Then and Now – Fauna Monitoring Within the Sydney Basin

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ABSTRACT A review of descriptions of fauna within the Sydney Basin since the First Settlement is used to illustrate the development of monitoring surveys over the last 200 years. Information about changes in fauna populations came initially from the use of inventories, using presence/absence data, then the use of ranking population status, onto the results from short-term surveys using systematic methodology and finally from surveys undertaken over longer periods of time. Such surveys, considered as repeatable and systematic, can be classed as monitoring surveys. Several such surveys are described in this paper.

Key Words: Surveys, monitoring, inventories, population status, changes

INTRODUCTION

Despite the common usage of the term 'monitoring' in scientific and other literature (particularly regarding conservation biology) it is difficult to find a precise definition of the word. A general definition for monitoring programme comes from "A Dictionary of the Environment" (p. 322, Allaby 1977) which states that a monitoring programme is "A programme designed to measure, quantitatively or qualitatively, the level of a substance over a period of time".

However, a focus on biological aspects of the environment needs to be considered when monitoring of fauna is to be considered. The Smithsonian Institute in their publication titled "Measuring and Monitoring Biological Diversity Standard Methods for Amphibians" point out that "*Monitoring* is used to determine species composition and abundance (numbers of individuals per species) at one or more sites through time" (p. 18, Heyer *et al* 1994). Thus the substance addressed in the previous definition can be considered as biological diversity. A similar publication by the Institute for mammals defines the monitoring of biodiversity as the 'estimation of diversity at the same location at more than one time, for the purpose of drawing inference about change" (p.1, Wilson *et al,* 1996).

There are numerous publications describing how monitoring of biodiversity should be undertaken (e.g. Chapter 17, Lindenmayer and Burgman, 2005; Legg and Nagy, 2006; Watson and Novelly, 2004). However, the overriding principles determining how monitoring should occur can be stated as:

Principle 1: Monitoring should involve a sound experimental design e.g. monitoring of control and treatment areas and/or pre- and post-treatment sampling, with suitable replication.

Principle 2: Survey techniques and survey efforts need to be consistent and repeatable during the period of monitoring and data be collected and analysed in a systematic manner.

These two principles can be summarised as: Monitoring surveys should be systematic and repeatable.

Do such monitoring programmes exist for fauna within the Sydney Basin and can data about fauna in the Sydney Basin obtained over time be used "for the purpose of drawing inference about change"?

A recent paper by Scott Field and others (Field *et al*, 2007) breaks up monitoring programmes into three approaches, based upon funding, objectives and sampling design. They divide monitoring programmes undertaken in Australia into three classes depending upon the particular approach. According to Field *et al* the three approaches to monitoring are Ecological Field Experiments, Unscientific Monitoring and Inventories based upon the approach taken regarding funding, objectives and sampling design. They conclude that "the field remains crippled by a pervasive lack of rigour in analysing, reporting and responding to the results collected" (p.485, Field *et al*, 2007). I would like to add another approach that is possibly the most important in today's commercial world – monitoring programmes financed and managed by private and public bodies that are responsible for developments and management actions that may have environmental impacts. I have called the approach Systematic Monitoring as its aim is to collect data in a systematic and repeatable manner that can be reported to and used by government agencies overseeing and managing impacts.

An extract from Figure 1 of their paper (Fig. 1. Schematic representation of approaches to monitoring by different actors in Australia, p.487, Field *et al* 2007) is modified herewith to include this additional type of monitoring that does not fit into their schema summarising approaches to monitoring. The first three approaches are extracted from the paper, and I have added my fourth approach to the table to show how systematic monitoring fits into their scheme.

Short to long term, often in response to short-lived political pressures. Unlikely to be sufficiently spatially and temporally replicated for meaningful analysis

Aim to gather snapshot inventories of particular locations. Usually lack rigorous scientific design and produce datasets that are unusable or have low statistical power.

Poor to medium quality data, systematically archived but usually inaccessible to outsiders.

Unscientific Monitoring

Short to medium term, discontinued due to lack of interest and focus on activities designed to attract and retain volunteers.

Aim to gather snapshot inventories of particular locations of interest to volunteers, or which support specific objectives. Usually lack rigorous scientific design and produce datasets that are unusable or with low statistical power.

