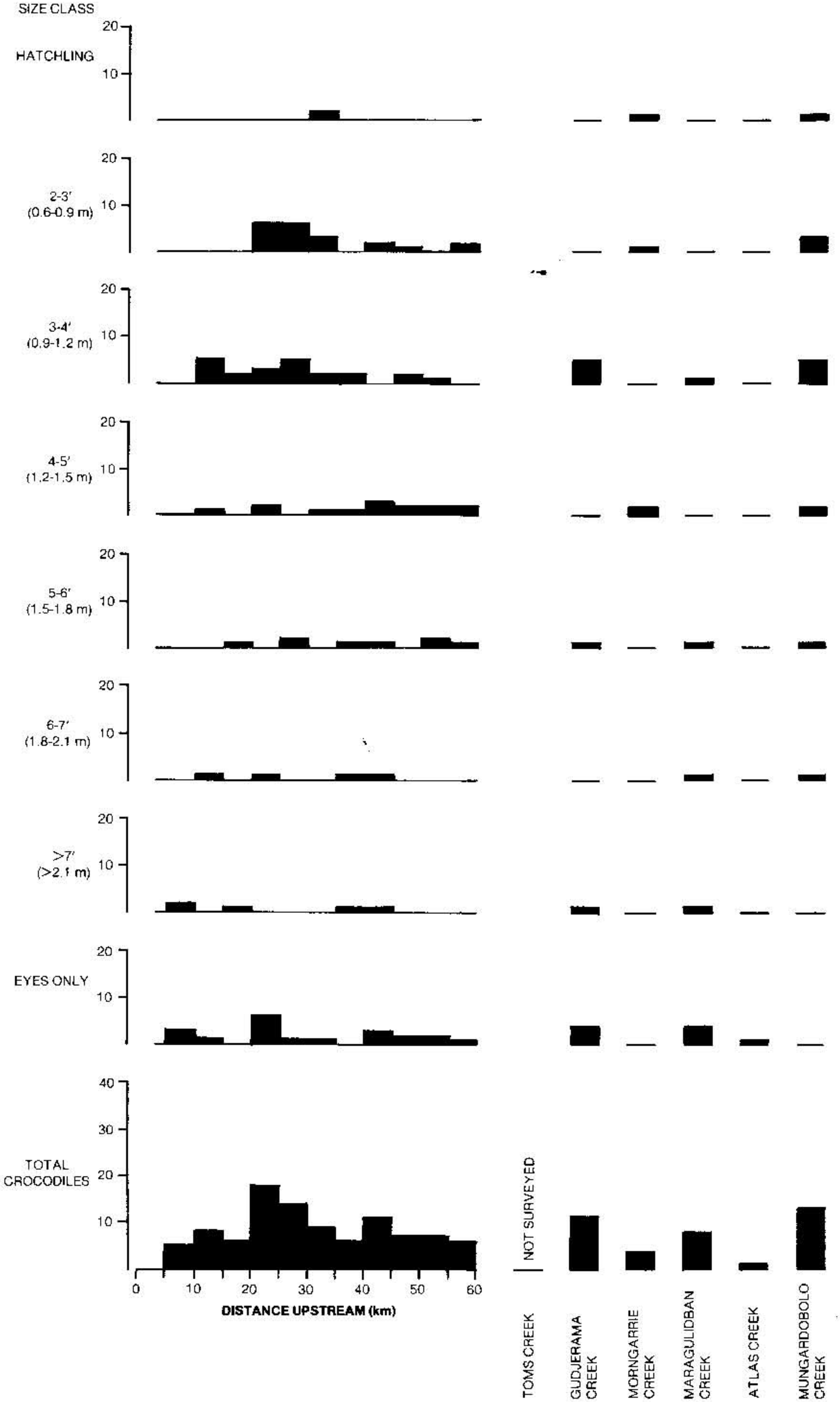


Fig. 18.7.7
Distributional pattern of *Crocodylus porosus* on the Liverpool River and its creeks in October, 1981.

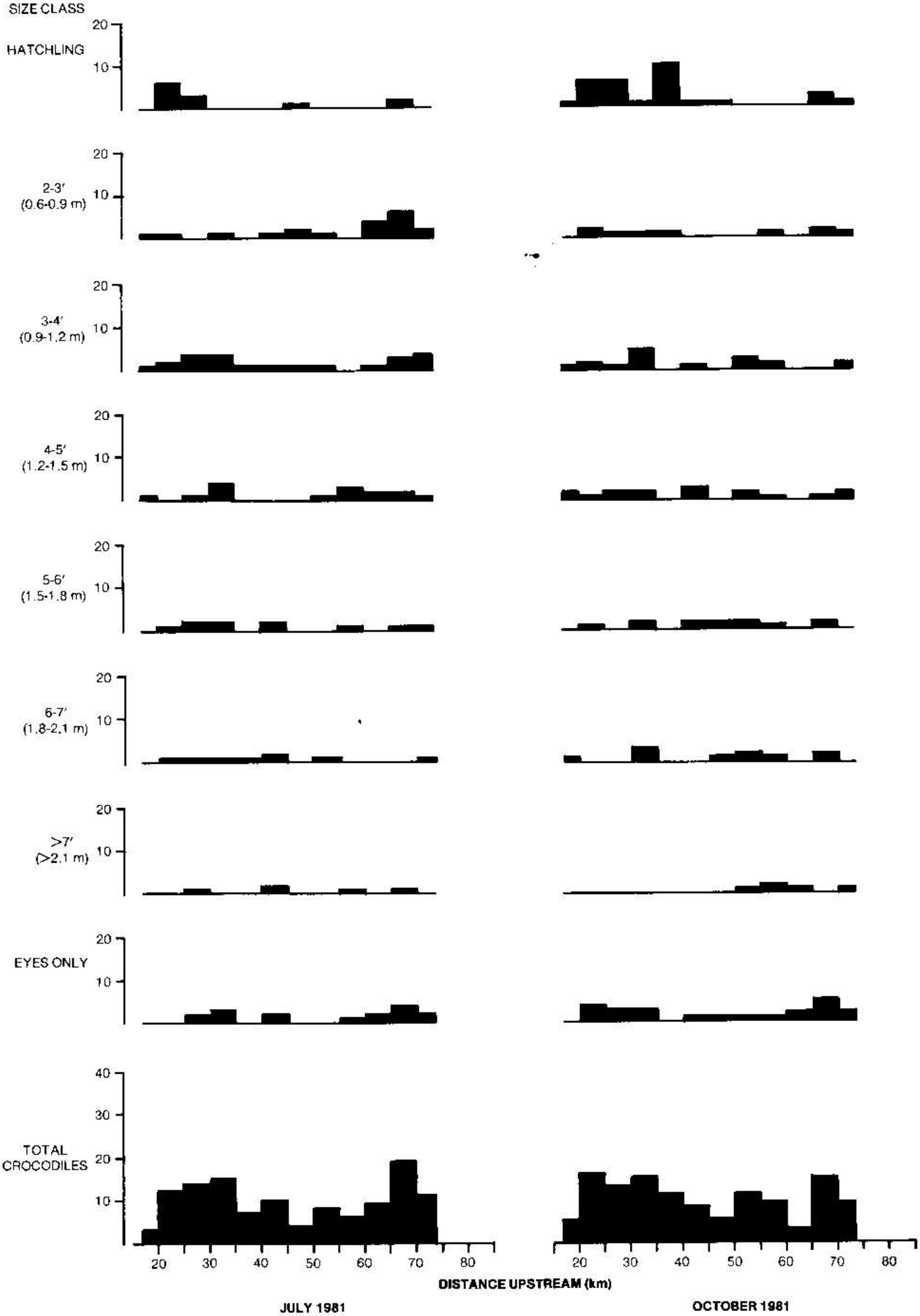


Fig. 18.7.8
Distributional pattern of *Crocodylus porosus* on the Tomkinson River in July and October, 1981.

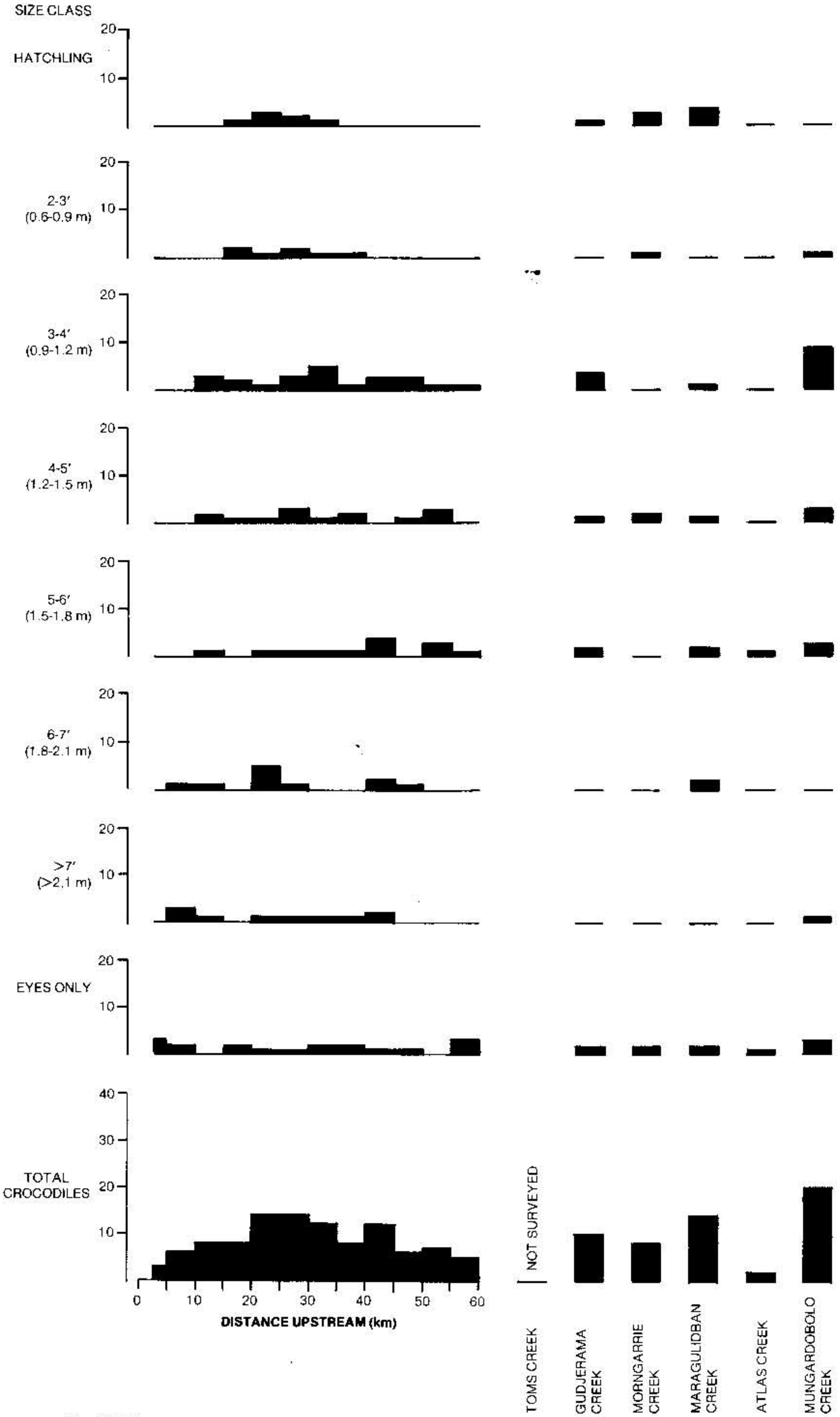


Fig. 18.7.9
Distributional pattern of *Crocodylus porosus* on the Liverpool River and its creeks in June, 1982.

