Ecological Analysis

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Biota Environmental Sciences

Fauna Monitoring Yardie Creek

Dept. of Conservation and Land Management

Preliminary Report

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ABN 49 092 687 119
2 / 183 Scarborough Beach Rd
Mt Hawthorn WA 6016

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Prepared by: R. Teale
Mr. R Johnstone
Dr. J. Prince
Checked by: G. Humphreys

Fauna Monitoring – Yardie Creek

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1.0 Summary

CALM (the Department of Conservation and Land Management) has a legislative requirement under the *CALM Act 1984* to promote the use and understanding of National Parks in WA whilst maintaining the conservation of natural resources: ie. 'to fulfil as much of the demand for recreation by members of the public as may be consistent with the proper maintenance and restoration of the natural environment, the protection of indigenous flora and fauna and the preservation of any feature of archaeological, historic or scientific interest'.

In Western Australia, CALM manage the conservation estate on behalf of the National Parks and Nature Conservation Authority (NPNCA).

The NPNCA requires that a program to identify and monitor any effects of boat tours and tourists on the wildlife at Yardie Creek be designed and implemented. In particular, the program should provide data on the effects of boats on bird behaviour and sightings of rock wallabies in Yardie Creek during Winter/Spring of 2000 and 2001.

Furthermore, a questionnaire has been developed and circulated to tour boat operators to survey tourists and determine their perceptions and level of satisfaction concerning wildlife sightings.

This progress report documents the findings of the Spring 2000 Pilot Study.

The Pilot Study

The numbers of rock wallabies visible to observers was relatively constant within any given period of any given day, but varied among days and among the identified groups (=sites) of wallabies present in the gorge. Eleven sites were identified as supporting between 1 and 6 rock wallabies. A total of between 16 and 20 animals occurred in the gorge accessible to the boats and a further 12 to 16 animals occurred over 750 m further up the gorge.

The analysis of the effect of boat use was confounded by the unpredictable schedules of the boat operators (both within and among days) and the presence of other craft such as canoes, kayaks and dinghies in the gorge at unexpected and uncontrollable times. For the purposes of analysing this data set only the power boats were considered, other boats were ignored.

There was no indication of a change in rock wallaby numbers to level of boat use. Numbers were generally higher before the boats arrived but too variable to differentiate from numbers during and after the boats. Nor did the arrival of the boats induce rock wallabies to move from their positions any more frequently than they did before the boats arrived. However, rock wallabies were not completely oblivious to the boats acknowledging their arrival with small changes in behaviour, usually involving head raising, looking around and/or changing stance. This was shown statistically by an analysis of the proportion of recordings in which wallabies were observed as being alert.

Thus while rock wallabies were certainly aware of the boats they did not hide from them or increase their movements in response to them. Anecdotal observations suggested that rock wallabies were more likely to move and hide when disturbed by walkers in close proximity to them, than when boats of any kind were in the gorge.

A total of 29 species of birds was recorded during the current survey. This total was represented by 18 families and included 18 non-passerines and 11 passerines. Breeding records were obtained for the Eastern Reef Heron (six nests), Nankeen Kestrel (two nests), Little Corella (over 50 nests), Welcome Swallow (over 25 nests), Little Woodswallow (a pair noted carrying nesting material) and the Black-faced Cuckoo Shrike (seen feeding a fledgling).

Little data was collated on the impact of boats on birds as the observers time was taken recording rock wallaby behaviour. However, the observations that were made suggested little reaction from any of the nesting species to the presence of boats. In contrast, walkers were seen to cause Little Corellas to leave roosting and nesting sites. Nesting Eastern Reef Herons and Welcome Swallows were not subject to disturbance from walkers.

A sub-set of nesting Corellas and Egrets will be monitored during the Spring 2001 survey to determine impacts. The methodology for this and the refined methodology for monitoring impacts to rock wallabies will be presented to CALM in March 2001.

The Questionnaire

Findings from the questionnaire have been summarised and presented in this progress report. Responses to several questions suggest that answers may have been influenced by the respective tour operators.

2.0 Methodology

The monitoring carried out between the 15/9/2000 - 23/9/2000 represented a pilot study that identified the best locations from which to view fauna (particularly the rock wallabies) and the type and nature of the data collected. This information has been used to refine the experimental design and analysis of the Spring 2001 survey. The study focussed on the following:

- Avifauna species richness;
- Abundance of species;
- Avifauna habitats;
- Typical responses of avifauna to boats and climbers;
- Number of rock wallaby groups;
- Location of rock wallaby groups;
- Number of rock wallabies per group;
- Types of behaviours exhibited throughout the day;
- Typical behaviour of rock wallabies in the absence of boat tours; and
- Typical responses of rock wallabies to boats and climbers.

2.1 Avifauna Monitoring

The methodology used to monitor avifauna responses is discussed under the following:

- Population effects; and
- Effects on individual birds.

Timing for the survey was suggested as late winter / early spring to coincide with breeding of key species previously identified as having nested or possibly nesting at Yardie Creek (sources: Johnstone 1990, Johnstone & Storr 1998):

1. Eastern Reef Heron - eggs laid from July to November;
2. Osprey - Eggs laid from early June to early September in the Pilbara;
3. White-bellied Sea-eagle - eggs laid from July to August;
4. Little Corella - eggs laid from July to September;
5. Bar-shouldered Dove - eggs laid from July to October;
6. Mangrove Robin - in the Pilbara, breeding occurs in August and September;
7. Mangrove Golden Whistler - nest building recorded in mid-September in the Pilbara.

2.2.1 Population Effects

This study can not determine whether there has been a population level effect: ie. whether disturbances to individual nesting birds translate to a reduction in nesting success and an eventual decline in population size. Population level effects require monitoring over several generations to establish whether impacts on individual birds translates to a population level effect (eg. a reduction in the number of breeding pairs).

Furthermore, there is little published systematic data on the avifauna of Yardie Creek that can be used to develop a pre-impact (prior to regular boat tours) scenario against which current observations can be compared. However, some historical literature and unpublished records for Yardie Creek have been collated and are presented in Section 3. These data, the results from the monitoring study of impacts on individual birds and results of studies elsewhere can be used to infer possible long term outcomes.

Avifauna Censusing
Morning censuses were conducted to collect baseline data on the composition and abundance of the avifauna of Yardie Creek. Censuses commenced at the mouth of Yardie Creek and continued along the rim of the gorge to the end of the water. Censusing started at between 6:30 and 7:30 each morning of the survey, 15/9/2000 to the 23/9/2000.

2.2.1 Effects on Individual Birds

The morning censusing (see Population Effects above) identified those locations that support the greatest number of birds, in particular nesting species, and which were therefore most valuable in obtaining information about effects on individual birds. Observers were positioned at two locations, View and opposite Island Group on the northern side of the gorge such that they could view both rock wallabies and nesting/roosting birds.

When possible observers monitored the behaviour of birds in response to the approaching vessel and walkers, however most attention was given to monitoring rock-wallabies.

2.2 Rock Wallaby Monitoring

At the commencement of the survey, several days were spent locating the different groups of rock wallabies. In all, 11 sites were identified and named according to some prominent feature at the location. Several of these localities are shown in plates 2.1 – 2.6. Numbers of rock wallabies were accurately determined for Ficus, Beach, Island and Splinter Sites. However, wallabies were noted moving between View, Peninsula and Boulder sites on a number of occasions making an accurate total difficult to determine. It is estimated that between 16 and 20 animals occurred in the gorge accessible to the boats and that a further 12 to 16 animals occurred over 750 m further up the gorge.

- Ficus site (Plate 2.1) (n=1 female);
- Beach site (Plate 2.2) (n=1 male);
- Opposite Ficus site (none noted by the observers however both the CALM Ranger and McLoed reported seeing two individuals at this location);
- Island site (Plate 2.3) (n=3);
- Splinter site (Plate 2.4) (between five and six animals recorded including a mother and joey);
- View site (Plate 2.5) (between two and three individuals including a mother an joey);
- Peninsula site (Plate 2.6) (between one and three individuals. Animals were seen moving between this site and Boulder);
- Boulder site (Plate 2.6) (five animals recorded on one occasion);
- North Grove site (five animals recorded on one occasion);
- South Grove site (two animals noted on one occasion); and
- Spire site (none seen but plenty of evidence).

The last four sites in the above list are not accessible to tour boats and would not be included in any tallies historically recorded by tour operators or currently assessed as part of the Visitor Questionnaire.

Plate 2.1. Ficus site

Plate 2.2. Beach Site

Plate 2.3. Island site

Plate 2.4. Splinter Site

Plate 2.5. View Site

Plate 2.6. Boulder Site and Peninsula Site

Data recorded

The following attributes were recorded for each rock wallaby:

- Time
- Site
- Posture
- Location
- Position
- Behaviour

Time
Recording of all attributes commenced on every half hour, typically between 10am and 4pm. Individual rock wallabies visible to the observer were scored for their posture, location and behaviour on a rotational basis for five consecutive recordings. If no rock wallabies were visible the observer waited approximately two minutes before commencing the second round of observations. Depending on the number of wallabies visible and their level of activity, each rotation of observations took between 8 and 30 minutes to complete.

Site
This refers to the location of the colony. Most have been photographed and included as Plates 2.1 to 2.6 above.

Posture
During the initial monitoring phase of this pilot study, the rock wallabies were observed for typical postures. Four different positions were recognised including:

- Tail sitting (Plate 2.7);
- Standing (Plate 2.9);
- Crouched (Plate 2.10); and
- Lying down (Plate 2.8).

On many occasions wallabies were partially obscured by rocks such that the posture could not be determined. These animals were recorded as obscured.

Location
Location referred to where the animal was observed in relation to "landmarks", for example at the front of a particular crevice or at the back of a crevice etc. This was used to determine whether an animal had moved between observations.

Position
This scored whether the wallaby was in the shade, in the sun or partially in the sun.

Behaviour
What the animal was doing at the time of each observation was recorded under this heading and included:

- None
- Grooming
- Looking alert
- Foraging
- Interacting
- Not recorded

Typically the wallabies showed no identifiable behaviour and where thus scored as 'None'.

Plate 2.7: Tail sitting at View

Plate 2.8: Lying-down at View

Plate 2.9: Standing

Plate 2.10: Crouched

Plate 2.11. The McGregor Boat

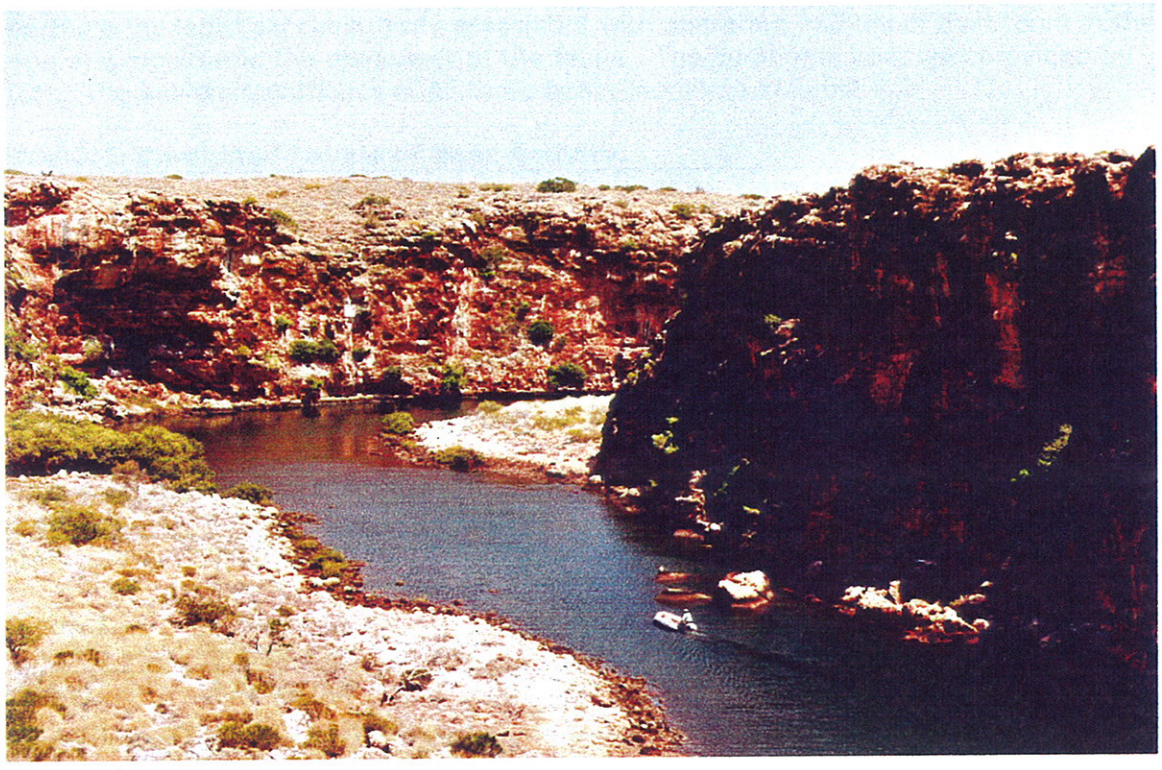

Plate 2.12. The CALM boat
Behaviour Monitoring

A primary aim of the pilot study was to identify the typical activity patterns of rock wallabies, and in particular establish whether the type of activity/activities displayed by the wallabies were constant across the time span required to manipulate boat trip frequency (ie. between 10am and 3pm).

Monitoring of rock wallabies commenced as early as 9am and continued throughout the day, usually until 4pm. Boat identity and approximate times (when first noted by one of our observers) are also given.

Search for Control Groups

The area of the gorge beyond that accessible to the tour boats was surveyed to locate additional groups of rock wallabies that may be used as control groups during the 2001 survey. The location and approximate numbers of rock wallabies in the additional groups was noted.