Poor to medium quality data, unlikely to be systematically archived except by largest and bestfunded organisations.

Ecological Field Experiments

Short to medium term, often associated with terms of students' projects or grants.

Aim to collect information on specific ecological characteristics of target organisms. Adhere to rigorous scientific design, but abundance and distribution usually measured incidentally.

Medium to high quality data, but rarely sufficiently long-term to permit demonstration of trends.

Systematic Monitoring

Medium to long term, mainly associated with regulatory and other obligations (e.g. Conditions of Consent, control programs)

Aim to collect information in a systematic and repeatable manner. Abundance and distribution usually measured. Able to undertake rigorous scientific analysis and relate to environmental changes.

Medium to high quality data, major restrictions of quality are funding, ability of monitoring body and conditions imposed by regulators This paper looks at the different types of monitoring within the Sydney Basin as a spectrum of degrees of systematic approach i.e. to what degree has monitoring been undertaken in a systematic manner. The spectrum ranges from simple inventories assembled from a number of sources, usually on an informal basis i.e. no consistent survey methodology or effort, through to monitoring programmes designed using scientific methodology with formalised descriptions and reporting. As will be seen, many surveys undertaken within the Sydney Basin over the years tend to fall into that end of the spectrum describing inventories. Over time, surveys have gradually moved from the listing of fauna species to estimates of population numbers and finally to studies that can be considered systematic monitoring surveys.

Previous papers found elsewhere in this publication have already defined Sydney Basin and it is within this area that I will draw examples of different types of monitoring over the years since European Settlement.

INVENTORIES

Inventories of fauna within the Sydney Basin have been produced since the early days of the Settlement, and even before that by the original inhabitants. Animals and plants are depicted in the rock art and paintings by aborigines. In addition, language can provide inventories of animals. For example, in 1802, George Caley listed six different macropods found in the Colony (Currey, 1966). The list was derived from descriptive words used by the local aborigines. These were:

Patagorang – Great Forest Kangaroo Cunimang – Kangaroo Rat Walaby – Brush Kangaroo Patty Melon - Paddymelon Werine – "tail covered in long hair" Betony – "in thickets"



Drawing of "The Kangooroo" by Arthur Bowes Smyth, reproduced from his Journal 1787-1789 (Fidlon and Ryan, 1979)

Inventories can provide a basis for comparison, but the problem of consistent survey effort makes such comparisons difficult. In 1865, Gerald Krefft listed 19 species of frog from the neighbourhood of Sydney (Krefft, 1865). Today there are as many as 45 species (Department of Environment and Conservation, 2005). Krefft also describes 17 snakes (including 2 sea snakes) from the "neighbourhood of Sydney" in 1862 and these are listed in Table 1. Recent surveys of the Southern Sydney Region by Department of Environment and Conservation (2005) list 18 species. The increase in frogs is more than likely due to greater survey effort and taxonomic changes, whilst the lack of an increase in snake species may be the result of a genuine decline in diversity. Comparisons of inventories over time may not be that valuable, as there are differences in the extent of survey effort, the sizes and locations of areas surveyed as well as taxonomic changes.

Table 1: Snakes Observed in the Neighbourhood of Sydney (Krefft,1862)

Typhlops rupelli Dendrophis punctulata Dipsas fusca Morelia spilotes Diemenia psammophis Diemenia superciliosa Brachysoma diadema Pseudechis porphyriacus Hoplocephalus nigrescens Hoplocephalus signatus Hoplocephalus variegates Hoplocephalus curtus Petrodymon cucullatus Vermicella annulata Acanthophis antartica Platurus scutatus Pelamis bicolour

Blind Snake Green Tree-Snake **Brown Tree-Snake Diamond Snake** Grey Snake **Ringed Diemenia Red-Capped Snake Black Snake Black-backed Hoplocephalus** Black-bellied Hoplocephalus **Broad-headed Snake Brown-banded Snake Red-bellied Snake Ringed Vermicella Death Adder Ringed Sea Snake** Black and Yellow Sea Snake



Red-bellied Black Snake (*Pseudechis porphyriacus*) reproduced from "The Snakes of Australia" (Krefft, 1869).