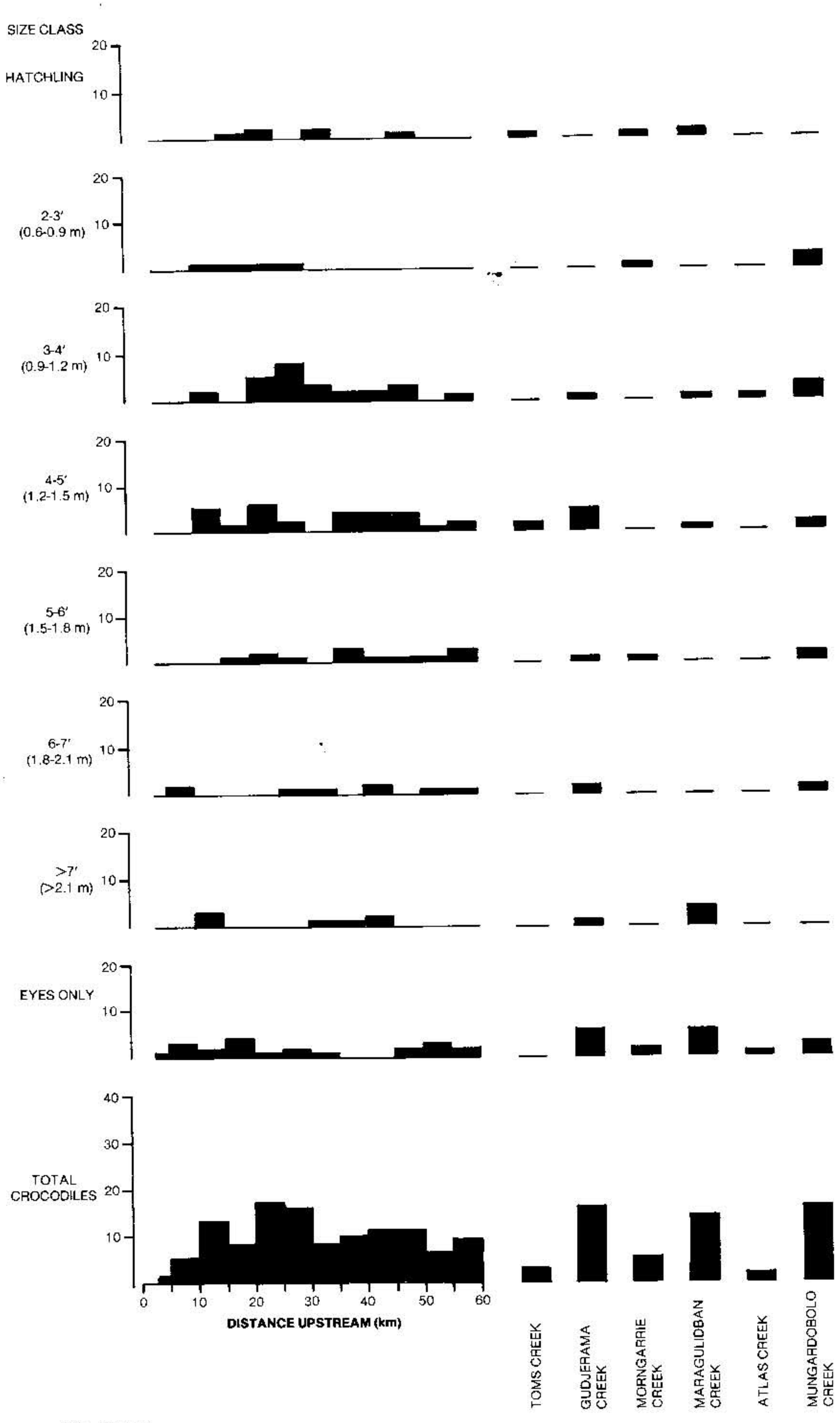


Fig. 18.7.10
Distributional pattern of *Crocodylus porosus* on the Liverpool River and its creeks in October, 1982.

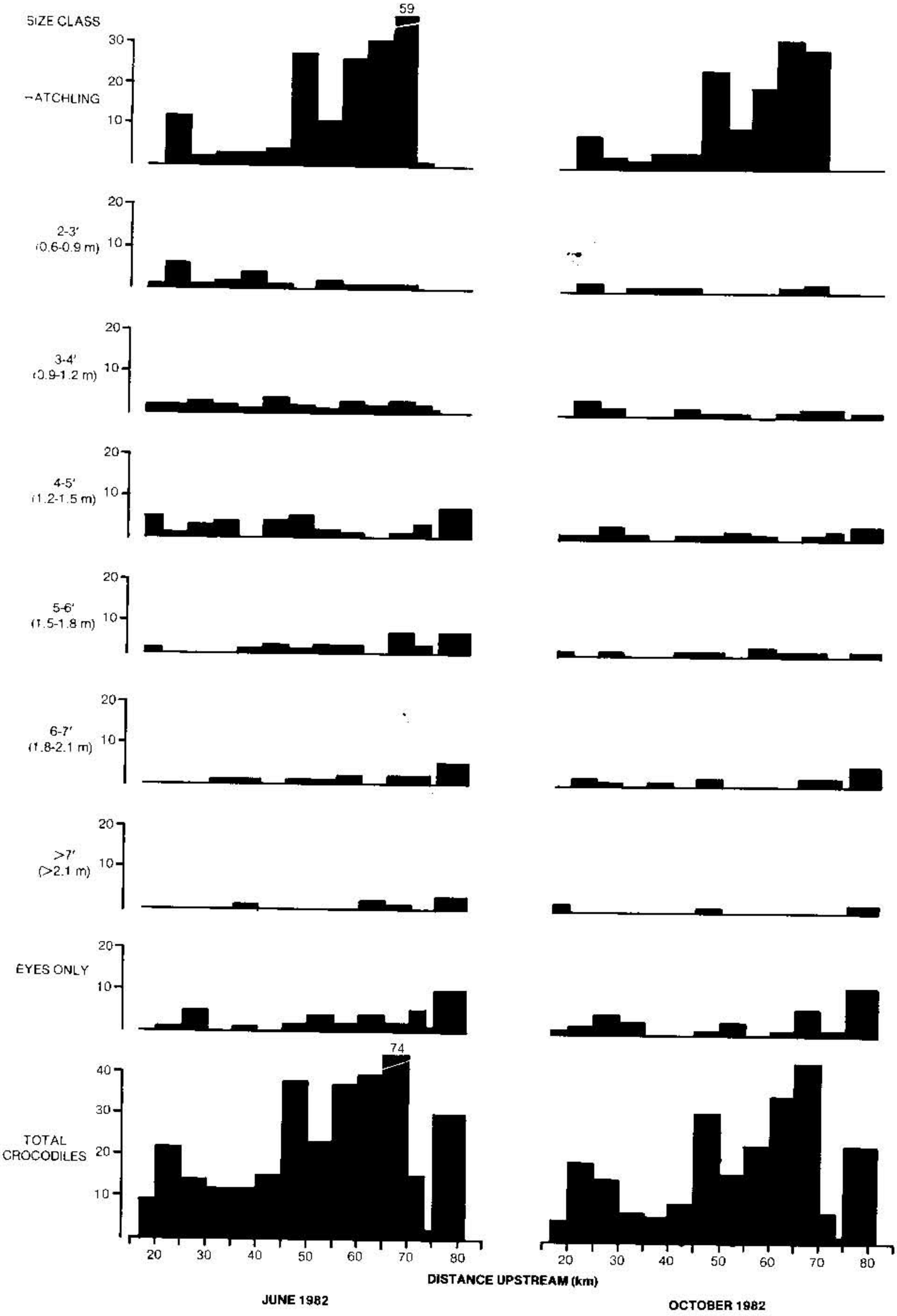


Fig. 18.7.11
Distributional pattern of *Crocodylus porosus* on the Tomkinson River in June and October, 1982.

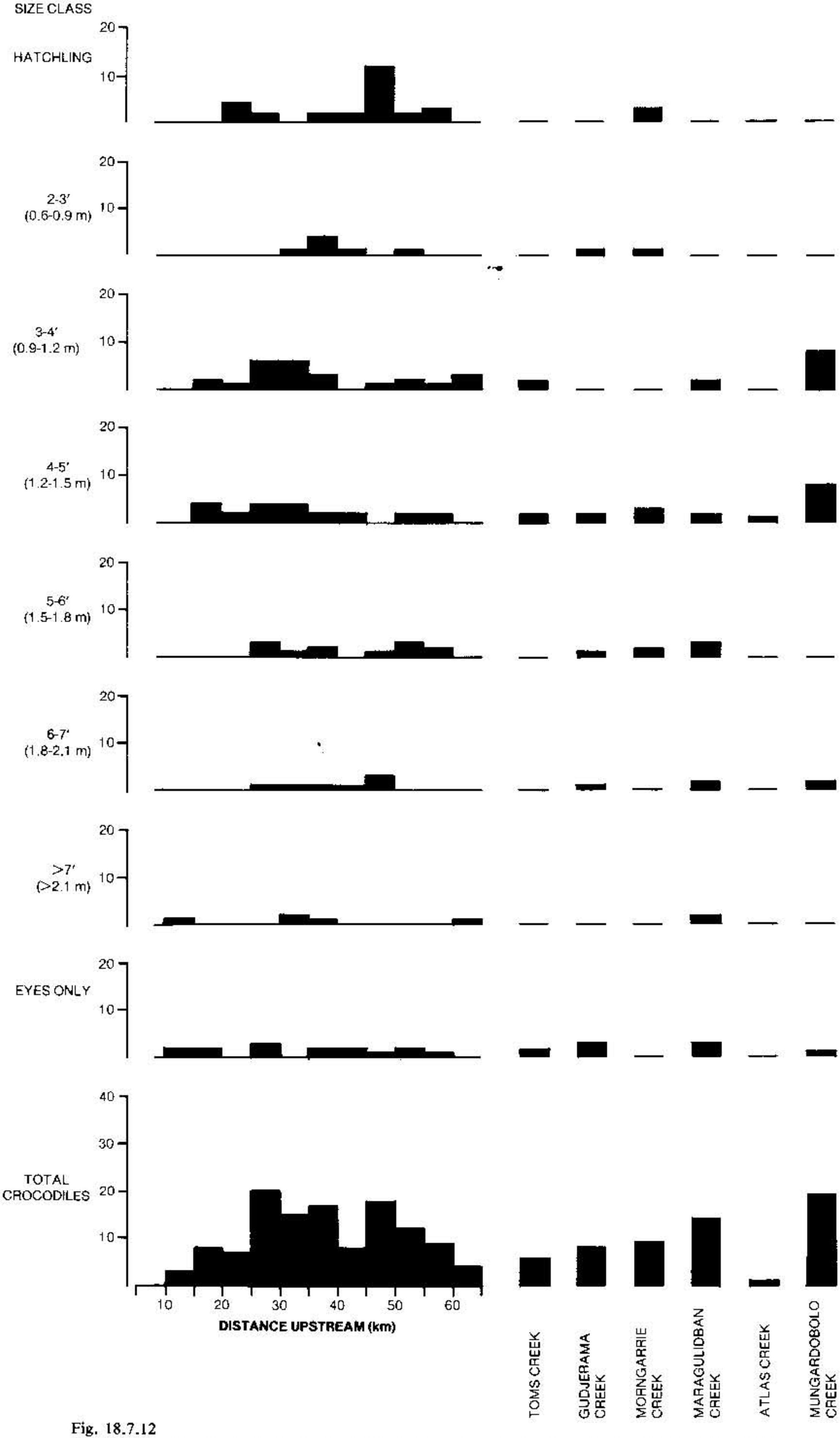


Fig. 18.7.12
Distributional pattern of *Crocodylus porosus* on the Liverpool River and its creeks in July, 1983.