Current Levels of Boat Activity

Tour frequency was not predictable and was dependent on bookings which were finalised the night prior to the tour. The number of tours per day (excluding the CALM boat trips) ranged from 0 – 3. The first tour of the day typically commenced at 12:00 whilst the last tour commenced at approximately 14:00. However, on the 22/09/2000 boat tours commenced at approximately 10:00 am.

Similarly unpredictable was the number of non-motorised boats on the creek. During the pilot study, groups of two and five kayaks were noted and on two occasions single dinghies were recorded. It may be necessary to restrict access to all boats for the duration of the 2001 study.

Additional Boat Trips

A preliminary design of the manipulative experiment was trialed during the pilot study to determine the logistical constraints associated with operating additional boat tours in the gorge and monitoring the responses of the fauna. The additional boat was provided by CALM. The key characteristics of all three boats are given in Table 2.2.

Table 2.1: Combined Levels of Boat Activity.

Dates	# of Boat Tours	Kayaks, Canoes etc
17/09/2000	2	0
18/09/2000	4	0
19/09/2000	1	8*
20/09/2000	4	0
21/09/2000	2	1
22/09/2000	3	0

* A group of two kayaks, five kayaks and a single dinghy.

Table 2.2: Description of boats currently operating on Yardie Creek.

Operator	Boat Type	Capacity	length	Engine Type
CALM	Quicksilver rubber inflatable	6 persons	3.8m	Evinrude 15HP 2 Stroke
McGregor	Multi Hull Australia	30 persons	2.6m x 7m	Yamaha 9.9HP 4 stroke
McCleod	Army hull	12 persons		Evinrude 15 HP 4 stroke

To gain an appreciation of general activities of the two existing tours, the operator of the CALM boat travelled on both tour boats. Average "tours" were then conducted using the

CALM boat to increase the number of boat trips per day. The CALM boat "tours" commenced at 11:30, 12:30 and 14:00 and lasted for approximately 60 minutes.

Experimental Design and Analysis

The pilot study examined different levels of boat activity on the creek: control (as per current use), medium use and high use.

It was originally proposed to compare rock wallaby numbers from before the boat tours (11 am to 12 noon), during boat tours (12 noon to 2 pm) and after boat tours (3 pm to 4 pm) on days with low, medium and high boat use. Boat use was to be increased by CALM personnel operating a motorised dinghy to simulate the disturbance of a boat tour. This design was dependent on: the number of boat tours to be conducted on any day being known in advance; the boat tours being conducted between 12 noon and 2 pm; and on the gorge being relatively free of disturbance outside those times. None of these conditions were met on all days.

While the basic structure of the design remained, some modifications were introduced:

- recordings before the boat tours were made earlier, usually from 10 am to 11am (but once from 9.00 am to 10.00 am); and
- two sets of recordings were made during boat tours: one during the first boat tour of the day and one during the last boat tour of the day.

The first boat tour of the day was usually between 12.00 noon and 1.00 pm, run by the McGregors. The last boat tour was between 2.00 pm and 3.00 pm and was either the McLeods tour or the CALM dinghy. These two sets of data were analysed separately as the "after" records were the same for each set.

Comparable data for these analyses were only obtained for five days. There were inconsistent differences in boat use among these days and it was not possible to differentiate low, medium and high boat use. Instead days were categorised as having low (1 or 2 powered boat trips) or higher (3 or 4 powered boat trips) boat use. Unfortunately the only day when there were no scheduled boat trips in the gorge was our first day of observation, before the exact details of sampling procedure had been agreed on, hence there are no "control" observations to establish a natural pattern of rock wallaby activity.

As it became evident that rock wallabies were not showing a numerical response to boat use in the gorge, a second line of comparison was established. This compared the amount of movement and "alertness" displayed by the rock wallabies immediately before, during and after the first and last boat tour of the day. As all recordings were taken at different times, these data were analysed together and were also compared between days of low and high boat use.

In all cases the data were analysed by a repeated measures analysis of variance with one between-subjects factor (boat use: low or higher). For the analysis of rock wallaby numbers there was one within-subjects factor (time of recording: before, during or after the boat tour) but for the analyses of alertness and movement there were two within-subjects factor (time of recording and boat trip: first or last). Both analyses were performed using SuperAnova (Abacus Concepts 1989), a statistical package for Macintosh.

2.3 Questionnaire / Survey

A questionnaire was developed by CALM and handed out to observers to determine their level of satisfaction with the tours. Questions were of three types: respondants were

given a choice between alternative answers; respondants were asked to provide data, for example, about themselves or the number of sightings made; and respondants were asked to comment on certain things. Results were entered into an Excel spreadsheet (Microsoft 1998) for analysis.

If alternative answers were selected, the number of respondants choosing each alternative was graphed and the percentages calculated for easy comparison. In some instances the two tour groups showed markedly different responses and the numbers were compared by contingency Chi Squared analysis. If respondants provided quantitative data, the mean and standard error were calculated and differences between tour groups were checked by unpaired t-tests. Comments were summarised. All analyses were performed using Statview SE+ Graphics (Abacus Concepts 1987).

3.0 Avifauna Results

A total of 144 species of bird has been recorded from the Yardie Creek area (Storr - Johnstone Bird Data Bank) (see annotated list below), over a third of which are seabirds and waders. The majority of these birds are common and widespread. However, it is worth noting that small stands of mangroves near the mouth of Yardie Creek represent the most southern mangals in the Pilbara mangrove system. These support three species, the Bar-shouldered Dove, Mangrove Robin and Mangrove Golden Whistler, which are at their southern limit in Western Australia. The mangroves at this locality and Mangrove Bay also represent an important stopover for many wader species migrating along the coastline.

There are records of several species breeding in or on the cliffs at Yardie Creek (Storr - Johnstone Bird Data Bank). These records include the following: Reef Heron (nests 1–3 m above the water line), Osprey, White-bellied Sea-eagle, Little Corella (in holes in the cliffs) and Red-backed Kingfisher. Of these species it is likely that the Reef Herons would be most at risk when breeding, as low-wave action may destroy nests that are close to the water.

The annotated list of birds recorded from the Yardie Creek area includes coastal habitats at the mouth of the creek, the Yardie Creek Gorge and adjacent parts of the Cape Range. Data on the area has been extracted from the Storr - Johnstone Bird Data Bank and is supplemented with observations made during the Spring 2000 study. The main sources of breeding information come from the following accounts and visits by naturalists.

1. Visits by Thomas Carter who resided at Point Cloates from 1889 - 1902. During this period he made several trips along the coast to Yardie Creek and North-West Cape. In 1911, 1913 and 1916 he re-visited Point Cloates, travelling north to Yardie Creek in 1913 and to Yardie Creek and North-West Cape in 1916.

2. I. C. Carnaby's visit from early January to late October 1943.

3. A. Douglas and G. F. Mees visit in August 1959.

4. G. Lodge's visits in May 1964, July 1972, August - September 1972, August - September 1974, July 1982, August 1983 and July - August 1984.

5. G. Lodge's and P. Stone's visit in October 1973.

6. N. Kolichis visit in July 1976, 1977 and 1978.

7. T. C. Allen's visit in July - August 1977.

8. J. R. Ford's visit in October 1978.

9. R. E. Johnstone's visits in July 1978 and July 1980.

Status of a species is listed as very common, common, moderately common, uncommon, scarce or rare either throughout its distribution or in given habitats. Season of occurrence of regular non-breeding visitors is indicated by months of earliest and latest records. For vagrants and rare visitors, records are often individually cited. Species in square brackets are recorded from just outside the region eg. Mangrove Bay and Point Cloates. Nomenclature follows Johnstone (in prep).

Mouth of Yardie Creek and Coast
The mouth of Yardie Creek contains a small area of mangroves, *Avicennia* and several *Rhizophora*, mainly low stunted trees and a few large dome-shaped shrubs. This is the southernmost limit for *Rhizophora* in Western Australia. To the north and south of the creek mouth the coastal strip has a diversity of habitats including broad intertidal flats, both rock and sand foreshore, beaches and small lagoons with mangroves, coastal dunes and samphire flats.

Yardie Creek Gorge and Cape Range
Yardie Creek essentially cuts through the Cape Range a heavily dissected limestone plateau rising to 315 m. The steep rock slopes are sparingly covered with *Triodia*, shrubs and low eucalypts. The upper section of the gorge is more heavily wooded.

The Assemblage
A total of 147 species has been recorded for the Yardie Creek area or is expected to occur there from their occurrence nearby. Of these, a number of species have important isolated populations in the Cape Range, mainly the Spinifex Pigeon, Rufous-crowned Emu-wren, Striated Grasswren, Grey-headed Honeyeater, Grey Shrike-thrush, Little Woodswallow and Spotted Bowerbird. Noteworthy of these are the Grey Shrike-thrush *Colluricincla harmonica kolichisi* and the Spotted Bowerbird *Ptilonorhynchus guttatus carteri,* both endemic subspecies in the region (Ford, 1987; Frith & Frith, 1997).

The broad intertidal flats and beaches are important habitats for many seabirds and waders, including many migrants from the northern hemisphere. The small stand of mangroves at Yardie Creek is the southern limit of the Pilbara mangrove system. Many mangrove birds have a broken distribution in Western Australia with isolated populations in the Kimberley, Pilbara and Carnarvon regions. Species whose Pilbara population is at its southern limit in the Yardie Creek area are the Mangrove Heron, White-breasted Whistler, Mangrove Grey Fantail, Dusky Gerygone and Yellow White-eye (Johnstone, 1990).

The Yardie Creek gorge contains one of the few breeding colonies of the Eastern Reef Heron in Western Australia. About 15 - 20 pairs have nested in the gorge for the past 40 years and probably since the early 1900's as Carter saw birds there in 1913. A high conservation value should be placed on this colony and possibly prevent disturbance during the breeding season. Other species recorded breeding in the cliffs of Yardie Creek include the Osprey, White-bellied Sea-eagle and Little Corella. This is one of the few areas in Western Australia where Corellas are cliff nesters.

The Yardie Creek area has a relatively rich fauna compared to other parts of the north-west and contains a number of endemic subspecies. The gorge area has both biological and scenic value. If tourism and boating are to increase then some specific guidelines for managing visitation will be needed.

A total of 29 species of birds was recorded during the current survey. This total was represented by 18 families and included 18 non-passerines and 11 passerines (Table 3.1).

Spring 2000
The 29 species were represented by 500 records, 55% of which were contributed by a single species, the Little Corella (Table 3.1). Twenty-two of the 28 species were recorded from ten or fewer individuals, with seven being recorded from just one individual (Table 3.1).

Observations of birds recorded during the current survey are discussed under each species in the annotated list below.

Breeding Records
Breeding records were obtained for six species including the:

Eastern Reef Heron – Six nests were identified. Nests were typically located behind small dense *Ficus* (rock figs) on the cliff face or in shallow caves behind *Ficus*. At least one nest contained chicks as they were heard calling when the parents returned with food.

Nankeen Kestrel - Two nests were recorded. A pair was seen nesting behind an old sea eagles nest and a second pair was recorded nesting in a shallow cave above Boulder site.

Little Corella – Approximately 50 nests in the Cliffs over the water in Yardie Creek with many more seen further up the gorge.

Welcome Swallow - Over 25 nests were recorded and fledglings were seen on a narrow rock shelf approximately 1.5 m above the water line to the north of Splinter site.

Little Woodswallow - A pair noted carrying nesting material to the cliff face adjacent to Gully site.

Black-faced Cuckoo Shrike - Seen feeding a fledgling in the mangroves on the southern side of the creek adjacent to the boat mooring.

Annotated Species List

FAMILY CASUARIIDAE

Dromaius novaehollandiae Emu. Moderately common. Mainly on coastal strip and base of range. Breeding recorded near Yardie Creek in samphire.

FAMILY PHASIANIDAE

[*Coturnix novaezelandiae* Stubble Quail. Possibly an uncommon visitor to coastal area. Breeding reported at Point Cloates in August and September.]

[*Coturnix ypsilophora* Brown Quail. Listed by Carter as occasionally breeding near the coast. It is doubtful whether this species does occur here.]

FAMILY ANATIDAE

[*Cygnus atratus* Black Swan. Possibly an uncommon visitor to mouth of Yardie Creek. Breeding recorded just outside the area in July.]

Anas gracilis Grey Teal. Moderately common visitor, often breeding. Pools on Yardie Creek and flooded samphire flats. Listed by Carter for the North-West Cape region as "the commonest duck breeding in hollow gum spouts". Breeding from February to October.

Anus castanea Chestnut Teal. Scarce or rare. Small flocks recorded just outside the area at Mangrove Bay in July 1980. Probably more common in past, as Carter recorded a great flock on large open sheet of water surrounded by mangroves between Yardie Creek and Vlaming Head in June 1902. He saw a pair at the same place in August 1916 and was told that they frequently occurred at these mangroves and occasionally bred there.

Anus superciliosa Pacific Black Duck. Uncommon visitor, occasionally breeding. Mainly Yardie Creek gorge.

Malacorhynchus membranaceus Pink-eared Duck. Uncommon visitor. Mainly near coastal pools.

Athya australis Hardhead. Uncommon visitor. Yardie Creek gorge and flooded samphire on coast.

FAMILY PODICIPEDIDAE

[*Poliocephalus poliocephalus* Hoary-headed Grebe. Scarce or rare visitor to coastal areas. Recorded just outside the area.]

FAMILY PHALACROCORACIDAE

Phalacrocorax varius Pied Cormorant. Uncommon or scarce visitor to coast.

FAMILY ARDEIDAE

Ardea pacifica White-necked Heron. Uncommon. Inland pools and occasionally on beach.

Ardea novaehollandiae White-faced Heron. Uncommon to moderately common. Flooded coastal flats, edges of mangroves and inland pools. Breeding recorded in mangroves in July and August - September.

Recorded on four occasions during the current survey. Recorded as singles, twos and threes typically from the waters edge.

Ardea alba Great Egret. Scarce. Coastal lagoons.

Ardea garzetta Little Egret. Scarce. Edges of mangroves.

