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Stereotypy and the Reinforcement of Play Behaviour in Asian Small Clawed Otters

(*Aonyx cinerea*)

Rachel Mellowship B.A.

Thesis submitted in partial fulfilment of the requirements for the Honours Degree in Psychology at the University of Adelaide.

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STATEMENT

This thesis contains no material offered for the award of any other Honours Degree, or material previously published, except where due reference is made in the text.

Rachel Mellowship B.A.

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ABSTRACT

This 'etho-experimentation' study was aimed at altering the stereotyped behaviour in two Asian small-clawed otters (*Aonyx cinerea*) at the Adelaide Zoo. This was done by reinforcing play behaviour in the otters using the operant conditioning paradigm. The play behaviour took the form of sliding, a behaviour exhibited by otters in the wild. A secondary function of the study, was to determine whether reinforcing a play behaviour, which is intrinsically motivating, would affect the topography of the sliding behaviour. One of the otters (C) fulfilled the operant in the strict sense of the word only. C displayed an aversive reaction to sliding, producing escape/avoidance behaviour on four of the seven occurrences of sliding. The topography of the sliding that did occur did not fulfil the criterion of sliding-as-play. The otter C exhibited 'communicative intentionality' during the shaping and conditioning procedure. The other otter (D) appeared to learn by observation, shaping to part of the operant criteria. The frequency of the stereotyped behaviour was not affected by the procedure, however the topography of the stereotyped behaviour of C was altered to include single non-repetitive paces. When the behaviour frequencies of the experimental pair of otters were compared to another pair of otters, who did not exhibit stereotyped behaviour, it was found that the otters exhibiting sterotyped behaviour performed roughly the same amount of active behaviours as the control pair but, spent less time sleeping and resting. Play and nesting behaviours were found lacking in the experimental pair.

It was concluded that there was an environmental and a social effect upon the production of stereotyped behaviour. As play behaviour was lacking in the otters exhibiting stereotypy the attempt to potentiate play behaviour was considered an appropriate intervention. It was suggested that future research may look at the variables of: dominance between otters, geographical variables and potentiating play behaviour in the form of sliding, introduced gradually, or the introduction of objects which would encourage manipulative play.

1. Introduction

"Zoo: a place devised for animals to study the habits of human beings."

Oliver Herford

The focus of zoological gardens has changed from the Victorian era where animals were housed in dark barren cages enclosed by heavy steel bars. The modern zoo attempts, within fiscal and spatial restrictions, to provide a light, airy and 'user friendly' zoo where there are minimal barriers between the public and the animals, who are, as far as possible, presented in their natural habitat. The modern zoo is not just a showcase for the weird and exotic. Its role is now geared towards education and conservation, as well as providing a pleasant day out. With tide of public opinion now flowing towards environmental concerns, zoos are now some of the last places where many endangered species can survive and reproduce. Zoos are seen as the 'ark' of modern times where the gene pools of now rare animals are maintained in spite of the destruction of their habitats through indiscriminate land clearing and logging operations.

"There is something in animals beside the power of
motion. They are not machines: they feel"

E.B. De Contillac: *Traité des animaux, I, 1755*

However, despite the best of intentions by zoos there are problems concerned with keeping wild animals in captivity, most of which could be alleviated with space and money. One of these problems is stereotypy. Stereotyped behaviour patterns are aversive to the public and considered to be symptomatic of boredom and unhappiness on the part of the animal caused by captivity. They can take the form of pacing, weaving and self mutilation. Theories of arousal reduction or arousal maintenance (Forehand and Baumeister 1969) indicate that stereotypy serves the purpose of maintaining a homeostasis within the animal or creating a new one. The creation of a new homeostasis is however, is not considered aversive, or necessarily damaging to the animal, but a means by which the animal is better able to cope with its environment. Stereotyped behaviours are of great concern to zoos, they are indicative that some essential environmental or social element is missing creating a bad impression to the public. The Adelaide zoo has had some special problems with stereotypy. The Asian elephant (*Elephus maximus*) 'Samorn' weaves incessantly, causing the public distress. The fennec foxes (*vulpes zerda*) formerly paced the front of their enclosure continuously, but this has since been remedied by a new enclosure.

This study is concerned with the stereotyped bouncing of the Asian small-clawed otters (*Aonyx cinerea*) in the Adelaide zoo. It is a systematic expansion on a previous informal study by William Myers (1978). Myers was curious to know why otters in zoos were so passive. A feature of their passivity was that they did not utilize the slides in their enclosures. The lack of this behaviour in particular was notable, as sliding is an integral part of wild otters' behaviour. Using the operant conditioning paradigm, Myers successfully trained three otters to slide on cue, one of which was an Asian small-clawed otter. This particular otter had little or no sliding experience: her first slide was inadvertent, and backwards. The present study was an attempt to alleviate through behavioural enrichment the stereotypy of the Adelaide zoo's otters, thus broadening the scope of their behaviours. By introducing a slide into the enclosure an attempt was made to potentiate sliding behaviour. If the sliding behaviour did not occur then it would be shaped using operant conditioning. Sliding is a play behaviour and in attempting to potentiate it, the experiment would attempt to generate other play behaviours in a generalization of the response. There is an inherent paradox within this, as play behaviours are by definition self-reinforcing and intrinsically motivating. In the operant procedure the otters would earn reinforcements in the form of fish for sliding. This meant that the reward contingency will be outside the animal and, by definition, no longer play. It is hypothesised that this would affect the topography of the behaviour. Otters in captivity, and under operant conditioning tend to slide with their forelimbs braced before them (Myers 1982, Harris 1968), while otters sliding in the wild, for play, trail their legs alongside their bodies. (Harris 1968, Liers 1954)

1.1. Otters

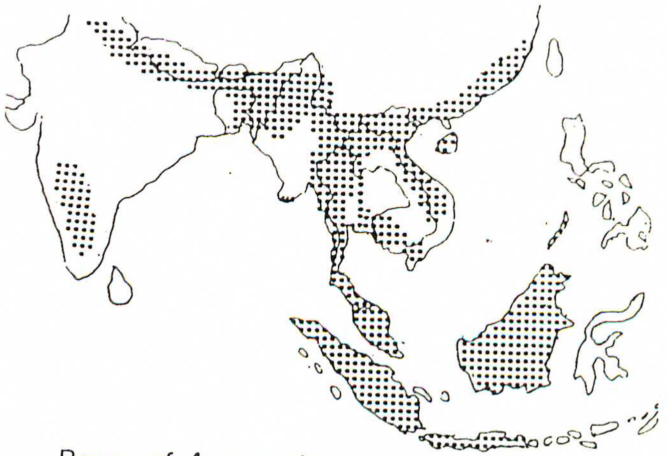
Otters are distributed to all parts of the world with the exception of Australia, New Zealand, Madagascar and the arctic and antarctic regions. They are Carnivores, placed in the Family Mustelidae (Subfamily Lutrinae) along with Badgers, Weasels and Stoats. There are four Genera of otter and thirteen species (Novak & Paradiso 1983) The largest Genera is Lutra, the River otters, which contains four subgenera and eight species. *Lutra lutra* the common or European river otter is the most widely distributed, with a range extending throughout Europe and Asia down through Java, Japan and Formosa. Genus Aonyx is the next largest, containing 3 subgenera and five species (Novak & Paradiso 1983). These are the clawless otters, characterised by their smaller size, the lack of webbing between the toes and vestigial claws which do not extend beyond the end of the toe. The Asian small-clawed otter (*Aonyx cinerea*) is considered the most dextrous of the otters. According to Harris (1968:6) their handedness dominates feeding behaviour. Lekagul and McNeely (1988) note that the claw reduction is accompanied by extreme sensitivity in the fingers and a freedom of movement facilitated by the lack of webbing (1988:559).