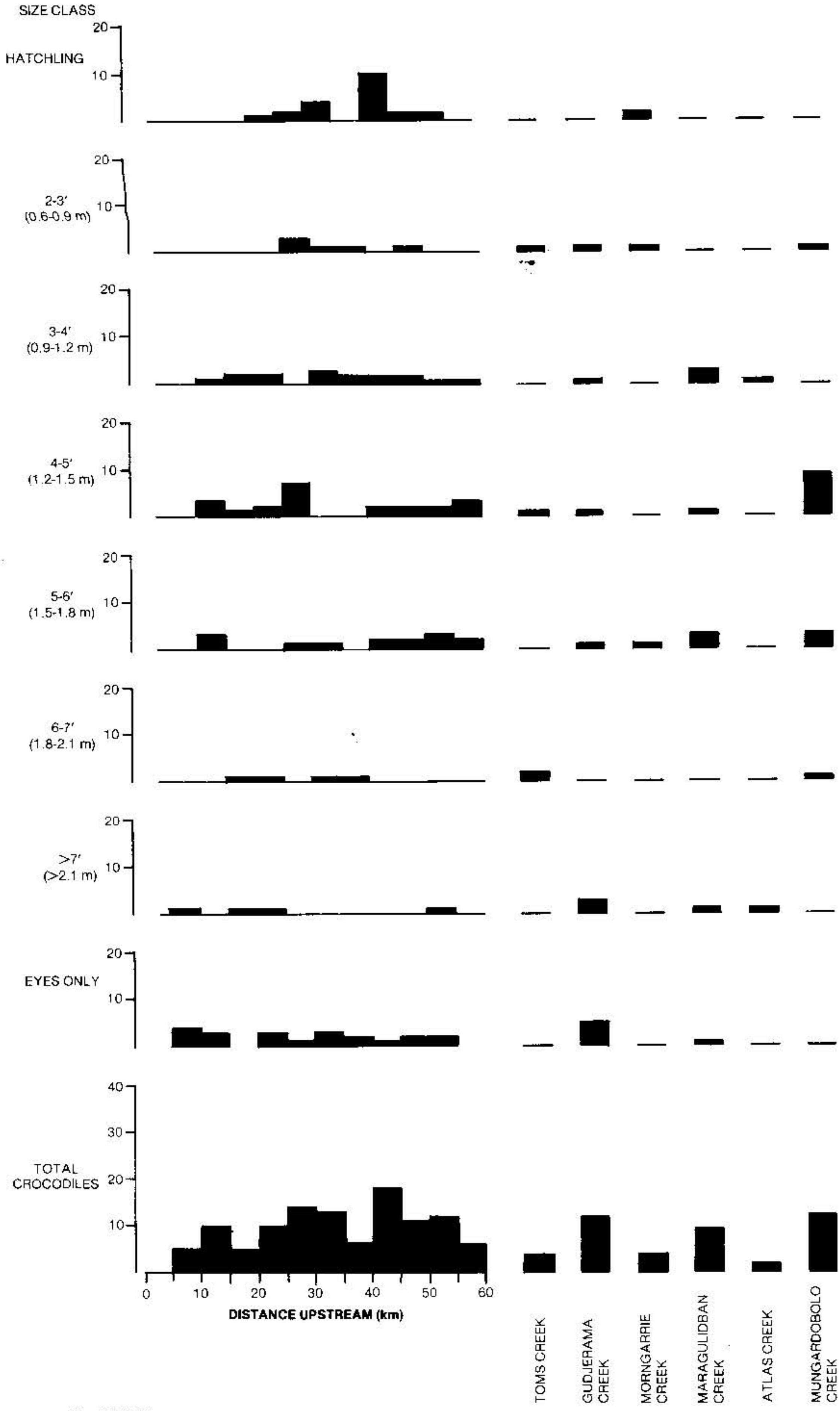


Fig. 18.7.13
Distributional pattern of *Crocodylus porosus* on the Liverpool River and its creeks in October, 1983.

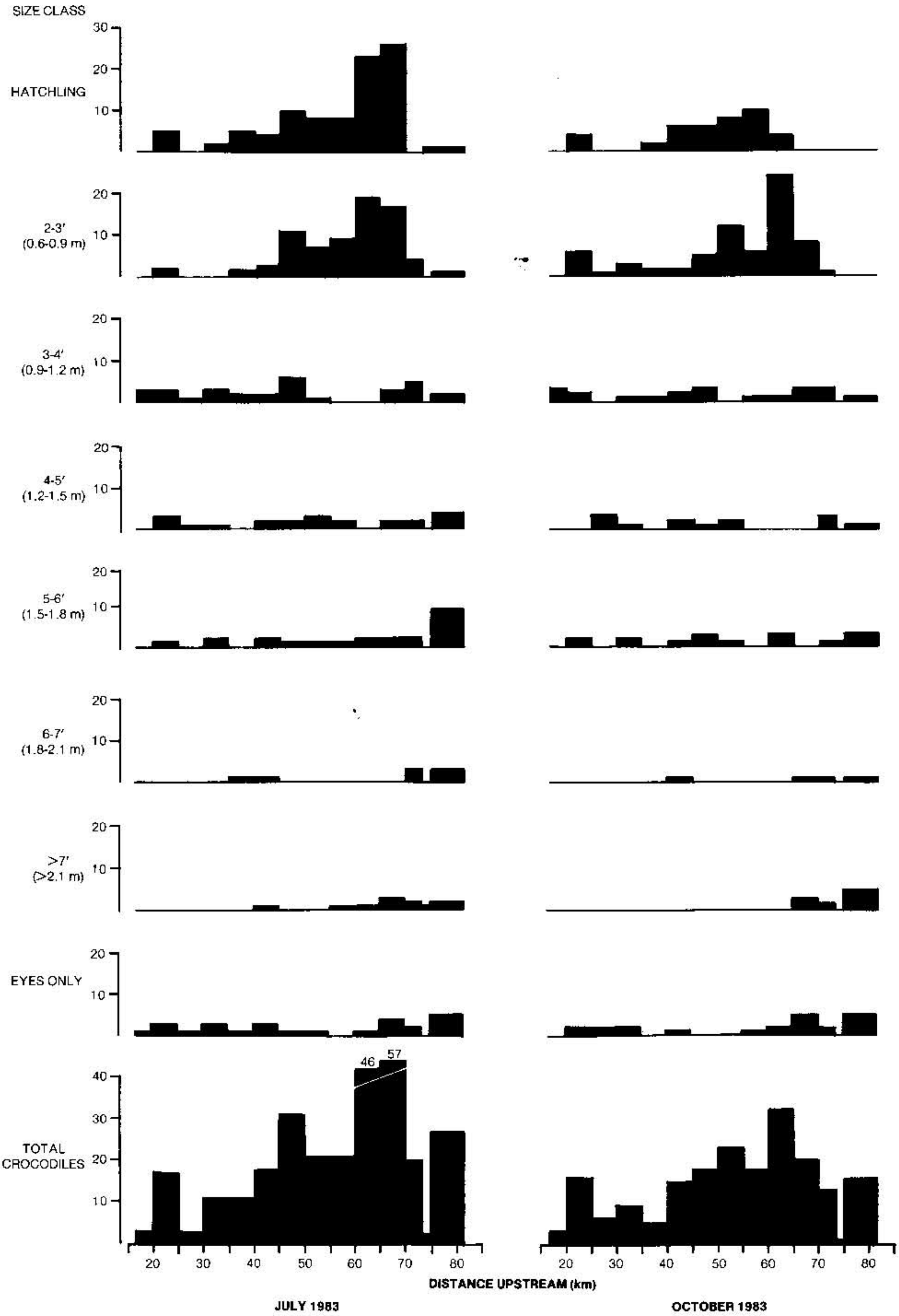


Fig. 18,7.14
Distributional pattern of *Crocodylus porosus* on the Tomkinson River in July and October, 1983.

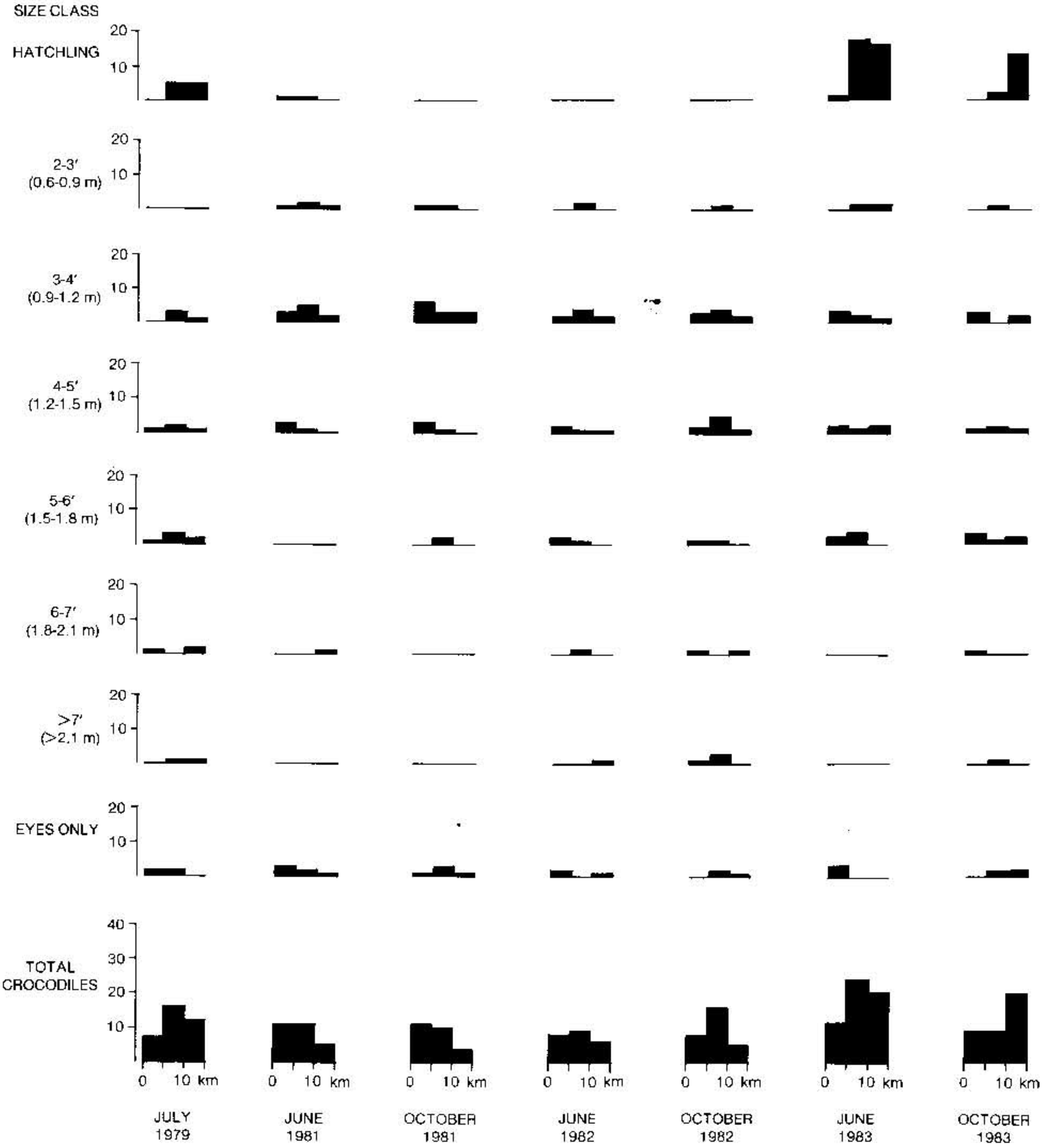


Fig. 18.7.15
Distributional pattern of *Crocodylus porosus* on Nungbulgarri Creek in July, 1979; June and October, 1981; June and October, 1982; and June and October, 1983.

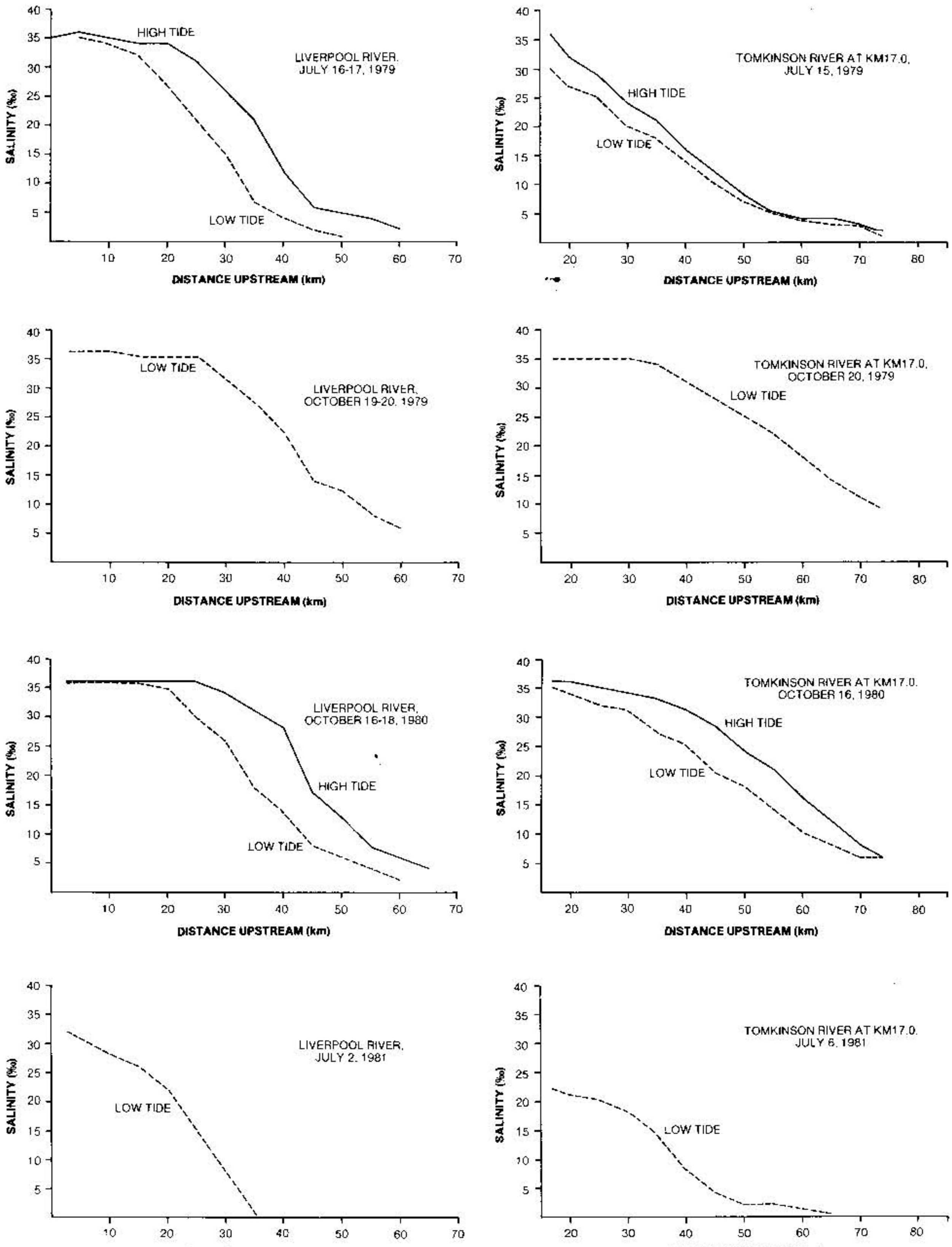


Fig. 18.7.16
Liverpool and Tomkinson River mainstreams, low and high tide salinities for 1979-1981.