Ardea sacra Eastern Reef Heron. Common resident. Tidal flats, rocky and sandy beaches and lower Yardie Creek. Breeding recorded from July to October. In August - September 1972 listed as common in Yardie Gorge with many nesting in the cliff sides. Nest were in *Ficus* trees growing out of the cracks in the cliff face. Seven nests were inspected: four contained three eggs, one with three young and one with two young. In October 1973 eight pairs were breeding in Yardie Gorge; nests with eggs and young at various stages. In July 1974 listed as common in Yardie Gorge and one nest with three eggs and several nests with young were noted. Both white and grey phase birds in the colony and nests ranged from just above water level to 3 m up the cliff wall.

Recorded on 23 occasions, typically as singles or twos. Often seen on the banks of the creek, the cliff face, mangroves and on nests behind ficus trees on cliff faces. Both white phase and dark phase birds were observed.

Butorides striatus Striated Heron. Uncommon to moderately common in ones, twos and small groups. Mangroves and rocky, muddy and sandy tidal flats. Breeding in mangroves near Yardie Creek, August - September.

Single bird seen resting on the stilt roots of the *Rhizophora stylosa* adjacent to the boat mooring.

Nycticorax caledonicus Rufous Night Heron. Uncommon or scarce. Recorded by Carter as plentiful about mangrove creeks in North-West Cape region and near Yardie Creek in early nineteen hundreds.

Single bird seen during the current survey perched on the stilt roots of *Rhizophora stylosa* adjacent to the boat mooring.

FAMILY THRESKIORNITHIDAE

Threskiornis molucca Australian White Ibis. Scarce or rare visitor. Carter was informed that they occasionally occurred in small numbers with flocks of Straw-necked Ibis.

Threskiornis spinicollis Straw-necked Ibis. Scarce, irregular visitor. First recorded by Carter in the North-West Cape region in May 1888 when numbers suddenly appeared. After the 1889 - 91 drought broke, immense numbers were seen. On 1 September 1913 Carter found the remains of an immature at Yardie Creek.

FAMILY ACCIPITRIDAE

Pandion haliaetus Osprey. Uncommon to locally moderately common. Mainly coast especially areas with mangroves and along Yardie Creek. Breeding recorded at Yardie Creek (nest on edge of cliff) in June.

Elanus caeruleus Black-shouldered Kite. Uncommon to moderately common. Many seen on coast during drought of 1891 by Carter and noted as fairly common in 1900. Recorded breeding just outside the area in July 1974 (nests with eggs and young) and recorded at Low Point in July 1980.

Hamirostra melanosternon Black-breasted Buzzard. Moderately common over range and coastal habitats.

[*Haliastur sphenurus* Whistling Kite. Uncommon or scarce visitor to the area.]

Haliastur indus Brahminy Kite. Uncommon. More frequent in mangroves further south on peninsula.

Accipiter cirrocephalus Collared Sparrowhawk. Single bird seen chasing kestrels above the cliffs at the upper reaches of the water in Yardie Creek.

Accipiter fasciatus Brown Goshawk. Moderately common autumn - winter visitor from further south. Mainly well wooded habitats along Yardie Creek and mangroves.

Aquila audax Wedge-tailed Eagle. Single bird seen over the cliffs at the end of the water in Yardie Creek.

Haliaeetus leucogaster White-bellied Sea-Eagle. Moderately common along the coast in ones and twos. Breeding recorded at Yardie Creek in June - July. Nests in cliff edges or in low trees on cliff edges.

Circus assimilis Spotted Harrier. Moderately common. Mainly over mangroves, samphire flats and coastal areas. Noted by Carter as most numerous in winter. Breeding recorded (nest with three eggs) in eucalypt, just outside the Yardie Creek area in July 1982.

Immature bird seen on two occasions over the sand dunes adjacent to the carpark.

[*Circus approximans* Swamp Harrier. Possibly a rare visitor. One collected by Carter at Point Cloates.]

FAMILY FALCONIDAE

Falco berigora Brown Falcon. Common resident. Breeding from June to August. Most nests in trees but one reported on top of a large termitarium.

Falco cenchroides Australian Kestrel. Common resident and autumn - winter visitor. Usually single but occasionally in twos or small parties. Favours coastal habitats especially samphire flats and dunes, also edges of range and Yardie Gorge. Breeding recorded in July to September. Nesting sites include tree hollows and ledges of cliffs in range and gorges.

Three pairs recorded nesting within the small overhangs in the cliff face.

Falco longipennis Australian Hobby. Uncommon, possibly only a winter visitor. Noted as quite common in the region by Carter during the abnormally wet year of 1900.

[*Falco peregrinus* Peregrine Falcon. Possibly only a rare visitor. One observed by Carter well to the north at Vlaming Head on 15 June 1902.]

Two records of a single bird over the cliffs at the end of the water in Yardie Creek.

FAMILY RALLIDAE

[*Gallirallus philippensis* Buff-banded Rail. Scarce. Nomadic. Ones and twos recorded just outside the area including a nest with eight eggs in dense clump of samphire near mangroves at Low Point in July 1980.]

Gallinula ventralis Black-tailed Native-hen. Nomadic. Locally common in good years but generally scarce, in ones, twos or small parties. Mainly inundated coastal flats (following winter or summer rains).

Fulica atra Eurasian Coot. Uncommon visitor. Listed by Carter for the North-West Cape region as an occasional visitor when water is plentiful, notably in 1898 and 1900.

FAMILY OTIDIDAE

Otis australis Australian Bustard. Nomadic. Uncommon to moderately common depending on season. Listed by Carter as very abundant in good seasons in pairs and small mobs. Mainly coastal flats. Breeding reported for May, July, August and September.

FAMILY TURNICIDAE

Turnix velox Little Button-quail. Common to moderately common in good seasons. Mainly coastal flats. Breeding in April and September.

FAMILY SCOLOPACIDAE

[*Limosa limosa* Black-tailed Godwit. Scarce visitor from northern hemisphere; recorded just outside the area at Low Point in July 1980. Tidal flats.]

Limosa lapponica Bar-tailed Godwit. Moderately common visitor from northern hemisphere. Sandy, rocky and muddy coasts. Numerous records in July 1980.

[*Numenius minutus* Little Curlew. Uncommon summer visitor from northern hemisphere. Small flocks recorded outside the region at North-West Cape and Point Cloates. Mainly coastal flats.]

[*Numenius phaeopus* Whimbrel. Scarce visitor from northern hemisphere. Recorded just outside the region at Low Point in July 1980. Coastal flats.]

Numenius madagascariensis Eastern Curlew. Moderately common visitor from northern hemisphere; usually in ones or twos, occasionally small parties. Mainly tidal flats. Noted by Carter as a common summer visitor, arriving about the end of September with odd birds remaining all winter. On 14 June 1902 he recorded "Curlews" as abundant at a large open sheet of water surrounded by mangroves between Yardie Creek and Vlaming Head (presumably the Mangrove Bay area).

[*Tringa totanus* Redshank. A shy wader seen by Carter at a large open sheet of water surrounded by mangroves between Yardie Creek and Vlaming Head (presumably near Mangrove Bay) on 22 June 1902 is believed to have been this species. Rare visitor from northern hemisphere.]

Tringa nebularia Greenshank. Scarce visitor (late August to early June) from northern hemisphere. Mainly tidal flats, mangroves, samphire flats, beaches and freshwater pools. One collected at Yardie Creek on 24 January 1898.

Tringa hypoleucos Common Sandpiper. Moderately common visitor from northern hemisphere (late August to early May). Usually in ones or twos. Tidal mud flats, mangroves, beaches and rocky pools including mouth of Yardie Creek.

Single seen around the mangroves near the mouth of Yardie Creek on three occasions.

Tringa brevipes Grey-tailed Tattler. Moderately common summer visitor from northern hemisphere; usually in ones or twos, occasionally flocks (up to 12). Mainly tidal flats, mangrove areas and shallow brackish water on coastal flats. Listed by Carter as fairly numerous on coast in summer from November to May.

Arenaria interpres Ruddy Turnstone. Moderately common visitor from northern hemisphere (especially in summer). Mainly ones, twos or small flocks. Tidal flats, beaches and edges of coastal lakes.

Calidris alba Sanderling. Uncommon to moderately common visitor from northern hemisphere; usually in small flocks. Mainly sandy beaches, but in July 1980 also observed around sandy edges of small coastal lakes near Low Point.

Calidris ruficollis Red-necked Stint. Common visitor from northern hemisphere. Tidal mud flats and beaches.

Calidris acuminata Sharp-tailed Sandpiper. Uncommon visitor from northern hemisphere (August - June). Recorded in mangroves near North-West Cape and on flooded saltmarsh near Point Cloates.

FAMILY BURHINIDAE

Burhinus grallarius Bush Stone-curlew. Uncommon, in ones and twos. Listed by Carter for the North-West Cape region as evenly distributed but nowhere in large numbers. Three in wash leading into range (just outside the Yardie Creek region) in July 1982.

Esacus neglectus Beach Stone-curlew. Uncommon. Several pairs recorded by Carter at Low Point and near Yardie Creek. Nest with one egg on a shingly ridge near Low Point on 24 October 1900.

FAMILY HAEMATOPODIDAE

Haematopus longirostris Pied Oystercatcher. Moderately common resident. Mainly in pairs and small flocks (up to 15). Favours sandy beaches. Breeds on coast from July to September.

Single bird seen on the rock platform at low tide adjacent to the mouth of Yardie Creek.

Haematopus fuliginosus Sooty Oystercatcher. Uncommon to moderately common resident. Tidal flats and beaches. Breeding recorded in September.

FAMILY RECURVIROSTRIDAE

Himantopus himantopus Black-winged Stilt. Nomadic. Scarce to moderately common. Listed by Carter for the North-West Cape region as numerous at pools and swamps after heavy rains.

[*Recurvirostra novaehollandiae* Red-necked Avocet. Nomadic. Scarce visitor. A small flock was seen by Carter at a large sheet of open water surrounded by mangroves between Vlaming Head and Yardie Creek (presumably Mangrove Bay area) on 22 June 1902.]

FAMILY CHARADRIIDAE

Pluvialis squatarola Grey Plover. Common summer visitor from northern hemisphere, but some birds remain during the winter. Sandy, muddy and rocky coasts and brackish near-coastal lakes.

Pluvialis fulva Pacific Golden Plover. Scarce visitor from northern hemisphere. Usually single occasionally in small parties. Listed by Carter as a summer visitor and rather more numerous than Grey Plover. He observed them feeding at high water mark among seaweed left by tide.

Charadrius ruficapillus Red-capped Plover. Moderately common in ones, twos, small flocks and larger aggregations (up to 80). Tidal flats, beaches, open samphire flats and coastal lakes. Breeding recorded in July and August - September. Most nests are shallow scrapes in the ground just above high-water mark and often at edges of mangroves.

Two birds seen on the beach near the swash zone adjacent to the mouth of Yardie creek

Charadrius mongolus Lesser Sand Plover. Scarce visitor from northern hemisphere. Tidal flats. One collected in North-West Cape region by Carter on 28 January 1900.

Charadrius leschenaultii Large Sand Plover. Moderately common visitor from northern hemisphere. Usually in ones, twos or small parties. Mainly sandy beaches.

Charadrius melanops Black-fronted Dotterel. Scarce. Two observed at Yardie Creek on 7 June 1978.

Charadrius veredus Oriental Plover. Common summer visitor (late August - early April) from northern hemisphere. Listed by Carter as a common summer visitor, arriving very regularly in second week of September and leaving about mid March. Mostly seen in flocks on saltmarshes, open grass and spinifex flats near the coast and beaches. In December 1895 Carter noted that the beach was lined with them for miles.

FAMILY GLAREOLIDAE

Glareola maldivarum Oriental Pratincole. Common, irregular visitor from northern hemisphere (December - May). Numerous flocks seen by Carter usually just before rains or stormy weather.

FAMILY LARIDAE

[*Larus pacificus* Pacific Gull. Several recorded by Carter at the whaling station near Point Cloates on 6 September 1913; he believed that they had been attracted to the hundreds of dead whales that lay along the beach from Point Maud to North-West Cape in 1913.]

Larus novaehollandiae Silver Gull. Uncommon to moderately common in small flocks (up to 50). Tidal flats and sandy beaches.

Recorded on seven occasions typically as singles or small groups of 2-3 on the beach adjacent to the mouth of Yardie Creek, however on one occasion a single flock of 11 was seen at the mouth.

Sterna nilotica Gull-billed Tern. Scarce. Recorded once by Carter for the North-West Cape region.

Sterna caspia Caspian Tern. Moderately common resident. Mainly in ones and twos and occasionally small groups. Coastal areas. Breeding (nests solitary or in colonies) recorded on tops of bare sand-drifts and at mouth of Yardie Creek; March to early November.

Single bird recorded from the rock platform adjacent to the mouth of Yardie Creek.

Sterna bengalensis Lesser Crested Tern. Moderately common, mainly in small flocks. Coastal areas. Listed by Carter for the North-West Cape region as fairly numerous in summer. In July 1980 a flock of sixteen was observed resting on exposed rocks at Mangrove Bay and on a sandy spit at Low Point.

Sterna bergii Crested Tern. Moderately common, in small flocks (up to 20). Coastal areas.

Single seen on the beach adjacent to the mouth of Yardie Creek.

[*Sterna dougallii* Roseate Tern. Common and recorded in large numbers about Frazer Island and on sandy points on the mainland.]

[*Sterna hirundo longipennis* Common Tern. Regular visitor to Pilbara coast (late August - late April) from north-east Asia. Flocks of '*Sterna frontalis*' recorded by Carter during the summer months in the North-West Cape region are almost certainly referable to *S. h. longipennis*.]

[*Sterna nereis* Fairy Tern. About 40 pairs were breeding on a sandy flat near Low Point on 3 October 1979. Coasts and blue-water seas.]