Enhydra lutris, the only species within Genus Enhydra, is a seagoing otter which weighs between 15-45kg and is up to 1570 mm long, including the tail. They have retractile claws and possess four incisors in the lower jaw, the only Carnivore to do so. The other Genus containing only one species is *Pteronura braziliensis*. This Giant Brazilian otter is found from Colombia to Northeastern Argentina and can be up to 2400mm long including the tail. It has a home range of up to 12km and its slow movements on land, diurnal habits and tendency to approach intruders have all contributed to its endangered status. (Novak & Paradiso 1983:1015-1022) When placed into an evolutionary context otters are divided into two groups according to their dentition and subsequent feeding habits. *Lutra* and *Pteronura* are considered more primitive forms of otter who catch prey with carnassials developed for shearing. The invertebrate feeders *Aonyx* and *Enhydra* developed from these primitive forms. They capture prey with their more developed forelimbs rather than their jaws. *Aonyx* still retain the shearing carnassials however, while *Enhydra* have developed crushing molars and premolars suited to their diet of mussels. (Riedman & Estes 1988)

1.1.2. Asian small-clawed otter (*Aonyx Cinerea*)

The Asian small-clawed otter was originally classified into Genus *Amblonyx* as either *Amblonyx cinerea*, *Amblonyx* Rafinesque, or *Amblonyx concolour* Rafinesque, prior to its current inclusion into the Genus *Aonyx*. It is the smallest of the otters with a head and body length of 450-610 mm and a tail length of 250-350mm. It weighs between 1-5kg and is a soft brown with paler underparts of a creamy colour which can reach up under the chin and sometimes form patches on the cheeks. The colour can vary according to season. The female has an oestrous cycle of 24 to 30 days but does not appear to breed at any particular season. Females usually produce 2 litters annually, the eyes of the young open at 40 days and they are eating solid food at 80 days. Young otters are usually swimming at 9 weeks. The male otter actively participates in rearing the young by cleaning the holt and bringing food. *A. cinerea* inhabits creeks, rivers, estuaries and coastal waters. Their diet is based upon shellfish and molluscs which they dig out of mud banks and river beds, fish not being a major part of their diet. They live in loose family groups of between 4 and 12 and exhibit about 12 vocalizations, not including basic cries (Timmis 1971). The Asian small-clawed otter is on Appendix II of the Convention on International Trade in Endangered Species of Wild Flora & Fauna (C.I.T.E.S.). This means that although they are not directly threatened with extinction, they do need to be protected. (Novak & Paradiso 1983)

Figure 1: Distribution of *Aonyx Cinerea* (Lekagul & McNeely 1988)



Range of *Aonyx cinerea*

The Asian small-clawed otter is readily trained by Malay fishermen to catch fish. When they catch shellfish for themselves they will lay the shellfish out in the sun to open, thus saving themselves time and energy from breaking the shells. (Lekagul & McNeely 1988:561) *A. capensis* and *Enhydra* both exhibit tool using behaiour. *A. capensis*, the African small-clawed otter, will use a hard object as a hammer to open shells. *Enhydra lutris*, the sea otter, floats on its back balancing a rock to be used as an anvil on their chests and banging open mussels on them (Riedman & Estes 1988).

Otters have no natural enemies (Harris 1968:6). The river otter is hunted for its pelt and also to 'protect' fisheries. However it has been found that where otters have been completely removed from fisheries, fish stocks decline dramatically. This is because otters mainly catch old and diseased fish. When this no longer happens, disease spreads rapidly, depleting stocks. The fur of Aonyx is not considered as good as that of Lutra, however they are classified as endangered as are all otters, and in Nigeria and Cameroon are hunted commercially and indiscriminately. The fur of Enhyra lutris, the sea otter, is considered the most valuable of all mammals, peaking in price in the late 19th Century at U.S.$1,125.00 a pelt. This animal was all but extinct in some parts until protected by international treaty.

The other great danger for the sea otter is oil and waste. This is because it does not rely on subcutaneous fat for protection against the cold, but water resistant guard hairs keeping its long undercoat clean and dry forming an insulating layer of air. (Novak & Paradiso 1983: 1014-1022)

1.1.3. Activity Cycle

The activity cycle of the Asian small-otter is not well known. Little observation has been done on *A. cinerea*, but the Canadian river otter (*Lutra canadensis*), the common otter (*Lutra lutra*) and the sea otter (*Enhydra lutris*) are all well documented in the wild and as tame otters. There are some reports of the Asian small-clawed otters in zoos, although they are helpful regarding husbandry and general maintenance in captivity, they are generally not behavioural accounts. Therefore I am forced to extrapolate from accounts of other otters, notably the common otter and the Canadian river otter. For example Gavin Maxwell popularized the behaviours and character of a number of different otters, ie; the Cape clawless otter (*A. Capensis*) and the Indian smooth coated otter (*L. persipicallata*), in his semi-autobiographical book The Ring of Bright Water. This account of tame otters is of great value in looking at some of the characteristics of the otter.

In the wild the common otter is considered to be nocturnal, travelling by night up and down streams hunting, and resting in riverside holts by day. (Stephens 1954:16 Harris 1968:6) According to Harris (1968:6) a healthy otter is always active during its waking hours and spends roughly equal time asleep and awake. Hodl-Rohn (1972) notes that for an otter in captivity, activity is synonymous with play. Gavin Maxwell also found difficulty providing an environment rich enough to occupy his otters. The *L. canadensis* of Emil Liers in captivity sleeps about 12 hours in 24, including 2 hours at about midday.

1.1.4. Swimming

Young otters are taught to swim by their mothers. They do not do so until their first waterproof coat is grown at two or three months (Harris 1968:96). Harris (1968:106-107) notes several cases of otters who have been captured before learning to swim and so being unable to do so. In these cases the owners have had to resort to such devices as pushing the unsuspecting otter into the water with a broom or inadvertently scaring them into the water. Thenceforth these otters will happily swim although according to Harris (1968:108) they prefer to play in water their own depth rather than swim. It appears that otters spend a considerable amount of time on land and most sources recommend that enclosures for otters, apart from sea otters, are proportionally 60:40 land to water. According to Harris (1968:107) the frequency of swimming is indicative of happiness in the captive otter.

1.2. Play Behaviour

Although play behaviour as such is difficult to define there is usually consensus between onlookers when it is occurring. (Miller 1973) Play behaviour can be placed in two categories viz object play and exploratory play, although these categories overlap in their response topographies, especially in carnivores and primates who are both exploratory and playful. (Aldis 1975:70) Miller (1973) notes that much play behaviour seems overtly aggressive, eg: play fights, but it is overlaid with meta-signals which indicate that no hostility is intended. When defining play behaviour Miller identifies several aspects of primate play. Play behaviour motor patterns resemble those of other specifiable contexts but are performed in novel sequences, are repetitive and uneconomic. These motor patterns are independent of the normal eliciting situations and occur only when survival contingencies do not need to be met. He sees play behaviour as having a 'galumphing' quality of action which is ineffective and indirect. The meta-message of play is often conveyed by the animals bouncy 'galumphing' gait. Play is seen as 'funktionlust' by Miller (1973) which is the pleasure of doing for its own sake, not for attaining effect. But play has important survival value in learning skills through exploration and early stimulation which extends the behaviour repertoire in a safe way. In this way reactions required for flight and fight are learned. (Aldis 1975:1-4) Play also has the function of learning about the environment through exploration and manipulation. (Aldis 1975:67) The intelligence of the otter is expressed in its curiosity and its need for constant stimulation. Unlike other animals for whom play is usually defined as mainly the behaviour of the young, otters remain playful throughout their lives. As one Keeper at the Adelaide zoo remarked "its like looking after 15 children". Fagen (1981) gives a functional definition of play:

> *to develop, practice or maintain physical or cognitive abilities and social relationships, including both tactics and strategies, by varying, repeating, and/or recombining already functional subsequences of behavior outside their primary context.*

1.2.1. Vestibular Reinforcement

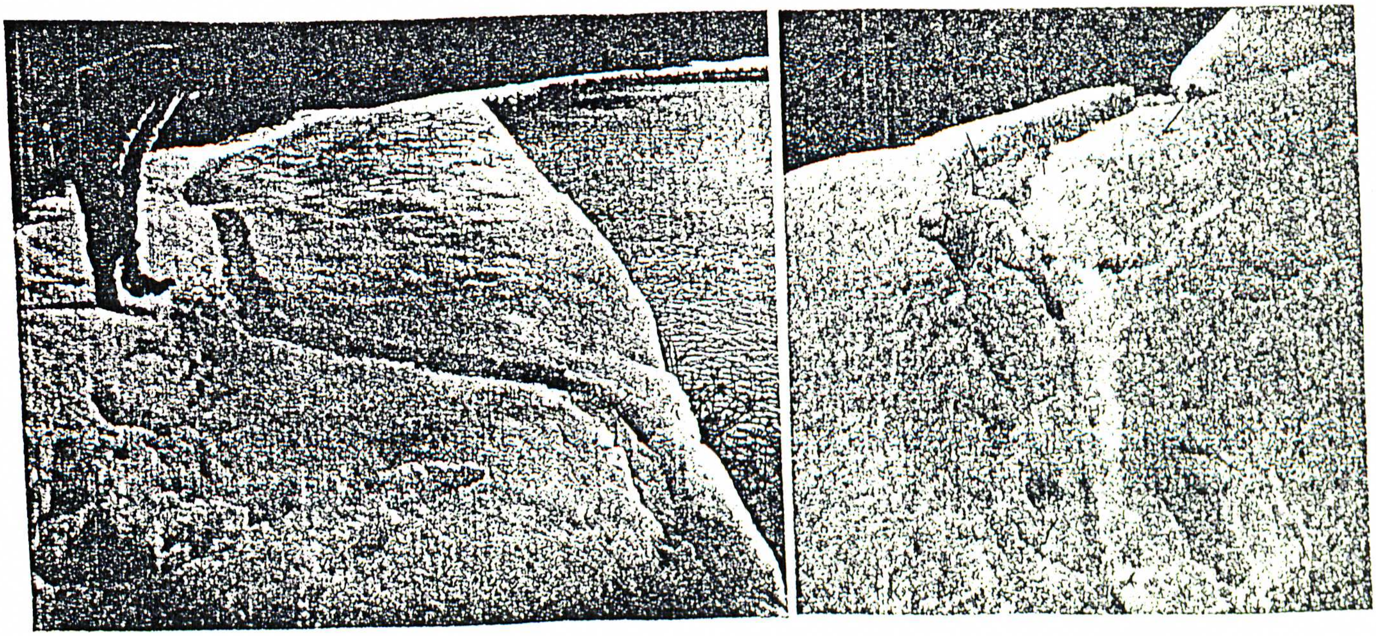
According to Aldis the common element in play is the rapid movement or turning through space. This results in vestibular reinforcement through stimulating the balancing mechanism in the labyrinth of the the inner ear. He defines two categories of attaining this stimulation, firstly by active responses, such as rolling on the ground, and secondly by passive stimulation, where the animal is being propelled by some outside force. He states that "animals mainly stimulate their vestibular senses themselves". The degree of stimulation that is reinforcing to the animal is dependent upon past experience. (Aldis 1975:52) So for in the case of otters the 'thrill' of the slide wears off and so faster and steeper slides must then be taken to gain stimulation. The ability to control the slide also increases the reinforcement