However, not all animals recorded from the First Settlement have been listed in the inventories of Krefft. One example comes from the journal of Arthur Bowes Smythe, surgeon on the Lady Penrhyn. On the 15th February 1788 (p. 73, Fidlon and Ryan, 1979) he states:

"An Alegator 8 feet long has several times been seen near the camp and among the shrubs behind the camp near the run of water wh. supplys the camp".

and on the 3rd March 1788 (p. 77, Fidlon and Ryan, 1979):

"A very large Allegator sd to be seen near the Tents 14 ft long.."

These observations pose the question of the adequacy of early inventories and the use of casual observations. Perhaps crocodiles did occur as far south as Sydney, or was the observation an exaggerated form of a monitor?

INVENTORIES AND POPULATION STATUS

Inventories do provide information about the natural environment and the number of species (species richness) does assist in defining the biodiversity values of an area on the basis of presence/absence data. However, population numbers are also needed in order to develop a better understanding of such values, particularly over time. Consequently, descriptions that add some estimate of population numbers are far more valuable when undertaking monitoring studies. Population numbers are usually provided as a ranking, ranging from very rare to abundant. Even though these are usually derived subjectively they do provide some insight into changes in the status of fauna in the Sydney basin.

Throughout the history of settlement of Sydney there are numerous lists (inventories) of fauna known to occur at different times. However, there are lists available that also provide some form of population ranking. For example, in 1898 a "Handbook of Sydney and the County of Cumberland for the use of the members of the Australasian Association for the Advancement of Science" was published for their Sydney meeting (Hamlet, 1898). This has a chapter on mammals, reptiles and amphibians by Edgar Waite, and an extensive chapter by Alfred North (of the nests and eggs fame) on the birds of the County of Cumberland. In this, North lists and describes all the bird species known from Sydney at the time (263). The descriptions include the suburbs in which they are mainly found, as well as population status (very rare to abundant). A description of the finch group by North is given in the following extract (p.89, North, 1898).

100. *Aegintha temporalis*, Lath. - Red-browed Finch. Abundant in *Melaleuca* scrubs and low trees overgrown with climbing plants. Young birds are plentiful at Meadow Bank and Hunter's Hill during January, but nests of this species containing eggs or young may be found throughout the year. Local name "Red-head."

101. *Stagonopleura guttata*, Lath. – Spotted-sided Finch. Fairly common at Belmore, where boys may be often met engaged in trapping them. More freely distributed in the open forest lands between Blacktown and Penrith. Usually builds low down in a *Hakea*, or mass of vines, but sometimes in a *Loranthus*, growing on a tall *Eucalyptus*.

102. *Taeniopygia castanotis*, Gould. – Chestnut-eared Finch. Rare. Driven to the coastal districts by the severe drought in 1896. Specimens were obtained during that year at Campbelltown and Belmore. A nest, containing eggs, was taken in September in the latter locality.

103. *Emblana picta,* Gould. – Painted Finch. The same remark applies to this as the preceding species. A small flock of five individuals appeared at Campbelltown in August 1986, three of which were obtained, and are now in the Australian Museum. It is the only locality this species has been recorded from in Eastern Australia.

Other early observations provide baseline data for future assessment. There are many such observations by George Bennett in his book "Gatherings of a Naturalist in Australasia", published in 1860. The following are some examples of the status of various fauna species (Southern Emu Wren, Emu and Brush-tailed Rock Wallaby) within Sydney during the mid 19th Century, as described by Bennett (1860):

"The delicate little Emeu Wren (*Malurus malachurus*), although formerly seen in great numbers in the vicinity of Sydney, is now very rare".

"Although Emeus are so scarce, that a traveller may journey hundreds of miles in the interior of Australia without seeing one, yet, in an unfrequented part of the country not fifty miles distant from Sydney, where they are left undisturbed, between twenty and thirty of these birds were observed together a short time ago.."

However, Emus still occurred within the Sydney metropolis, as described by Bennett.

"One day, during the levee, when the Domain was crowded with people to see arrivals and listen to the band, Emeus mingled with the crowd, apparently enjoying the gay scene around them, when some strangers, who were afraid of these birds, ran away; on seeing this, the Emeus (enjoying the chase) pursued, and overtaking one of the gentlemen, took off his hat, to his great surprise". These Emus were tame and kept by the Governor as pets.

