APPENDIX 1

Marine Ecology Report

1 INTRODUCTION

Randwick City Council commissioned LandSystems EBC to undertake a study to assess the significance of Gordon's Bay as a natural coastal recreational and environmental resource and to prepare a comprehensive plan of management and concept landscape master plan for the Bay. The plan of management is intended to provide Council and the community with:

- Long-term guiding principles for the balanced use and management of Gordon's Bay
- Proper assessment of existing conflicting user demands relative to the management of the reserve as a whole.

Marine Pollution Research Pty Ltd (MPR) were contracted by LandSystems EBC to undertake and report on information available on the marine flora and fauna and of the water quality of the Bay and foreshores. The following report is based on information received via LandSystems EBC, via our own contacts and via a limited field study. Water quality and foreshore management issues were assessed by site visit on 7 May 1993. MPR diver/biologists undertook a qualitative assessment of the intertidal and subtidal environment of the Bay on 20 May 1993.

2 EXISTING ENVIRONMENT

Gordon's Bay is a narrow indentation of the Sydney coastline south of Sydney Heads. It is characteristic of a number of such narrow embayments situated between Bondi Beach and Botany Bay. These inundated bays are unusual in the Sydney regional context and represent the heads of short incised coastal stream valleys which fed a geologically earlier entrance to Sydney Harbour. This earlier entrance was situated south of Ben Buckler (between the present Rose bay and Bondi Beach). In the last ice age, when sea levels were substantially lower, the river system which

formed Sydney Harbour flowed through the valley south of Ben Buckler and parallel to the present coastline. This lower valley was fed by short streams situated on the west bank. During the last sea level rise, the eastern bank of the lower river section plus the lower river section itself was inundated and the heads of the short western streams formed the present inundated bays of Tamarama, Clovelly and Gordon's Bay.

The present bay drains a small narrow catchment to the north west, with its apex situated at Clovelly Post Office. The Gordon's Bay catchment butts against the Coogee Beach catchment (to the south) and the Clovelly Bay catchment (to the north). The bay is about 500 m long (along an approximate NW-SE alignment) by 250 m wide (at the middle). The Bay heads are 500 m apart but the bay itself is protected from the south east by a shallow subtidal shelf and bombora running north east from the southern headland (Fig 1). The depth of the bay is under 10 m ISLW (Indian Spring Low Water - essentially the lowest tide) and shelves gradually from 10 m at the mouth to a small beach at the head of the bay.

2.1 Water Quality in Gordon's Bay

There are a number of inputs to Gordon's Bay which may affect overall water quality. These are listed below and then discussed in detail:

- Ocean waters. In the recent past Gordon's Bay waters were probably affected by sewage emanating from the Bondi and Malabar shoreline ocean sewage outfalls. Nearshore ocean waters are also frequently degraded by other coastal stormwater inputs and by general ships and other garbage.
- Stormwater. There are three sources of stormwater to the Bay; natural runoff from the catchment, stormwater directed to the bay via road and footway

drains and stormwater collected from adjacent catchments and directed to the head of the bay via a large stormwater outfall structure situated immediately to the north of the Gordon's Bay Amateur Fishing Club clubhouse.

- Sewerage overflow points. There is a sewage pumping station located near the northern head of the Bay. This pumping station has an emergency bypass (as do all pumping stations) with an outlet to Gordon's Bay. This bypass would only be operational in an emergency in the event of total pump failure (both main and standby pumps).
- Rubbish and garbage donated to the bay by people and animals. There are a number of sources of rubbish; casual rubbish from the car park, rubbish brought into the bay from the ocean, rubbish and animal droppings brought down with the stormwater plus deliberate dumping of rubbish (ranging from back yard grass clippings and garden refuse to abandoned machinery).

2.1.1Bay water quality

There are no water quality data available for Gordon's Bay. The council does not collect water quality data from either the Bay or from Clovelly Pool and the Water Board has not monitored the Gordon's Bay stormwater outlet in its study of selected ocean outfalls. Beachwatch has not collected water quality information from Gordon's Bay but has collected information from Clovelly Pool and from off Coogee Beach. These data are tabulated in Appendix A and summarised in Table 1 below. The data clearly show that near shore coastal waters in the vicinity of Gordon's Bay improved following the substitution of deep water ocean sewage outfalls for the shoreline outfalls at Bondi and Malabar.

Table 1 Summary of Beachwatch Bacterial Data† - Summer 1989/90 to Winter 1992

Month	Year	Fc Clovelly	Fc Coogee	Fs Clovelly	Fs Coogee
Summer††	1989/90	281.96	171.56	34.87	31.56
Winter††	1990	105.72	58.23		17.16
Oct	1990	11.28	4.94	4.75	3.95
Nov	1990	32.58	26.77	9.96	13.18
Dec	1990	57.1	26.04	11.63	10.24
Jan	1991	37.58	72.9	8.28	19.82
Feb	1991	52.83	30.77	14.15	15.07
Mar	1991	26.75	20.18	11.14	14.22
Apr	1991	51.22	28.16	28.54	13.06
May	1991	63.34	68.62	34.76	29.39
Jun	1991	61.59	53.55	35.02	33.59
Jul	1991	10.52	11.47	8.7	10.54
Aug	1991	2.87	5.45	1.7	3.15
Sep	1991	2.55	8.22	1.82	3.72
Oct	1991	14.91	14.4	6.62	5.23
Nov	1991	11.23	27.53	5.11	13.22
Dec	1991	25.64	33.18	12.33	13.84
Jan	1992	14.3	33.45	8.22	11.47
Feb	1992	62.62	37.54	24.96	18.39
Mar	1992	41.29	14.97	12.02	5.06
Apr	1992	40.84	19.34	15.33	7.81
May	1992	30.12	8.74	9.94	6.71
Jun	1992	7.12	5.97	5.57	4.44
Jul	1992	2.9	6.07	2.65	3.41
Aug	1992	6.32	6.13	3.83	
Sep	1992	5.18	6.61	3.59	3.9

Notes:

[†] Fc = Faecal coliforms, Fs = Faecal streptococci.
All values are geometric means of available data

^{††} Insufficient monthly data available

2.1.2Stormwater

Enquires by LandSystem EBC to both Council and the Water Board failed to ascertain the catchment drained into the large stormwater outfall at the head of the bay. Anecdotal information indicates that the outfall drains from Beach Street and that when it flows, it brings much rubbish street refuse and detergents (from car washing?) into the bay. Given the dry spell which has prevailed over the period of this study this could not be checked. Nevertheless, the stormwater outfall and its contents have been highlighted by the community as of concern. There are no apparent grates or sediment traps at the head of the stormwater outfall and information on these structures at the sources to the drain were not available.

Council also did not have details of the local stormwater catchment and outfalls. Given the age of the built environment around Gordon's Bay this is not surprising as records of drainage were frequently not kept in the past. On the basis of our field inspection the following road stormwater collection and drainage points were identified:

- Lowe Street plus part of carpark drain near divers path to bay.
- Thorne and Tower Street drains. Drainage points not located.
- Beach Street and Gordon Avenue stormwater possibly connected to large stormwater pipe?
- Portion of Major Street (in catchment) appears to drain down pathway and over cliff near date palm.

In addition to the above, there appear to be a number of natural (uncollected) drainage points draining the vegetation and clifftop around the Bay.

There are also a number of apparently natural seepage points around the Bay. Most of these were small rock seepages. Two were larger and warrant mention. Water seeps from the cliff top above the southern extremity of the beach. The pool under this seepage was observed to be full of algae indicating a high nutrient concentration. It was unclear whether the high nutrients were contributed by the seeping water or were in the pool to start.

There is a natural source of running water emanating from a point within the reed bed (Phragmites australis) located behind the fishing club. This water is said to be potable (suitable for drinking) and is collected by locals for production of home brewed beer (John Bolton pers comm). The water has also apparently been tested in the past but Council had no record of The water flows as an overflow from a steel tank located within the reed bed. It is said that this tank was placed by the army during world war two to sustain a coast-watch crew located at the head of the Bay. The tank collects water from a natural spring. Offtakes supply water to taps located at the fishing club and on the beach. Again, we could not find any information about the derivation of the waters into the spring. Local knowledge has it that the water emanates as seepage from Centennial Park. Given the reputed quality of the water, its flow rate and duration this may well be the case. However, as further geological enquiries were beyond the scope of our study brief, we can make no further comment about the source and quality of this water.

2.1.3Sewage Catchment

Sewage is collected from the properties along the clifftop at Majors Road and drained via a sewer main laid around the perimeter of the Bay to a pumping station on Cliffbrook Parade (near the Clovelly carpark). This main collects sewage from all the properties fronting the perimeter of the bay and from

properties further up the catchment via another main, which joins the perimeter main behind the Fishing Club garden. The raising main is connected to the coastal main which flows to Malabar treatment plant. There were no indications of wet-weather overflow points although there was a vent located above the public pathway just below the Major Road entrance.

There were no data available on the frequency of overflows from the Cliffbrook Parade pumping station but indications are that it is a rare event. During our site visit sewer gases were noticed on the path leading up to Major Street, probably emanating from the vent. There was also a water seepage in the vicinity of the vent, running out of the retaining wall on the high side of the public path, along the path and into the scrub around the date palm. The water looked clear and the moss around the seepage point in the retaining wall indicated that it had been running for some time. It was unclear whether this was a natural seepage or water from a leaking water main. It was judged by us unlikely to be of sewage origin.

2.1.4Rubbish and litter

At the time of our field inspections there had been little rain in the catchment for the previous month and therefore we are unable to report much rubbish on the bay floor or on the strand at the head of the bay. It is our understanding that locals and members of the fishing club endeavor to keep the beach and pathway clear of rubbish. There was also little rubbish in the carpark near Gordon's Bay or amongst the supra-tidal rocks below the carpark. Given the time of year of our inspection (May) this is not surprising. Litter would probably be a greater problem in the high use summer months.

In contrast we observed many instances of garden refuse and grass clippings thrown over the cliff or into the public reserve.

Given a good rainfall some of this rubbish would find its way into the bay.

Even though we observed quite a number of people walking dogs along the paths around the bay and in the Major Street reserve we did not observe many dog droppings along the pathway. In summary, the waters of Gordon's Bay were clear and probably of very good quality at the time of our inspections (in May). It is likely, based on the analyses of water quality by Beachwatch, that under dry weather conditions water quality would generally be good.

Under wet weather conditions water quality would be expected to deteriorate as a result of stormwater inputs from the various stormwater outfalls in the bay and as a consequence of the general deterioration of near shore coastal waters as a consequence of general urban stormwater drainage to the coast. The degree of deterioration cannot be stated without further information on the nature and extent of the stormwater catchment draining into the main outfall at the head of the bay. The minor drainage points identified for this study did not incorporate litter traps, grates or silt traps and were likely to contribute a minor amount of road refuse, pollutants from roads and nutrients in the form of vegetation and animal droppings.

2.2Intertidal Shores

The supra-tidal and inter-tidal foreshores of the bay are relatively narrow with no wave cut intertidal shelf or reef (Fig 2). The major marine habitats of Gordon's Bay are rocky intertidal, boulder slope, rocky reef and sand bottoms.

There are small patches of salt tolerant or saltmarsh plants at a

few locations (generally around seepages) and there is a freshwater wetland, mainly reeds (*Phragmites australis*) around the spring at the head of the bay. Within the reeds there are a number of planted specimen plants, including a traveller palm apparently planted to commemorate the 70th birthday of Mr Fred Boulton, a long-time and still active member of the Fishing club. One larger patch of salt tolerant plants is located around the stormwater drain which drains Victory Street, near the Sewage Pumping Station.