1.2.2. Sliding

Mustelids generally are noted for their play behaviour. The European badger (*Meles meles*) have been seen to somersault and play leapfrog in the evenings as a part of their complex social life. Tame badgers are known to incite humans to play by performing somersaults and bringing in objects for tug-o-war fights. (Fagen 1981:152) However the most famous of the playful mustelids is the otter. Otters play fight and play with novel objects in the water and on land. Harris (1968:98-9) reports many anecdotes of sliding-as-play in the North American otter where whole families of otters repeatedly slide down banks of snow or mud. Sliding behaviour in otters is generally regarded as a play behaviour as well as a form of locomotion over ice, snow and mud. It may also serve as a possible scent marking function. (Fagen 1981:153) When travelling down snowy hillsides or muddy banks the otter alternates between running and sliding. The spoor left by the otters whilst doing this is easily identified, during the running phase there are paw prints in the snow interspersed with the sliding marks (fig. 2) (Ivester-Lloyd 1953, Murie 1954:72) There is some discrepancy about the means of sliding as locomotion. According to Murie (1954) the otter pushes off strongly with all four feet to propel itself a considerable distance. Ivester-Lloyd (1953) notes that the otter continues to propel itself with its back legs whilst sliding and produces photographs in evidence of this. (fig. 3) According to Harris (1968:3) and Duplaix-Hall (1973) the slide is initiated by a push with the back legs and propulsion is supplemented by lateral flexing of the body. All agree that in the natural situation the sliding otter's forelegs are tucked under the body and are only put forward as a braking device in the young and inexperienced otter. These slides can be as long as 25 feet and are usually between 8 and 12 inches wide (Harris 1968:98-9, Harrison 1989:229). Although the angle of natural slides is not reported, slides in zoos of 45 degrees are rarely utilized. From this it is inferred by Harris (1968) Best (1962) and Aldis (1975) that 45 degrees is too steep and that 37 degrees is the maximum inclination which is acceptable. It is difficult to determine the angles of natural slides in photographs of slides by Ivester-Lloyd (1954) and Harrison (1989) (figs. 2 & 3) but Harrison's picture seems to show a slide of about 30 degrees although this is not an accurate indication. During the summer the North American River otter will carefully clear away debris from a section of bank with clay soil to create a slide into water. Repeated use by the wet otter renders it increasingly slippery. From this we can infer that sliding in otters is excitatory and so self-reinforcing. However there may also be a natural reinforcement contingency as small prey may be startled from their hiding places when the otter lands in the water.

fig. 2

fig. 3



1.2.3. Playing Otters at the Adelaide Zoo.

The Adelaide zoo otters (*Aonyx cinerea*) incite each other to play in much the same way as a puppy incites another puppy, or its human. They orient towards the other otter with a lowered posture, chin near the ground and with their hind end raised. They then look at the other otter, often with a small vocalization before bounding away. This process is repeated until the otters are engaged, with a mouth to neck, head or any other available body part, in a wrestling match. Alternatively the otter may launch itself onto the other otter, generally attaching itself, mouth to scruff. The family of five otters in Marine and Aquatic Carnivores Exhibit 7 (M.A.C. 007) generally play in the mid morning, either playing 'follow the leader' in the pond or wrestling. They utilize submerged logs in the pond during play fights, either as protection, to hide behind, or as platforms to launch themselves onto their opponent. Otters are highly inquisitive creatures for whom novel objects are great play things. Coins, sunglasses and pens often land in the enclosure and are immediately incorporated into their activity.

1.3. Maintaining the Otter in Captivity.

There have been many non scientific texts written about keeping otters such as Gavin Maxwell's Ring of Bright Water. Nicole Duplaix-Hall (1973) writes specifically about the problems of maintaining otters in zoos. She states that otters need a rich environment containing such things as hollow logs, tree stumps, bushes, saplings and most importantly areas of sand, gravel and grass for grooming. If such materials are not supplied then the otters' underfur will become wet and cling to the body. If this happens then the otter may have difficulty in staying afloat in the water, and so will be forced to dog paddle in an uncharacteristic manner. The otters' coat is an indicator of its health. If it does not immediately form spikes and fluffs up when the animal leaves the water, then the otter is probably unwell or water logged. This can result in deaths from pneumonia. Duplaix-Hall also stresses the need to feed otters 3 or 4 times a day. (Duplaix-Hall 1973) The metabolism of the otters is very high and food is digested and excreted within one hour of ingestion (Liers 1951). This results in otters that are hungry again quite soon after being fed. If captive otters are fed only once a day they will then spend the rest of the day pacing up and down calling for food (Duplaix-Hall 1973).

Otters are curious animals and enjoy observing the goings on around them. Duplaix-Hall (1973) recommends that enclosures are raised to enable the otters to see out, a behaviour that may, incorrectly be interpreting as begging. Otherwise they spend most of the day on their hind legs attempting to see out. This is often interpreted by members of the public as begging who then throw unsuitable food and dangerous objects into the enclosure. She also stresses the need for more natural slides in zoos. Currently most slides available to otters in zoos are made of artificial materials such as cement, metal or vinyl and canted at steep angles. This forces the otters, if they do use the slides, to slide in an unnatural manner with their forepaws braced. To elicit natural sliding in unnatural conditions the slide needs to be made of a natural material such as mud or turf, be 35 degrees or less, be slightly concave and continue underwater for a foot or more. (Duplaix-Hall 1973)

1.4. Stereotypy

Baumeister (1973) defines abnormal stereotypy as:

> *repetitious topographically invariant motor behaviours or action sequences in which reinforcement is not specified or is non contingent, and the performance of which is regarded as pathological.*

he later amends this definition to include such words as 'excessive', 'atypical' and 'maladaptive'.

Stereotyped behaviour is however, not necessarily abnormal. Fixed action patterns of birds, snakes and spiders, for example, are rigid behaviour patterns which, once elicited by environmental stimuli, are invariant in their production. However they are highly specialised adaptations which are both efficient and functional. The strike of a snake is an effective killing mechanism that is purely reflexive and fixed in nature. Similarly the nesting behaviour of birds or the grooming behaviour of mice is a stereotyped behaviour.

Stereotypies occur in humans who are normal as well as the abnormal. Behaviours such as grooming and pacing will occur in people under stress, for example, the expectant father in the waiting room of a hospital maternity ward. There is a reported incidence of rocking in normal infants confined to cribs of between 7% and 14% (Repp et al 1988). Stereotypy caused by the inability to perform usual behaviour patterns is per se 'abnormal'. However in retardates this rate goes up to about 66%. (Berkson & Davenport 1962, Kaufmann & Levitt 1965). Berkson and Mason reported that there is a 13% incidence of rocking in all institutionalized people which indicates the amount of stress generated by such barren environments and where the locus of control is very much outside the individual.

Abnormal stereotypy in humans can occur as either body rocking, head banging and complex hand and finger movements. In animals stereotypies are often species, or locomotion specific. Stereotypies occur in both captive wild animals maintained in zoos and in domestic animals kept in high density housing. For example canoids such as foxes and dingoes pace. This pacing can either be linear, circular or figure of eight. Meyer-Holzaphel (1968) demonstrates how a linear range in pacing can develop into a figure of eight as the animal relaxes its pacing due to decreased tension.

The armadillo is also reported to to pace in a figure of eight by Meyer-Holzaphel (1968). The armadillo (*Dasypus noreminctus*) at the Melbourne zoo was observed by the experimenter performing a stereotyped figure of eight. Larger animals such as elephants and horses tend to weave or sway. Horses who are stabled when young may start to weave, sway or crib-bite. Crib-biting is where the animal bites down onto a post or the stable door and swallows air into the stomach by forcing open the soft palate. This behaviour is considered to make the animal feel replete. (West 1982:199) Weaving is characterised by the animal swinging "the head and neck and the anterior parts of the horse to and fro, so that the weight rests alternately on each forelimb" (West 1982:883) Both of these behaviours can be considered learned. Pigs, cattle and battery hens also demonstrate stereotypies.