[*Anous stolidus* Common Noddy. Carter recorded great numbers on low sandbanks adjoining Frazer Island in April - May 1902.]

FAMILY COLUMBIDAE

Phaps chalcoptera Common Bronzewing. Scarce or uncommon. Several recorded by Carter.

[*Phaps histrionica* Flock Pigeon. Scarce. Irregular visitor from Kimberley. Recorded by Carter for the North-West Cape region. Common in some seasons usually after good rains.]

Ocyphaps lophotes Crested Pigeon. Uncommon to moderately common, mainly ones and twos and small flocks. Coastal flats, edges of range, also gorges. Breeding in July - August, nests in small trees and shrubs.

Recorded on eight occasions as either singles or twos typically from the near coastal dunes or adjacent areas.

Geophaps plumifera Spinifex Pigeon. Moderately common in Cape Range south to Yardie Creek, in pairs and small groups (up to 7). Breeding recorded in May, July and August - September. Nests on ground on slopes of gorges and hilly country with spinifex and acacia. Birds from the Cape Range are the palest of all red-bellied populations (see Johnstone 1981) and are isolated from the Pilbara population by the unsuitable sandy country south and east of Exmouth Gulf.

Geopelia cuneata Diamond Dove. Partly nomadic, uncommon to common. Recorded by Carter for the region as very common in summer when water is scarce especially on the ranges at Yardie Creek. Often aggregating in pairs or small parties at permanent water.

[*Geopelia humeralis* Bar-shouldered Dove. Recorded just outside the area at Mangrove Bay, the southernmost record for this species in Western Australia. Confined to coastal mangroves.]

FAMILY PSITTACIDAE

[*Cacatua roseicapilla* Galah. Uncommon. Mainly coastal plain near Mangrove Bay.]

Cacatua sanguinea Little Corella. Common at Yardie Creek in flocks (up to 200). Breeding in crevices of the cliffs in July - August. Also reported in other parts of Cape Range.

The most commonly recorded species during the current survey. This species was seen throughout the day regularly moving between nesting sites in the cliffs above Yardie Creek and feeding sites in the coastal dunes. There were approximately 50 nesting pairs in the cliffs with many more further up Yardie Creek.

Nymphicus hollandicus Cockatiel. Uncommon to moderately common depending on rainfall; usually in pairs or small flocks. Listed by Carter as occasionally visiting the coast after rains, April to July. Common in July - August 1984 flying over ranges. Breeding recorded in hollows in eucalypts in the ranges in July - August.

Platycercus zonarius Ring-necked Parrot. Moderately common in gorges in range. Breeding in tree hollows in July - September.

[*Neophema elegans* Elegant Parrot. Rare, autumn - winter visitor from the south-west. Recorded at Point Cloates.]

Melopsittacus undulatus Budgerigar. Abundance extremely variable, scarce or absent after long dry periods to common in good seasons. Breeding in hollows in eucalypts in gorges and on range in July - August.

FAMILY CUCULIDAE

Cuculus pallidus Pallid Cuckoo. Moderately common winter visitor from south-west. Open acacia and edges of mangroves.

Chrysococcyx basalis Horsfield's Bronze Cuckoo. Moderately common. Breeding visitor and passage migrant. Noted by Carter as a common winter visitor arriving usually in June but occasionally seen after summer rains. Most habitats including samphire flats. Breeding recorded in May, parasitising *Malurus.*

FAMILY STRIGIDAE

Ninox novaeseelandiae Boobook Owl. Scarce or rare, probably mostly winter visitor. Recorded for the North-West Cape region.

FAMILY TYTONIDAE

Tyto alba Barn Owl. Scarce or rare. Perhaps only an autumn - winter visitor. Listed by Carter as a winter visitor to the North-West Cape region.

FAMILY PODARGIDAE

Podargus strigoides Tawny Frogmouth. Scarce in wooded habitats. Breeding reported just outside the area in July.

FAMILY CAPRIMULGIDAE

Eurostopodus argus Spotted Nightjar. Uncommon. Recorded near the coast at Yardie Creek.

FAMILY AEGOTHELIDAE

Aegotheles cristatus Australian Owlet Nightjar. Uncommon in most wooded habitats. Breeding in hollows in eucalypts in gorges and edges of range in July and August.

FAMILY APODIDAE

Apus pacificus Fork-tailed Swift. Irregular visitor (November - April) from north-east Asia. Recorded in the North-West Cape region.

FAMILY HALCYONIDAE

Todiramphus pyrrhopygia Red-backed Kingfisher. Uncommon. Carter listed a pair breeding in a large white-ant hill at Yardie Creek on 4 August 1916.

Todiramphus sanctus Sacred Kingfisher. Uncommon to moderately common. Mangroves and Yardie Gorge. Most are probably winter visitors from south-west.

Single birds recorded from mangroves on three occasions. Localities included adjacent to the boat mooring, the mangrove island in the middle of Yardie Creek and the mangroves at the major bend in the creek.

[*Todiramphus chloris* Collared Kingfisher. Recorded by Carter as not uncommon on the coast especially in summer but these records are more likely Sacred Kingfishers. The Collared Kingfisher ranges south only to Bay of Rest.]

FAMILY MEROPIDAE

Merops ornatus Rainbow Bee-eater. Uncommon to moderately common. Mainly winter visitor and passage migrant. Lightly wooded country especially near water including Yardie Creek.

FAMILY MALURIDAE

Malurus lamberti Variegated Fairy-wren. Moderately common resident. Mainly edges of mangroves and coastal acacia thickets in gullies. Breeding recorded in July and August - September. Most nests in acacia on edge of range.

Malurus leucopterus White-winged Fairy-wren. Moderately common in small flocks (up to 6). Mainly coastal dunes with *Spinifex longifolius,* samphire flats, edges of mangroves and open acacia. Breeding reported in May.

Stipiturus ruficeps Rufous-crowned Emu-wren. Moderately common. Isolated population in the Cape Range south to Yardie Creek. Mainly dense *Triodia* on range especially along drainage lines and watercourses. Breeding in clumps of spinifex in July - August.

Amytornis striatus Striated Grasswren. Uncommon in pairs and family parties. Isolated population in Cape Range about the sources of Yardie Creek. Mainly *Triodia* in rocky or stony country including gorges. Breeding in April - May.

FAMILY PARDALOTIDAE

Pardalotus rubricatus Red-browed Pardalote. Uncommon in ones or twos. Reported for the Yardie Creek area. Mainly canopy of eucalypts.

FAMILY ACANTHIZIDAE

Calamanthus fuliginosus Striated Fieldwren. Moderately common resident. Coastal dunes, samphire flats and coastal heath. Breeding in July - August. Most nests in spinifex just above high-water mark.

[*Gerygone tenebrosa* Dusky Gerygone. Moderately common in mangroves in Mangrove Bay area. Confined to mangroves.]

FAMILY MELIPHAGIDAE

Lichmera indistincta Brown Honeyeater. Uncommon to moderately common in ones and twos. Mainly well wooded habitats in range and in mangroves.

Recorded from calls on four occasions and as two birds once. Typically from the areas of dense vegetation in the gorge and minor gullies.

Certhionyx niger Black Honeyeater. Irregular visitor. Locally and seasonally common eg: throughout the North-West Cape peninsula in June 1902 and August 1970, but generally scarce. Attracted to flowering *Acacia, Grevillea* and *Eucalyptus*.

Certhionyx variegatus Pied Honeyeater. Irregular visitor. Locally and seasonally common eg: North-West Cape peninsula in June 1902 and July - August 1982 and 1984. Open woodlands with flowering trees and shrubs. Breeding recorded in July - August.

Lichenostomus virescens Singing Honeyeater. Moderately common to common, usually in ones and twos. Mangroves, open acacia behind coastal dunes, gorges and range country. Breeding recorded in July - August.

Recorded on 16 occasions typically from the coastal dunes and adjacent areas.

Lichenostomus keartlandi Grey-headed Honeyeater. Locally common in ones and twos. Mainly eucalypts in gorges and on ranges. Isolated population in Cape Range south to Yardie Creek. Breeding in July, August and September. Most nests in eucalypts in ranges.

A single group of three birds recorded from amongst *Ficus* trees in a small gully near the end of the water in Yardie Creek.

[*Melithreptus gularis* Black-chinned Honeyeater. Possibly an uncommon or scarce visitor, two collected by Carter from a party of six near Exmouth in June 1902.]

Phylidonyris albifrons White-fronted Honeyeater. Irregular visitor. Locally common in some years. Recorded at Yardie Creek and common in some years at Point Cloates. Mainly lightly wooded areas with flowering trees and shrubs.

[*Manorina flavigula* Yellow-throated Miner. Uncommon, usually in pairs or small parties. Breeding recorded edge of range in July and August.]

Acanthagenys rufogularis Spiny-cheeked Honeyeater. Moderately common in Cape Range in ones, twos or small flocks. All wooded habitats including mangroves. Breeding reported in July.

[*Epthianura albifrons* White-fronted Chat. Rare, possibly a casual visitor. Carter noted flocks in February - May 1899.]

Epthianura tricolor Crimson Chat. Irregular visitor, numbers varying according to rainfall. Uncommon to common.

FAMILY EOPSALTRIIDAE

Petroica goodenovii Red-capped Robin. Uncommon winter visitor. Mainly coastal acacia thickets.

FAMILY CINCLOSOMATIDAE

Psophodes occidentalis Western Wedgebill. Uncommon in ones and twos. Mainly *Acacia* thickets. Breeding recorded just outside the area in July - August.

FAMILY PACHYCEPHALIDAE

Oreoica gutturalis Crested Bellbird. Moderately common in ones and twos. Mainly open acacia. Breeding in May and July.

[*Pachycephala melanura* Mangrove Golden Whistler. One collected by Carter in dense patch of mangroves between Yardie Creek and Vlaming Head (presumably Mangrove Bay area) on 14 June 1902. There are no other records for the area.]

[*Pachycephala lanioides* White-breasted Whistler. Moderately common in Mangrove Bay area, confined to mangroves.]

Colluricincla harmonica Grey Shrike-thrush. Moderately common in Cape Range. This isolated population treated as a subspecies *C. h. kolichisi* Ford 1987 is endemic to the region.

FAMILY DICRURIDAE

Rhipidura phasiana Mangrove Grey Fantail. Common resident in mangroves. Breeding in spring.

[*Rhipidura fuliginosa* Grey Fantail. Winter visitors of *R. f. preissi* from southern Western Australia have been recorded in the area.]

Rhipidura leucophrys Willie Wagtail. Moderately common winter visitor. Noted by Carter as arriving in middle of April and leaving in October. Mangroves and open woodland.

Grallina cyanoleuca Magpie-lark. Recorded on four occasions as single birds from the mangroves adjacent to the boat mooring during the course of the survey.

FAMILY CAMPEPHAGIDAE

Coracina novaehollandiae Black-faced Cuckoo Shrike. Moderately common resident. Mainly mangroves and woodlands. Breeding in July - August, most nests in river gums.

A pair seen feeding a fledging in the mangroves adjacent to the boat mooring.

Two adults and a fledgling recorded from the mangroves at the mouth of Yardie Creek.

[*Lalage tricolor* White-winged Triller. Moderately common breeding visitor and passage migrant. Recorded by Carter as a common winter visitor in the North-West Cape region. Also recorded breeding at Point Cloates in July.]

FAMILY ARTAMIDAE

Artamus leucorhynchus White-breasted Woodswallow. Moderately common along the coast especially about mangroves. Breeding reported in August - September.

Artamus personatus Masked Woodswallow. Nomadic visitor. Locally and seasonally uncommon to very common. Usually in small flocks, occasionally in large flocks. Mainly lightly wooded country. Breeding in large numbers in July - August 1984.

Artamus cinereus Black-faced Woodswallow. Uncommon to moderately common. Mainly lightly wooded country.

Artamus minor Little Woodswallow. Uncommon to moderately common in range country. Isolated population in the Cape Range south to Yardie Creek. Mainly about cliffs in gorges. Breeding in cliffs in August - September.

Recorded in small groups of between two and four including a pair that was collecting nesting material and constructing a nest in the cliff face.

FAMILY CRACTICIDAE

Cracticus nigrogularis Pied Butcherbird. Moderately common. Most habitats including mangroves. Recorded breeding in July - September.

Identified from call and seen in twos and threes above a small pool just past the upper reaches of the water in Yardie Creek.

FAMILY CORVIDAE

Corvus orru Torresian Crow. Uncommon, usually in ones and twos. Mainly coast and gorges. Specimen collected from Yardie Creek and reported breeding in August - September.

Corvus bennetti Little Crow. Nomadic, uncommon to common. Lightly wooded country, vicinity of water, garbage and road kills. Breeding in July.

FAMILY PTILONORHYNCHIDAE

Ptilonorhynchus maculatus Spotted Bowerbird. Uncommon in one, twos and small parties. Isolated population in Cape Range south to Yardie Creek. Mainly gorges and *Ficus* thickets in vicinity of water. Breeding in July - August.

Single birds recorded on four occasions. Recorded from the mangroves, dense Eucalypts and over the coastal dunes.

FAMILY ALAUDIDAE

[*Mirafra javanica* Singing Bushlark. Uncommon and patchily distributed further south eg: near Point Cloates.]

FAMILY MOTACILLIDAE

Anthus novaeseelandiae Richard's Pipit. Moderately common. Mainly open samphire flats and coastal dunes.

FAMILY PASSERIDAE

Taeniopygia guttata Zebra Finch. Common in flocks (up to 50). Lightly wooded habitats including mangroves. Breeding in July and August - September.

Single flock of four recorded from the base of Yardie Creek.

FAMILY DICAEIDAE

Dicaeum hirundinaceum Mistletoebird. Moderately common throughout the Cape Range also recorded in mangroves.

FAMILY HIRUNDINIDAE

[*Cheramoeca leucosterna* White-backed Swallow. Recorded breeding in hard sandy cliffs of the beach near Point Cloates.]