The marine rocky intertidal comprises small boulder tallus at the base of the cliffs around most of the perimeter of the bay and at the head of the bay below the carpark. For much of the northern perimeter of the bay the intertidal boulders and rocks terminate abruptly onto the subtidal sandy bottom. For the remainder of the bay the intertidal rocks merge into subtidal rocks and some subtidal shelves, particularly around the southern headland. The intertidal zonation patterns sampled at the margins of Gordon's Bay (two on the north and two on the south side) and described below were consistent with respect to depth.

At the highest intertidal level (splash zone) the small blue shelled gastropod (snail) Nodilittorina unifasciata occurs in large numbers and is the only visible fauna. A larger gastropod Nodilittorina pyramidalis appears in the lower end of the N. unifasciata range. Below this zone a broad band of the barnacle The Sydney rock oyster Chamaesipho columna dominates. Saccostrea cucullata occurs in the lower end of the barnacle Also in this zone are the gastropod molluscs Nerita atramentosa, Austrocochlea constricta and Morula marginalba. Gammaridean amphipods occur along with anemones and algae in permanent rock pools. Below these two zones is a distinct band of polychaete tube worms, mainly Galeolaria caespitosa. this band, encrusting algae grows supporting a large population of limpets along with some chitons. The anemone Actinia tenebrosa also occurs in this zone. On one of the transects

examined, a cluster of the gastropod snail Hinea brasiliana was found. The next lower zone is composed of macro-algae beginning with coralline species Amphiroa sp. andCorallina officinalis and the brown algae Hormosira banksii and Padina pavonea. These species grade into a mixed and diverse flora visually dominated by the red algae Porphyra sp. and the green algae Enteromorpha intestinalis. The starfish Patiriella calcar also occurs at this level. Kelp, Ecklonia radiata appears at the very lowest level of the algal band. The lowest intertidal level consists of the ascidian Pyura stolonifera (conjevoi) plus encrusting sponges and small algae.

There were little signs of higher vertebrate life around the perimeter of the bay. Seagulls and domestic pigeons were observed on the beach as were a common (black?) rat and a local cat (Tom) who frequents the vicinity of the fishing club. An Australian gannet (Morus serrator) was fishing the waters of the bay entrance and swallows were hawking for insects along the cliff face. A number of native and introduced birds were observed in the vegetation along the pathway and in the Majors Street reserve.

2.3Subtidal Flora and Fauna

Below the intertidal zone towards the bays entrance is a 'white rock' zone and below this zone boulder surfaces are dominated by kelp beds (E. radiata). The boulders in the white rock zone are mainly encrusted in corraline algae. In this zone, any other algae settling on the rock plus micro algae are grazed by a number of molluscs and by sea-urchins (Centrostephanus rodgersii). Some large fish shelter in these rocks, among them the eastern rock blackfish (Girella elevata), red morwong (Cheilodactylus fuscus), eastern blue groper (Achoerodus viridis), and sergeant baker (Aulopus purpurissatis).

The reef bottom supported dense assemblages of kelp E. radiata

and associated fish fauna (see below). Encrusting sponges occurred on the hard bottom among the kelp. Upright sponges were also in evidence, generally in slightly deeper water. Upright sponges included cup massif and tubular forms.

Fish and invertebrate lists have been compiled as support documentation for the Pro-Dive Underwater Nature Trail (see below) and were made available to us for this study (John Rowe, pers comm). A fish list was also compiled by us for the present study. These lists are shown in Appendix B. The lists are by no means exhaustive but merely indicate the range and diversity of animal life found in Gordon's Bay.

There were 58 fish species listed; 45 by Pro-Dive and 24 by MPR. Of the fish noted by MPR, 12 (21 %) were also on the Pro-Dive list. MPR added 12 species (21 %) to the Pro-Dive list.

There is no mention of abalone, lobsters or sea urchins. During the MPR inspection these species were searched for specifically. Whilst one common species of sea urchin (*C. rodgersii*) was observed, the rock burrowing urchin (*Heliocidaris erythrogramma*) was not seen. This species is generally found in the shallow sub-tidal. No abalone or lobsters were located. There is little commercial fishing activity in Gordon's Bay (Glen Roberts, pers comm). Coastal lobster fishers will occasionally set traps in the bay when high seas prevent setting of traps but these pots are said to yield few catches. Some meshing for yellow tail māy also occur in the bay mouth during rough weather.

2.4 Water Related Recreational Pursuits

There are a number of water based recreational pursuits undertaken in the Bay. By far the major ones of these are angling and SCUBA diving. Angling is undertaken from most vantage points during favourable times of the year (mainly summer

months) and from small boats, mainly by members of the Gordon's Bay Amateur Fishing Club.

Boat fishing in the bay is not popular as fishing is generally The amateur fishing fleet located in Gordon's Bay generally ventures into deeper waters to fish over deeper and more productive reefs. The club has about 64 members. Whilst the club generally is conscious of its responsibility to the community and has strict self-imposed guidelines for fish cleaning and disposal of offal (take away, dispose back at sea or use as garden nutrients) policing of the policy requires a combination of peer pressure and education. As both club members and casual shore-anglers use the fish cleaning facilities at all times of the day and night, it should not be surprising that odd occurrances of fish refuse being left at or around the facilities does occur. As this generally requires later clensing by club members, instances such as these highlight to other club members the need to keep the facilities clean. In this way such incidences have been found to have decreased over the years (per. comm., Mr N Ward, President of Fishing Club and others).

Spearfishing was popular in the bay, owing more to accessibility than to the chances of catching decent fish. Although the Bay has been closed to spearfishing for about 1.5 years (Glen Roberts, pers comm) there are sporadic reports of spearfishers in the bay. Signs indicating the spearfishing bans were placed at the most popular entry points but were soon removed. A single sign located at a height to deter vandalism serves the purpose of legality but does little in informing of the ban, as it is too high to see (and was not seen by us during our inspection).

The bay is a popular SCUBA diving location, particularly with learning and novice divers. It is sheltered from most prevailing seas and swell and ocean water entries and exits can be made easily. The overall water depth is under 10 m ISLW making it an ideal site for learners. A local dive shop (ProDive Coogee) in

conjunction with a local school (Maris Brothers Pagewood) and a number of local residents established an underwater nature trail in the mouth of Gordon's Bay in 1990 (see Appendix B, Fig B-1). Randwick City Council established a concrete walkway into the water to facilitate diver entry and exits and the dive shop assisted by others established the trail using chains anchored between drums filled with cement.

On our diving inspection of the trail we found that the chain had been broken or buried at a number of places and that part of the trail had been smothered by a steep-sided submerged dune midway in the Bay and running along the long axis of the bay. The dune was judged to be of recent origin and was probably mobile.

Whilst swimming is not popular in Gordon's Bay, probably owing to the bays exposure to the sea and the proximity to Clovelly Pool, in summer months the small beach is well used by family groups who paddle in the shallows off the beach. There have been complaints of jet ski usage in the Bay last summer. The complaints have been noise related rather than about actual usage in the bay.

In summary, Gordon's Bay represents a prime recreational asset on the Sydney coast, mainly by virtue of its high accessibility. The two main recreational uses are angling (from the shore) or from boats launched from the head of the bay) and SCUBA diving (mainly from the established diver entry and exit pathway at the southern head of the Bay. These uses are enhanced by the ample parking on Clovelly headland. The bay and its environs are also important to local family groups in the summer months.

3MANAGEMENT ISSUES

The following sections summarises the water related management issues identified for the study

3.1Water Quality

The main issues relating to water quality would appear to be stormwater quality and litter/refuse.

Issues relating to stormwater are the location of stormwater overflows, the volumes and frequency of stormwater flows and the quality of the stormwater. As discussed above, there is little information available on the actual locations of the outfalls and little information on stormwater catchments or flows. There was no information on source controls at the stormwater inputs. Anecdotal information suggests that the large stormwater outfall at the head of the bay contributes a significant litter load.

Apart from stormwater borne litter and garbage the other source of litter would appear to be garden refuse thrown into the reserve.

Other water quality issues relate to the unknown source of seepages along the southern path and the location and frequency of sewage overflows into the bay. Quantifying these issues would require further information from the relevant authorities.

Resolution of the plantings around the spring would also appear to be an issue.

3.2 Intertidal Shores

The main water related issue for the intertidal shore is the collection of shore fauna. Our qualitative sampling of the intertidal shore would indicate that over-collecting has been and

continues to be a major problem in Gordon's Bay. The general paucity of intertidal molluscs and the lack of intertidal sea-urchins would be consistent with over-collection in the previous summer months.

3.3 Sub-tidal Areas

The major issues in sub-tidal areas are spear-fishing, restoration of the underwater SCUBA trail and collection/disturbance of invertebrate fauna. As indicated above, spearfishing is banned in the Bay but the signs decreeing the ban have generally been vandalised or removed. Over collection of abalone and lobsters (and urchins?) has probably occurred in the past, accounting for the absence of these animals from the bay. It should be noted that whilst this problem is generally found along most of the metropolitan beaches, the ease of accessibility to Gordon's Bay under most weather conditions The popularity of probably increased the collection pressure. the underwater trail has presented the marine biological community of the bay with another problem, that of disturbance. Divers, generally novices, have been found to take the observation of marine invertebrate life to extremes, overturning rocks to observe bottom and cryptic fauna and collecting fauna to observe at the surface or back on shore. It has been suggested that proclamation of the bay as an Aquatic Reserve (in whole or in part) plus appropriate signage could help prevent this problem.

3.4 Recreational Usage of the Bay

Whilst there were some reports of conflicts between individual fishing club members and SCUBA divers in the past, our enquiries indicate that both the fishing club and the local SCUBA diving fraternity now agree that any perceived conflicts in the past have been overcome. Both groups agree that over collecting and spearfishing (plus water quality) are the main problems facing

the marine biological community of the bay.

4 SUGGESTED MANAGEMENT STRATEGIES

Given the paucity of some necessary information on aspects of the marine ecology of the bay the management strategies include recommendations for collection of additional information.

4.1 Water Quality

It is recommended that the location and catchments of all stormwater flows and of possible sewage overflows into Gordon's Bay be investigated and documented. Once this is done, an assessment of probable water quality, volumes and litter loads could be made. Following this assessment, remedial works (source controls, source pollution traps and outlet pollution traps (grates, sediment pits, landscaped wetlands) could be planned.

4.2 Intertidal Areas

The two areas of wetland plant life (near the divers bay entrance and around the spring should be formalised as wetlands. The diver entrance wetland contains saltmarsh plants which should be retained, encouraged and possibly extended by formalising the substratum on which these plants are currently growing. This tiny wetland currently functions as a wetland filter on a stormwater drain. The enhanced wetland could continue this function.

Rehabilitation of the spring wetland would require careful consideration of the source and nature of the current stream (which could not be investigated owing to the size and density of the present reed bed). Landscape planning of the wetland would need to take account of the various historical features of the area (the water tank and the specimen plantings).

Cleaning of fish at the Fishing Club facilities would appear to be as well controlled as is currently possible, given the nature and wide usage of the facilities by both members and itinerant shore anglers. Consideration could be given to additional signage indicating the need to collect and dispose of all fish offal and fishing related rubbish (bait wrappers etc).