1.4.1. Causal Hypotheses for Stereotypy

Stereotypy is seen primarily as a regulator of motivational state (Broom 1988, Repp 1988, Wong 1987). Repp (1988) stresses that different stereotypies have different causes so that no one treatment can be universally effective. There is a wide literature on stereotypy which posits a plethora of causes, ranging from biochemical imbalances to S-R contingencies. The main hypotheses accounting for stereotypy are:

i) Arousal or tension reduction through self stimulation.
ii) avoidance responses
iii) compressed activity cycle
iv) superstition/positive reinforcement

All of these theories recognise that abnormal stereotypy occurs only in monotonous, barren and confined environments. However the underlying theoretical causes of the stereotypy are different, ie: whether the organism is trying to reduce tension created by the environment or, whether it is trying to alleviate the boredom by creating its own stimulation. Studies using human and primate subjects tend to see the organism as self-stimulating in a positive way, that is, it is trying to raise its level of stimulation. They see the environment as monotonous more that stressful. Berkson and Mason (1964b) found that enriching the environment of chimpanzees by giving them a stuffed toy reduced stereotypy. However Menzel et al (1963) found that monkeys reared in isolated conditions reacted with fear to novel objects, and that there was a curvilinear relationship between prior experience, fear and stereotypy. This fits in with Baumeister and Forehands (1973) hypothesis that deprived rearing interferes with neuronal development and so the number of behaviours in an animals repertoire, and the extent of their curiosity.

Non-primate animal studies on the other hand, see caged environments as extremely stressful for the animal. This is particularly so for captive wild animals in zoos. Stereotypy is a behavioural response by these animals used to lower aversive stimuli by regulating the motivational state. Stereotypy regulates the mean sensory input to the animal, effectively blocking out stresses. Zoo visitors were identified by Meyer-Holzaphel as causing stereotypy in a caged dingo (*Canis familiaris dingo*), but contrary to this Clode (1989), found that the number of visitors was not correlated with the frequency of pacing in the fennec fox (*Vulpes zerda*). This brings us to Repp's (1988) hypothesis that different stereotypies have different causes and so the behaviour should be functionally analysed before treatment is attempted. For example it was found by Mulhern and Baumeister (1969) that retarded children could be trained to stop rocking using operant procedures, but children whose stereotypy is in the form of complex hand and finger movements were not helped. Clode (1989) attempted to use operant procedures to alleviate pacing in the fennec fox but with inconclusive results.

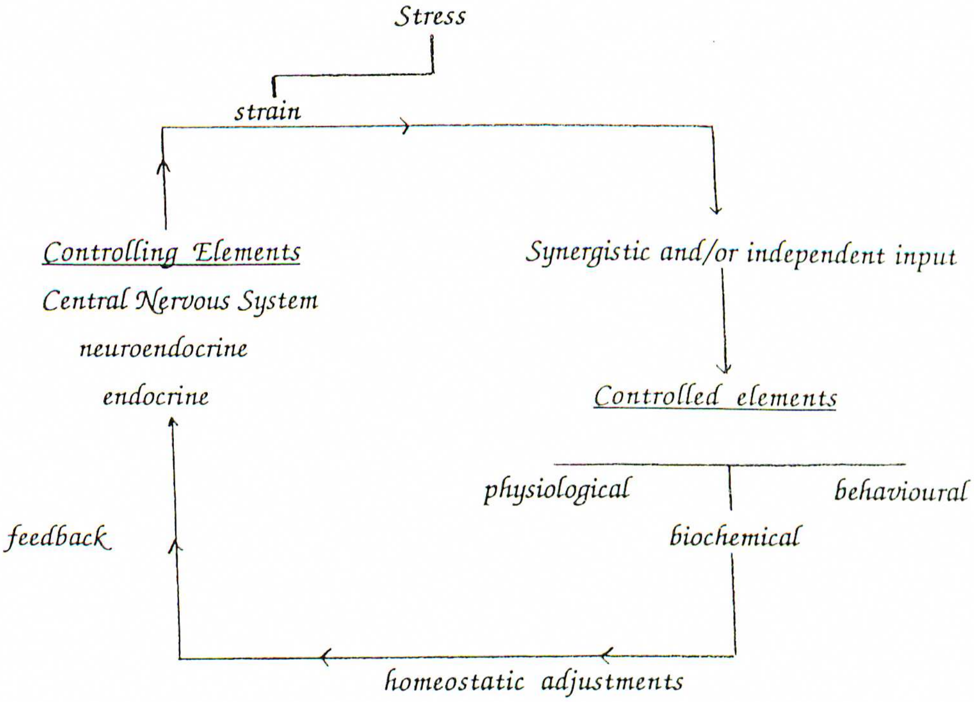
1.4.2. Behavioural Enrichment

In animal studies attempting to alleviate stereotypy, the emphasis is upon creating natural conditions within the space available. This has worked in two studies. Clode (1990), found that when fennec foxes with a history of chronic pacing were moved to a larger outdoors enclosure, which emulated their natural Saharan environment, pacing ceased. Prior to this, the fennecs had been housed in a small glass fronted enclosure in the nocturnal house of the Adelaide zoo, and an enclosure similar in size to their new enclosure, which was not a simulation of their natural environment. From this it appears that the combination of the larger enclosure and the natural environs alleviated the pacing. This concurs with Hediger's hypothesis (1950) that maintenance of species specific flight distances by providing an enclosure that is at least twice the size of the organism's flight distance and simulation of the correct environment are necessary for maintaining homeostasis. Clarke et al (1982) found that translocating chimpanzees from a sterile caged environment to a naturalistic island environment resulted in a dramatic reduction in stereotyped and self directed behaviour. The chimpanzees were more manipulative and active in the enriched setting. So naturalistic environments are clearly conducive to normal behaviour patterns.

Other more interventionist forms of behavioural enrichment use operant conditioning procedures, such as the work done by Clode (1989) and Myers (1978). Myers has run behavioural enrichment programs with a rich diversity of animals kept in zoos and aquariums. He reduced the stereotyped pacing in a pair of jaguars (*Panthera onca*) by training them to rear and strike a paddle which triggered a feeding mechanism which delivered a small piece of horsemeat. Not only did this reduce the pacing but also made the exhibit more attractive to the visiting public (Myers 1978:136-139). Foster-Turley and Markowitz (1982) trained captive otters to hunt for crickets at the sound of a tone. This produced more diverse behaviours from the otters and a more entertaining exhibit for the public. Shepherdson et al (1989) identified a need for natural goal directed behaviour in the slender tailed meerkat (*Suricata suricatta*) to broaden its behaviour repertoire, as did Clode (1989) with the fennecs. Sheperdson et al (1989) created a mealworm dispenser out of a plastic tube by drilling holes in it and filling it with sawdust and mealworms. In the process of moving around the mealworms dispensed themselves by falling out of the holes. This caused the animals to spend significantly more time foraging and so visible to the public. There was a subsequent reduction in the frequency of stereotypy, sleeping and social interaction.

1.4.3. Homeostasis

According to Yousef (1988), survival in animals is contingent upon their ability to maintain homeostasis. Stresses and strains upon the animal will produce physiological and biochemical reactions in an attempt to regulate the homeostatic level. The result of this is relief of stress by avoidance (behaviour response) or by altering physiological and/or biochemical responses to create a new level of homeostasis.



Biofeedback model (Yousef 1988)

It is suggested that neurotransmitters are affected by both environmental and genetic influences which may disrupt discrimination and manipulative abilities (Fox 1968). Environmental deprivation, leading to disuse of the nigrostriatal system, results in supersensitivity to dopamine. Second order neurotransmitters, the monoamines, are made up of catecholamines and endolealkylamines and regulate affective states. Catecholamines, such as dopamine and norephinephrine, have either excitatory or inhibitory functions according to the receptor tissues targeted. These systems are associated with motor function disorders such as Parkinson's and Huntington's chorea. Altered functions in these transmitter systems, such as an excess of dopamine, or dopamine supersensitivity are associated with psychoses, such as schizophrenia etc.. Dopamine is directly related to activity levels, as is norephinephrine and epinephrine. (Atrens 1984, Prosser 1973:493-495) According to Fraser (1985), "sensory stimulation plays an active role in the final differentiation of neurons and is necessary for the normal development of neuronal organization". This ties in with the reports of McGuire and Fairbanks (1977) who state that monkeys reared in isolation, with peers only or in sterile environments, will develop abnormal behaviours such as stereotypies. Therefore, animals reared, and/or maintained in barren environments, will have affected neural transmission which will be expressed in self stimulatory behaviours.

1.4.4. Superstitious Behaviour

Skinner (1948) posited that stereotyped behaviours developed in an organism in anticipation of food. He labelled these responses 'superstitious' as they emerged through accidental juxtapositions of reward and response. Timberlake and Lucas (1985) found that response contingencies and prior experience modified wall directed 'superstitious' behaviour in pigeons. They also hypothesised that learned behaviour is based upon species specific modules of appetitive response tendencies and stimulus sensitivities organised within a larger functional system relating to survival. This concurs with Clode's hypothesis (1989), that pacing in fennec foxes was part of their appetitive behaviour cycle (linear range patrolling) which was frustrated by their cage size. However she did not see the behaviour as response contingent. Timberlake and Lucas (1985) concluded that "superstitious behaviour under periodic delivery of food probably develops from components of species typical patterns of appetitive behaviour related to feeding".