Hirundo neoxena Welcome Swallow. Moderately common resident. Mainly coastal.

Numerous pairs noted with young on the lower sections of the cliffs near the upper reaches of the water in Yardie Creek.

Hirundo nigricans Tree Martin. Common winter visitor. Mainly coastal dunes and samphire flats also vicinity of water in gorges.

Two birds seen flying over the cliffs during the current survey.

FAMILY SYLVIIDAE

[*Megalurus gramineus* Little Grassbird. Status uncertain, possibly a rare non-breeding visitor. Recorded in flooded samphire near Mangrove Bay in July 1980.]

Eremiornis carteri Spinifex-bird. Moderately common in Cape Range south to Yardie Creek. Dense spinifex on range. Breeding in July - August. Nests in clumps of spinifex.

Cincloramphus cruralis Brown Songlark. Uncommon to common. Coasts and inland. Breeding in July - August, nests on ground in low vegetation.

FAMILY ZOSTEROPIDAE

Zosterops lutea Yellow White-eye. Common, confined to mangroves. In ones, twos and small flocks (up to 20). Breeding in July.

The current survey identified just 29 species using the gorge during the period of the survey (Table 3.1).

Table 3.1: Total number of records or each species recorded during the survey.

Species	Sum of Records
ARDEIDAE	
Ardea novaehollandiae White-faced Heron	9
Ardea sacra Eastern Reef Heron	28
Butorides striatus Striated Heron	1
Nycticorax caledonicus Rufous Night Heron	1
ACCIPITRIDAE	
Accipiter cirrocephalus Collared Sparrowhawk	1
Aquila audax Wedge-tailed Eagle	1
Circus assimilis Spotted Harrier	2
FALCONIDAE	
Falco cenchroides Australian Kestrel	10
Falco peregrinus Peregrine Falcon	2
SCOLOPACIDAE	
Tringa hypoleucos Common Sandpiper	4
HAEMATOPODIDAE	
Haematopus longirostris Pied Oystercatcher	1
CHARADRIIDAE	
Charadrius ruficapillus Red-capped Plover	2
LARIDAE	
Larus novaehollandiae Silver Gull	22
Sterna caspia Caspian Tern	1
Sterna bergii Crested Tern	1
COLUMBIDAE	
Ocyphaps lophotes Crested Pigeon	10
PSITTACIDAE	
Cacatua sanguinea Little Corella	278
HALCYONIDAE	
Todiramphus sanctus Sacred Kingfisher	3
MELIPHAGIDAE	
Lichmera indistincta Brown Honeyeater	6
Lichenostomus virescens Singing Honeyeater	27
Lichenostomus keartlandi Grey-headed Honeyeater	3
DICRURIDAE	
Grallina cyanoleuca Magpie-lark	4
CAMPEPHAGIDAE	
Coracina novaehollandiae Black-faced Cuckoo Shrike	6
ARTAMIDAE	
Artamus minor Little Woodswallow	14
CRACTICIDAE	
Cracticus nigrogularis Pied Butcherbird	7
PTILONORHYNCHIDAE	
Ptilonorhynchus maculatus Spotted Bowerbird	4
PASSERIDAE	
Taeniopygia guttata Zebra Finch	4
HIRUNDINIDAE	
Hirundo neoxena Welcome Swallow	46
Hirundo nigricans Tree Martin	2
29	500

Effects of Tourism/Boating on Birds.

Little work has been done on the impacts of tourism/boats on breeding colonies of birds. Most available information is anecdotal and descriptive with little scientific analysis. Furthermore, most studies focus on individuals rather than populations. However, according to a 1984 review of the status of worldwide seabird populations, 85 seabird species were considered endangered or affected by human activities, and population decreases in 25% of these species were attributed to recreational visits and tourism related activities (Giese, 1999). Breeding success was found to be reduced by disturbance in 36 of 40 papers studying breeding biology. The reduction was attributed to increased predation and nest abandonment (Hockin *et al.*, 1992). Similarly, Jehl (1993) attributed persistent boating activities associated with whale watching activities around Isla San Martin (California) to the significant decline in numbers of breeding Brown Pelicans *Pelicanus occidentalis californicus,* and tourists visiting the Antarctica via helicopter have caused a 50% decline in an Adelie Penguin rookery (www.edf.org).

Studies that have been done suggest that different bird species respond differently to different types of disturbances. Blue Herons (*Ardea herodias*) were more disturbed by shore-based activities than water based activities (Vos *et al.* 1985). This was also the case for Coots *Fulica atra*, but the reverse was true for Great Crested Grebes *Podiceps cristatus* (Pluger and Ingfold 1988). Common Terns were found to fly away from windsurfers earlier than for either rowing or motor boats (Dietrich and Keopff, 1986). Rogers and Smith (1995) found that some species of colonial waterbirds (e.g. cormorants) could be approached closer by boat than on foot before flushing from their nests. Dunnet (1977) noticed that a close approach of crayfish boats to nesting seabirds did not cause any change in adult nest attendance.

One authors' (R.E. Johnstone) experience in the lower Ord River gorges (between Kona Lakeside and the main Ord Dam) suggests that responsible boat owners can approach rookeries without causing stress. The area has 3 - 5 tour boats and numerous pleasure boats that visit bird breeding areas, flying fox roosts and rock wallaby sites on a regular basis. Johnstone observed that if boats are kept at a 'reasonable' distance with motors idling or turned off, a close approach can be made to nesting birds and resting mammals. On the Ord Johnstone has boated to within 20 m of cormorant and egret rookeries without birds flushing.

Also it is possible to boat directly under trees with thousands of roosting flying foxes without causing any disturbance. Short-eared Rock-wallabies are a feature of the lower Ord gorges and are regularly seen resting on ledges. Boats often anchor and drift into the ledges to allow a close approach however at the first threat of danger or any loud noise they retreat into crevices.

Clearly responses to disturbance vary depending on the severity of the disturbances. Slight disturbances may result in head raising or small body movements. Giese and Riddle (1999) monitored the effect of overflights of a Sikorsky S-76 twin engine helicopter at 1000 m on creching Emperor Penguins (*Aptenodytes forsteri*). These authors found that "all chicks became more vigilant when the helicopter approached and 69% either walked or ran, generally moving less than 10 m toward other chicks (ie. not scattering). Most chicks (83%) displayed flipper-flapping, probably indicating nervous apprehension. This behaviour was seldom displayed in the absence of disturbance". Moderate disturbances result in animals moving small distances or wing flapping by birds, whilst prolonged or significant disturbances will initiate bolting or escape responses.

The response of animals to a disturbance can also vary depending upon the external parameters and life history characteristics of the animal eg season, current activity of the animal, sex, age, previous exposure and whether the animal may already be stressed (Manci *et al.*, 1988). For example, Burger and Gallie (1987) reported that the proportion of Gulls flying away when disturbed was less in a heavily disturbed area compared to areas where disturbances were less frequent.

The time of the disturbance can be important both from a seasonal and daily perspective. Disturbances during the breeding season are likely to be worse, especially for colonial nesting species as are disturbances during the early stages of the breeding cycle when complete nest abandonment is more likely (Anderson, 1988; Anderson and Keith, 1980; Preece and Simons, 1986).

Observations during the Spring 2000 phase of the study suggest that walkers will cause Little Corellas to leave nest holes. However, it was unclear whether the nests were abandoned or if only a single parent left the site. On several occasions walkers were seen along the southern rim of the gorge which resulted in the Corellas flying from the rim. This behaviour was not noted when the boats alone moved below the nest sites. Interestingly there were fewer nesting Little Corella on the northern side of the creek compared to the southern side. It is unclear whether this is a result of fewer available nest holes or increased disturbance.

Six Eastern Reef Heron nests were noted, all of which were well above the water line and located behind *Ficus* plants on the cliffs. The boats were able to cruise past nesting egrets without causing birds to leave their nests. These nests were well concealed and not observed by most persons on board the tour boats.

4.0 Rock Wallaby Results

4.1 Analysis of Rock Wallaby Numbers

The numbers of rock wallabies visible to observers was relatively constant within any given period of any given day, but varied among days and among the identified groups of wallabies present in the gorge. The proposed analysis of the effect of boat use was confounded by the unpredictable schedules of the boat operators (both within and among days) and the presence of other craft such as canoes, kayaks and dinghies in the gorge at unexpected and uncontrollable times. Thus over the five days for which reliable data before, during and after boat tours were obtained, there was no real difference in the amount of boat use in the gorge. For the purpose of analysis, power boats only were considered, making it possible to differentiate two "low" use days and three "high(er)" use days. The average number of rock wallaby sightings were compared before, during and after boat tours on these days. Two analyses were performed; one using numbers observed during the McGregor tour at around 12.30pm each day, the other using numbers taken during boat use between 2.00 and 3.00 pm each day, when either the McLeod tour, or the CALM dinghy were operating. For both analyses, the "before" records were taken between 10.00 am and 11.00 am each day, and the "after" records were taken between 3.00 pm and 4.00 pm.

In neither case was there any indication of a numerical response to level of boat use or to time of observation (Table 4.1). Numbers were generally higher before the boats arrived but too variable to differentiate from numbers during and after the boats (Figure 4.1). Crucially lacking were comparisons with days when there were no boats on the gorge, so it is impossible to tell if this differed in any way from a natural diurnal rhythm.

Table 4.1: Repeated measures analysis of variance of the average number of rock wallaby sightings made before, during and after boat tours on days of low and higher boat use.
(*Greenhouse-Geisser correction to probability for lack of sphericity in the data)

- "During" recordings taken during the 12.30 boat tour

Source	df	Mean square	F-value	p-value
Boat use	1	0.1778	0.0247	0.885
Subject within groups	3	7.1852		
Time of recording	2	0.6778	0.4306	0.569*
Time x Boat use	2	0.8111	0.5153	0.622*
Time x Subject within groups	6	1.5741		

- "During" recordings taken during the 2.00pm boat tour

Source	df	Mean square	F-value	p-value
Boat use	1	0.2054	0.1690	0.709
Subject within groups	3	1.2158		
Time of recording	2	5.0259	2.0701	0.236*
Time x Boat use	2	6.0044	2.4731	0.201*
Time x Subject within groups	6	2.4279		

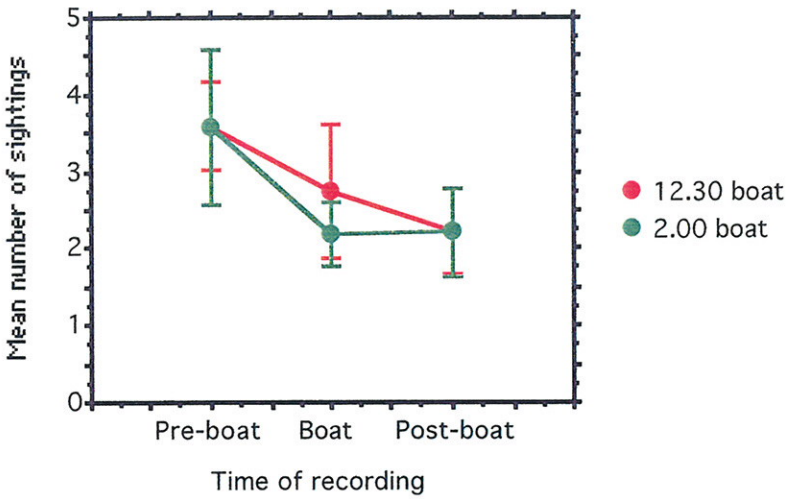

Figure 4.1: Comparison of sightings of rock wallabies before, during and after boat tours, with "during" records taken during the 12.30pm boat tour (red) and 2.00pm boat tour (green). The analyses of these numbers are shown in Table 4.1.

The arrival of the boats did not induce rock wallabies to move from their positions any more frequently than they did before the boats arrived (Table 2, time of recording). There was also no effect of Boat Use or Boat Trip. The non-significance of the Boat Trip by Boat Use interaction term despite the large F-value (4.2262) shows the weakness of the test with only 1 and 3 degrees of freedom from the total of five days on which observations were possible. Rock wallabies did appear to show more movement in response to the first boat of the day than to the last boat of the day (Figure 4.2), although response to the first boat was very variable

Table 4.2: Repeated measures analysis of variance in the proportion of rock wallabies seen moving before, during and after the first and last boat tours on days of low and higher boat use.

(*Greenhouse-Geisser correction to probability for lack of sphericity in the data)

Source	df	Mean square	F-value	p-value
Boat Use (low or higher)	1	0.003	0.845	0.790
Subject within groups	3	0.036		
Boat Trip (first or last)	1	0.003	0.0558	0.829
Trip x Use	1	0.195	4.2262	0.132
Trip x Subject within groups	3	0.046		
Time of recording (before, during, after)	2	0.054	0.9067	0.426
Time x Boat Use	2	0.091	1.5236	0.303*
Time x Subject within groups	6	0.059		
Trip x Time	2	0.051	1.1969	0.364*
Trip x Time x Use	2	0.015	0.3512	0.683*
Trip x Time x Subject within groups	6	0.043		

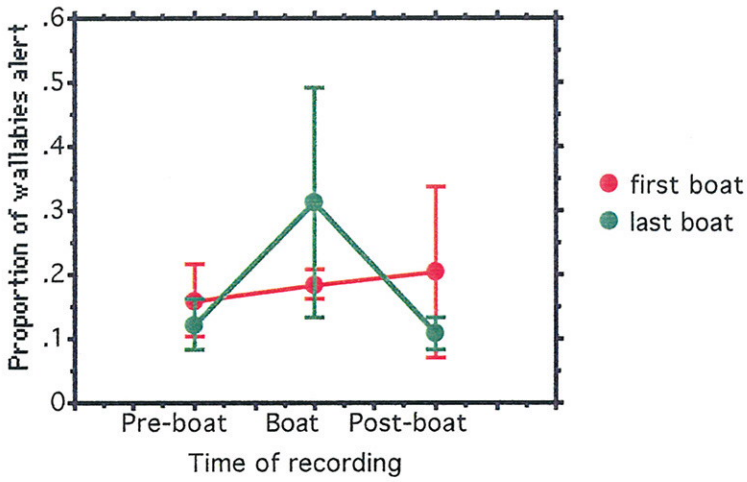

Figure 4.2: Comparisons of the proportion of rock wallabies that moved before, during and after the first (red) and last (green) boat of the day. The analyses of these numbers are shown in Table 4.2.