Over-collecting of marine invertebrate life from the intertidal and shallow sub-tidal has been identified as the prime management issue for Gordon's Bay. This problem has been generally recognised by NSW Fisheries who have instigated bag limits for collection of invertebrate fauna from the rocky shores of Sydney generally (see Appendix B). These bag limits were gazetted recently. However, given the acute pressure on Gordon's Bay, Fisheries are currently formulating regulations to prohibit all collection from Gordon's Bay (and from other sites in the region). The management plan should strongly endorse this ban plus its proper communication via appropriate signage and education programmes.

4.3 Subtidal Areas

The two major issues for subtidal areas of the bay are the restoration of the SCUBA trail and prevention of disturbance to marine life along the trail. It is our understanding that the Department of Sport, Recreation and Racing plus Randwick City Council are currently negotiating with the Gordon's Bay Management Committee to facilitate funding of the restoration works (to be undertaken by volunteers and ProDive). This restoration is to be recommended.

The problem of animal disturbance is complex. It is doubtful whether proclamation of the area as an aquatic reserve would prevent disturbance, and NSW Fisheries have indicated in the past that they consider areas other than Gordon's Bay have higher priorities for inclusion into the aquatic reserve list. Certainly, on the basis of existing flora and fauna, the bay does

not support biological communities which are unrepresented elsewhere along the Sydney coast. Protection of the sub-tidal invertebrate fauna from collection and disturbance pressure may well be afforded by the combined spear-fishing ban and impending total intertidal invertebrate collection ban. Whatever the combination of bans, closures or proclamations of aquatic reserves given to the bay, the protection of marine life will still be based on a combination of user education and enforcement. The former will be based on overcoming the problem of loss and vandalism to signage plus a local education campaign. The latter could well hinge on local education. The more local residents and users understand and appreciate the basis for the bans etc., the more likely that self-policing will occur. Council may also wish to consider a system of honorary rangers with limited powers of enforcement. As with all honorary positions, the aim of the honorary rangers should be one of education rather than enforcement.

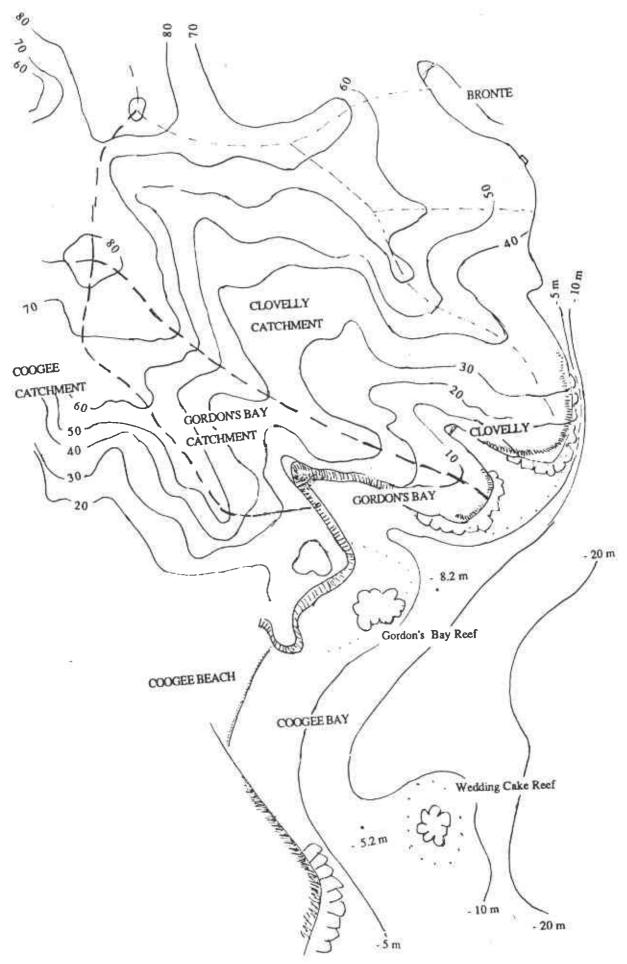


Fig 1 Gordon's (Thommo's) Bay And Catchment

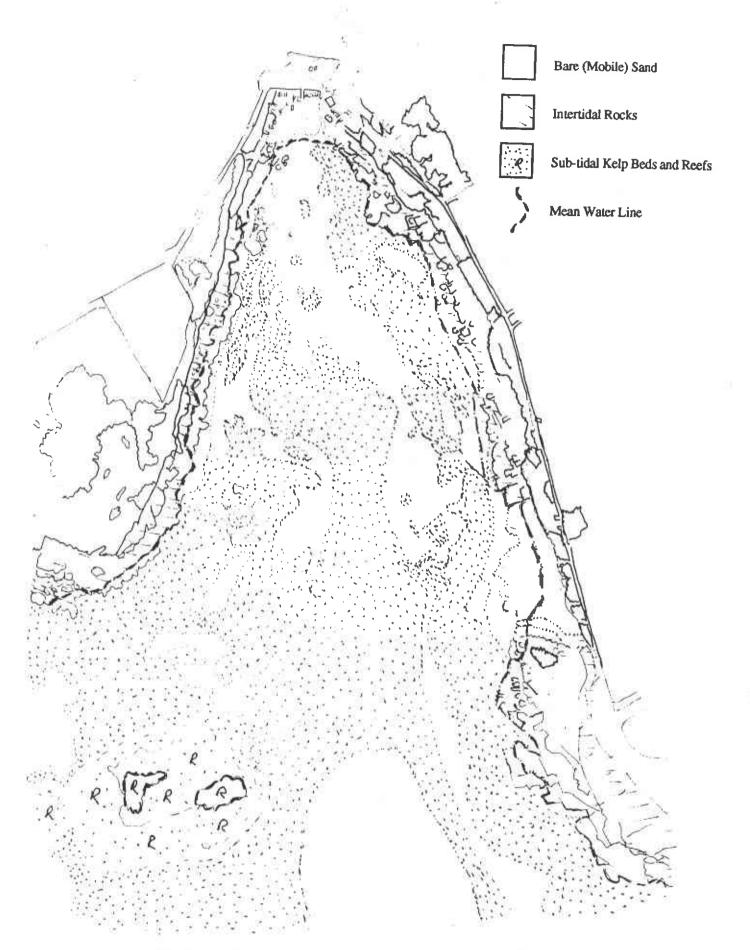


Fig 2 Gordon's Bay Intertidal and Subtidal Features

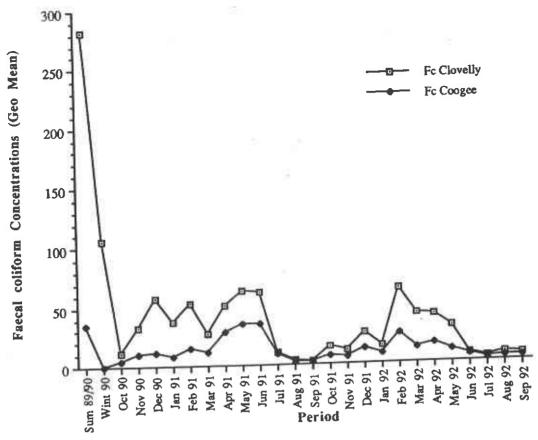


Fig 3 Monthly Variation in Mean Faecal coliform Concentrations - Clovelly and Coogee Beaches

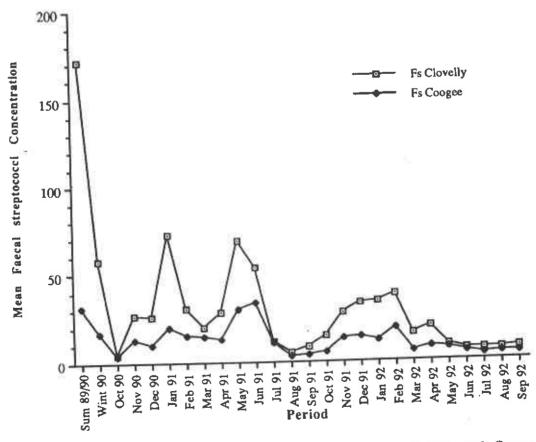
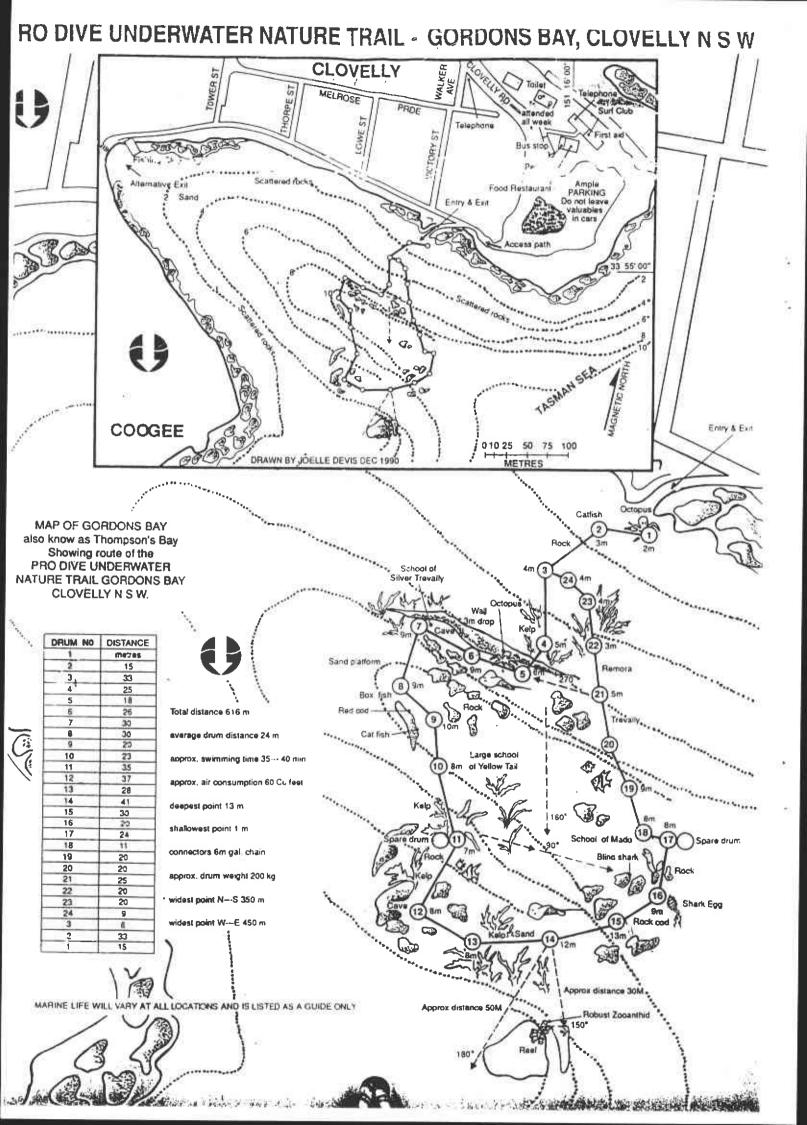


Fig 4 Monthly Variation in Mean Faecal streptococci Concentrations - Clovelly and Coogee Beaches