1.5. Aims of the present study

The aim of the present study is to try to alleviate the stereotyped bouncing in a pair of otters using both environmental enrichment and behavioural enrichment. Theoretically, an operant which broadens an animal's behaviour repertoire by providing stimulation, will in turn reduce the level of stereotypy.

A slide was installed in the otters' enclosure to determine its effect on behaviour patterns and whether sliding would occur naturally. If sliding behaviour was produced, its topography would be examined in relation to the topography of the behaviour in nature. Natural sliding behaviour is topographically defined by Liers (1951), and others (Ivester-Lloyd 1954, Harris 1968, Murie 1954, Stephens 1954) by the placing of the forelegs alongside the body whilst sliding on the ventral surface of the body down a sloping surface, usually a riverbank or a hillside. The sliding behaviour produced by the otters would then be reinforced using operant conditioning procedures and any topographical changes recorded. If the sliding behaviour was not produced naturally then the otters would be shaped, using operant conditioning, and put on a schedule of reinforcement, and the topographical features of the behaviour noted. The aim of the reinforcement procedure was this: Firstly it is an attempt to potentiate, in captive otters, a play behaviour (sliding) that occurs in wild otters. Also potentiating natural play behaviour of the animal. Secondly it was to see whether, what is essentially a play behaviour, would change its topograpy when it became contingent upon reinforcement. Finally whether potentiating one play behaviour, would generate other play behaviours, generalizing from the first play behaviour.

1.6. Brief Summary of Proposed Study

1. To compare and measure the behaviour of a pair of otters exhibiting stereotypy (Otters C & D) with that of a pair of normal otters (F &S).
2. To introduce a slide to the enclosure to see whether the otters will spontaneously slide.

2.1. To reinforce the sliding behaviour of the otters, if it occurs naturally, to determine the effect of reinforcement upon the topography of the behaviour.

3. If sliding does not occur naturally, to shape the otters to slide using operant procedures.

3.1. To place the sliding behaviour on schedule of reinforcement, either C.R.F., or intermittent.

4. To place the otters in an S Δ condition by removing the reinforcement contingency and observing the effect of this upon the topography of the sliding behaviour.

5. To remove the apparatus and compare and measure the level of sterotypy with the Baseline one data for the experimental pair of otters, and both Baseline one and two of the normal pair of otters.

2. METHODOLOGY

2.1. Marine & Aquatic Carnivore Exhibits at the Adelaide Zoo

The Marine & Aquatic Carnivore Exhibits (M.A.C.) currently house 14 otters in 5 enclosures. The largest of these, M.A.C.007, is approximately 75m^2, and the smallest, M.A.C.001, is 16m^2. (fig. 4) The walls are 1.25 metres high and made of local rock, faced with epoxy smooth cement. (Lancaster 1975). M.A.C.001, which contains the experimental pair, is slightly lower than ground level, with a moat .3m deep between the land area within the enclosure, and the perimeter wall. The terrain consists of rock set into cement, with scattered loose rocks, a tree branch, log and a stream running from a small pond at the head of the enclosure into the moat. Two hollow logs mark the entrances to the holts or dens, one on each side. A low post and rail "Permapine" fence keeps visitors from leaning over the wall. An observation platform enables better public viewing into both M.A.C.001 and M.A.C.002.

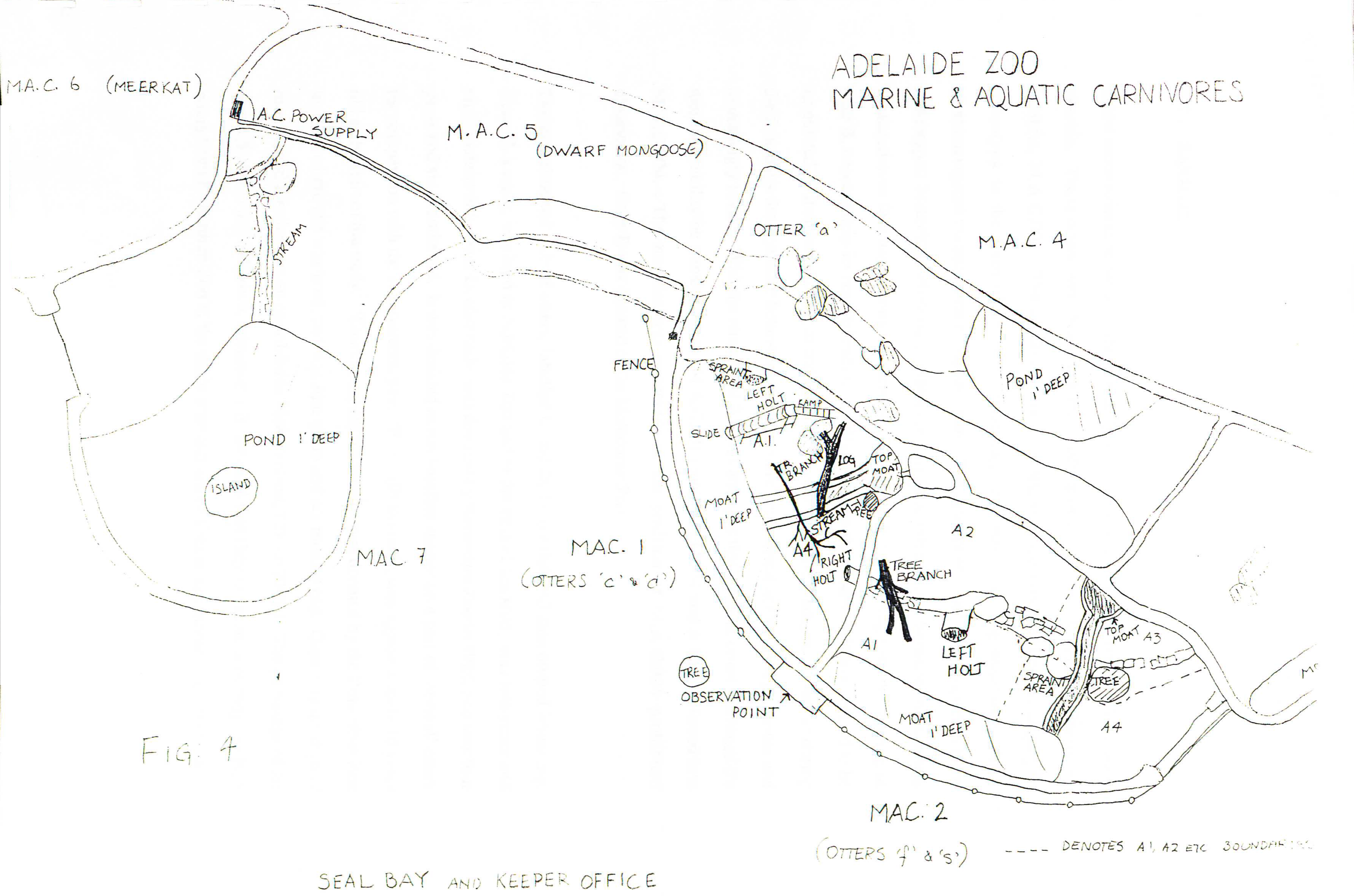

ADELAIDE ZOO
MARINE & AQUATIC CARNIVORES
M.A.C. 6 (MEERKAT)
A.C. POWER SUPPLY
M.A.C. 5 (DWARF MONGOOSE)
STREAM
POND 1' DEEP
ISLAND
MAC. 7
MAC. 1 (OTTERS 'c' & 'd')
FENCE
TREE
OBSERVATION POINT
OTTER 'a'
M.A.C. 4
POND 1' DEEP
SPRAINT AREA
LEFT HOLT
RAMP
SLIDE
A.1.
TR. BRANCH
LOG
TOP MOAT
MOAT 1' DEEP
STREAM
TREE
A4
RIGHT HOLT
A2
TREE BRANCH
A1
LEFT HOLT
SPRAINT AREA
TOP MOAT
A3
TREE
A4
MOAT 1' DEEP
MAC. 2 (OTTERS 'f' & 's')
---- DENOTES A1, A2 ETC BOUNDAR
SEAL BAY AND KEEPER OFFICE

FIG: 4

2.2. Subjects

Initial reconnaissance work in the Adelaide Zoo identified two male otters which were suitable. These otters were housed in the smallest of the Marine & Aquatic Carnivore exhibits, M.A.C.001. The smaller of these otters, subsequently labelled A, displayed stereotypy in the form of bouts of 'bouncing', and also a pacing behaviour which circumnavigated the perimeter of the enclosure. The other otter, labelled B, displayed some stereotyped bouncing behaviour. However agonistic interactions between these otters escalated over four days during the reconnaissance period, culminating with the injuring of otter B, necessitating its hospitalization. Conflict between these otters initially seemed to be stimulated by incipient feeding as indicated by the approach of the keeper. However during the four days the agonistic behaviour became more generalized across daylight hours and increasingly severe. With the removal of B it was arranged that a pair of otters renowned for their amicability be transferred into M.A.C.001 from M.A.C.004 and A be transferred into M.A.C.004. The transfer was necessary as the position of M.A.C.004 prohibited observation. Otter B was donated to the Melbourne Zoo.