Rock wallabies were not completely oblivious to the boats. They acknowledged their arrival with small changes in behaviour, usually involving head raising, looking around and/or changing stance. This was shown statistically by an analysis of the proportion of recordings in which wallabies were observed as being alert, again before during and after boat use. The change in "alertness" on the arrival of the boats was significant in the uncorrected analysis but became non-significant when the Greenhouse-Geisser correction was applied (Table 4.3). Again the large F-value (6.2334) points to the considerable added variation due to time of recording and hence the weakness of the test for it (2 and 6 degrees of freedom) due to insufficient replicate days of observations. Clearly wallabies became more alert when the boats arrived and also did not "relax" immediately after the boats left (Figure 4.3). There was no indication of an effect of Boat Use or Boat Trip and although wallabies appeared to respond more to the first boat trip than the last (Figure 4.3), there was no suggestion of a significant interaction term (Table 4.3).

Table 4.3: Repeated measures analysis of variance in the proportion of rock wallabies seen to be alert before, during and after the first and last boat tours on days of low and higher boat use.
(*Greenhouse-Geisser correction to probability for lack of sphericity in the data)

Source	df	Mean square	F-value	p-value
Boat Use (low or higher)	1	0.001	0.0074	0.937
Subject within groups	3	0.055		
Boat Trip (first or last)	1	0.001	0.0087	0.932
Trip x Use	1	0.070	1.7520	0.278
Trip x Subject within groups	3	0.040		
Time of recording (before, during, after)	2	0.177	6.2334	0.083*
Time x Boat Use	2	0.051	1.7951	0.271*
Time x Subject within groups	6	0.028		
Trip x Time	2	0.037	0.5225	0.582*
Trip x Time x Use	2	0.023	0.3216	0.691*
Trip x Time x Subject within groups	6	0.071		

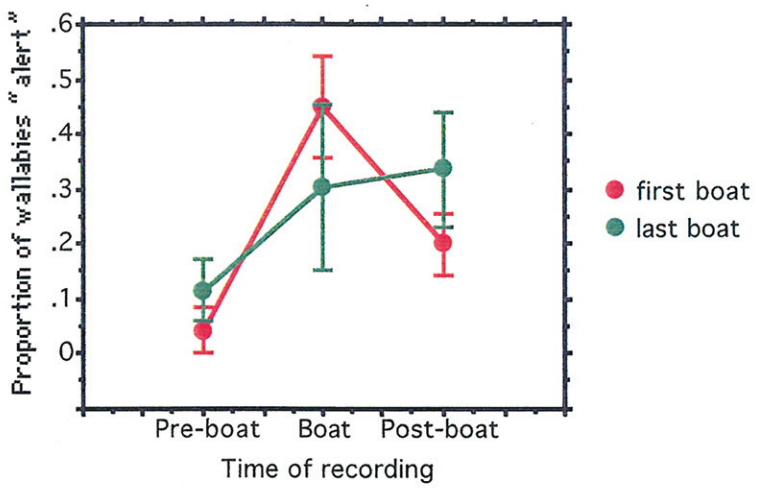

Figure 4.3: Comparisons of the proportion of rock wallabies that were alert before, during and after the first (red) and last (green) boat of the day. The analyses of these numbers are shown in Table 4.3.

Thus while rock wallabies were certainly aware of the boats they did not hide from them or increase their movements in response to them. Anecdotal observations suggested that rock wallabies were more likely to move and hide when disturbed by walkers in close proximity to them, than when boats of any kind were in the gorge.

5.0 Responses to the Yardie Creek Visitors Survey

Question 1. What was the main reason for taking your tour today?
Please tick one or more boxes.

To sightsee	☐	**To meet people**	☐
To take photos	☐	**To see rock wallabies**	☐
To learn about the landscapes	☐	**To see the bird life**	☐

To see other animals (please specify) _____

For other reasons (please specify) _____

The most common reason was to sightsee, followed by to learn about the landscape and to see rock wallabies and bird life (Figure 5.1). Slightly fewer respondents mentioned taking photos and even fewer were there to meet other people. Comments included a desire to see euros and kangaroos, wildlife in general or simply to take a boat trip. Several respondents mentioned learning about the area and its history.

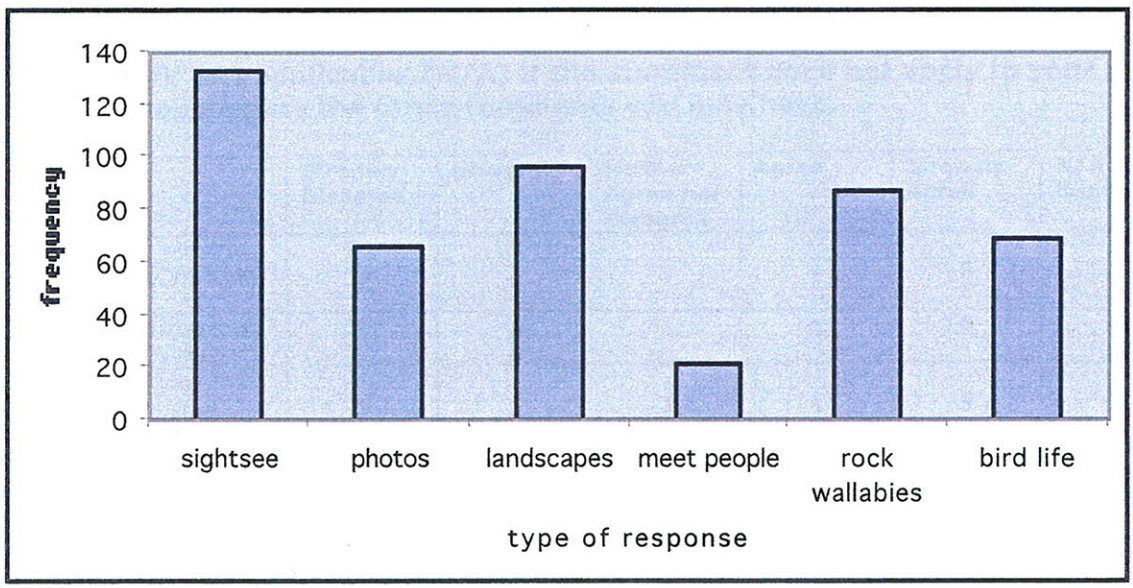

Figure 5.1: Reasons for taking the tour. Each respondent was able to give more than one reason.

Question 2. The number of rock wallabies I saw in this tour was:
Please write the number in the box.

Respondents on the McGregor tours claimed to have seen more rock wallabies (7.1±0.29 per trip, n = 80) than those respondents on the McLeod tours (5.9±0.19 per trip, n = 98). This difference was statistically significant ($F_{1,176} = 11.576$, $p<0.001$). However, there was a marked difference between operators in the days on which surveys were collected. If only those responses from days when both operators held boat tours are considered, the significance disappeared ($F_{1,48} = 2.544$, $p = 0.117$). Respondents on the McGregor tours claimed to have seen 7.2±0.33 rock wallabies per trip (n = 29) compared with 6.3±0.51 seen by respondents on the McLeod tours (n = 21). This close correspondence of numbers reflects the stability of rock wallaby numbers visible on any one day in the gorge.

This is further substantiated by comparison of reported numbers seen by boat passengers on days when Biota observers were present in the gorge. On the 19th September respondents on the McLeod tour reported seeing an average of 5.8 rock wallabies compared with the 5 seen by Biota observers during the time the McLeod boat was on the gorge. Similarly, on the 18th, 20th and 21st of September, respondents on the McGregor tours reported seeing an average of 2.8, 9.8 and 7 rock wallabies, compared with 2, 8 and 6 seen by Biota observers while the McGregor tours were operating. Considering that Biota observers were only observing wallabies from two vantage points along the gorge, these figures are highly consistent among days and between operators.

Question 3. How do you feel about your tour today?
Please circle one number only in each row.

Please mark 'not applicable' (N/A) if the statement does not apply to your tour. We would appreciate the other comments you may have.

Statement	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree	N/A Don't Know
I was satisfied with the number of rock wallabies seen	1	2	3	4	5	
I was satisfied with the number of birds seen	1	2	3	4	5	
I was satisfied with the diversity (number of different species) of birds seen	1	2	3	4	5	
I received sufficient information about the birds and animals during the tour	1	2	3	4	5	
There were too many people on the tour to fully appreciate the wildlife	1	2	3	4	5	
Comments						

Respondents on both tours were generally satisfied with the number of rock wallabies and birds that they saw on the tour (Figure 5.2). 86.7% of respondents were either satisfied or highly satisfied with the number of rock wallabies seen, while 75.4% of respondents were either satisfied or highly satisfied with the number of birds seen. Opinion was more divided on the diversity of birds seen, with only 64.2% of respondents being satisfied or highly satisfied. Several comments (from respondents on both tours) suggested that

numbers and diversity were down from previous years. In contrast, everyone appeared to appreciate their tour guide, with 92.8% of respondents satisfied or highly satisfied, and very few respondents (2.2%) seemed to think that there were too many people on their boat tour.

There were some significant differences in the way that respondents on the two tours answered this question. Interestingly, respondents on the McGregor tours were less satisfied with the number of rock wallabies they saw than were respondents on the McLeod tour ($\chi 2 = 21.04$, $p = 0.0001$, $df = 3$), despite the fact that on average respondents on the McGregor tours saw more rock wallabies than did respondents on the McLeod tours. Respondents on the McGregor tours were also less satisfied with the number and diversity of birds seen and with the number of people on their boat than were the respondents on the McLeod tours. This latter difference is understandable given that there were nearly twice as many passengers on the McGregor tour (19.3±0.92) as there were on the McLeod tour (11.9±0.14).

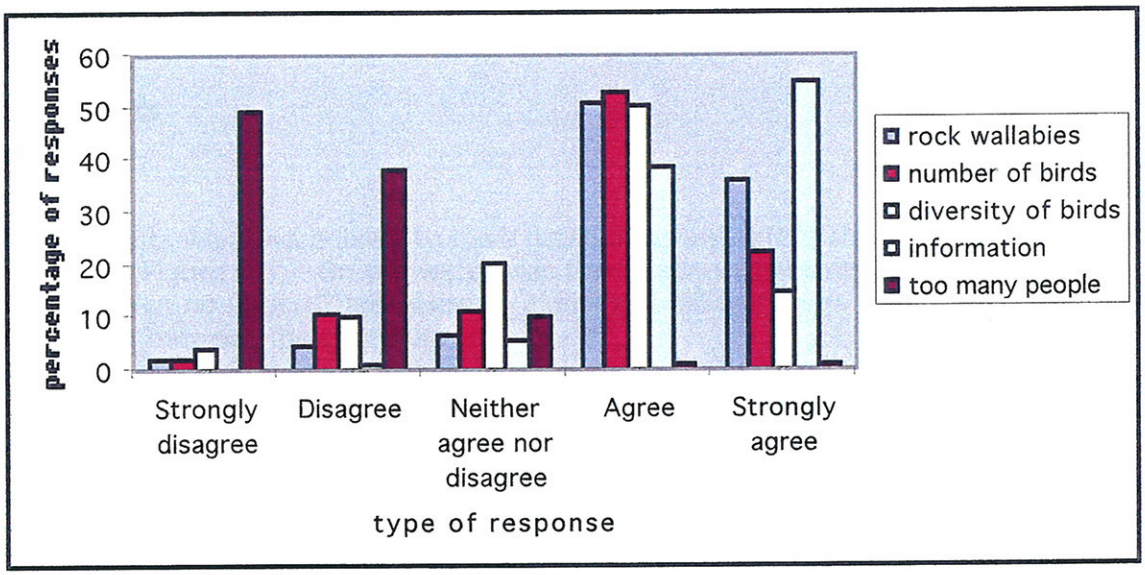

Figure 5.2: Responses to question 3 a-e regarding satisfaction with aspects of the tour.

Question 4. With regards to viewing wildlife the boat speed was:
Please tick one box.

The boat speed was too slow ☐ **The boat speed was appropriate** ☐

The boat speed was too fast ☐

99.5% of respondents thought that the boat speed was appropriate for viewing wildlife. One respondent thought the boat went too slowly!

Question 5. Which of the following statements best describe your sightings of birds?
Please tick one box for each row.

	I noticed many birds	I noticed some birds	I noticed no birds at all
On the water	☐	☐	☐
Along the gorge	☐	☐	☐
Nesting	☐	☐	☐
Flying overhead	☐	☐	☐

Comments_____

Respondents were more likely to have noticed "some" rather than "many" birds in the four locations (Figure 5.3). On the water was the location where respondents were most likely to have seen no birds. There were no significant differences in frequency of the different responses between the two tours.