	Sub-tidal Invertebrate Fauna d from Gordons Bay	
Reporte	d Holli Coldoni 249	
	(List compiled by John Rowe)	
Major Taxa	Common Name	
Porifera	Slimy Lemon Sponge	
Cnidaria	Mosaic Sea Jelly	
	Rastons Jimble	
	Southern Tube Anemone	
	Swimming Sea Anemone	
	White Striped Sea Anemone	
	Robust Zoanthid	
Polychaeta	Tangled Tube Worm	
Crustacea	Hinge Beaked Shrimp	
	Hairy Red Hermit Crab	
	Red Bait Crab	
Mollusca	Pear Helmet	
Wortusea	Red Triton	
	Black Sea Hare	
	Varcos Nudibranch	
	Sweet Chromodorid	
	Marigold Dorid	
	Variable Dorid	
	Opalescent Acolid	
	Cuttlefish	
	Octopus	

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Echinodermata	Biscuit Star	
	Firebrick Sea Star	
	Spurred Sea Star	
	Brittle Star	
	Slate Sea Urchin	
	Rodgers Sea Urchin	
Ascidiacea	Giant Jelly Ascidian	
	Magnificent Ascidean	
	Giant Sea Squirt	

7.5

Table B-2 Fi	Fish Observed in Gordon's Bay					
	(Data based on list compiled by John Rowe and by MPR for this study)	by John Rowe and by MPR	for this stu	dy)		
Habitat	Common Name	Scientific Name	MPR	JR	Common	
			List	List	to Both	
Sand Bottom	Si .					
	Port Jackson Shark	Heterodontus galeatus		-	0	
	Common Stingaree	Urolophus testaceus			1	-
	Long Tailed Catfish Ecl	Euristhmus lepturus	н		0	
	Numbfish	Hypnos monopterygium			0	
	Dusky Flathead	Platycephalus fuscus		-	0	
	Slender Scamoth	Parapegasus natans		-	0	
	Goatfish	Upeneichthys sp.	1		0	
	Blue Spotted Goatfish	Upeneichthys vlamingii		1	0	
	Banks Shovelnose Ray	Aptychotrema sp.	1		0	
	Black Sole	Achlyopa nigra	1		0	
2	Sand Whiting	Sillago ciliata			0	
	Eastern School Whiting	Sillago flindersi		1	0	
Open water					0	
	Eagle Ray	Myliobatus australis		-	0	
	Roughy	Trachichthys australis		1	0	

	Long Finned Pike	Dinolestes lewini		1	0	
	Ladder Finned Pomfret	Schuettea scalaripinnis			0	
	Robust Garfish	Hemiramphus robustus	1		0	
	Yellow Tail	Trachurus novaezelandiae	1	1	1	
	Slender Suckerfish	Echeneis naucrates		1	0	
	Silver Trevally	Psuedocaranx dentex		1	0	
	Yellowtail Kingfish	Seriola lalandi		1	0	
	Silver Sweep	Scorpis lineolatus	*	1	0	
	Bullseye	Pempheris sp.		1	0	
	Small Scaled Bullseye	Pempheris affinis	1		0	
Hard bottom					0	
	Blind Shark	Brachaelurus waddi	1	1	1	
	Green Moray	Gymnothorax prasinus		1	0	
	Estuary Catfish	Chidoglanis macrocephalus	S	1	0	
	Pink Clingfish	Aspasmogaster costatus		1	0	
	Bearded Cod	Pseudophycis barbata		1	0	
	John Dory	Zeus faber		1	0	
	Spotted Pipefish	Stigmatopora argus		H	0	
	Eastern Fortescue	Centropogon australis		1	0	
	Eastern Wirrah	Acanthistius ocellatus		F	0	

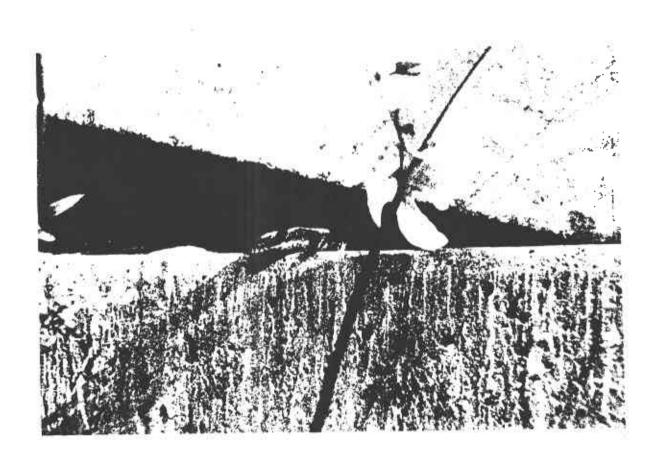
Eastern Hulafish	Trachinops taeniatus		1	0	
Bream	Acanthopagrus sp.		1	0	
Half Banded Seaperch	Ellerkeldia mccullochi		1	0	
Luderick	Girella tricuspidata		1	0	
Mado	Atypichthys strigatus		-	0	
Stripey	Microcanthus strigatus			0	
White Ear	Parma microlepis		1	0	
Snakeskin Wrasse	Eupetrichthys angustipes		1	0	
Common Name	Scientific Name	MPR	R	Соттоп	
		List	List	to Both	
					7
Herring Cale	Odax cyanomelas		1	0	
Eastern Smooth Boxfish	Anoplocapros inermis		1	0	
Three Barred Porcupinefish	Dicotylichthys punctulatus	us		0	
Crimson Banded Wrasse	Psuedolabrus gymnogenis	1	1	1	
Red Morwong	Cheilodactylus fuscus	1	-1	1	
Moari Wrasse	Ophthalmolepis lineolatus	1	1	1,	
Eastern Red Scorpionfish	Scorpaena cardinalis	1		-	
Dock Cale	Crinodus Iophodon	1	1	1	17

0.30 0 8 8 8 8

Old Wife (Experienced	Enoplosus armatus		1	1	
spouse?)					
Eastern Rock Blackfish	Girella elevata	1		0	
Sergeant Baker	Aulopus purpurissatus	1	1	1	
Six Spined Leatherjacket	Mueschenia freycineti	1	1	1	
Painted Stinkfish	Eocallionymus papilio	1		0	
Eastern Blue Groper	Achoerodus viridis	1	1	1	
Bastard Trumpeter	Latridopsis forsteri	1		0	7/
Mullet	Mugildiae	1		0	
Goby	Gobiidae	1		0	
Total		24	45	12	

TERRESTRIAL VERTEBRATE SURVEY OF GORDON'S BAY, SYDNEY.

Renée Ferster Levy May 1993



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SUMMARY

A survey of the terrestrial vertebrates of Gordon's Bay was carried out between 30 April and 30 May 1993. Over 30 field hours was devoted to the study, which employed the following techniques: mammal trapping, bird census, intensive searches by day and spotlighting at night. Additional information was gained from a questionnaire distributed to residents, and regular users of the bay.

One species of frog, eight reptile species, 42 bird species (comprising 36 native and six introduced species) and five mammal species (three of which are introduced) were recorded in and around the Bay. Concerns about the viability of the habitat are listed, and management recommendations made, taking into account the food, shelter and breeding needs of species present.

The main recommendations are:

- 1. To prevent further erosion and loss of habitat.
- 2. To prevent stormwater runoff.
- 3. To monitor the water quality in pools and springs, and take steps to prevent further reduction in breeding habitat for frogs.
- 4. To increase habitat diversity by a gradual bush regeneration program and revegetation with local native plant stock.
- 5. Purchase and/or arrange to manage the northern slope above the path with its valuable native heath and wildlife habitat. This area should be protected and managed consistent with principles of bush regeneration.
- 6. To revegetate sections of the car park with low, locally native plants.
- 7. To provide an educational program aimed at encouraging residents to:
 - keep cats indoors at night
 - stop using pesticides and herbicides which may wash down into the bay
 - •stop washing cars on the street
 - •plant local native species
 - •encourage an appreciation of the local native flora and fauna with pamphlets and guided walks, in the hope that the above recommendations will be understood and carried out.
- 8. To ask users of the bay not to feed introduced animals and Silver Gulls.
- 9. To monitor the vertebrate groups regularly as changes are implemented.

AIMS

The aims of the study were to:

- prepare an inventory of the terrestrial vertebrate fauna of Gordon's Bay, and assess its significance within the site and relative to surrounding coastal ecosystems.
- devise effective management objectives and strategies for conservation action.
- ·identify fauna of educational significance.
- recommend monitoring strategies.

LIMITATIONS OF THE STUDY

The limited time span of this survey, as well as the fact that it was carried out in late autumn, would have affected the completeness of data. Many frog species call in summer, and tape recordings of their calls may have enabled additional species to be identified. However few frogs were heard calling during the time of the survey. Reptile species are less active in cooler weather and several bird species are migratory or occasional visitors, and may not be observed in a short term study. Similarly, patterns of plant/animal interactions may only emerge when observations are made over different seasons. Flowering or fruiting of certain plants may provide an important resource for birds.

Due to the high public usage of the area, mammal traps could not be placed to cover all the accessible parts of each zone. Their placement was biased to areas of vegetated or otherwise concealed areas (eg. under the boat racks).

The many vegetated outcrops on the cliffs around the bay are potentially valuable habitat for vertebrate species. However many are inaccessible and were not sampled for reptiles, amphibians and mammals as much as the more accessible areas. Bird observations could include these areas.

Additional sources of data:

My own observations over several years living adjacent to Gordon's Bay have been included. Additional information was gained from surveying residents and long-time users of Gordon's Bay. A questionnaire was distributed to 300 residents adjacent to the bay and to long-time users of the bay. Information was sought about well-known species, how long ago they were observed, nesting birds and changes in the wildlife. This proved to be a valuable addition to the field information.