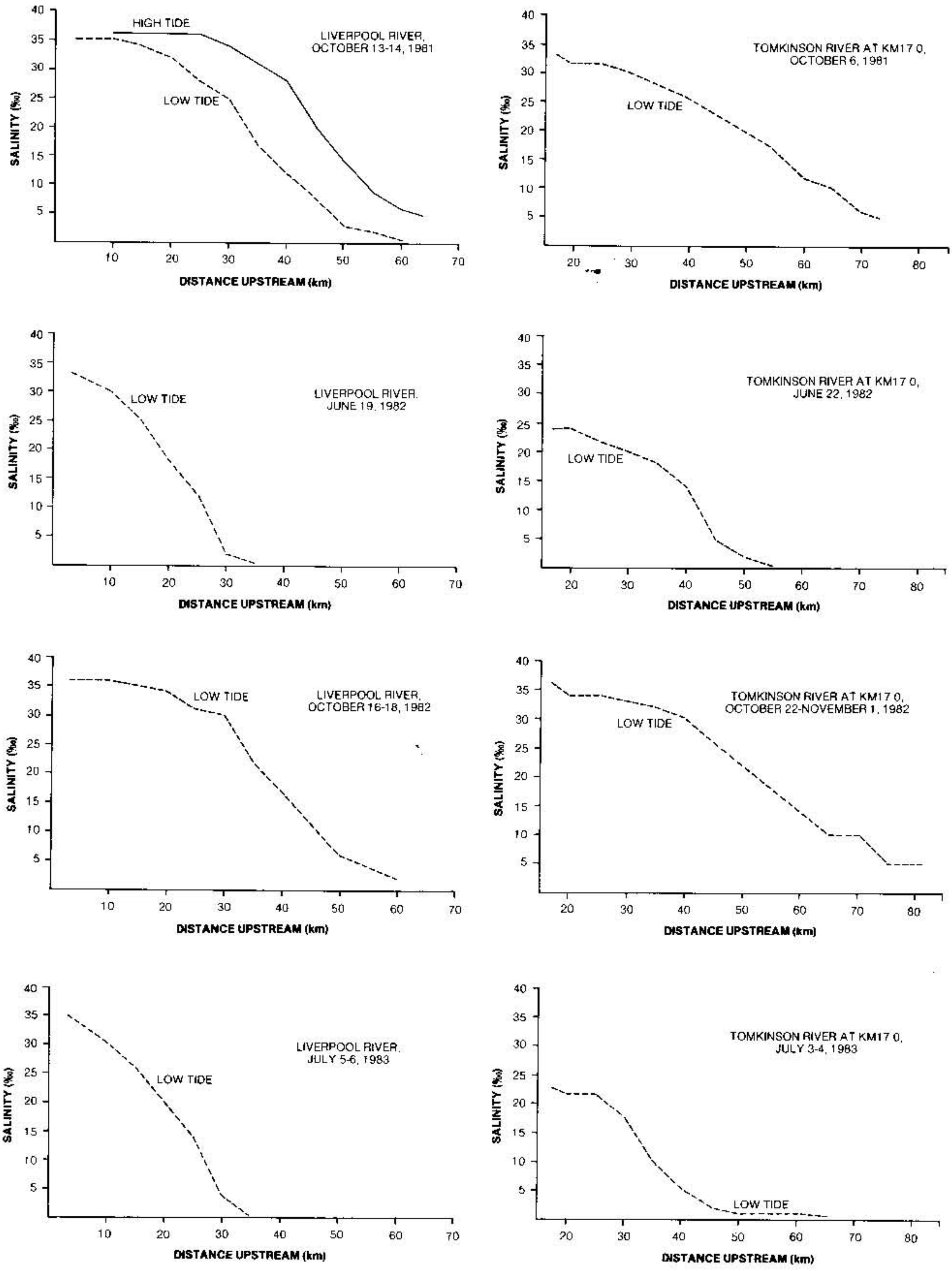


Fig. 18.7.17
Liverpool and Tomkinson River mainstreams, low tide salinities for 1981-1983.

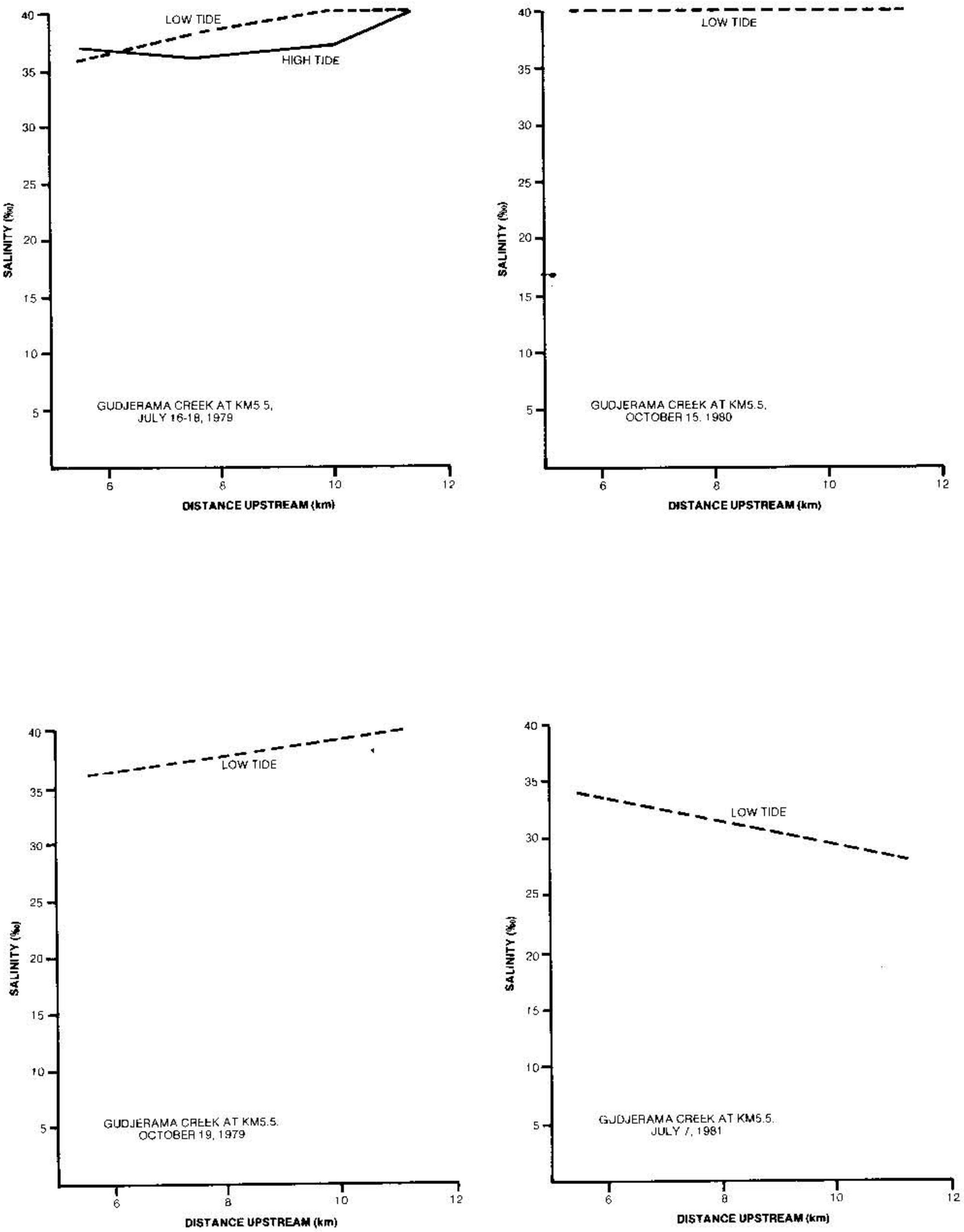


Fig. 18.7.18
Gudjerama and Mungardobolo Creeks, low tide salinities for 1979-1981.