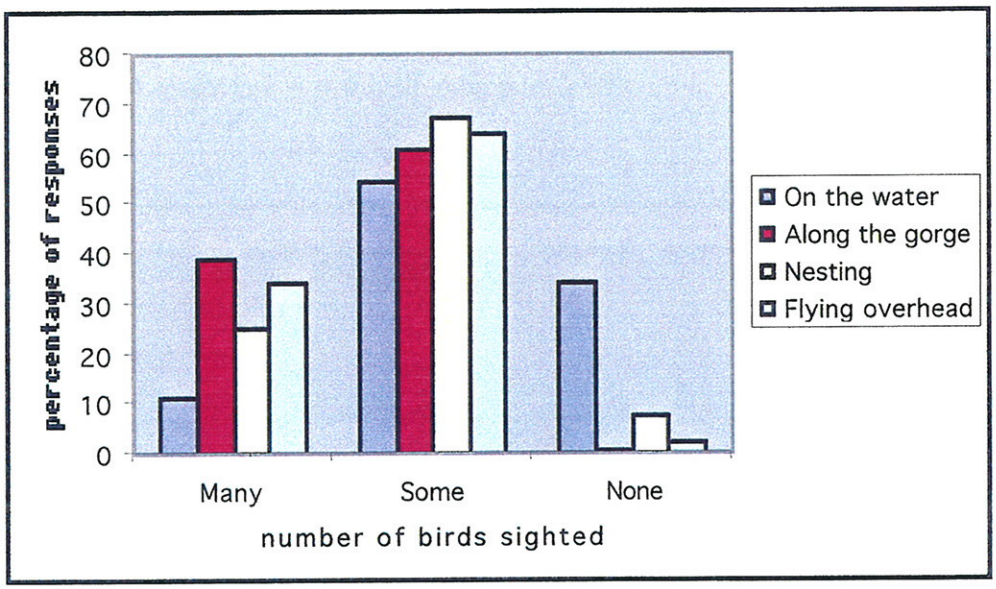

Figure 5.3: Responses to question 5 regarding sightings of birds

Question 6. During the tour, the birds i sighted behaved as follows:
Please tick one box for each row where appropriate.

	All birds moved away	Some birds moved away	No birds moved away	N/A Don't know
When walker(s) approached	☐	☐	☐	☐
When the boat moved slowly	☐	☐	☐	☐
When the boat Moved faster	☐	☐	☐	☐
When other boat(s) approached	☐	☐	☐	☐

Comments_____

_____

Many respondents recorded "Don't know" answers to this question, or left it blank. Of those that did respond, most recorded that some birds moved away in response to walkers, but were more evenly divided over whether birds responded to the boat moving slowly or faster or to another boat (Figure 5.4). The two groups of respondents were fairly consistent in their answers to the first three parts of the question, but differed significantly in how they recorded the response of birds to the approach of a second boat. Respondents on the McGregor tours were more likely to record that all or some of the birds moved away, while those on the McLeod tours were more likely to record that none had moved away ($\chi 2 = 4.48$, df = 1, p = 0.03).

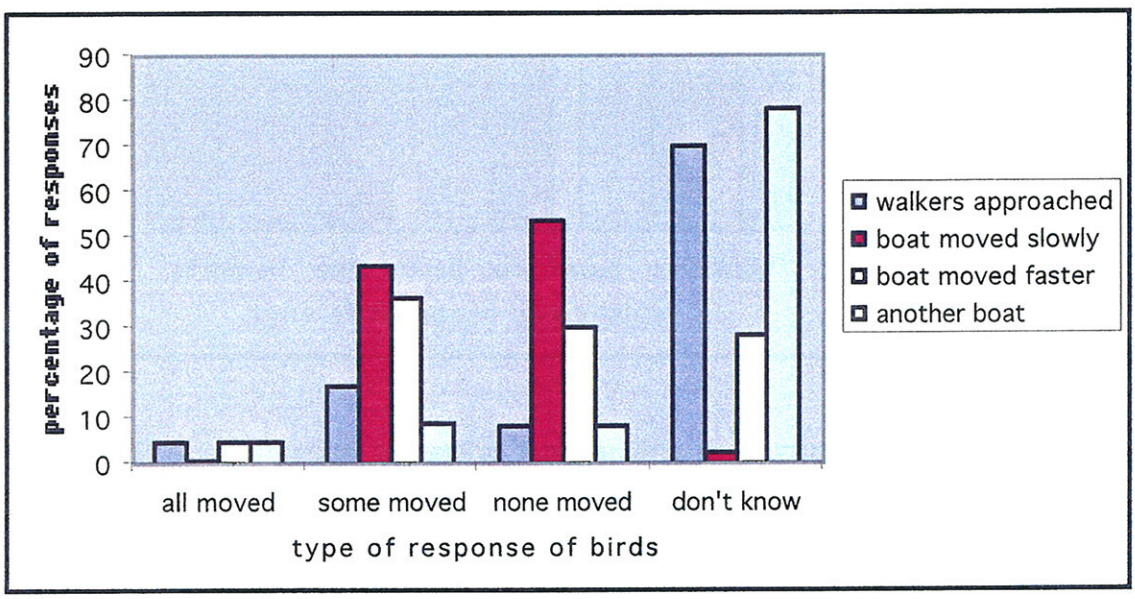

Figure 5.4: Responses to question 6 regarding behaviour of birds

Question 7. During the tour, the rock wallabies I sighted behaved as follows:
Please tick one box for each row where appropriate.

	All wallabies moved away	Some wallabies moved away	No wallabies moved away	N/A Don't know
When walker(s) approached	☐	☐	☐	☐
When the boat moved slowly	☐	☐	☐	☐
When the boat Moved faster	☐	☐	☐	☐
When other boat(s) approached	☐	☐	☐	☐

Comments_____

_____

Responses to this question were consistent among the four parts of the question, between groups of respondents and with the observations of Biota. Very few rock wallabies move in response to walkers and/or boats (Figure 5.5).

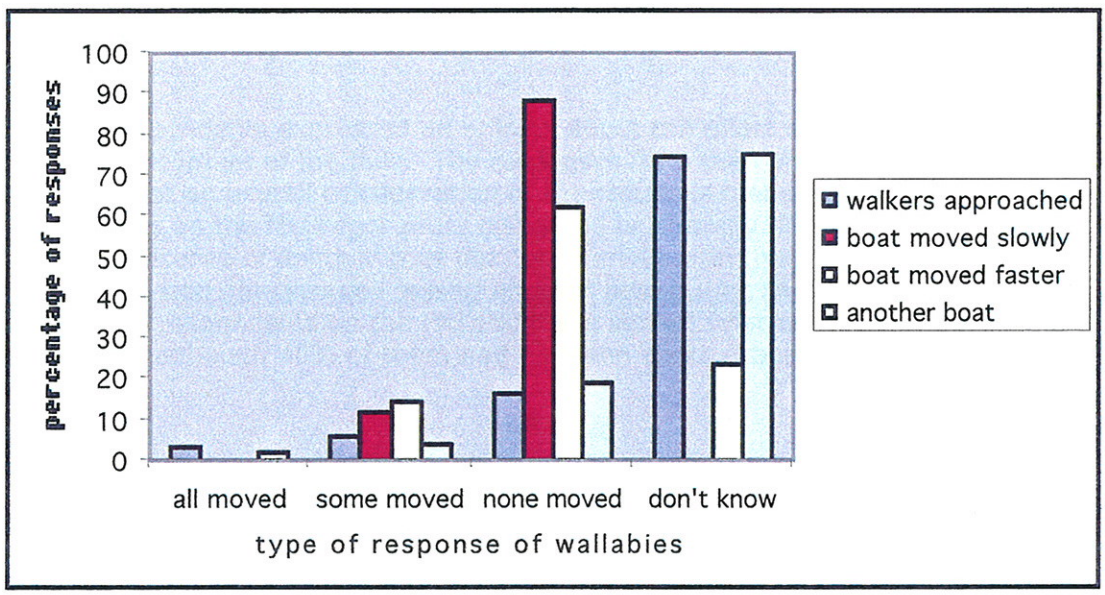

Figure 5.5: Responses to question 7 regarding the behaviour of rock wallabies

Question 8. How many people were in your boat tour? ☐ *(number)*

On average, respondents on the McGregor tours reported 19.3±0.9 people per tour with a range from 8 to 48 (n = 77). Respondents on the McLeod tours reported 11.9±0.14 people per tour, ranging from 9-16 (n = 96). There was a slight positive correlation ($r = 0.235$, $df = 168$, $p < 0.05$) between the number of persons on the tour and the dissatisfaction with that number recorded in question 3e. This correlation did not hold within the two separate data sets and should only be interpreted as respondents on the McGregor tours disagreeing less strongly with the statement that there were too many people on the tour, rather than that they were dissatisfied with the number of people on the tour.

Question 9a. How many other boats did you see during your tour?
Please write the number in the boxes provided. If you saw none please write zero.

Power boats ☐ **Others (eg. Canoes/kyaks)** ☐

Question 9b. The presence of another boat does not interfere with my enjoyment of the wildlife viewing tour.
Please circle one number only.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree	N/A Don't Know
1	2	3	4	5	

50% of respondents expressed an opinion about the effect of the presence of another boat on their enjoyment of the tour. The responses from the two sets of respondents were so different that an overall consideration of the results is meaningless (Figure 5.6). 58% of respondents on the McGregor tours disagreed or strongly disagreed with the statement that the presence of another boat did not interfere with their enjoyment of the tour. Of these, 25% had not recorded seeing another boat during their tour. In direct contrast, 60% of the respondents on the McLeod tours agreed or strongly agreed with the statement, although 40% of them had not seen another boat during their tour.

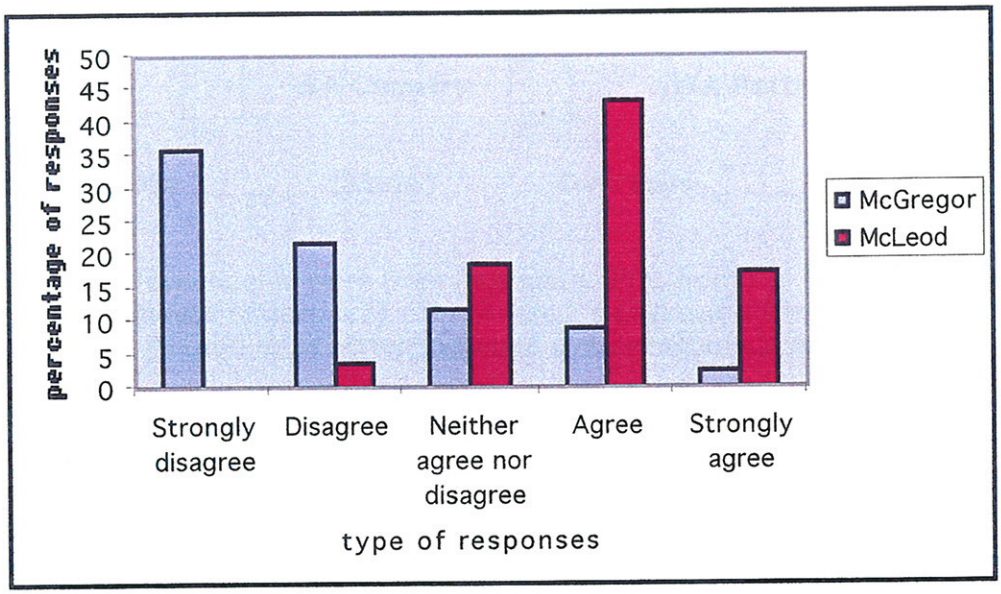

Figure 5.6: Responses to question 9b regarding whether the presence of another boat did or did not interfere with the enjoyment of the tour. (N.B. Agree/Strongly Agree = did not interfere with enjoyment).

Question 10. Would you recommend this tour to others?

Yes ☐ **Because** _____

_____

No ☐ **Because** _____

_____

An unanimous "YES". Comments praised the friendliness and knowledge of both operators with special thanks for fruit cake (Neil McLeod) and jokes (Neil McGregor) (see Appendix 1 for a full listing of the comments).

Question 11. Where do you normally live?

Locally ☐ **WA Country** ☐ **WA Perth Metro Area** ☐

Interstate_____ **(State)** **Overseas** _____**(Country)**

36% of respondents were from interstate, 25% from the Perth metropolitan area and 21% from overseas (Figure 5.7). There was a significant difference between tour operators with the McLeod tours attracting more overseas tourists and McGregors more local and WA country.

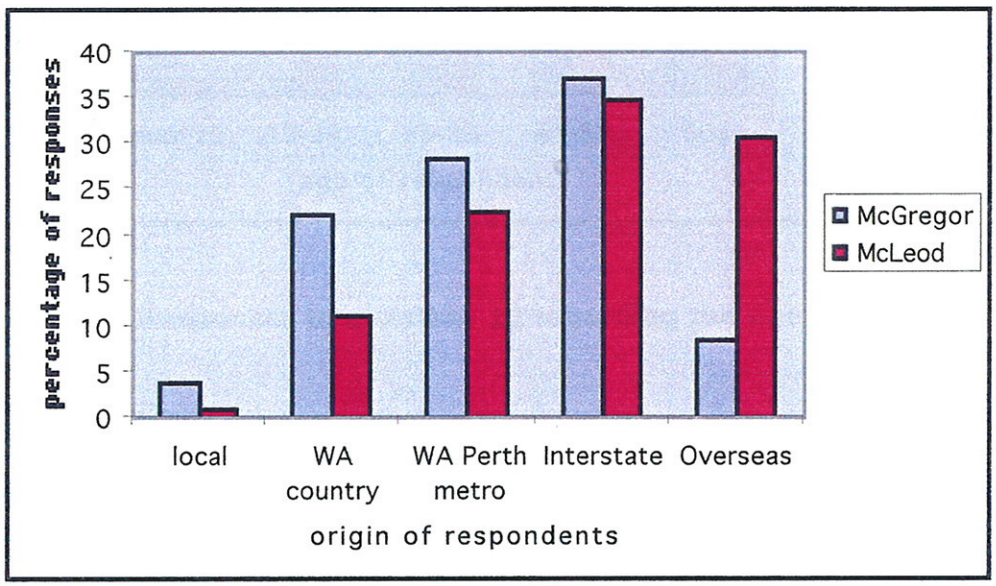

Figure 5.7: Responses to question 10 regarding where the respondents usually live.

12. Age group

Under 15 ☐ **25 - 39** ☐ **60 & Over** ☐

15 - 24 ☐ **40 - 59** ☐

The 40-59 age group made up 39% of respondents, followed by the 25-39 and the 60+ age groups (both 26%) (Figure 5.). There was no difference in the age distribution of respondents on the two tours.