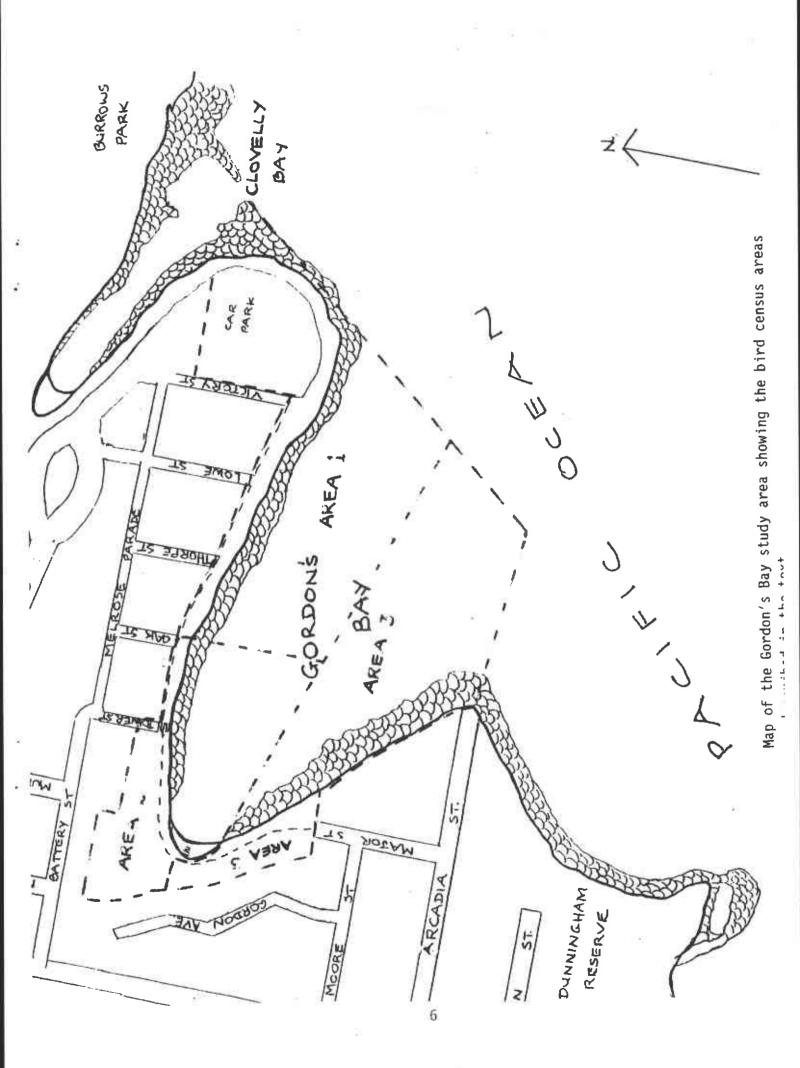
HABITATS

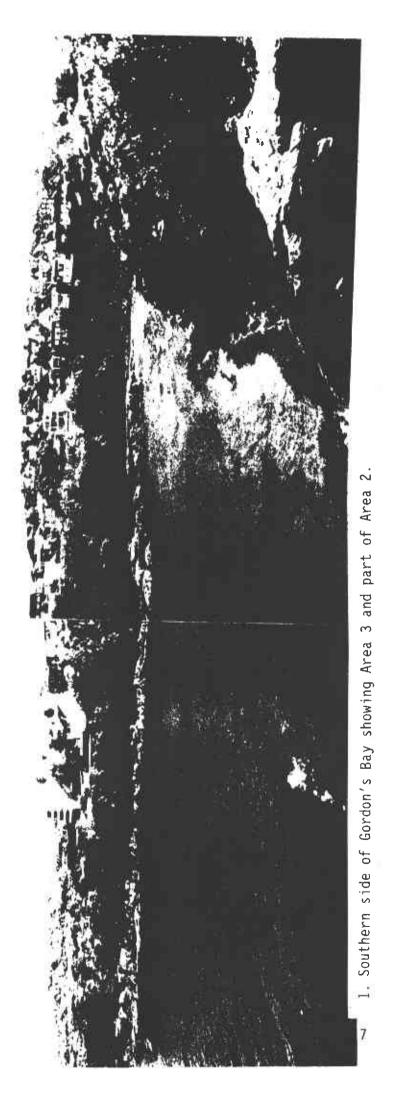
The area studied included the bay itself, the beach and surrounding vegetation on the slopes to the surrounding residential area. While the management area as defined for this study does not include the northern slope above the path, it is integral to the Bay habitat and was included in the vertebrate survey. For the purposes of bird census, three sub-areas were defined (see Map):

Area 1 includes the Clovelly Bay car park and northern headland and the cliff and slope to Oak St. This area seems to have the lowest vegetation cover and diversity, The car park has some flat grassy areas, the cliff has much introduced Mirror Bush Coprosma and some patches of Gladiolus and grasses. There are small areas of native plants, predominantly Baeckia virgata, Westringia fructicosa and Lomandra longifolia, and moisture loving plants near the drip-lines including Coral fern. There are several very moist areas below drip lines on the northern cliff, particularly where the sandstone rock overlies shale.

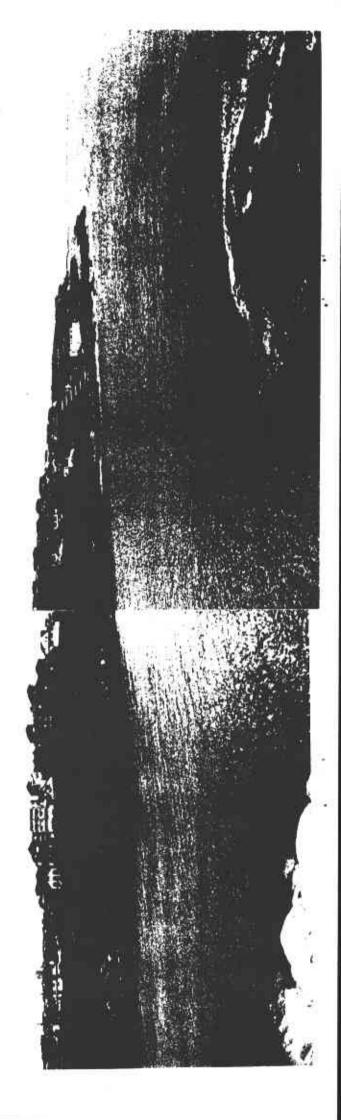
Area 2 includes the northern cliff and slope from Oak St to the head of the bay, and the beach and rocks on the north side. This area contains the most significant patch of native heath, dominated by Banksia integrifolia, Baeckia virgata, Hakea teretifolia, Bauera rubioides and Lomandra longifolia. There are many germinating specimens of some of these species. Part of this heath was burnt several months ago and is regenerating, although weeds are also growing there. There is a large area of Gladiolus next to the Tower St steps, which has formed a virtual monoculture, blackberry bushes are spreading next to it and there are large patches of Coprosma. This introduced plant survives extremely well on the coast, but it shades or crowds out most other plants in its vicinity and has also formed virtual monocultures. Above the heath is a large, bare grassed area adjacent to the houses.

Area 3 includes the spring and reed bed at the head of the bay, the southern cliff and vegetated slope to the southern end of the track. The clear spring feeds an area of reeds *Phragmites sp.*, and introduced Pennywort *Hydrocotyle bonariensis*. Many insects are seen and heard there, and the dense growth could provide shelter for wildlife. There are many Coral Trees which form a shady canopy over the southern part of the track, and large *Banksia integrifolia* trees. Other native plants were planted there in a successful revegetation program some years ago, however these are being overrun by the introduced Morning Glory *Ipomoea indica*. The southern extremity of the cliff is covered in patches of diverse low-growing coastal heath plants and is free of *Coprosma*. There are drip lines below this cliff and a few small pools.





2. Northern side of Gordon's Bay mainly showing Area 1.



AMPHIBIANS

Methods

Approximately two hours was spent searching in the reed bed and spring at the head of Gordon's Bay, and below the many drip lines on the cliffs. Night time visits totalling three hours (combined with spotlighting) were made on warmer nights to listen for calls in various parts of the Bay. Attempts were made to record frog calls as species can be identified by their calls.

Results

Species

One species of frog was positively identified, by call and in the hand; the Common Eastern Froglet *Crinia signifera* from the Family Myobatrachidae. It was heard near drip-lines and pools below the cliffs on the north side of the bay, in gardens with ponds adjacent to the bay, and in the native vegetation near the bus terminus at Clovelly beach.

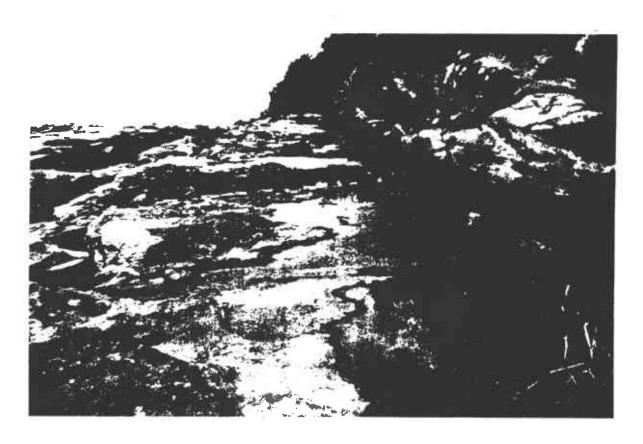
At least one other species was been heard calling in my garden adjacent to the bay last summer.

No calls were heard in the reed bed and spring area at the head of the bay, nor were frogs or tadpoles found there. Attempts to record calls were unsuccessful, as there were very few nights when they were calling. Further studies could be carried out in summer to record calls and search for other species.

At nearby Trenerry Reserve a different frog was heard calling in September 1992. This species, the Brown Striped Frog, *Lymnodynastes peronii*, may also be present at Gordon's Bay.



3. Common Eastern Froglet Crinia signifera.



4. Former breeding pool for frogs.



5. Pools on shale containing tadpoles.

Habitat

Two areas of ponds with many tadpoles were found, both under the cliffs on the north side of the bay. While there seem to be suitable drip lines and small ponds on the south side, no tadpoles were seen there and no frogs were found or were heard calling there.

There is a small semi-permanent pool of water on the rocks at the south end of the beach, where many tadpoles were seen on successive visits approximately 3 years ago. On a later visit, this pool was covered in an oily film and no tadpoles were seen. While there is no longer an oily film on it, and it holds high numbers of freshwater invertebrates, no tadpoles are present, nor any frogs found in its vicinity. The pool is covered in dense algae, possibly a sign of eutrophication. It lies near an area of runoff which may have affected it, bringing nutrients or pollutants from the streets and gardens above. I tested the pH of water from this pool and compared it with that of a pool with tadpoles on the north side. The former pool (without tadpoles) had extremely alkaline water, and the latter pool (with tadpoles) had neutral water.

Regional significance

There is concern that many frog species are decreasing worldwide (Tyler 1991). Possible reasons are their sensitivity to changes such as acidity or toxins in the water, due to their absorbent skin and dependence on clean water for their reproduction. Therefore, any natural area where frogs are found holds special importance.

Concerns

That in addition to the reduction of breeding habitat noted above, two long-time residents noted changes. One that many years ago there had been many small pools full of tadpoles next to the path on the south side, and that these no longer exist; and the other that frogs used to frequently come into the garden above the bay, but no longer do.

Recommendations

- •That the discharge of stormwater down the cliffs and into the bay be stopped. This would prevent contamination of freshwater pools and marine areas alike by detergents, garden pesticides or herbicides, oil or excess nutrients from fertilisers.
- •That until this is achieved water quality of runoff be tested and the source of any contaminants be ascertained and controlled.
- •That there be further monitoring of frog species and populations in the area to establish whether there are other species present, what their status is and that no further reduction in breeding habitat occurs.

REPTILES

Methods

Approximately four hours of daytime searches were made in accessible parts of the bay area, observing basking lizards and checking under stones, bark, leaf litter and in rock crevices.

Three pitfall traps were sunk, approximately 17cm in diameter and 20cm deep, in areas 2 and 3. These were left open for two daytime-only periods and three 24-hour periods, and checked regularly.

Results

Searches

Eight species of reptiles, from two families, are known to be present (Table 1). All but three were found during the survey time. The Skink, Lampropholis guichenoti and Weasel Skink, Saproscincus mustelina have been found in my garden, only 50m from the northern slope of the Bay and are likely to occur in the study area. Blue-tongue Lizards Tiliqua scincoides have been observed by several local people. The most recent observation was of a pair on the south side of the Bay earlier this year.

Pitfall traps

One Eastern Water Skink was trapped at site 3, photographed and released.

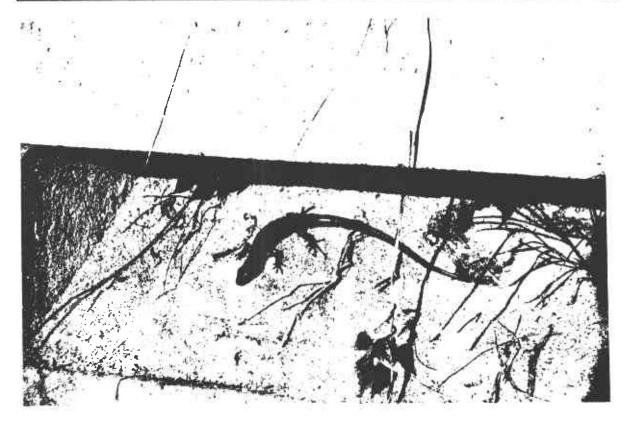
Questionnaire

In response to the questionnaire, residents reported snakes of at least two families, Boidae "Carpet Snake" and (probably) Elapidae, which had been seen many years ago. No recent sightings of snakes have been reported.