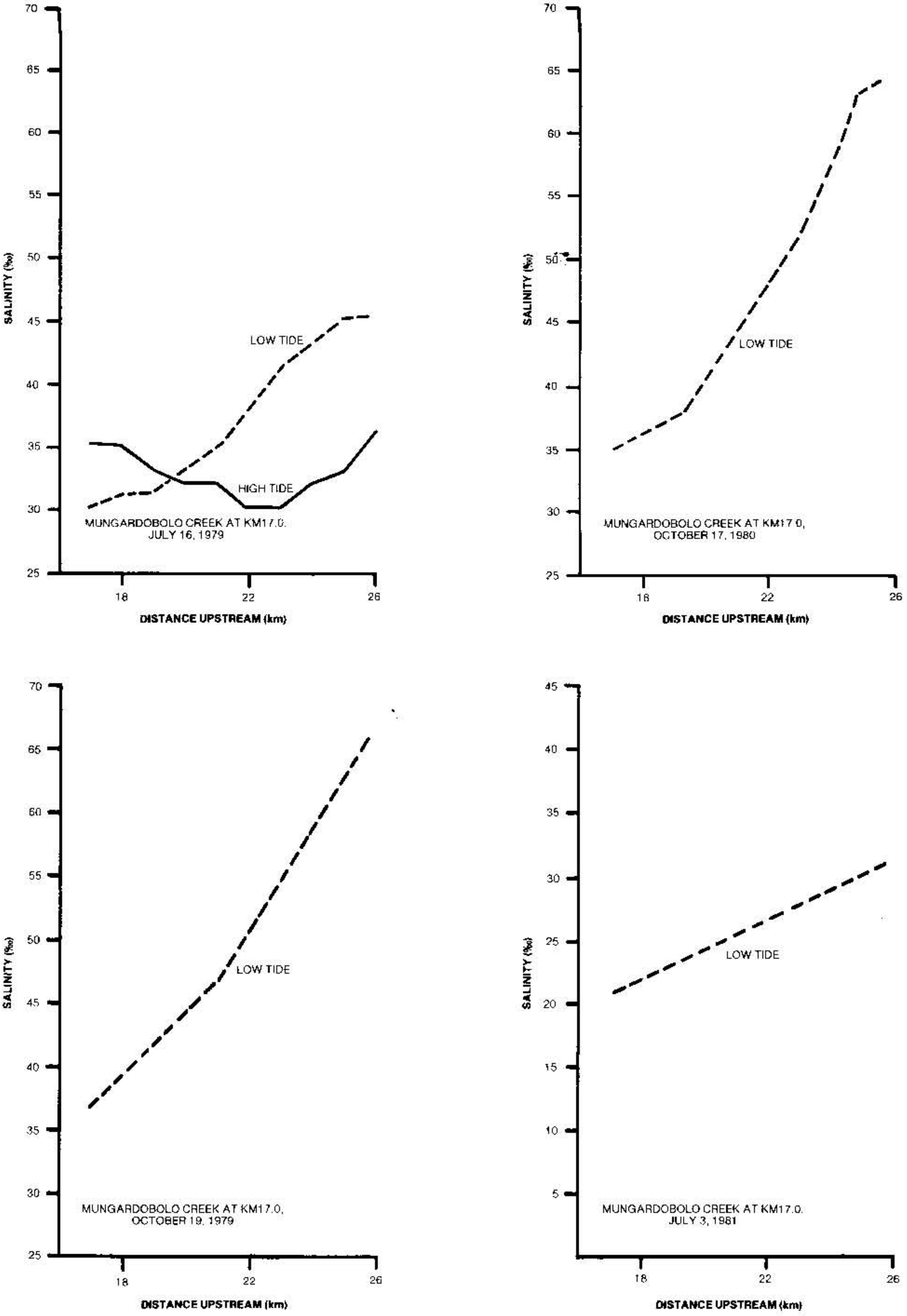


Fig. 18.7.18 continued

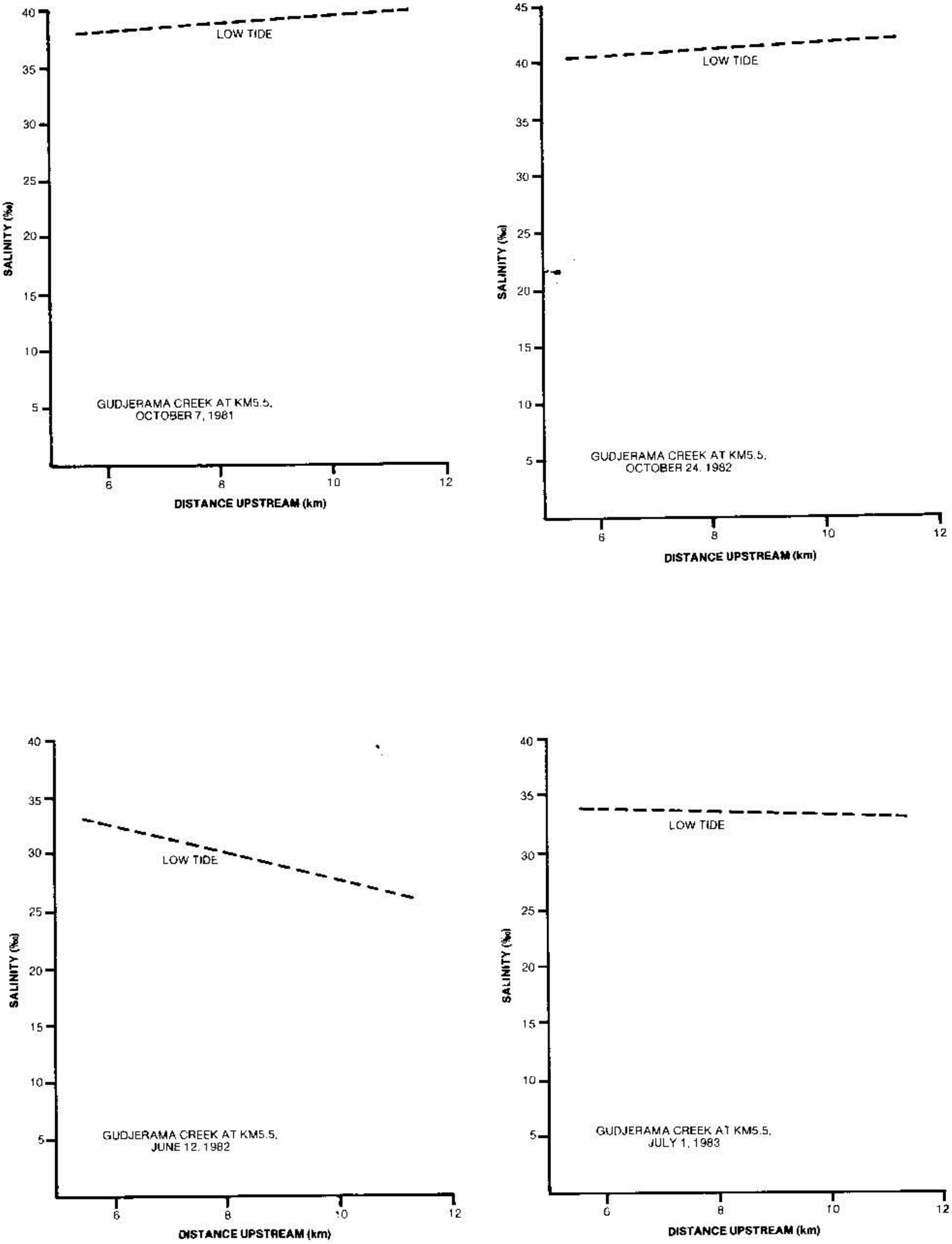


Fig. 18.7.19
Gudjerama and Mungardobolo Creeks, low tide salinities for 1981-1983.

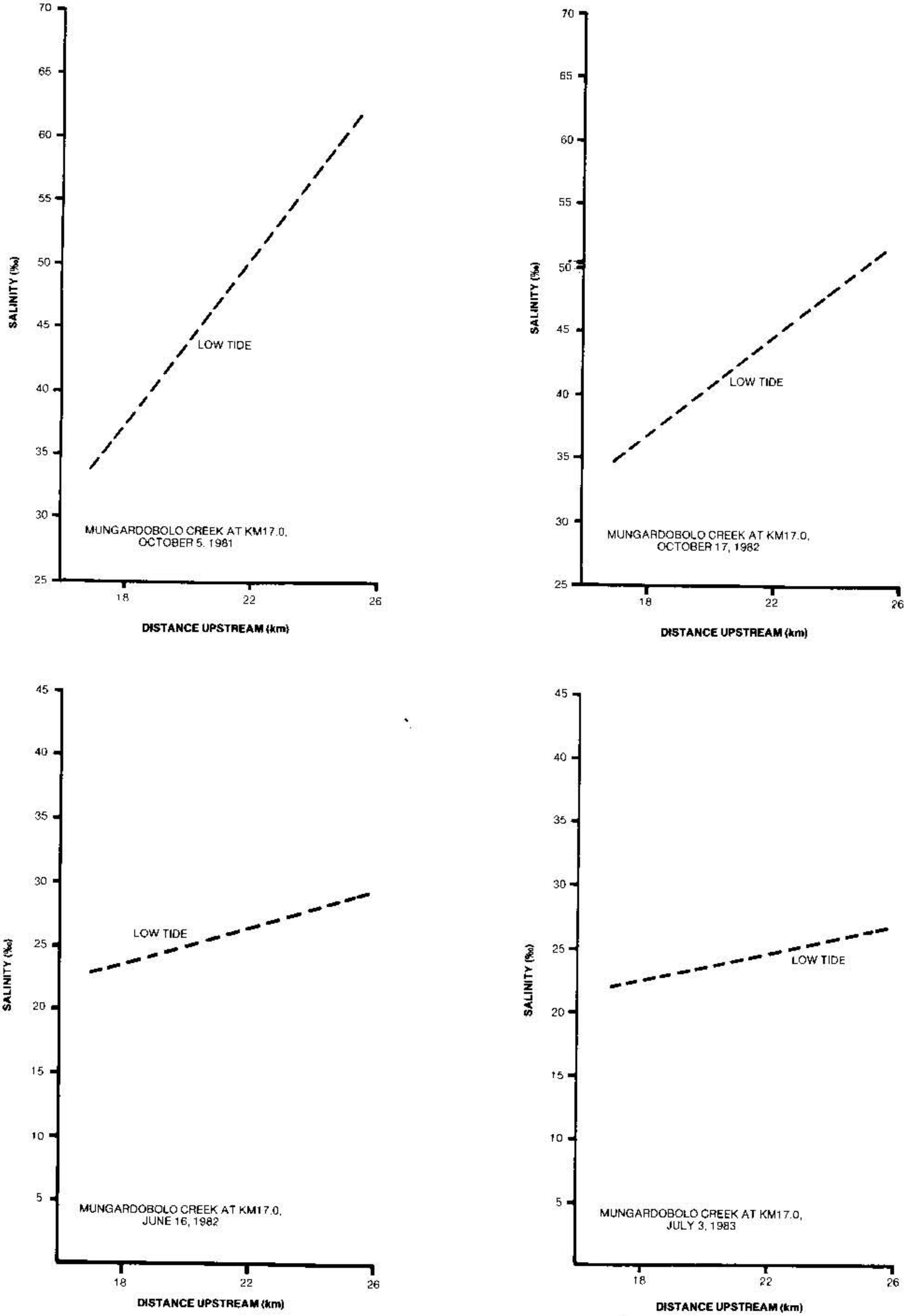


Fig. 18.7.19 continued

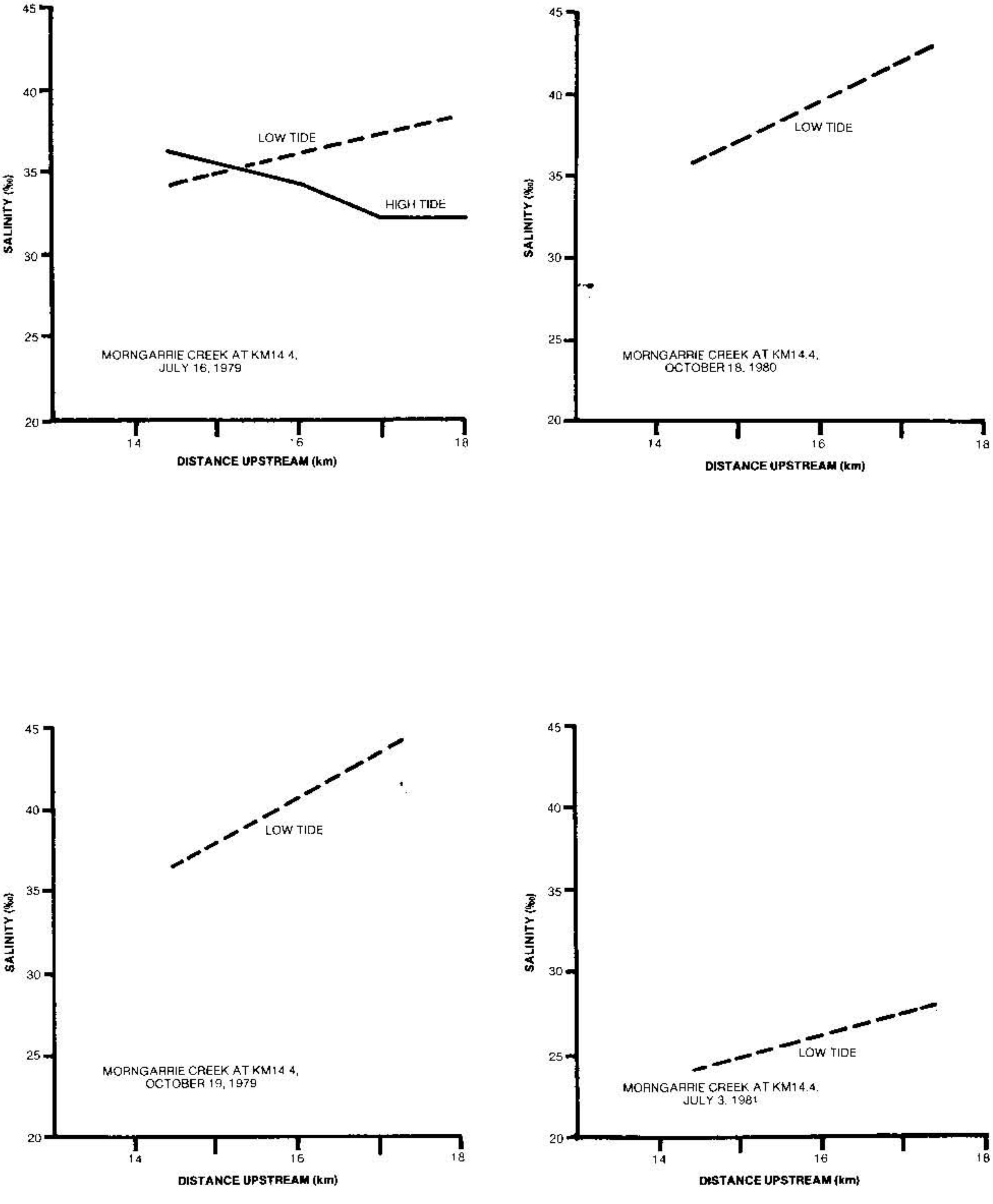


Fig. 18.7.20
Morngarrie and Maragulidban Creeks, low tide salinities for 1979-1981.