The experimental pair of otters, labelled C and D, both exhibited stereotyped bouncing. Otter C, a male, was bred at Adelaide Zoo and at the start of the study was two years and eight months old. Otter D, also male, was donated by Rotterdam Zoo in 1986, and was four years and six months old. It was decided to run baseline studies on a pair of 'normal' otters for comparison with the experimental pair. 'Fatty' (F) the male, was approximately 10 years old at the start of the study. 'Slutterdam' (S) the female, was donated by the Rotterdam Zoo in 1986 where she was bred, and was four years and six months old. Otter S is the dam of otter C, and the sire was an otter bred in New Zealand, I.D. no 77030. The parentage of the otters S and D are unknown, however it is assumed that they are related as they are both come from Rotterdam Zoo at the same time and are of similar appearance. Otters S and F were not a 'control' pair in the strict sense of the word, but were as close a match as could be found in the circumstances. Therefore I shall refer to them as a 'control' pair. There were significant variable differences between the two pairs of otters and their environments. Otters F and S were housed in M.A.C.002, an enclosure nearly double the size of M.A.C.001. They were also a male/female pair of otters, C and D were both male. M.A.C.002 has comparatively large areas of dirt and vegetation in comparison to M.A.C.001, which has no areas of dirt and only a few tufts of grass. Environmental and social factors such as these were considered crucial to the lack of stereotypy in the 'control' pair.

2.3. Data Collection Technique

Data collection involved evaluating the behaviour patterns of the otters over a 24 hour time frame and over several experimental and baseline conditions. It was considered appropriate to use a sampling technique for collecting the data. The instantaneous scan sampling technique used to sample the behaviours, ensured, as far as possible, a random sample of the behaviours emitted over time, and thus charting the progression of behaviour according to the diurnal cycle. This involved scanning the enclosure once every five minutes, immediately noting the behaviour emitted by each otter and at which location on the checksheet. (see appendix A) In this way 12 observations were tallied each hour, for each otter. The same checklist was used for both otters each hour using colour coding for each otter.

2.3.1. Behaviour Checklist

The behaviour checklist was in the form of a grid. The behaviour categories were listed on the Y axis and the location categories on the X axis. There were 27 behaviours on the checklist and 14 locations. The behaviour checklist was designed for otters A and B, so subsequent to the change of subjects, two of the behaviours on the checklist became redundant (stereotyped paddle & stereotyped circle). It was too difficult to keep track of the otters' vocalizations due to their incessant nature, so these behaviours, although very important, had to be omitted. However an estimate was taken of the rate of vocalizations at certain times of the day eg: immediately before feeding. Empty cells were left for uncategorized behaviours. The space at the bottom of the sheet was allocated for comments such as, noting the feeding times and any unusual or notable behaviours which occurred outside of the scheduled behaviour scans. Checksheet categories A1, A2, A3 and A4 are rough quadrant divisions of M.A.C.002. As M.A.C.001 was a smaller enclosure it was only sectioned in two, A1 and A4. Sections A.2 and A.3 were changed to 'Tree Branch' and 'Log' when used with the experimental pair C and D.

2.3.2. Behaviour Classifications

Running	A 3 time gait where sequence of leg movement is : 1: off hind. 2: near hind and off fore together. 3: near fore. The order may be reversed.
Walk	A sequential four time gait. 1: off hind. 2: near hind. 3: off fore. 4: near fore.
Dog Paddle	Swimming on the surface of the water with head raised out of the water. Otter 'paddles' with front feet and may 'scull' with tail.
Diving	Swimming completely submerged, propelled by undulations of the body and tail.
Play with other	See definition of play (page 8)
Play with object	See definition of play (page 8)

These two categories were joined together in analysis

Exploring	Combination of walking and sniffing behaviour. Animal appears to be questing for unknown object (food?), may manipulate environs with paws.

Observing Visitors	Otter raised in vertical bipedal position supported by hindlegs only. Otter oriented towards Visitors.
Observing Observer	Otter making direct eye contact with experimenter. Can be in either bipedal or quadripedal position.
Observing Keeper	Bipedal position as in 'Observing Visitor', otter oriented towards keeper.

The three 'Observing' categories were subject to fundamental attribution bias according to the inter-observer reliability tests and so were lumped into one 'observing' category in the final analysis.

Stereotyped Bounce	Repetitive raising and lowering of the otter into and out of the bipedal position. This behaviour may vary in magnitude from low to high. Where there is low stereotyped bouncing the forepaws are barely raised from the ground. Moderate stereotyped bouncing involves raising and lowering repetitively into and out of the bipedal position. High stereotyped bouncing involves the hindlegs leaving the ground.
Stereotyped Pace	A single non-repetitive pace along the edge of the moat between bouts of stereotyped bouncing.
Sliding	Descending the slide.
Eating	Manipulative action where objects (food or objects) are placed in the mouth with the forepaws and chewed.
Drinking	Ingesting water.
Spraint	Simultaneous elimination of both faeces and urine. Otter arches both head and tail upwards and exhibits paddling movement with hind feet during elimination.
Groom Rub	Rubbing side or back on object (tree branch, log) for the purpose of cleaning fur.
Groom Roll	Otter supported on dorsal surface, rolling from side to side.

Allogrooming	Mutual nibbling of fur between two otters.
Groom Self	Nibbling or scratching own fur.

Grooming behaviours were lumped into one category for final analysis as they all served essentially the same function.

Mark	Rubbing face, ventral or anal scent glands on surfaces.
Resting	Non ambulatory behaviour with weight not wholly supported by legs, but resting on some body surface such as dorsal or ventral.
Sleep	Usually not directly observed. Inference of sleep was made if otter did not emerge from holt after 20 minutes.
Mating	Act of one otter mounting another. Also includes eliciting behaviour characterised by naso-anal contact and soft vocalizations.

2.3.3. Observer Position

During the observation periods the observer was seated on the viewing platform. (fig. 4) This platform overlooked both M.A.C.001 and M.A.C.002, so the observer simply had to change orientation according to which enclosure she was observing (fig 4). During the night observations were taken from a Zoo vehicle parked alongside the appropriate enclosure. During the evening sessions M.A.C.001 and M.A.C.002 were partially lit by the floodlights in M.A.C.005 so the infra-red equipment was not used.

2.3.4. Apparatus

A slide and feeder were constructed by Mr. Steve Tupper in the University of Adelaide Psychology Department workshop. (See figures 5 & 6) Mr. Geoff Matthews constructed the electricals. The body of the slide was constructed from .6 mm galvanized iron tubing halved, and was 300 mm in diameter. It was supported by a framework of one inch aluminium framing and canted at 37 degrees. The top of the slide was 800 mm from the ground and its total length was 1700 mm long, including a 300 mm platform area. Access to the slide was via a wooden ramp which was 930 mm long and 245 mm wide (fig.7). The ramp had small treads nailed in place to prevent slippage. The side edges of the slide were capped and the bottom corners bevelled to protect the otters. The slide was anchored at the base by two large rocks and the ramp was also weighted down by a rock. The slide entered the water to a depth of about 10mm, depending on the water level in the moat. Set into the slide were two photoelectric cells (Light Dependent Resistors) which registered the movement of the otters down the slide, one 335 mm from the top of the slide and the other 380 mm below the first. To adjust for the different light levels at the different times of the day, shadows from the trees, and weather conditions, a reference sensor (L.D.R.) was attached to the top of a conduit at the side of the slide, 11 mm above the edge of the slide. This reference sensor controlled the light level sensitivity of the two sensors on the slide to overcome the differential input from these sensors, which caused inappropriate triggering of the feeder. This was done by taking a reference measurement of the light levels off the slide. The signals from the photoelectric cells were cabled across the moat to the control box. This cable was passed through a conduit, emerging 790 mm above the top of the slide to raise it out of the otters' reach.

The control box (fig. 8) operated the feeder, upon receiving a signal from the photoelectric cells embedded in the slide . It recorded the number of slides and the number of reinforcements delivered. However, as the study did not get past the conditioning phase, the manual override button only was used to sound the buzzer when a reinforcement was delivered by hand. The control box also had a potentiometer control to override the reference sensor on the slide. The control box and cumulative recorder were set up on a University exam table.