TABLE 1. REPTILE SPECIES PRESENT AT GORDON'S BAY

Common Name	Species Name	Status
FAMILY GEKKONIDAE	H III TOP	
Southern Leaf- Tailed Gecko	Phyllurus platurus	Restricted to areas of sandstone around Sydney.
FAMILY SCINCIDAE	D.	
Fence Skink	Cryptoblepharus virgatus	Very common.
Eastern Water Skink	Eulamprus quoyii	Very common in Gordon's Bay.
Garden Skink	Lampropholis delicata	Very common.
(No common name)	Lampropholis guichenoti	Common.
Three-toed Skink	Saiphos equalis	Not often found, as it is a burrowing species, but may be common.
Weasel Skink	Saproscincus mustelina	Seen in garden adjacent to Bay. Probably present in study area.
Blue-tongue Lizard	Tiliqua scincoides	Few recent observations in Gordon's Bay.



Regional significance

It is very likely that other species are present, and may be found with a longer survey time. Jacky Lizards *Amphibolurus muricatus*, of the Family Agamidae, were found several years ago north of Clovelly Bay (Dr Cogger pers. communication) and may be present in Gordon's Bay. Another species of gecko may be present, as may small burrowing lizards, and the skink *Eulamprus tenuis*.

Concerns

Predation by domestic animals

Two residents reported that their cat often brings in lizards, and another that a dog had captured a gecko.

Pollution

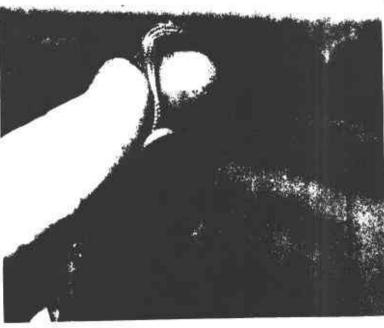
The fact that Gordon's Bay is surrounded on three sides by houses poses a potential hazard in the form of pesticides/herbicides or other chemicals, including those for termite control which may be used if the two empty blocks of land are built on.

Recommendations

- •That an education campaign be carried out to give householders an appreciation of the species present, and the important part they play in the food chain; and of non-toxic methods of pest and weed control.
- •That residents be requested to keep cats indoors whenever possible, and dogs on leads to reduce the chance of their preying on wildlife.
- •That further monitoring be carried out over several seasons to establish whether other species are present and their status.







8. Three-toed Skink Saiphos equalis

Methods

Bird censuses were carried out using the technique of the "Australian Bird Count", coordinated by the Royal Australian Ornithologists' Union. The whole area is divided into three smaller units, each is surveyed for a 20 minute period, during which all birds seen and heard within the count area are recorded, as well as those outside this area. For the count areas as defined in this survey, see map page 6.

Results

TABLE 2. BIRD SPECIES OF GORDON'S BAY

This table presents the avifauna based on the 4 counts during this survey, my own observations prior to and during the survey, and reliable reports from the questionnaire (eg. 3 reported Sulphur-crested Cockatoos nesting in the cliff).

Common Names and Species names follow the accepted order, as given in Simpson and Day 1989, a B denotes evidence of breeding in the Bay and adjacent area. Survey areas 1, 2 and 3 are shown on page 6, and the habitat of each described on page 5. An O means that the bird was flying over the area.

Resid. means observed in residential area adjacent to the bay.

Status shows the abundance in the Gordon's Bay area and whether the species is a resident, visitor or migrant. The abundance categories are:

abundant (present in large numbers)
common (present in small numbers)
uncommon (1 to 3 seen regularly)
rare (small numbers, hardly ever seen)

N/I shows whether the species is native or introduced.



TABLE 2. BIRD SPECIES OF GORDON'S BAY

Common Name		Species Name	s: are	urvej a	у	R e	Status	N/ I
			1	2	3	s i d		
Australasian Gannet		Morus serrator					uncommon resident	N
Little Pied Cormorant		Phalacrocorax melanoleucos					common resident	N
Great Cormorant		Phalacrocorax carbo		ı		0	common resident	N
White-faced Heron		Ardea novaehollandiae	0				uncommon visitor	N
Great Egret		Egretta alba			0		rare visitor	N
Sacred Ibis		Threskiornis aethiopica		0			rare visitor	N
Black-shouldered Kite		Elanus notatus				0	rare visitor	N
White-bellied Sea-Eagle		Halieetus leucogaster					rare visitor	N
Australian Kestrel		Falco cenchroides					common resident	N
Masked Lapwing		Vanellus miles					common resident	N
Silver Gull		Larus novaehollandiae		1			abundant resident	N
Crested Tern		Sterna bergii					common resident	N
Feral Pigeon	В	Columba livia		ı		H	abundant resident	I
Spotted Turtle-Dove	В	Streptopelia chinensis		ı			abundant resident	Ī
Galah		Cacatua roseicapilla		0	0		uncommon visitor	N

Common Name	Species Name	s are	urve a	у	R e	Status	N/ I
		1	2	3	s i d		
Sulphur-crested Cockatoo B	Cacatua galerita					common resident	N
Rainbow Lorikeet	Trichoglossus haematodus					common resident	N
Fan-tailed Cuckoo	Cuculus flabelliformis					uncommon migrant	N
Horsefield's Bronze-Cuckoo	Chrysococcyx basalis					uncommon migrant	N
Common Koel	Eudynamys scolopacea					uncommon migrant	N
Swift						uncommon migrant	N
Laughing Kookaburra	Dacelo novaeguineae					common resident	N
Sacred Kingfisher	Halcyon sancta					rare migrant	N
Welcome Swallow B	Hirundo neoxena					abundant resident	N
Black-faced Cuckoo-Shrike	Coracina novaehollandiae			1		common resident	N
Red-whiskered Bulbul	Pycnonotus jocosus			1	1	uncommon resident	I
Willie Wagtail	Rhipidura leucophrys			ı	1	uncommon resident	N
Superb Fairy-Wren B	Malurus cyaneus					common resident	N
Yellow-rumped Thornbill	Acanthiza chrysorrhoa		•			rare visitor	N
Red Wattlebird	Anthocaera carunculata					uncommon visitor	N
Yellow-faced Honeyeater	Lichenostomus chrysops				0	uncommon migrant	N

Common Name		Species Name	SI	arve	y	R	Status	N/
			are	a		e s		I
			1	2	3	i		
						d		
New Holland Honeyeater	В	Phylidonyris novaehollandiae			I		abundant resident	N
Spotted Pardalote		Pardalotus punctatus					uncommon visitor	N
Silvereye		Zosterops lateralis		J			common resident	N
House Sparrow		Passer domesticus	1	1	ı	ı	abundant resident	I
Common Starling	В	Sturnus vulgaris					abundant resident	I
Common Mynah	В	Acridotheres tristis	1		I	ı	abundant resident	I
Figbird		Sphecotheres viridis				ı	uncommon visitor	N
Spangled Drongo		Dicrurus bracteatus					uncommon migrant	N
Australian Magpie		Gymnorhina tibicen					common resident	N
Pied Currawong		Strepera graculina					common resident	N
Australian Raven		Corvus coronoides				ı	uncommon resident	N

Questionnaire

When asked about changes to the wildlife in the area, 48% of those who responded to the questionnaire reported that there were many more birds than there used to be, most related this to more planting of native plants in gardens and by Council. However, one reported that there were fewer Wrens than years ago, and the size of the resident group used to be four or five, but is now two or three. Two people noted an increase in large birds like Currawongs and Ravens.

Breeding

Eight species are known to breed in the bay area, four of which are native: Sulphur Crested Cockatoo, Welcome Swallow, Superb Fairy Wren and New Holland Honeyeater. A further 7 species are likely to breed in the area, and further observations could confirm this. These are: Australian Kestrel, Laughing Kookaburra (have been observed with young), Black-faced Cuckoo-Shrike, Willie Wagtail, Silvereye and House Sparrow.

During the time of this survey, the New Holland Honeyeaters were breeding. In area 2 (north side), 2 fledglings were heard and later seen among the dense *Banksia integrifolia*, and in area 3 (south side) another 2 fledglings were seen being fed in the Banksias and Coral Trees. An adult was seen carrying nesting material in area 3. Immature Starlings were also observed, and two Dove nestlings.

Plant usage

There was abundant flowering of *Banksia integrifolia* during the survey, and many New Holland Honeyeaters were seen feeding on their nectar, and hawking for insects around them, as well as around other plants. Other nectarivorous species such as Rainbow Lorikeets and Red Wattlebirds are attracted to *Banksia integrifolia*, as observed in nearby gardens. The Honeyeaters also feed from the flowers of the introduced Coral Trees and Gladioli. The tall Coral Trees and Banksias were frequently used by the Black-faced Cuckoo-Shrikes and the migratory Spangled Drongo, as well as the introduced Spotted Turtle-Dove.

Coprosma covers much of the bay slopes, and Silvereyes and Common Starlings feed on its seeds. Superb Fairy Wrens use Coprosma for it for shelter, as well as any other dense cover.

Open areas covered mainly in grass, as at the car park and the top of the northern slope, are mainly used by introduced birds. Turtle-Doves, Feral Pigeons, Sparrows and Starlings are frequently seen and rarely native species.

Seabird usage of the area

Gannets fish offshore and occasionally in the bay; Cormorants fish in the bay and sit on the rocks drying out their wings; Herons rarely feed on the rock platforms; a White-bellied Sea-Eagle was seen once gliding across the mouth of the bay and just below the southern cliff line; Masked Lapwings use the grassy areas south of Gordon's Bay (Dunningham Reserve) and north of Clovelly Bay. The Silver Gulls are present every day, at the car park, where they are fed by visitors, and on the beach, where they scavenge along the tide line and from fish offal.

Banding of individual Gulls has shown that the same individuals return to regular sites. One Gull, with band number 05005 was seen on the beach at Gordon's Bay

during the survey and at the same site in January 1989, and at Coogee in April 1992. This bird was banded at the main breeding island for local gulls, Big Island off Wollongong in September 1988. Silver Gulls, while they are native birds, have increased to pest status in the last few decades. (Smith, G. 1989) There are concerns that they can foul water reservoirs when they congregate on them in large numbers, pose a threat to aircraft, and reduce the population of other birds by direct predation on eggs and nestlings. Therefore it has been suggested that any artificial feeding of Silver gulls be discouraged.

Regional Significance

The maximum number of bird species recorded during a one-hour count was 21; 6 sea and waterbirds, 9 native species and 6 introduced species (Table 3). Numbers of most species are not high, with the exception of aerial feeding flocks of Welcome Swallows (25), New Holland Honeyeaters (>17), Silver Gulls at the car park (up to 163), Feral Pigeons at the car park (75) and roosting on the northern cliff in the evening (>60). Using the same census technique, I have been surveying other sites over the last tree years. A count at nearby Bronte Park from May 1991 shows a much greater species diversity (18 native species and 5 introduced - seabirds not included) as does a count in June 1992 (14 native and 6 introduced). Numbers of most species are also higher. Bronte is clearly a more diverse and forested habitat, but being so close it gives an indication of the potential for attracting more bird species to the Gordon's Bay area with the planting of more plants of diverse species and providing greater stratification of habitat.