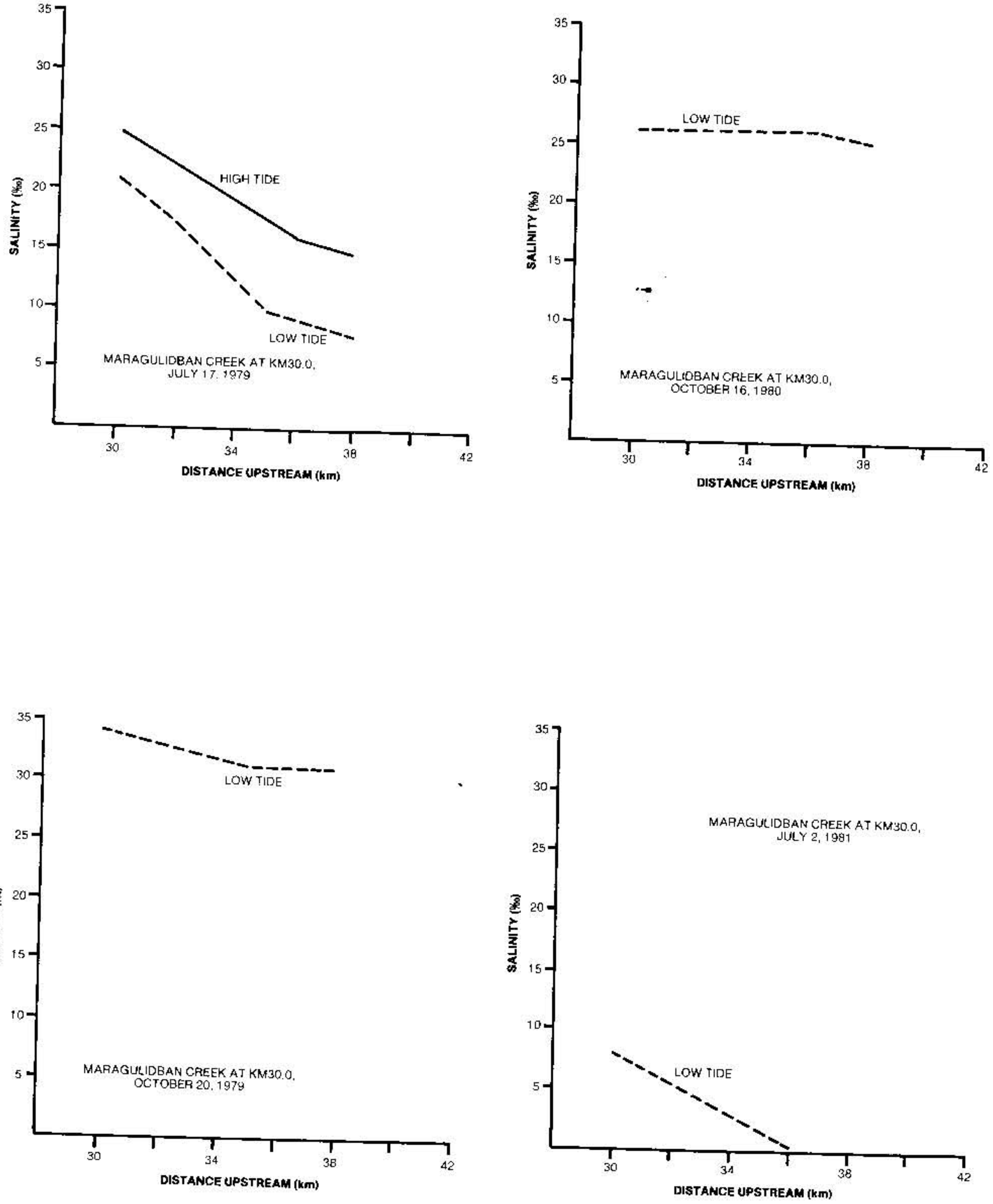


Fig. 18.7.20 continued

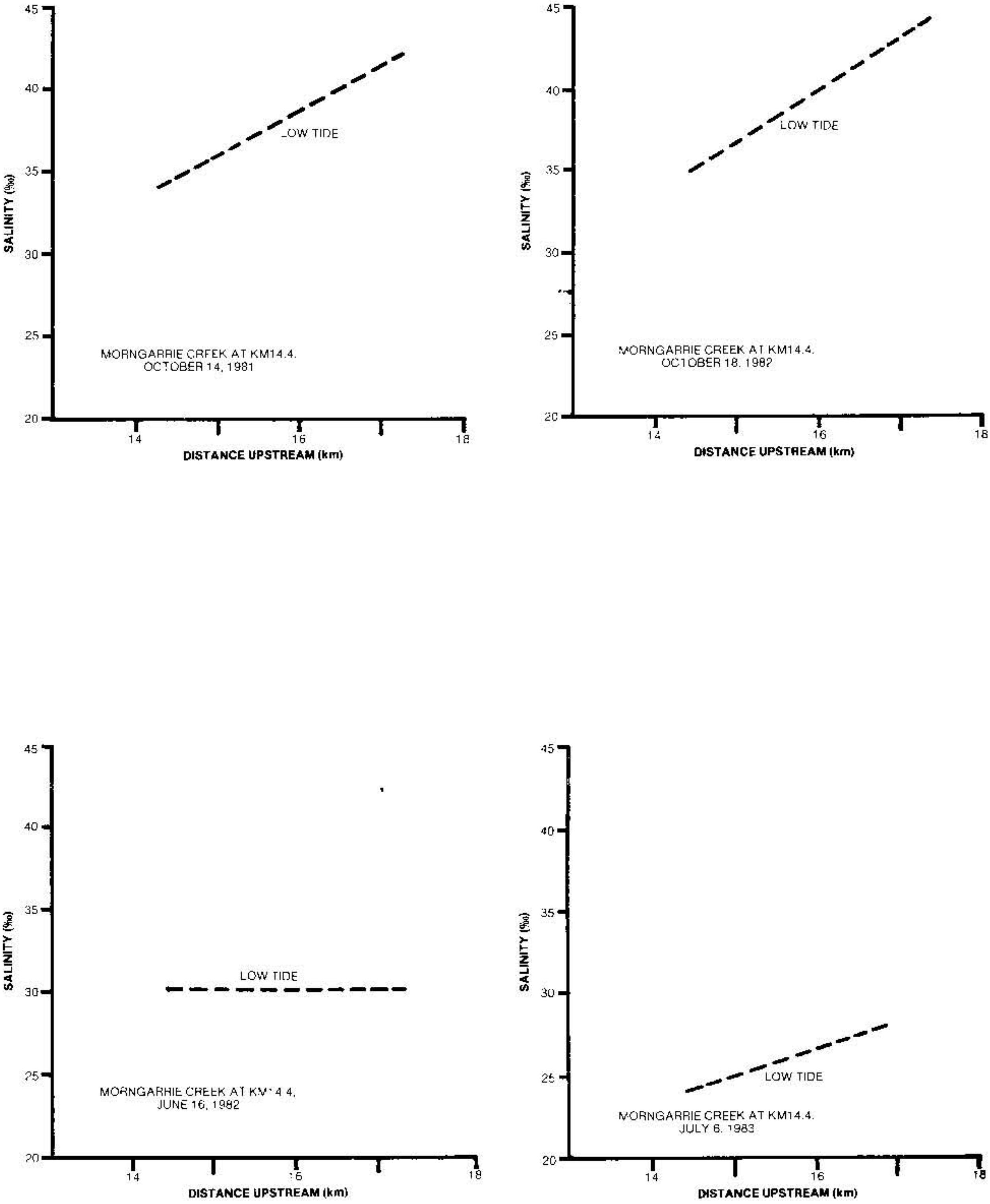


Fig. 18.7.21
Morngarrie and Maragulidban Creeks, low tide salinities for 1981-1983.