"A species of Wallaby-Kangaroo was found about the rocky ranges at the Nepean; and on examining one fine specimen that was shot in this locality, I found it was the small Brush-tailed Rock Wallaby (*Petrogale penicillata*): when cooked like jugged hare, it had much the flavour of that animal". The surveys undertaken by Liz Dovey and others show that all colonies of Brush-tailed Rock Wallabies near Sydney are now extinct (Dovey *et al,* 1997).

Other milestones that provide some form of baseline data to use for monitoring are the publication of "The Birds of Sydney" by Hindwood and McGill in 1958. This book provides some estimates of population status as well as distribution data. This publication was revised by Ernie Hoskin in 1991 and there is a chapter on status changes since 1958. Put together with the Australian Museum publication "The Natural History of Sydney" from 1962 (The Trustees of The Australian Museum, 1962), there is a reasonable picture of the fauna within the Sydney Basin in the mid to late 20th Century. This picture can be compared with that described by 19th Century observers.



Jacky Winter (Microeca fascinans), from Barrett et al, 2003

Taking an example at random, the Jacky Winter or Brown Flycatcher. In 1898 this was considered "The commonest resident species in the county, over which it is generally distributed. It is the first bird to welcome in with cheerful notes the dawn of day." (North, 1898)

In 1958, the Jacky Winter is described as "A resident species widely distributed throughout open-forest country and parks...." (Hindwood and McGill, 1958).

And in 1991 "A breeding resident which was formerly very common. Now moderately common in some areas of the Shale and still to be seen in Centennial Park." (Hoskin, 1991)

In the 1970s there appeared to be a increased interest in the fauna of Sydney, with the publication of numerous descriptions of fauna known to occur in various suburbs and parks. Some of these do provide some form of population status. Although it is difficult to determine how each status was derived, the broad rankings do provide information about population status within parts of Sydney. Table 2 provides a list of some of these reports produced during this period of time:

Cooks River	Cooks River Environmental Survey and Landscape Design
	(Cooks River Project, 1976)
Pennant Hills Park	Plan of Management, Beecroft Cheltenham Civic Trust 1976
South Turramurra	A Plan of Management for South Turramurra Bushland
Bushland	(Buchanan, 1980a)
Mowbray Park	Mowbray Park Description and Management (Buchanan, 1980b)
Bankstown	Check List of Birds of Bankstown (Nordstrom, 1984)
North Wahroonga	Flora and Fauna of North Wahroonga Bushland (Rose, 1978)
Bantry Bay	Bantry Bay The Case for Conservation (Upper Middle Harbour Conservation Society, 1980)
Elouera Bushland	Elouera Bushland Natural Park Trust, 1983
Natural Park	
Lane Cove River	The Impact of Man on the Mammals and Birds of the Lane Cove
Valley	River Valley (Stephens, 1978)
Royal National Park	NPWS Guide 1976
Ku-ring-gai Chase National Park	Teacher's Handbook (NPWS, 1982)
Hornsby-Upper North Shore	Bush in the City (Bradstock, R. and Fitzhardinge, R. 1979)
Hawkesbury River	The River and Human Impact (NPWS, 1980)
Ryde District	Resource Book for Field Studies in the Ryde District (Shearer and Jenkins, 1979)
Vaucluse	Flora and fauna of Vaucluse (Nathan, 1952)
Centennial Park	The Wildlife of Centennial Park (Gould League, 1965)
Dobroyd Head	Reptiles of Dobroyd Head Reserve (Hardy et al, 1979)
Lane Cove River	Lane Cove River State Recreation Area Trust, 1980

Table 2: Selection of Publications Describing Fauna in Parts of Sydney

As pointed out, the derivation of these lists and associated information remains obscure in most cases. Consequently, reliably monitoring changes based on the information in some of these publications can be difficult.

There are several studies that use the results from systematic surveys to compare with results derived from inventories and observations taken in the past. Some examples include a study of Koala populations in the Warringah Shire by Peter and Judy Smith in 1990 (Smith and Smith, 1990). The authors used a variety of sources to obtain an estimate of population status since 1788. Although some of the sources used systematic surveys, others are from anecdotal and other information e.g. records of injured animals.

The review of the changing status of Platypus around Sydney by Tom Grant in 1998 (Grant, 1998) also uses information from a variety of sources, including

a questionnaire survey and a review of published and unpublished literature. As Grant states in his paper "It is unfortunate that no comprehensive survey has been done of the distribution and status of platypus populations around the Sydney-Wollongong region".