TABLE 3. NUMBER OF BIRD SPECIES PRESENT IN AND ADJACENT TO GORDON'S BAY DURING THE FOUR CENSUSES.

	Count 1	Count 2	Count 3	Count 4
Sea & Waterbirds (incl. Sea-eagle)	3	4	6	5
Native land birds	8	9	9	2
Introduced birds	5	6	6	5
TOTAL	16	19	21	12

At nearby Trenerry Reserve, a Golden-headed Cisticola was recorded in September 1992, and the reed bed at Gordon's Bay is potentially suitable habitat for this species, which is not often seen in urban areas.

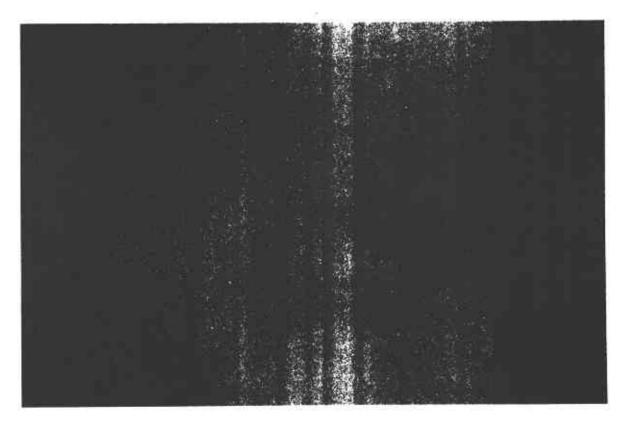
Concerns

•That there are areas of low habitat diversity which attract mainly introduced birds. These areas could be improved to attract a variety of native species.

- •That there is not enough shelter for small birds, providing protection from cats and predatory birds such as Currawongs.
- •That there are some weed plants which grow rapidly and are spreading at the expense of diverse native heath, which supports more invertebrates and vertebrates alike.
- •That introduced birds and pest species are being artificially fed.

Recommendations

- •That a bush regeneration program be carried out, and revegetation of open grassy areas and weed infested areas. It is very important that this take place gradually as many animals use the introduced plants for food or shelter, and their removal must only take place as native species grow to take their place. Many of the local plants are prickly or dense and will provide excellent shelter and nesting opportunities for small birds. Small patches of grasses should be left uncut, as they will attract many invertebrates and hence provide food for birds and reptiles.
- •That residents be discouraged from keeping cats, or that their cats be kept indoors as much as possible. That an education campaign be mounted to explain the extent of cat predation on native wildlife.
- •That users of the bay be discouraged from feeding pest species.



11. Australian Kestrel, usually seen above Area 2.

MAMMALS

Methods

Metal "Elliot" Traps were set out over four nights, baited with Peanut butter and rolled oats. The numbers of traps used were 27, 27, 10 and 25 on the successive nights. They were spread between the three areas, with more in area 2 that in the other areas in an attempt to sample the different habitats of beach and heath.

Results

Trapping

Four mammals were caught in the Elliot traps, one Black Rat, *Rattus rattus*, in the reed bed (area 3) and three Domestic Mice, *Mus musculus* (two on one night in the heath of area 2, and one in area 1 under *Coprosma*). Although the mice were marked with temporary markings, they were not retrapped.

Observations

During spotlighting I observed a Black rat climbing one of the Coral Trees on the South side of the path.

A third species, the Brown Rat, *Rattus norvegicus*, is frequently observed on the beach area. All three of these are introduced rodents.

Grey-headed Flying Foxes, *Pteropus poliocephalus*, are occasionally seen flying overhead at night. In response to the questionnaire, two people reported that the Bats used to feed on Fig trees, one which still exists near the fishermen's hut, and another below Gordon's Ave, which has been removed.

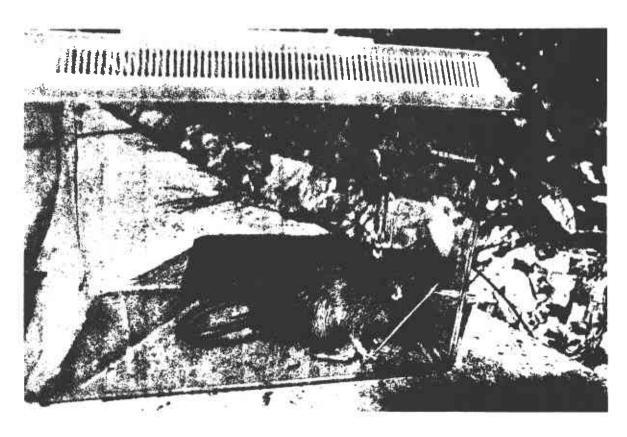
In response to the questionnaire, several people reported Brush-tailed Possums, *Trichosurus vulpecula*, in the district but not specifically using the Bay area. None were reported in the past year.

Cats Felis catus are often seen in the study area.

Rabbits Oryctolagus cuniculus are present at Burrows Park, north of Clovelly Bay, but were not reported at Gordon's Bay.



12. Elliot trap in Baeckia grove - Area 2.



13. Black Rat Rattus rattus caught in reed bed

Regional Significance

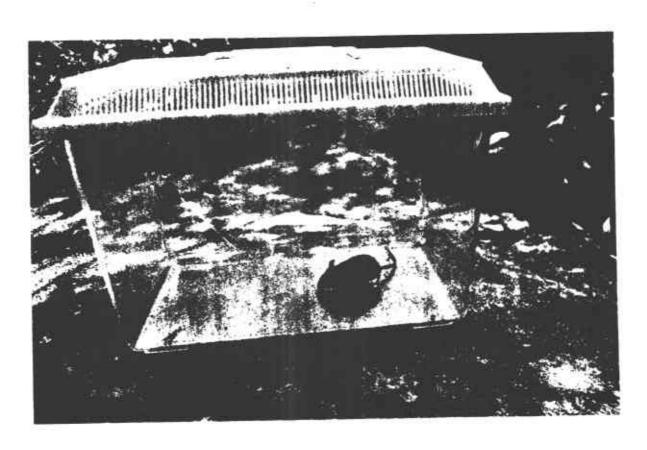
All the small mammals found are introduced species, and the usage of the study area by bats and possums seems to be marginal.

Concerns

- •That the area is depauperate in native mammalian fauna.
- •That cats are common in the study area and are known to take native reptiles and birds.
- •That rats feed on fish scraps on the beach. Limiting their extra food may help to keep their populations low.

Recommendations

- •That cats be controlled as proposed above (p21).
- •That no fish remains be left for the rats.



14. House Mouse Mus musculus

DISCUSSION

Concerns about wildlife habitat

- 1. Erosion, particularly on the northern slope, leading to loss of vegetation and wildlife habitat.
- 2. Runoff/stormwater and other causes of contamination of freshwater pools (which pose a threat to the survival of frogs)
- 3. Pollution by pesticides and/or herbicides from surrounding gardens which may pose a threat to invertebrates and hence to reptiles, frogs and birds.
- 4. Lack of shelter for small birds and reptiles, especially with many cats present and an increase in predatory birds such as Currawongs
- 5. Virtual monocultures of Gladiolus and Coprosma have taken over some areas of the bay, and while they are used for food and shelter by some species, the reduction in floristic diversity and stratification, would lead to a decreased faunal diversity.
- 6. Weeds from surrounding gardens can exacerbate the above problem, and dumping of garden cuttings has been seen near the Tower St steps.
- 7. The Clovelly car park is a virtual wildlife desert, and only attracts introduced and pest species (Silver Gull), which are fed by many visitors. Rats have also been reported on the rocks below the car park.
- 8. The future of the northern slope of the bay. This area contains a large patch of native heath and is an important feeding and breeding area for native birds. The Banksias, which are currently flowering profusely, attract many New Holland Honeyeaters which feed on their nectar and on insects. They also breed in the dense vegetation in and around the Banksias. The Australian Kestrels are mainly seen hunting over this area, and the Black-faced Cuckoo-Shrikes hunt for insect prey here. The dense growth and prickly foliage of some of the native plants, such as Hakea teretifolia provides valuable protection for small birds and lizards, which are too easily preyed upon by cats and



MANAGEMENT RECOMMENDATIONS

- 1. Stabilise the slope to prevent further erosion and loss of habitat.
- 2. Prevent stormwater runoff, which contributes to the erosion problem and pollutes the freshwater and marine habitats alike.
- 3. Increase habitat diversity by a gradual bush regeneration program and revegetation with local native plant stock. This will provide a greater diversity of habitats for invertebrates and vertebrates alike. It is vital that any such program be gradual, as many animals use the introduced plants for food or shelter, and their removal must only take place as native species grow to take their place.
- 4. Purchase and/or arrange to manage the northern slope above the path with its valuable native heath and wildlife habitat. This area should be protected and managed consistent with principles of bush regeneration.
- 5. Revegetate the car park with low-growing local plants. The area on the cliffs on the south side (Dunningham Reserve) is extremely diverse and attractive and may be a suitable model. Such low species would enhance the beauty of the area and the opportunities for wildlife, without detracting from the open view.
- 6. To provide an educational program aimed at encouraging residents to:
 - •keep cats indoors at night
 - •stop using pesticides and herbicides which may wash down into the bay, (attracting birds and predatory insects to gardens by planting a diversity of local native species will help control insect pests)
 - stop washing cars on the street
 - •plant local native species. Seeds of weed plants will continue to disperse down into the bay area and spread, whereas local seed stock will help the regeneration effort
 - stop dumping garden cuttings, proposing alternative ways of disposal (composting or council collection)
 - ·encourage an appreciation of the local native flora and fauna with
 - -pamphlets and guided walks, in the hope that the above recommendations will be understood and carried out.
- 7. To ask users of the bay not to feed introduced animals and Silver Gulls.
- 8. To monitor the vertebrate groups regularly to see the effect as changes are implemented

ACKNOWLEDGMENTS

I would like to thank my family for their help during the survey, and their extreme tolerance to my disappearing "down to the bay" at all hours of the day and night. My thanks go to John Barker (National Parks and Wildlife Service), Hal Cogger, Liz Cameron and Martyn Robinson (Australian Museum) for advice on herpetology, to Rod Kavanagh (Forestry Commission of NSW) for advice on mammal work and Dan Lunney ((National Parks and Wildlife Service) for the loan of Elliot traps. Thanks also to members of the Gordon's Bay Fishing Club who were extremely helpful and to all those residents who responded to the questionnaire.

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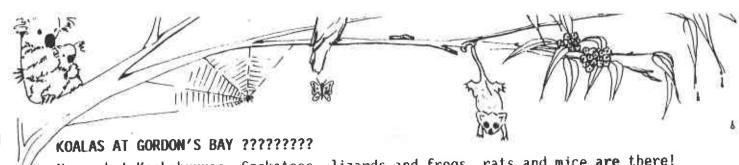
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APPENDIX - Questionnaire distributed to 300 residents and regular users of the Bay.



16. Northern slope showing extent of vegetated area - Area 2.



No....but Kookaburras, Cockatoos, lizards and frogs, rats and mice are there!

Dear Resident.

As part of Randwick Council's management study of Gordon's Bay, I am investigating land animals in Bay area. While I am surveying the area intensively, you may be able to add valuable information from your own observations, and if you have lived in this area for several years, you may have noticed changes.

I hope that you will take a few moments to fill out this questionnaire.