The feeder was 660 mm long and 120 mm deep. Reinforcements were held by 37 stainless steel plates, 30 mm deep with a 10mm lip, placed 25 mm apart. The plates were riveted to a plastic fabric belt which was driven by a 12 volt D.C. motor at 8 R.P.M. (Radiospares motor P/N 341-676) The feeder was canted at 15 degrees to stop the reinforcements from becoming dislodged. Reinforcements were delivered from the bottom of the feeder into the moat. The feeder was attached to the wall of M.A.C.001, overhanging the moat, by a framework of 1 inch mild steel square tube.

fig. 5 **Slide**

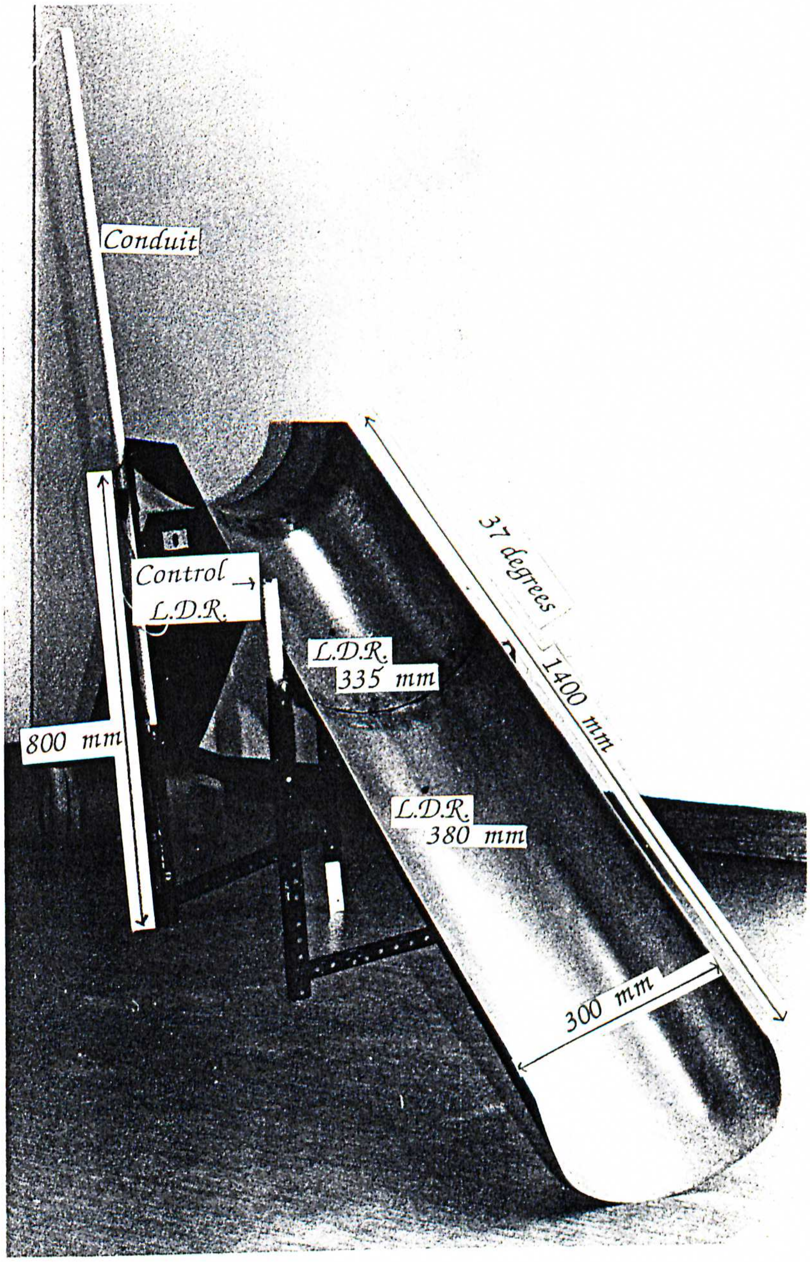
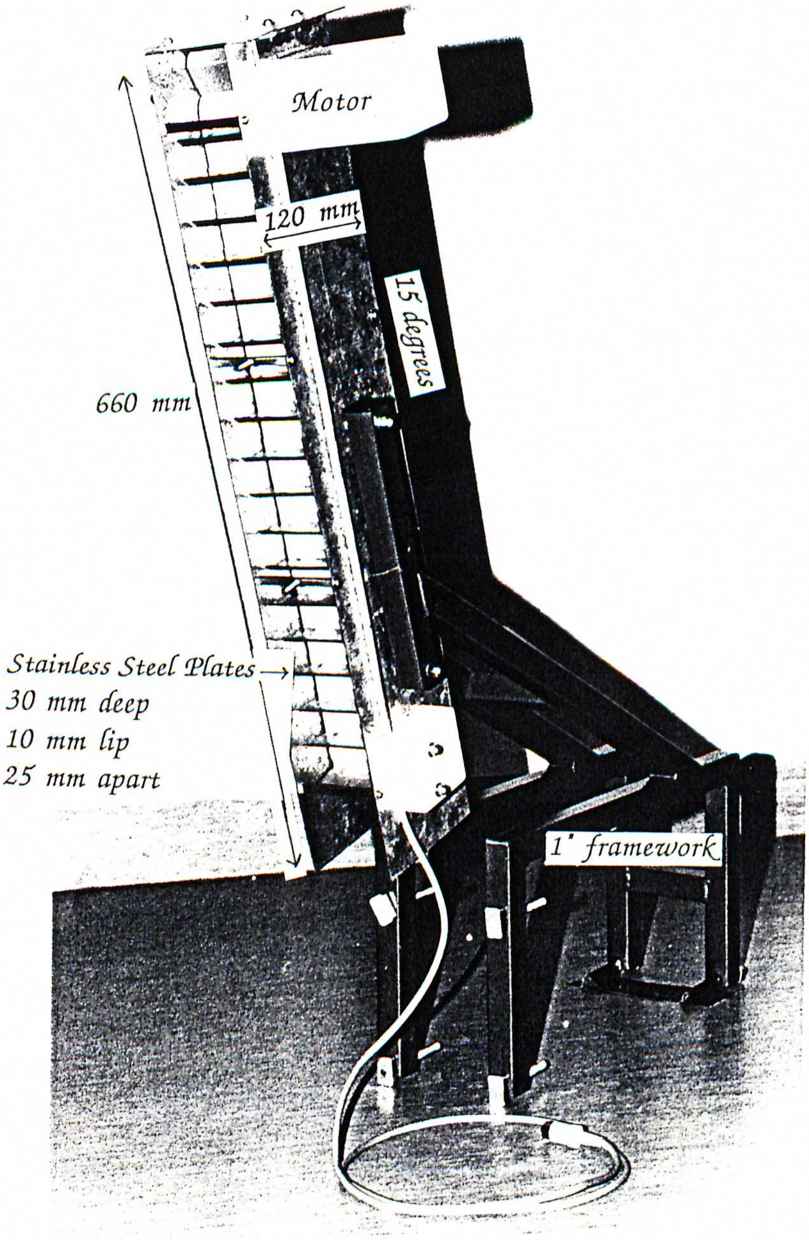

Conduit
Control L.D.R.
800 mm
L.D.R. 335 mm
L.D.R. 380 mm
37 degrees
1400 mm
300 mm

fig. 6 **Feeder**



Motor
120 mm
15 degrees
660 mm
Stainless Steel Plates
30 mm deep
10 mm lip
25 mm apart
1' framework

fig.7 **Ramp**

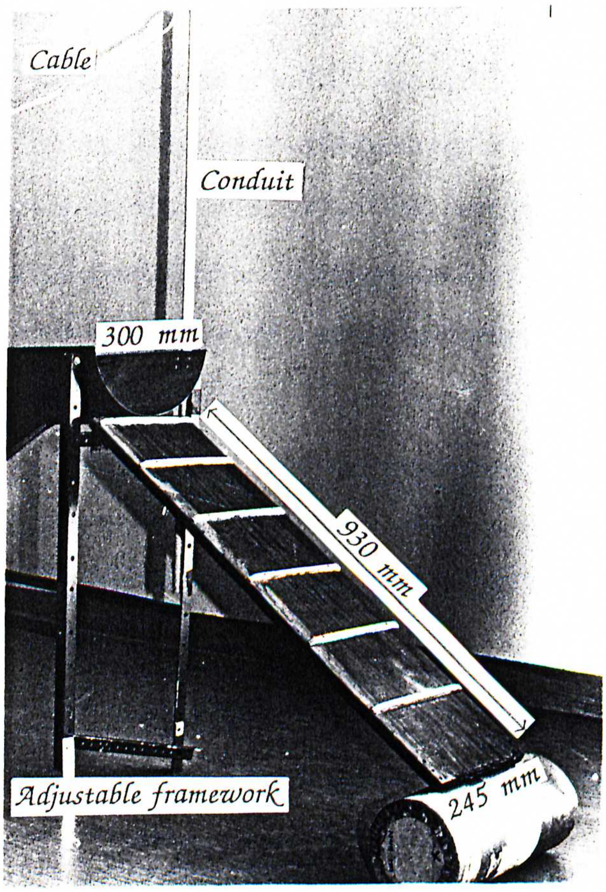
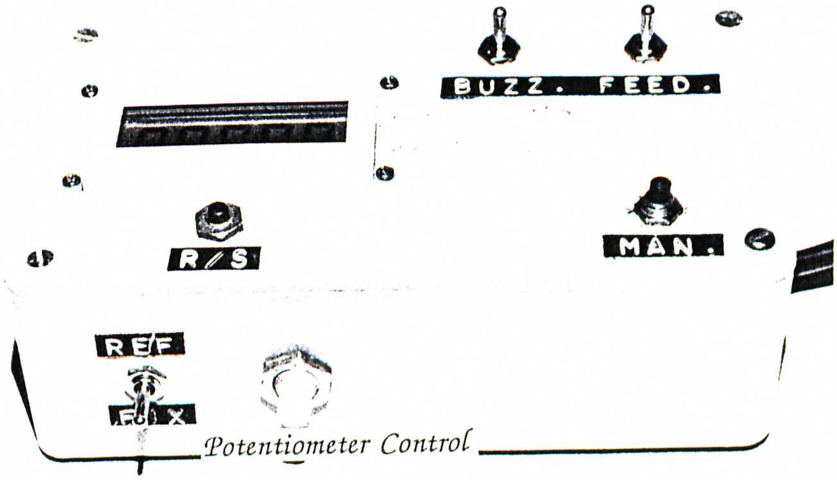