Two recent papers illustrate the problems of attempting to monitor fauna populations over time. Arthur White's study of the herpetofauna of the Malabar Headland (White, 2007) used historical information provided by John Cann and his father, George. This gives a list of reptiles present in the area 70 to 80 years ago. Modern records of reptiles came from systematic surveys undertaken by Arthur White, but how much confidence can be placed on comparing records produced by two different methods?

A similar approach was taken by Shelley Burgin and Tony Saunders (2007) in their study of changes to the parrot populations in Sydney over the last 100 years. Modern records were derived from several sources, all using different methods of recording status (Birds Australia, Cumberland Bird Observer's Club, Field Ornithologists Club – Birding NSW) and historical records came from different inventories dating back to the 19th Century.

All such monitoring studies are encumbered by the lack of comparative data obtained in a systematic manner. This is to be expected, but it is important that studies such as those described above are undertaken. They, at the very least, provide an insight into changes in the status of fauna within the Sydney Basin over time.

THE BEGINNINGS OF SYSTEMATIC STUDIES

As described in the Introduction, monitoring surveys require sound experimental design and have survey techniques and survey efforts that need to be consistent and repeatable over a period of time. There have been such systematic surveys undertaken in the past and the results of which can be used as reliable baseline data, even if these surveys have not been undertaken over a period of time. These include trapping surveys for small mammals within Lane Cove Valley by Sally Stephens in 1978, O'Hara's Creek Nature Reserve, Kenthurst by Jeff Johnston in 1991 and in Ku-ring-gai Chase National Park in 1986 (NPWS, 1986).

There have been systematic surveys for avifauna for many years and results from such surveys are discussed elsewhere in this publication. There are systematic surveys within relatively small areas that could provide information on changes in population status. In 1962-63 Bell (Bell, 1966) surveyed heathland birds within Holsworthy Manoeuvre Area in a rigorous fashion and in 1995 the Australian Museum Business Services surveyed terrestrial fauna within Holsworthy Training Area for an environmental audit (AXIS Environmental/AMBS Consulting, 1995). It could be possible to compare the results from such studies, as long as the methods used are clearly described.

Long term studies by individuals can also be considered as systematic, as equal effort and methodology is often used. Thus, the avifauna surveys of Wolli Creek by N. Rankin from 1969 to 1990, and by Arnold McGill between 1941 and 1970 provide valuable insights to changes in bird populations in this area. A copy of a page from their bird list developed over the years is given here. A similar study of changes in the avifauna at Maroubra over 40 years was reported by H. Bell (1983). The constancy of the survey effort allows for some conclusions to be drawn about changes in species diversity over time and these studies could be considered monitoring surveys..

Table 1.	M 6100
Woll, Creek.	Bind List. A. Mecill.
Bras	recorded each year
· · · · · · · · · · · · · · · · · · ·	70 72 74 76 78 60 82 84 86 88 40.
1. He ded fide x	×× ×
2 Aust Little Grebe ×	* * * * * * * * * * *
3 Aust Pelican *	× × ×
+ Great Germanant *	× × × × × ×
5 Pied Commorant	× × ×
& Little Black Component ×	**** *******
7 Little Brid Comprist *	* * ***********
8 Pacific Heren x	× × × × × × × × × × × × ×
a kilbite Eared Herron T	*****
10 Cattle Easet	× ×
11 Great Earet ×	** ** * * * * * * * *
12 Little Easet	××
13 Rufous Night Heron x	× × × × × × ×
14 Manarove Heron ×	× x ×
15 Brown Bittern. ×	× × ×
16 Sacred Ibis ×	** ***** *******
17 Straw Neck ibis ×	
18 Royal Spoonbill x	******
19 Yellow Bill Spoarbill	×
Jo Black Swan x	
21 Mallard.	× × × × × × ×
22 Black Duck ×	* * * * * * * * * * * * * * * * * * * *
23 Grey Teal ×	********
2.4 Chestant Teal x	* * * * * * * * * * * * * * * * * *
25 Hardhead	** * * *
26 Maned (Wood) Juck	x x x x X X
27 Black Should Kite x	× × × × × × × × × × ×
28 Brown Goshawk x	* **** *********
29 White Bellied Sea Eagle x	× × ·
30 Little Eczque	×××
(Little Falcon) 31 Australian Hubby X	** **
32 Brown Falcon X	
33 Whistling Kite ×	
34 Wedge Tail Eagle ×	
35 Peregnie Falcon ×	
36 Nankem Kestel X	* * * * * * * * * * * * * * * *
57 Marsh Harrier	×.
38 Banded Rail ×	×
39 Marsh Grake ×	
40 Dusky Moorhers ×	* * * * * * * * * * * * * * * * * * * *
41, Purple Swamphen, X	× .× · · · × × × × × × × × × ×
	•