How many years have you lived in the Clovelly/Coogee area? ____years

Have you ever seen any of the following animals in this area? If so, how many years ago? Could you please mark on the map (over) approximately where you saw them:

Possum	yes/no	years	ago/this year
Blue-tongue Lizard	yes/no	years	ago/this year
Snake	yes/no	years	ago/this <u>y</u> ear
Gecko	yes/no	years	ago/this year
Ow1/Tawny Frogmouth	yes/no	years	ago/this year
other		Contract of the second	

Do you know of any birds that nest in the area? yes/no If yes, please provide details, and mark on map approximate location.

Have you noticed any major changes to the wildlife in the area? If so, please

Phone no.

Could you please drop your completed form at 3 lower St, Clovelly, by 26.5.93 or phone me on 6658082. Thank you very much for your help. Yours sincerely,



GORDON'S BAY?

Randwick City Council have recently engaged consultants, Land Systems EBC, to prepare a Draft Plan of Management for Gordon's Bay (located between Clovelly Beach and Coogee Bay – see plan below). A Plan of Management sets out strategies and guidelines for implementation of landscape works, maintenance and procedures. In order to determine resident's needs and wants and how best to improve the bay, we enclose a questionnaire which we would like you to complete and return to Council by June 4, 1993.

If you have any questions please do not hesitate to contact Council's Landscape Architect, Mrs Lynda Ohlmus at Randwick City Council on 399 0928.



Please forward the completed questionnaire to Town Clerk, Randwick City Council, 30 Frances Street, Randwick NSW 2031, or drop into Council's barrell located outside the fishing clubhouse at Gordon's bay between 9.00am and 5.00pm.

Closing date for return of surveys is June 4, 1993.

Thank you for your interest in this survey.

Please tick appropriate boxes

How often do you visit Gordon	n's Bay?		
Daily Weekly Monthly	000	Bimonthly Annually Less than Annually	000
Why do you use or visit Gordo	n's Bay?		
As an access route Walking Relaxing Swimming Sun baking Enjoy nature Running/jogging	0000000	Picnics/barbeques Fishing Collecting fish bait Fossicking Scuba diving Snorkelling	000000
Others (please state) What do you like about Gordon			
Peace and quiet Nature Marine environment Swimming		Scenic/visual qualities Good fishing No motor vehicles	
What do you dislike about the			
Safety - path Safety - dark and enclosed Weeds Litter Water pollution Fishing authorities	000000	Lack of pedestrian access Lack of space Nude bathing Dogs Visual quality	00000
Others (please state)			•
Repair and upgrade footpath Upgrade bushland - remove w and plant native plant species Preservation of Marine Life	eccds	More seats Provision of picnic facilities Improve access	000
Others (please state)			***************************************
Of the items in question 5, plea	se list the 3 items you co	msider most important?	
1. With regard to Clovelly car part	2 k what improvements (if	any) would you like to see impleme	3
Is there anything further you wo	nuld like to say about imp	proving Gordon's Bay?	
***************************************			***************************************

RESULTS FROM QUESTIONNAIRE SURVEY - STATISTICS

Question 1

How often do you visit Gordon's Bay?

- 31% visiting daily
- 41% visiting weekly
- 12.5% visiting monthly
- 4% visiting Bimonthly
- 1.6% Annually
- 0.4% less than annually.

Question 2

Why do you use or visit Gordon's Bay?

- 78% using it for walking
- 57% for relaxing
- 54% enjoy nature
- 42% swim at the bay
- 21% use it as an access route
- 20% use it for snorkelling
- 19% jogging/running
- 7% fish at the bay
- 6% fossick at the bay
- 5% scuba dive
- 3% picnic and barbecue
- 1% collecting fish bait.

Question 3

What do you like about Gordon's Bay?

- 78% liking the peace and quite
- 72% enjoying the scenic/visual qualities
- 68% enjoying nature
- 58% experiencing the marine environment
- 58% preferring the fact that there are no motor vehicles
- 39% enjoyed swimming at the bay
- 7% enjoyed the fishing.

Question 4

What do you dislike about Gordon's Bay?

- 68% disliking the litter
- 51% water pollution
- 47% disliked the weeks
- 30% stated the path unsafe
- 30% objected to dogs
- 27% disliked nude bathing
- 23% stated the path dark and enclosed
- 50% disliked the lack of pedestrian access.
- 4% disliked the visual quality.
- 3% disliked the lack of space.

Question 5

How would you like to see the bay improved?

- 73% would like to see the bushland upgraded weeds removed and plant native species.
- 65% stated they would like to enhance preservation of marine life.
- 58% would like to have the footpath repaired and upgraded.
- 26% nominated for more seats.
- 13% would prefer access to be improved.
- 11% would like to have picnic facilities provided.

Question 6

Of the items in question 5, please list the 3 items you consider most important?

Listing items considered most important was tabulated by rating the first choice as 3 points, the second choice, as 2 points and the third choice as 1 point:

This resulted in the following.

- upgrade bushland removal of weeds and plant native plant species 369 points.
- repairing and upgrading footpath 296 points.
- preservation of marine life 237 points.
- more seats 48 points.
- improve access 28 points.
- provision of picnic shelters 17 points.

Others included:

- cleaning of beach pollution 25 points.
- removal of fishing club, ramps and boats 19 points.
- to improve lighting and bins 8 points.

Question 7

With regard to Clovelly carpark, what improvements (if any) would you like to see implemented?

Improvements to Clovelly carpark in order of preference included:

- planting of shrubs and trees.
- reduce size of carpark and accommodate with appropriate planting
- reduce speed by introducing speed humps and signage
- addition of bins for rubbish
- general clean up of carpark.

Question 8

Is there anything further you would like to say about improving the bay?

- Maintain the character and visual quality.
- General keep clean and tidy.
- Removing storwmater.
- Beach and water pollution.
- Improve access to water.

APPENDIX 4

Cost Estimate - Preliminary

COST ESTIMATE

PROJECT: GORDONS BAY

This preliminary cost estimate is indicative only and is based upon unquantified scope of works, unknown site conditions, and no determination of methods of implementation. This estimate is based upon current commercial rates

rates.	rates	Unit	Quantity	Rate	Amount	Total
1.0.	PATH WORKS					
11.	New concrete path between Tower					
	Street steps and Fishing club.		1			
	clear vegetation	Item	1 1		\$2,000.00	
	excavate	m2	200	\$50.00	\$10,000.00	
	install new concrete path (1.8 x 100m)	m2	180	\$100.00	\$18,000.00	
	demolish existing path	m2	120	\$20.00	\$2,400.00	
	remove spoil	m3	35	\$100.00	\$3,500.00	
	reinstate soil and vegetation	m2	120	\$40.00	\$4,800.00	
	Note: includes allowance for site costs	11112	"			
	NOIS. II CITUDS allowaltos for sito costs				subtotal	\$40,700.00
1.2.	New path from Beach Street (1.8 x 250m) clear vegetation excavate	m2	450	\$180.00	\$81,000.00	
	install new concrete path and steps					
	reinstate vegetation				subtotal	\$81,000.00
1.3.	Widening of path from Major Street to					
	fishing club		4440			
	excavate rock (50 x 1 x 1m)	m3	50	\$250.00	\$12,500.00	
	relocate sewer pit	item	1 1		\$5,000.00	
	relocate electricity pole	item	1 1		\$10,000.00	
	install additional path area (1m wide)	m2	50	\$100.00	\$5,000.00	
	includes allowance for site costs				subtotal	\$32,500.00
	TICLUIUS OLLUB DEL COATION					
2.0.	FISHING CLUB RELOCATION	, m2	36	\$1,000.00	\$36,000.00	
	construct new structure 6 x 6m	m2	30:	\$1,000.00	\$3,500.00	
	demolish existing structure	item	50	\$100.00	\$5,000.00	
	reinstate new path	m2	50	\$100.00	ψ3,000.00	
					subtotal	\$44,500.00
3.0.	RESERVE ENTRY TREATMENT		1			
0.0.	Major Street	item				
	Car Park	Item	1 1		\$20,000.00	
	our run	10000000	1 1	1	\$20,000.00	
						*** *** **
		1			subtotal	\$40,000.00
4.0.	VEGETATION AREA	1				
	Works include:	1			\$100,000.00	
	Clearing of weeds			1		
	Installation of new planting over 3 years			1		
	- assumes volunteer labour				950047459254	04 00 00C C
					subtotal	\$100,000.00

	ltem	Unit	Quantity	Rate	Amount	Total
5.0.	SIGNAGE				\$30,000.00	
	Signage Stations				700,000.00	
	organige connected		1 1		subtotal	\$30,000.00
6.0.	CLOVELLY CAR PARK INTERIM		1 1			· · ·
20000	REFURBISHMENT		1 1			
	Works include:					
	excavation	m3	390	\$150.00	\$58,500.00	
	soil	m3	390	\$40.00	\$15,600.00	
	grass	m2	1000	\$6.50	\$6,500.00	
	planting	m2	300	\$22.00	\$6,600.00	
	trees	ea	30	\$80.00	\$2,400.00	
	drainage	m2	1300	\$3.00	\$3,900.00	
	seats	ea	10	\$900.00	\$9,000.00	
	K&G	lin.m	200	\$60.00	\$12,000.00	
	picnic area	allowan		V	\$30,000.00	
	diver drop off	allowan	227		\$10,000.00	
	aror arop on	anowa.			V.0,000.00	
		II			subtotal	\$154,500.00
			1 1			
7.0.	DIVER PREPARATION AREA	14				\$10,000.00
	Works include: paving, seating, minor	item				\$10,000.00
	landscape works					
8.0.	SEATING	өа	20	\$750.00	\$15,000.00	\$15,000.00
9.0.	HYDRAULIC STUDY	item				\$10,000.00
10.0	VEGETATION STUDY & MANAGEMENT	item				\$5,000.00
10.0.	PLAN	ii.oiii	1 1			40,000.00
11.0	TRAFFIC STUDY TO					
11.0.	CLOVELLY CARPARK					\$5,000.00
	CLOTELLI ONIT AIN					44,444
_					TOTAL	\$568,200.00
40.0	CONTRIDENCE (45%)					\$85,000.00
12.0.	CONTINGENCES (15%)					405,000.00
13 0.	FEES (7%)					\$40,000.00
,	(. ,•)					
				C	RAND TOTAL	\$693,200.00

Exclusions: Long term carpark option construction Fencing/Barrier to paths Escalation

ACKNOWLEDGEMENTS

GORDONS BAY CONSULTATIVE COMMITTEE

Cr Freda Backes Randwick City Council - East Ward

Cr John Buchanan Randwick City Council - North Ward

Cr Tony Sherbon Randwick City Council - North Ward

Mr Ernie Page Local Member for Coogee

Mr Ted Plummer Office of Ernie Page

Mrs Lynda Ohlmus Randwick City Council - Landscape Architect

Mr Gary Eastman Randwick City Council - Recreation Planner

Mr John Calvani Randwick City Council - Landscape Architect

Mr Michael Young Department of Planning

Mrs Fiona Decelis NSW Fisheries Department

Mr Bill Hayes Gordons Bay Amateur Fishing Club

Ms Maria Long Department of Sport, Recreation and Planning

Mr Noel Ward Gordons Bay Amateur Fishing Club

Mr John Rowe Resident

Ms Suzanne Llewelyn Resident

Dr Al Lovric Resident

Mr Bill Fisher Resident

Mr Stephen Sheldon Coogee Residents Against Pollution

Mr David Owen Resident

Mr Mark Percy Resident

Mr Alan Yuille Resident

Mr David Bennet Resident