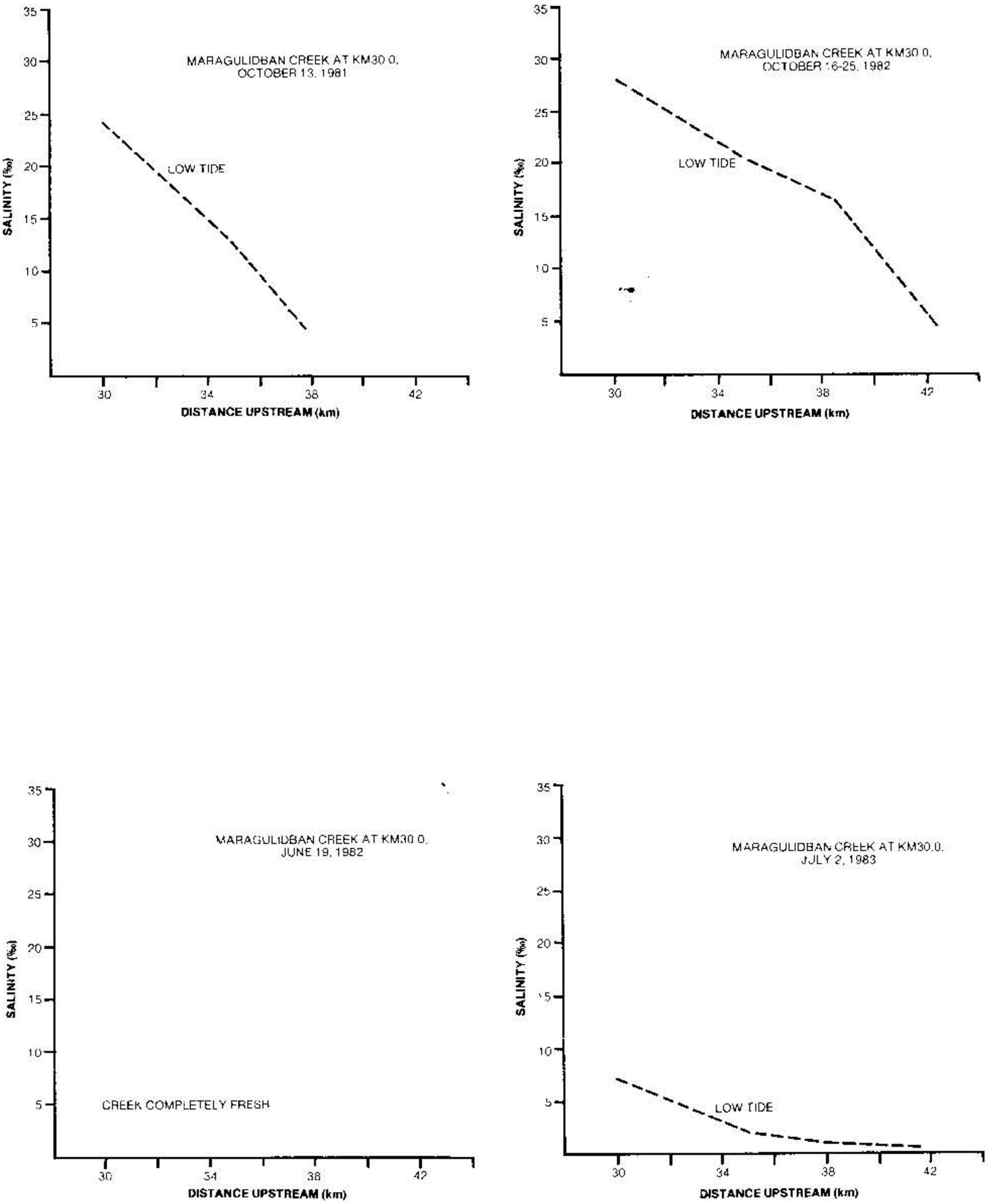


Fig. 18.7.21 continued

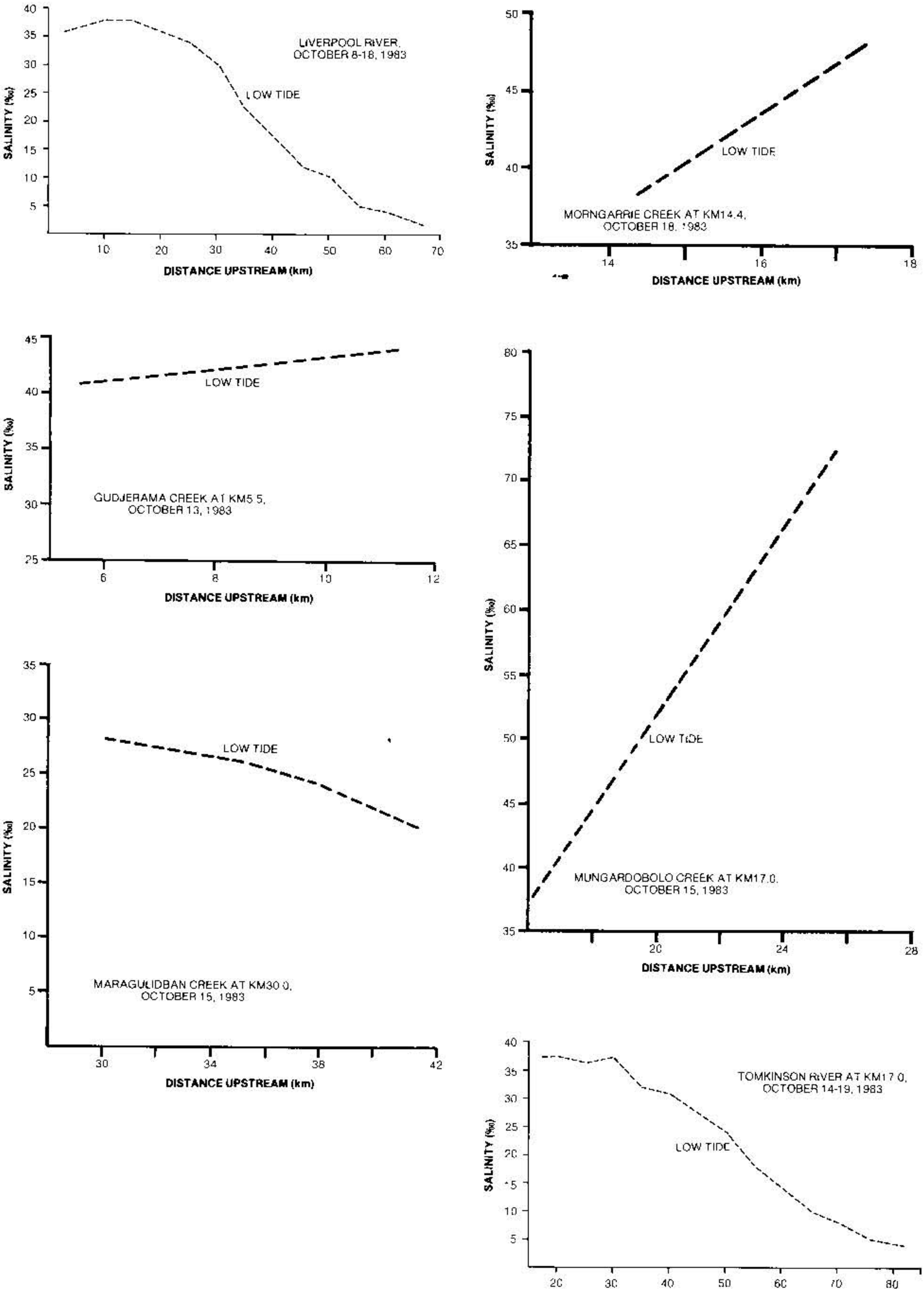


Fig. 18.7.22
Liverpool and Tomkinson Rivers, Gudjerama, Mungardobolo, Morngarrie and Maragulidban Creeks, low tide salinities for October, 1983.

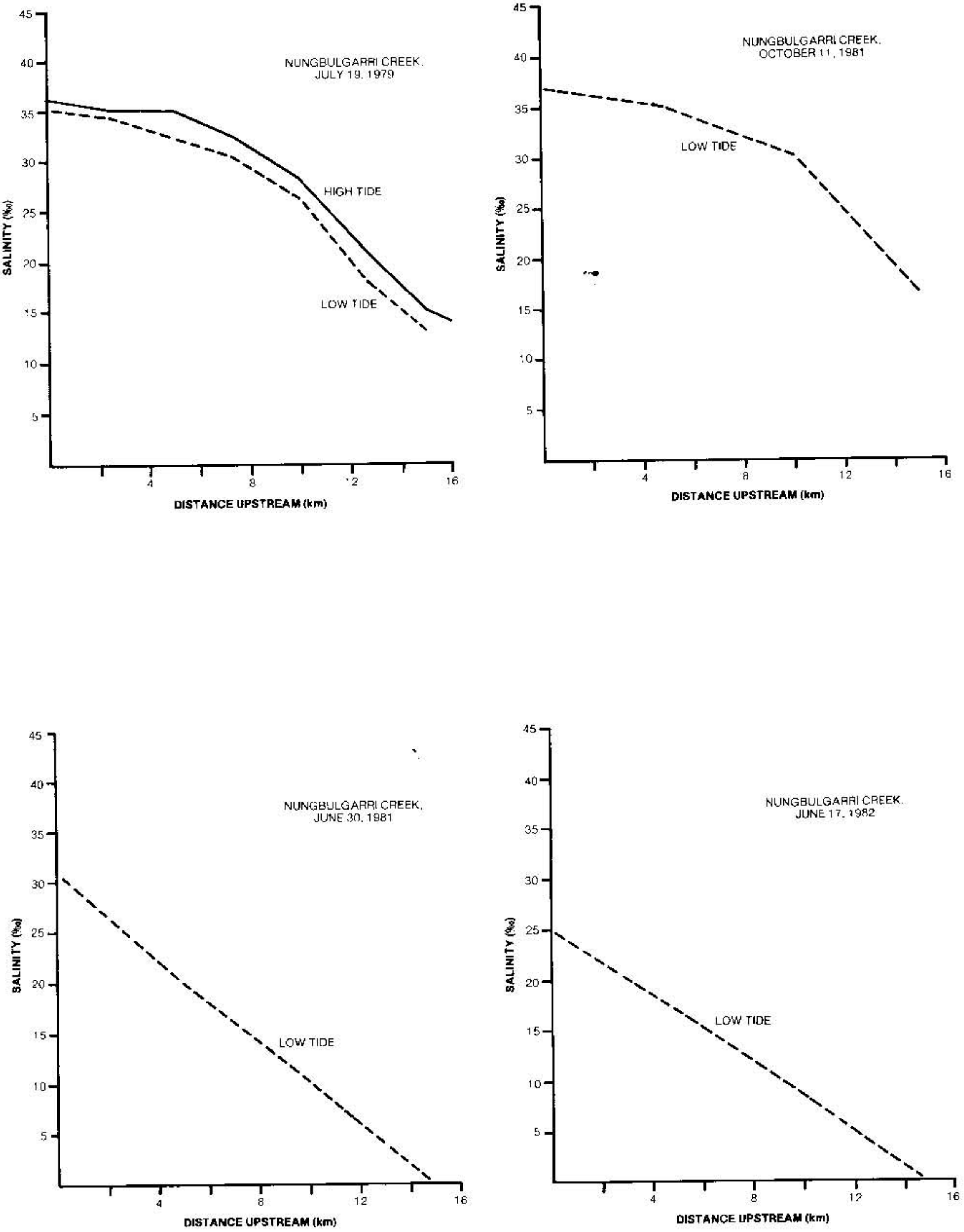


Fig. 18.7.23
Nungbulgarri Creek, low tide salinities for 1979, 1981-1983.

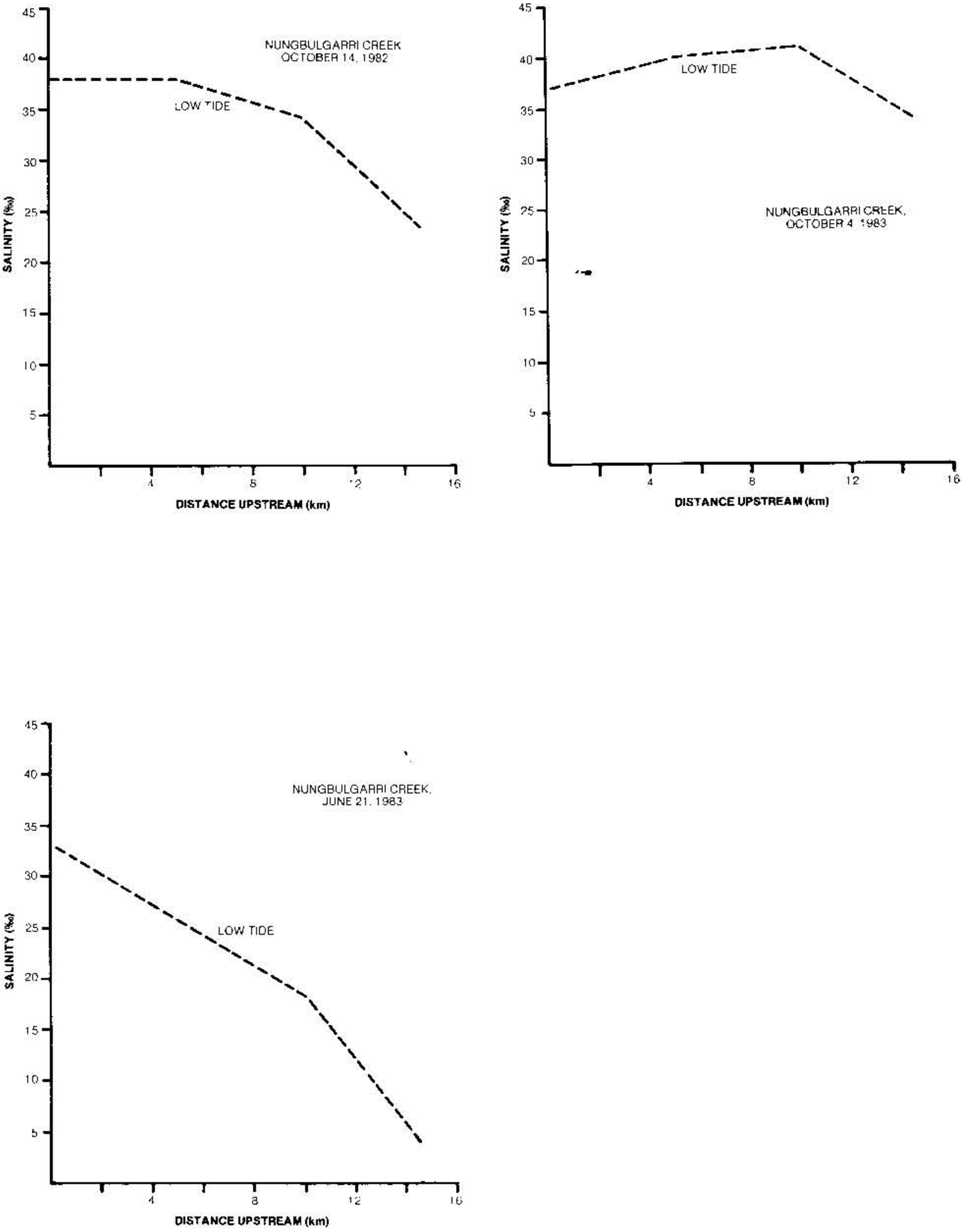


Fig. 18.7.23 continued

10.

MONOGRAPH 9

Additional data, 1983
for
The Glyde River and Ngañdadauda Creek

TABLE 18.9.1
NGANDADAUDA CREEK, JUNE 26, 1983

SIZE IN FEET *(metres)*	**NUMBER OF CROCS**	**SITUATION**						**OBSERVED FEEDING**
		IV	**IVIW**	**OM**	**IM**	**SWOE**	**MS**	
HATCHLING								
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*	2					2		
4-5 *(1.2-1.5)*	5					5		
5-6 *(1.5-1.8)*	7					6	1	
6-7 *(1.8-2.1)*	1					1		
>7 *(>2.1)*	2					2		
EO<6 *(<1.8)*	2					2		
EO>6 *(>1.8)*	6					6		
EO	5			1		4		
TOTAL	30	—	—	1	—	28	1	—

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 18.9.1
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of Ngandadauda Creek, June 26, 1983. Total distance surveyed was 23.6 km, mainstream 20.6 and creek 3.0 km.

TABLE 18.9.2
NGANDADAUDA CREEK, OCTOBER 12, 1983

SIZE IN FEET *(metres)*	**NUMBER OF CROCS**	**SITUATION**						**OBSERVED FEEDING**
		IV	**IVIW**	**OM**	**IM**	**SWOE**	**MS**	
HATCHLING								
2-3 *(0.6-0.9)*								
3-4 *(0.9-1.2)*								
4-5 *(1.2-1.5)*	5			3		2		
5-6 *(1.5-1.8)*	8			1		6	1	
6-7 *(1.8-2.1)*	4					4		
>7 *(>2.1)*	2			1		1		
EO<6 *(<1.8)*								
EO>6 *(>1.8)*								
EO	2	1				1		
TOTAL	21	1	—	5	—	14	1	—

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 18.9.2
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of Ngandadauda Creek, October 12, 1983. Total distance surveyed was 23.6 km, mainstream 20.6 and creek 3.0 km.

TABLE 18.9.3
GLYDE RIVER, JULY 7-8, 1983

SIZE IN FEET *(metres)*	**NUMBER OF CROCS**	**SITUATION**						**OBSERVED FEEDING**
		IV	**IVIW**	**OM**	**IM**	**SWOE**	**MS**	
HATCHLING	5					5		
2-3 *(0.6-0.9)*	9					9		
3-4 *(0.9-1.2)*	35					35		
4-5 *(1.2-1.5)*	16			2		14		
5-6 *(1.5-1.8)*	8					7	1	1
6-7 *(1.8-2.1)*	6			2		4		
>7 *(>2.1)*	10			6		3	1	
EO<6 *(<1.8)*	5					5		
EO>6 *(>1.8)*	23			2		19	2	
EO	1					1		
TOTAL	118	—	—	12	—	102	4	1

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 18.9.3
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Glyde River, July 7-8, 1983. Total distance surveyed was 45.9 km.