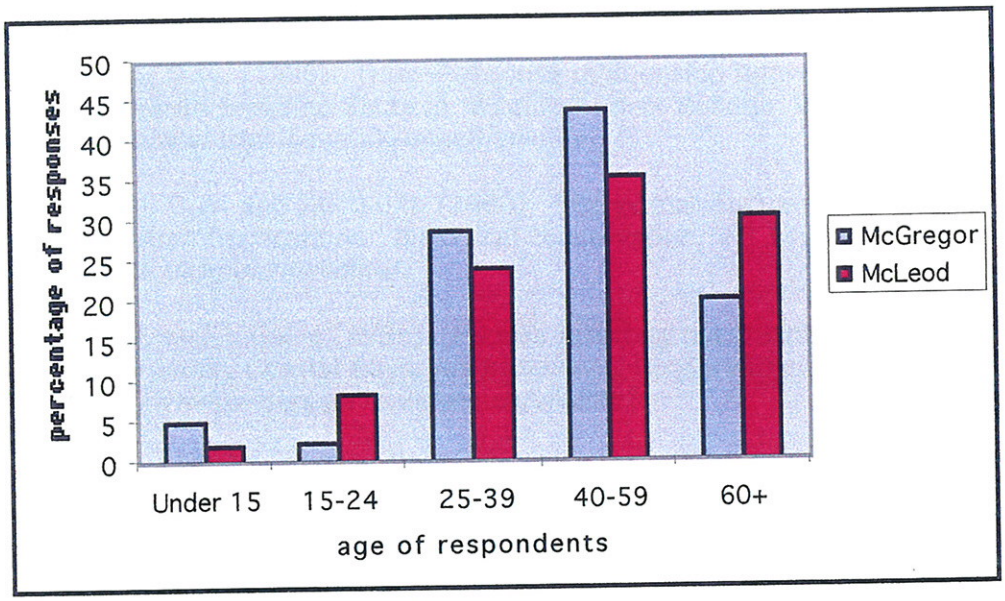

Figure 5.8: Responses to question 12 regarding the age group of respondents

13. Are you?

Male ☐ **Female** ☐

38.5% of respondents were male, 61.5% were female. There was no difference in sex ratio between the two groups of respondents.

6.0 References

Anderson, D.W. (1988). Dose-Response relationship Between Human Disturbance and Brown Pelican Breeding Success. Wildlife Society Bulletin, Vol 16: pp 339-345. In http://www.w-isles.gove.uk/minch/wildlife/.

Anderson, D.W. and J.O. Keith (1980). The Human Influence of Seabird Nesting Success: Conservation Implications. Biological conservation. Vol 18: 65-80. In http://www.w-isles.gove.uk/minch/wildlife/.

Burger, J. and J. Gallie (1987). Factors Affecting the Distribution of Gulls (Larus spp) on Two New Jersey Coastal Bays. Environmental Conservation: Vol 14, 59-65. Vol 18: 65-80. In http://www.w-isles.gove.uk/minch/wildlife/.

Carter, T. (1903 to 1904). Birds occurring in the region of North-West Cape. *Emu,* 3 (1), to July 1: 30 - 38; (2), October 1: 89 - 96; (3), January 7, 1940: 171 - 177; (4) April 2: 207 - 213.

Carter, T. (1920 to 1921). On some Western Australian birds collected between the North-West Cape and Albany (950 miles apart). With nomenclature and remarks by Gregory M. Mathews. *Ibis* (Ser. 11), 2 (3), July 1: 679 - 719; 3 (1), January 1, 1921: 48 - 87.

Dietrich, K and C. Keopff (1986). Wassersport im Wattenmeer als storfaktor fur brutende und rastende Vogel. Natur and Landshaft Vol 16: 290-291. In http://www.w-isles.gove.uk/minch/wildlife/.

Dunnet, G. M. (1977). Observations on the effects of low-flying aircraft on seabird colonies on the coast of Aberdeenshire, Scotland, *Biological Conservation* 12: 55 - 63.

Ford, J.R. (1987). New subspecies of Grey Shrike-thrush and Long-billed Corella from Western Australia. *West. Aust. Nat.* 16, 172 - 176.

Frith, C.B. and Frith, D.W. (1997) *Clamydera guttata carteri* Mathews, 1920 - an overlooked subspecies of Western Bowerbird (Ptilonorhynchidae) from North-West Cape, Western Australia: *Rec. West. Aust. Mus.* 18, 225 - 231.

Giese, M. (1999) Eco-tourism and seabirds: Antarctica as a case study In: Richard Thomas (Ed.). World Birdwatch 21(1). 12-15

Giese, M. and Riddle, M. (1999) Disturbance of Emperor Penguin *Aptenodytes forsteri* chicks by helicopters. In: G. Hempel (Ed.). Polar Biology 22.
366-371

Hockin, D., M. Mounstead, M. Gorman, D. Hill, V. Keller and M.A. Barker (1992). Examination of the Effects of Disturbance on Birds with Reference to its Importance in Ecological Assessments. Journal of Environmental Management Vol 36 256-286.

http://www.edf.org/pubs/EDF-Letter/1990/Apr/a_tourist.html

Jehl, J.R. (1973). Studies of a Declining Population of Brown Pelicans in North-western Baja, California. Condor, Vol 75, 69-79.

Johnstone, R.E. (1981). Notes on the distribution, ecology and taxonomy of the Partridge Pigeon (*Geophaps smithii)* and Spinifex Pigeon (*Geophaps plumifera)* in Western Australia. *Rec. West. Aust. Mus.* 9: 49 - 64.

Johnstone, R.E. (1990). Mangroves and Mangrove Birds of Western Australia. *Rec. WA Museum* Suppl. No. 32.

Johnstone, R.E. (in prep). Checklist of the Birds of Western Australia 2000. *Rec. WA Museum* Suppl. No. 00.

Johnstone, R.E & G.M. Storr (1998). Handbook of Western Australian Birds: Volume 1 – Non-passerines (Emu to Dollarbird). Western Australian Museum.

Manci, K.M., Gladwin, D.N., Villella, R. And M.G. Cavendish (1988). Effects of aircraft noise and sonic booms on domestic animals and wildlife: A literature synthesis. U.S. Fish and Wildlife Service. National Ecology Research Centre, Ft, Collins, CO NERC-88/29. 88p. In Fact Sheet. Noise Effects on Wildlife. http://www.nonoise.org/library/fctsheet/wildlife.htm.

National Park Service (1994). Report to Congress. Report on the effects of aircraft overflights on the National Park System. In Fact Sheet. Noise Effects on Wildlife. http://www.nonoise.org/library/fctsheet/wildlife.htm.

Pfluger, D. and P. Ingold (1988). Zur Empfindlichkeit von Blasshuhnern und Ha ubentauchern gegenuber Storungen vom Wasser und vom Land. Review of Suisse Zoology, Vol 95, 1171 – 1178. In http://www.w-isles.gove.uk/minch/wildlife/.

Preece, D.J. and T.R. Simons (1986). The Influence of Human Disturbance on Tufted Puffin *Fratercula cirrhata* Breeding Success. Auk Vol 103: pp 214-216.

Rogers, J.A. and Smith, H.T. (1995). Set-back distances to protect nesting bird colonies from human disturbance in Florida, *Conservation Biology* 9: 89 - 99.

Vos, D.K., R. A. Ryder, and W.D. Graul (1985). Response of Breeding Great Blue Herons Ardea herodias to Human Disturbance in North Central Colorado, USA. Colonial waterbirds. Vol 8 13-22. . In http://www.w-isles.gove.uk/minch/wildlife/.

Appendix 1

Selected Survey Comments

BIOta

Selected Comments on Yardie Creek Visitor Survey Forms

These comments were selected to indicate the breadth of opinions expressed, but are not representative of the frequency of any type of response. They are identified by boat tour operator. In general respondents on the McLeod tours were more likely to make comments than those on the McGregor tours.

Other reasons for taking the tour (question 1).

Respondents from McLeod tours

- To be shown the area by an expert
- To see euros and kangaroos
- Learn more about Australia
- Social history of region and early and early aboriginal life

Respondents from McGregor tours

- Boat trip up the gorge
- To hear Maca's stories

Comments on satisfaction with the tour (question 3)

Respondents from McLeod tours

- No-one can make wildlife appear on cue
- We had the gorge on our own – it was magic
- Especially enjoyed how the operator stopped the engine so we could take in the serenity.
- I strongly disagree with the word satisfied as it commodifies the wildlife. I was very satisfied with my whole experience of Yardie Creek of which the wildlife was a part.
- Wonderful – tour was very well conducted
- Serenity was not disturbed
- Well informed, patient and helpful tourguide
- Very good information
- An excellent tour
- I particularly appreciate the landscapes and rock wallabies
- I am a bird watcher and my desire to see many species of birds is greater than the average tourist (in response to expressing dissatisfaction with diversity of birds seen)
- Walkers may have scared the wildlife
- Did the tour 5 years ago – more birds and wildlife on this tour than last time.
- Would have liked more info on birds

Respondents from McGregor tours

10. Cruise was enjoyable without being detrimental to wildlife
11. Captain was careful not to disturb wildlife – fabulous
12. Good speed

13. Would have been nice to see more of rock wallabies, we realise you can't always do this
14. Excellent tour and commentary
15. Fewer birds and animals than five years ago
16. Very informative and interesting
17. Funny and informative guide – an hour well spent
18. Would like to have seen more wildlife
19. Please restrict casual access to the gorge
20. I expected to see more wildlife, ie birds and wallabies, but was satisfied with what I saw. Why is there so little diversity here now?
21. Disappointed not to see sea-eagles or osprey
22. The wildlife was limited

Comments on bird sightings (question 5)

Respondents from McLeod tours

- Wonderful opportunity to see nesting birds
- I saw appropriate numbers of birds

Respondents from McGregor tours

- Would like to see more birds
- Birds are seasonal
- The number of birds generally seems very low
- The tour operators were great in pointing out what few birds remain here
- For breeding season, I thought there would have been greater numbers
- I expected to see many more bird species

Comments on bird behaviour (question 6)

Respondents from McLeod tours

- Birds didn't seem to worry
- The birdlife appeared as it should have.
- Not something I paid attention to.
- The boat never went "faster" and there were no other boats

Respondents from McGregor tours

- Birds took no notice of boat
- When the other boat with the ranger went passed, all info from our captain had to stop
- Other boat was too fast and too close to wall
- The birds did not seem at all concerned; in fact one swallow actually sat on the front of the boat.
- Operator slowed down near all birds
- Birds didn't seem to be bothered by us
- Anymore boats or activity on the water would disturb the birds

Comments on rock wallaby behaviour (question 7)

Respondents from McLeod tours

- All animals seemed very much at home
- Rock wallabies do not seem in the least upset by the boat
- The rock wallabies seemed unfased by the tour group.
- Wallabies were in same position throughout
- Our tour moved slowly and we were able to see and photograph the rock wallabies.

Respondents from McGregor tours

- Seems like you will have to eradicate all cats and foxes.
- The wallabies were easily seen
- They weren't bothered by us being there at all
- The wallabies were so cute. They were everywhere and the guide spotted them quickly.

Comments on why you would/would not recommend the tour to others (question 10)

Respondents from McLeod tours

- The knowledge of the tour guide – just a great day out (and Mum's boiled fruit cake)
- It was educational and you got cake!
- Respected wildlife
- Excellent – would recommend the tour to anyone
- Good value for money
- Experienced guide
- Saw lots of wildlife and it's the best way to see the rock wallabies
- Enjoyable and exciting
- Commentary excellent
- One of the best I've been on – Neil's knowledge and love of the area is contagious
- Informative – worth the money
- Neil McLeod has a lot of local knowledge. He is interesting and informative.
- Beautiful scenery, good guiding
- It was an excellent combination of sights, wildlife and stories
- Gave a good description and overview of the area
- Explained about the area well and was keen for us to see the wildlife and birds
- Excellent tour, personal, not too many people. Neil is excellent, his knowledge is impressive and he obviously cares deeply about the environment.
- Much attention and respect to nature and wildlife
- Tour guide is very knowledgable and informative
- It is a very professionally run tour. Deserves a boat mooring.
- The creek was a fascinating place to visit – as well as birds and rock wallabies, the rock formations and vegetation was very interesting to see and mangroves and fossilised corals.
- Visit unaccessable areas by 2WD car.

Respondents from McGregor tours

However at half the price, overall interesting, the guide knew his stuff
Interesting and enjoyable
Educational
Relaxing and peaceful
Operator knowledgable and very interested in flora and fauna

It does not interfere with the wildlife and is informative and scenic
Informative, scenic and entertaining – good value for money
Quiet trip, able to see everything, commentary very good
Boat very comfortable, captain very informative
Information and presentation was terrific
Good place to see rock wallabies
It was very informative and environmentally conscious
Nature at it's best. Macca took the time needed to appreciate the viewing.
I found it very informative and relaxing. The commentary was given in an amusing manner and kept the children interested.
Excellent tour. Will recommend it. Good value for money.

Other unsolicited comments

Respondents from McLeod tours

- Please allow the tour guide, Neil McLeod to have a mooring at Yardie Creek as he is providing an excellent service to the tourism industry in this area.

- I was worried about the tone of the questionnaire, which seems to place high value on "numbers" of birds or rock wallabies (unless you are using these forms as a very simple form of census). To me, the value and satisfaction derives from being able to see both marine and terrestrial flora and fauna in a (relatively) unmodified environment, not from the numbers seen.

Respondents from McGregor tours

- There were two yahoos on the top of the gorge throwing rocks into the creek – this behaviour should be sanctioned.
- Don't make another Milford Sound
- Too many boats would deter from the experience here and have too much impact on the fauna.
- Should only be one boat
- Are any measures being taken regarding feral cats, goats and foxes? Yellow footed rock wallabies increased at Arkaroola after a programme to rid area of goats etc.
- I believe there won't be a great deal of fauna and birds in the years to come if not managed properly