Perhaps the best example of this approach is that reported by Allan Keast. In 1995 Allan drew upon his experiences with birds from the 1930s onwards, as well as other bird observers, particularly Arnold McGill. His three papers provide information about changes in bird populations and habitats in Sydney over a 50 year period (Keast, 1995a-c).

Avifauna surveys reported by Alan Morris provide information on population status as a series of general rankings. These rankings are defined within his papers. For a waterbird survey of the Parramatta River in 1990 rankings from scarce to very common are adopted, using the percentage of total surveys that each species was observed (Morris *et al*, 1990). In his survey of birds in Botany Bay National Park in 1989 (Morris, 1989), Alan ranks each species from rare (only a few individuals) to abundant (normally present in substantial numbers). Not necessarily too systematic, but sufficient for some comparison in the future.

These surveys are starting to approach the ideal monitoring criteria i.e. there is some form of rigor to survey methodology and effort and they have been undertaken over a sufficient of time to be of use in documenting changes.

SOME EXAMPLES OF MONITORING SURVEYS OF FAUNA WITHIN THE SYDNEY BASIN

At present, there are many surveys being undertaken in the Sydney Basin that can be described as systematic i.e. there are control and treatment sites; consistent and repeatable survey methods and constant survey effort. Some of these surveys have been undertaken over a relatively long period of time and could be classed as monitoring surveys.

Such surveys have been undertaken as privately or publically funded projects. At present, the NSW Government has developed a Monitoring, Evaluation and Reporting Strategy that describes its broad purposes as:

(a) resource condition monitoring (measuring the state of the resource e.g. fauna) without any attempt to explain cause and effect ,and (b) performance monitoring (measuring the resource e.g. fauna) to determine if a particular management action has had the desired effect.

Monitoring by government agencies includes Little Penguin monitoring at Manly, Long-nosed Bandicoot monitoring on North Head and monitoring of shore-bird populations in a fox-baited area.

Recent surveys within the Sydney Basin in a joint project between the Sydney Catchment Authority and the Department of Environment and Climate Change have been undertaken using rigorous methodology, including systematic sitebased methods and stratified sampling. These surveys covered much of the south-western part of Sydney ("Southern Blue Mountains to the Sea", Department of Environment and Conservation, 2005). This study provides information on the distribution, habitat associations and current population and conservation status of fauna within the Sydney Basin. Although such surveys have not been undertaken over a long time-period and cannot be classed as monitoring surveys, they do provide important baseline data that can be used for future monitoring purposes, if similar methodology is adopted.

Some other examples of systematic monitoring surveys within the Sydney Basin follow. These surveys are funded from a variety of sources, both public and private. There are obligations for many developments, particularly major developments such as mining, to undertake on-going monitoring of environmental parameters as part of their Conditions of Consent. The monitoring of populations of the Green and Golden Bell Frog at Sydney Olympic Park is an example of regulatory requirements driving on-going surveys over a period of years. Although the focus of many of these monitoring programmes is mainly on environmental parameters such as chemicals, water flows and noise, biological characteristics (flora and fauna) are often included. As there are legal obligations to satisfy such conditions, monitoring of biodiversity has been undertaken within the Sydney Basin for many years.

1. FLYING-FOX MONITORING

One programme that is known to most Royal Zoological Society members is the ongoing monitoring of flying fox numbers at the colony at Gordon. Concern about the preservation of this colony has been expressed since1985 (see article in Koolewong reproduced here).