TABLE 18.9.4
GLYDE RIVER, OCTOBER 6, 1983

SIZE IN FEET *(metres)*	**NUMBER OF CROCS**	**SITUATION**						**OBSERVED FEEDING**
		IV	**IVIW**	**OM**	**IM**	**SWOE**	**MS**	
HATCHLING								
2-3 *(0.6-0.9)*	3					3		
3-4 *(0.9-1.2)*	22			1		21		
4-5 *(1.2-1.5)*	12			2		10		
5-6 *(1.5-1.8)*	11			6		5		
6-7 *(1.8-2.1)*	5			2		3		
>7 *(>2.1)*	11			5		5	1	
EO<6 *(<1.8)*	2					2		
EO>6 *(>1.8)*	18			2		14	2	
EO	7	1				4	2	
TOTAL	91	1	—	18	—	67	5	—

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 18.9.4
Crocodylus porosus numbers, size structure and situation, sighted during the general night spotlight survey of the Glyde River, October 6, 1983. Total distance surveyed was 45.9 km.

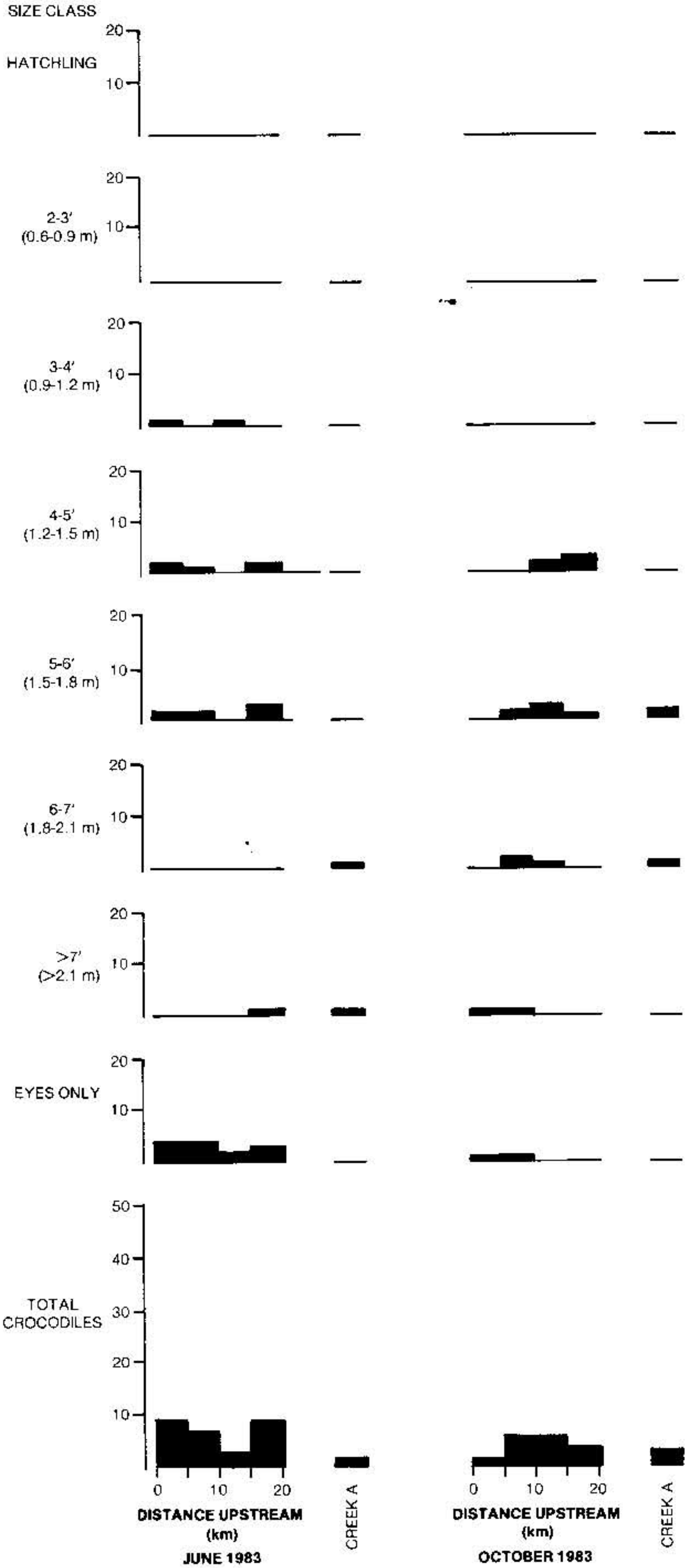


Fig. 18.9.1
Distributional pattern of *Crocodylus porosus* on Ngandadauda Creek in June and October, 1983.

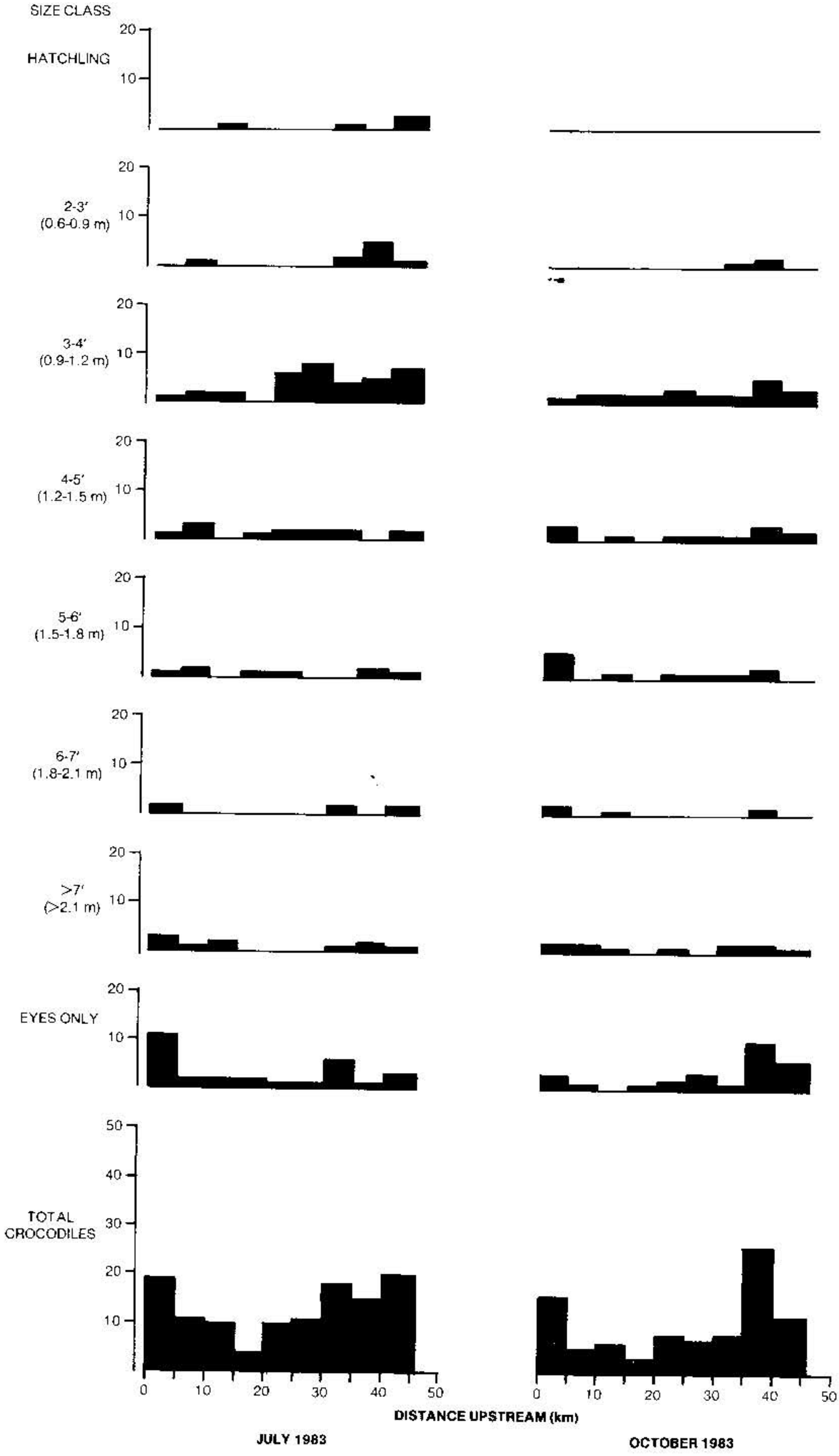


Fig. 18.9.2
Distributional pattern of *Crocodylus porosus* on the Glyde River in July and October, 1983.

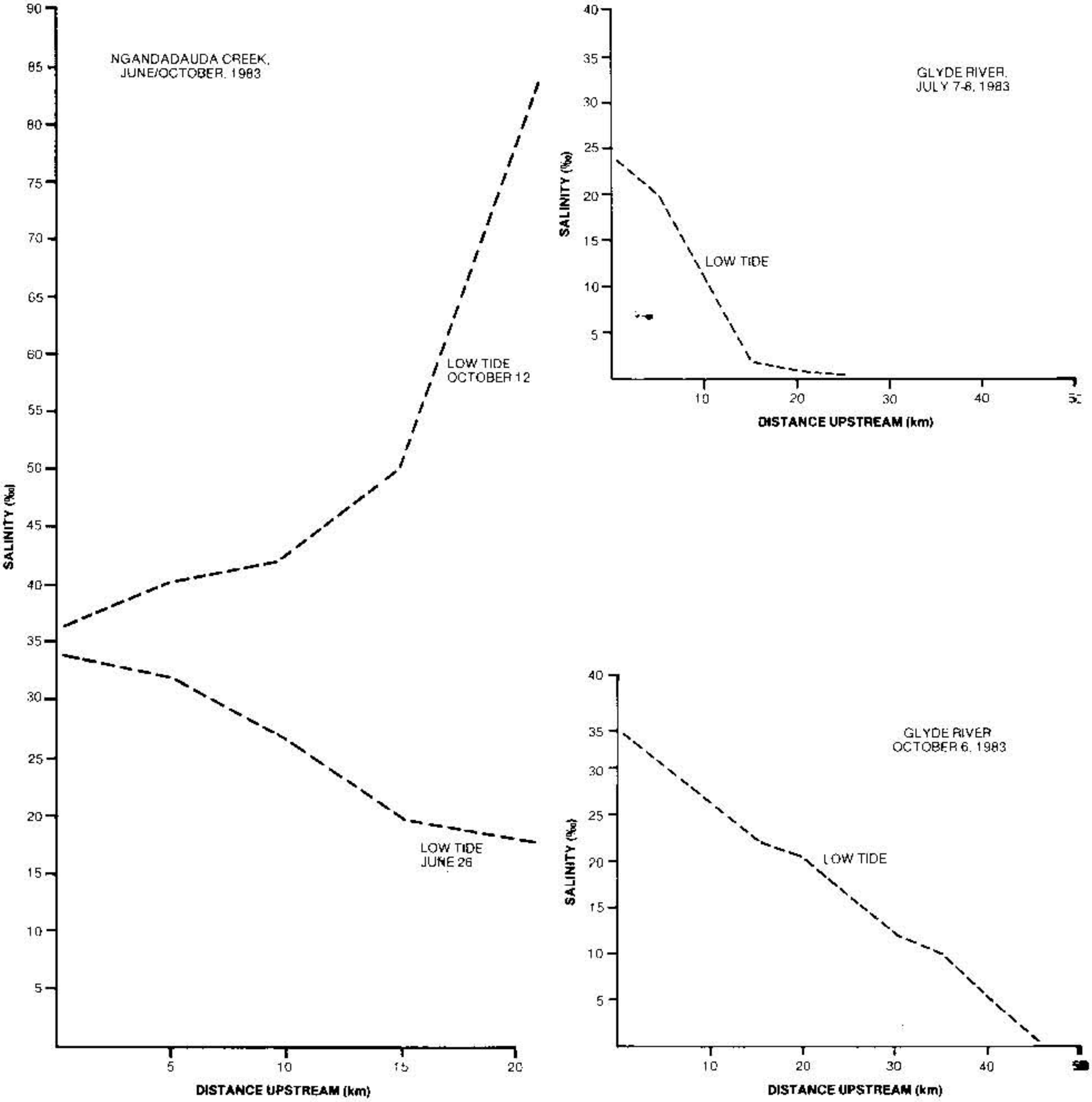


Fig. 18.9.3
Ngandadauda Creek, low tide salinity on June 23 and October 12, 1983 and Glyde River, low tide salinity on July 7-8 and Octob
6, 1983.