Exit counts of the Grey-headed Flying-Fox at Gordon have been undertaken since 1985 (Parry-Jones, 1987) and still continue. Although exit counts can be influenced by several factors e.g. wind, rain, moon cover, number of animals exiting, the method used and survey effort is constant from count to count and can be repeated by any trained observer. The surveys at the camp at Gordon are undertaken by the Ku-ring-gai Bat Conservation Society - a not for profit community organisation (<u>www.sydneybats.org.au</u>), with little outside finance. Results from this monitoring programme have been published widely and are available on their web site.

2. PLATYPUS MONITORING

From 1991 to the present day, Tom Grant from Education and Environment Services Pty. Ltd. has undertaken systematic monitoring surveys for platypus along two river systems in southern Sydney. The surveys are funded by the Sydney Catchment Authority to monitor the effects from water transfers from Shoalhaven River into the Wingecarribee and Upper Nepean Rivers. A small part of the results from this project are shown in the accompanying figure.



<u>Figure 4.1</u> Captures of platypuses in the upper Nepean River system during studies in December 1994, June 1995, April 2002, May 2004, February 2005 and February 2006 (the current study).





3. BOTANY BAY BIRD COUNTS

Waders in Botany Bay have been systematically counted since 1942. Arnold McGill, together with Keith Hindwood, Ernie Hoskin and Allen Keast surveyed the mudflats in Botany Bay between 1941 and 1966. This data has been described by Keast (1995c). From that time onwards wader counts by the NSW Field Ornithologists and the NSW Wader Study Group have been a regular occurrence within the Bay, with additional monitoring of waders being undertaken as a response to the building of the second runway. There have been systematic summer and winter counts in Botany Bay since 1986.

Port Botany Authority are now financing a 10 year study of waders in Botany Bay that will provide weekly counts in summer and fortnightly counts at other times. Wader counts along Parramatta River and at Sydney Olympic Park will be used as controls (Phil Straw, *pers. comm.*).

4. AQUATIC ECOSYSTEM MONITORING

In 2001, the Department of Mineral Resources and the Sydney Catchment Authority approved a combined geology, water quality, hydraulics/hydrology and aquatic ecology Integrated Environmental Monitoring Program (IEMP) of the impacts of longwall mining under creeks. The IEMP was required in part to meet monitoring requirements of extraction approvals.

The full integrated monitoring program included the following components:

- 1. Geology & Geomorphology
- 2. Hydrology
- 3. Terrestrial Ecology
- 4. Aquatic Ecology
- 5. Water Quality

Since 2002, macroinvertebrate sampling of up to 19 sites (depending on seasonal water availability) has been undertaken in Autumn and Spring in selected water courses in the southern parts of the Sydney Basin. Sampling involves the documentation of aquatic macroinvertebrate fauna, fish fauna and water quality.

CONCLUSIONS

Over the years monitoring of fauna within the Sydney Basin has become increasingly rigorous. There has been a move away from just lists of animals sighted (inventories) towards providing greater detail about population sizes and changes in diversities over time. Importantly, survey methodology has assumed greater consistency between surveys and between survey times. Consequently, it is now possible to start tracking fauna populations within the Sydney Basin and to relate any changes to other parameters, whether natural and physical or social.

There are some key times that stand out in the period since European settlement of the Sydney Basin. The description of some of the fauna known

from Sydney in 1860 by Bennett is one such key milestone, as is the Handbook of Sydney and the County of Cumberland published in 1898 with the detailed description of birds by North. Other key milestones are the two editions of "Birds of Sydney" in 1958 and 1991. There are other descriptions that provide population estimates as well as inventories, although some of these may not be as rigorous as desired. However, they still provide an insight into the biodiversity at a certain time in the history of the Sydney Basin.

Overall, it can be seen that some species have declined in population status or even been lost from Sydney whilst others have risen in status. The situation with the Australian White Ibis (*Threskiornis molucca*) illustrates the dynamic nature of Sydney fauna. In 1973, the occurrence of the Australian White Ibis in Sydney was so unusual that it made the cover of Koolewong. However, this bird is now considered a pest throughout Sydney and measures are now in place to lower population numbers.





This paper provides a short overview on fauna monitoring within the Sydney Basin. It is only a brief look, and a full day's conference on biodiversity

monitoring and its standardisation is urgently required to provide a better picture.

However, the information given here not only gives a broad view of knowledge of Sydney's fauna it also shows that comparisons between 'then and now' provide some insight into changes in the composition of animal populations.

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