fig.8 **Control Box**



During the differential shaping of the otters, the reinforcements were delivered by hand from a small white bucket. The experimenter wore a blue parka only while reinforcing the otters and setting up the apparatus. This was to maintain a constant appearance on the part of the experimenter creating a constant stimulus for the otters, and to protect normal clothing. The experimenter used several pairs of disposable surgical rubber gloves each session to stop the control box from getting wet as this affected the operation of the buzzer to prevent the possibility of electrocution.

The conditioning sessions were recorded on video using a National 'New Vicon Auto Focus' video camera (Model WVP-AZN) and a National VHS portable video cassette recorder (Model NV-180A). The videos were viewed on a National Colour T.V. (Model T.C. 293 NSP). The camera was mounted on a Glitzo Tripon R No. 2 tripod. The area around the experimenter during the conditioning phase was cordoned off using orange plastic hazard flags and a 'Zoowatch' sign was erected asking the public to refrain from disturbing the experimenter. (plate 2) Once the conditioning sessions started another sign informed the public as to the nature of the experiment. (Appendix B)

2.4. Otter Identification

As otters are amphibious their water resistant fur makes marking for identification very difficult. Pellis (1984) was unable to identify accurately otters in a family group during observations and so could only catalogue the behaviours of the two dominant males. The Adelaide zoo identifies the otters with a coded series of tattooed dots and v's on the lower lip of each animal. This, however does not enable ready identification of the animals for the purpose of this study. To read these markings efficiently, if at all, the animals must undergo general anæsthesia. Other forms of marking are equally unviable. The otters' ears are too small to tag, their wrists and ankles are as large as their paws, so rings slip off, and their water resistant coats will not hold dyes such as gentian violet. There is also the problem of unsightliness of such markings. A letter from C. Wright of the Lincoln Park Zoological Gardens in the U.S. to D. Langdon of the Adelaide Zoo, suggested tattooing the inside hind leg of the otter as a viable identification technique but this was also not suitable for observation work. Eventually it was decided to shave a patch of fur off C's rump. However this could only be done once, as the procedure unduly stressed the animals. This was done mainly for the benefit of the naive observers during the inter-observer reliability checks. During the Baseline studies animal morphology was used to identify the otters. For both the pairs, the more senior otter was distinctly larger. Otter F also had a more grizzled coat colour and most of his teeth missing, giving him a distinctly different appearance to S. He also had a hoarser cry. Otter D was .5 of a kilo heavier and had a wider face than otter C. During the Familiarization, Conditioning and S Δ phases, the shaved patch remained on C's rump but by the final Baseline condition the otter's coat had regrown and morphological cues had to be relied on again.

2.5. Ethics

Ethics approval had to be gained from both the University of Adelaide Animal Ethics Committee and the Royal Zoological Society. In particular the University Ethics Commmittee required a statement from the Zoological Societies Vetinarian, two days after the procedure commenced stating that the procedure did not cause agonistic behaviour between the experimental pair of otters. The Royal Zoological Society required a research application stating the aims and the methodology of the proposed research. (Appendix C)

plate i. *Top* The control pair of otters: F is on the left and S is on the right, inside the hollow log. Note how coat colour of the otters enables them to blend in with their environment.

Bottom The experimental pair in 'observing' position: left; D the larger otter and right; C.

plate ii *Top* Experimental setup during conditioning.
Bottom Experimental setup within the enclosure during conditioning. Note the relationship between the bottom of the slide and the feeder.

plate iii Otter C on the slide showing full extension past the first sensor, with nose lowered. This position is alternated with extension with both paws placed out, and with direct eye contact with the experimenter.

2.6. Experimental Design

2.6.1. Proposed Design

The original experiment design was as follows: Baseline data was to be collected over a 24 hour time frame for both the experimental and the control groups. This is to establish, as far as possible, the otters' normal behaviour patterns. The sliding apparatus was then to be introduced into the enclosure and the otters' response to this observed and quantified as above. If the sliding behaviour occurred it would be recorded and topographically analysed. The topographical analysis would be in terms of whether the behaviour fit the definition of 'natural play behaviour' (sliding with forepaws tucked back). Other generalized play behaviours generated by the sliding-as-play-behaviour would also be recorded. If the sliding behaviour was not produced by the introduction of the slide, it would then be shaped, using operant conditioning procedures. The sliding behaviour thus produced would then be topographically analysed as above, then placed on a schedule of reinforcement, either continuous or of a fixed ratio. A second baseline study would then be conducted with both the experimental pair and the control pairs of otters to quantify any changes in behaviour patterns as above.

2.6.2. Time Frame of Studies Conducted

Observations commenced on the 22nd of May and ended on the 2nd of August. The observations were conducted in six hour shifts, dividing the 24 hour observations into four. On the weekends only half the Zoo keepers are rostered on, and there are double the number of Zoo visitors. To ensure a stable level of these external variables data was only collected on weekdays. However, there were still fluctuations in both the keeper routines due to sick days, and in the visitor numbers, due to the school holidays.

As it happened the sliding behaviour was not shaped to reinforcement contingencies. One

24 hour observation was made of both the control and the experimental groups using the checklist, prior to installing the slide and feeder. As the otters slept for the 12 night-time hours some of the follow up studies were only done over the 12 daylight hours. The slide was then introduced and two twelve hour observations were taken during the familiarization period.

Control Otters: S & F

Baseline study 1	22.05.90 - 01.06.90	24 hour study
Baseline study 2	30.07.90 - 06.08.90	24 hour study

Experimental Pair: C & D

Baseline study 1	26.05.90 - 15.06.90	24 hour study
Familiarization study 1	19.06.90 - 20.06.90	12 hour study
Familiarization study 2	21.06.90 (one 12 hour shift)	12 hour study

Magazine Training and Conditioning	26.06.90 - 19.07.90	

S Δ study 1	23.06.90 - 25.06.90	24 hour study
S Δ study 2	27.06.90 - 28.06.90	12 hour study
Baseline study 2	30.06.90 - 02.08.90	24 hour study

A total of 156 hours of observations were recorded using the behaviour checklist. The magazine training and operant conditioning sessions were videotaped.

2.6.3. Magazine Training

It took two days to magazine train the otters. They had to be shaped to enter the water and approach the feeder by successive approximation. This may be a result of being fed on land as part of their daily routine. Reinforcements for the first session were two Weedy Whiting cut into 40 reinforcements. These were difficult to discern when at the bottom of the moat after delivery from the feeder and so may have been misapprehended by the otters. During magazine training it was difficult to differentially reinforce each otter. So the reinforcements were hand delivered to the proximity of the animal. This method of delivering reinforcements continued through out shaping and conditioning.

2.6.4. Reinforcements

The otter's routine feed was 1500 grams of food per day each, divided into three to five meals a day, depending on what was fed. Their diet consisted of: dead day old chicks, dead Tommy Ruffs, Weedy Whiting, Trout, dried dog food and otter's mince. The otters were deprived of their 10.00 am meal which was delivered as reinforcements at 1.00 pm during the conditioning sessions. This was considered enough deprivation as otters take between 20 and 40 minutes to metabolize and excrete their food (Liers 1954). Reinforcements consisted of 500 grams of Tommy Ruff (3 large or 4 small) cut into about 40 pieces.

2.6.5. S Δ Condition

After the operant conditioning sessions the otters' behaviour was again observed. Firstly otters C and D were observed in an S Δ condition. The S Δ condition was indicated by the removal of the reinforcement contingency. The reinforcement contingency was defined as removed by experimenters absence and the cover being placed over the feeder. This was to see whether the equipment was utilized by the otters, post reinforcement and conditioning. Also to see whether the S Δ condition would elicit any sliding behaviour or generate general behaviour changes.

2.6.6. Baseline Two

A final 24 hour baseline study was conducted with the equipment removed from the enclosure to determine whether there had been any alteration in the number and frequency of behaviours emitted. A second 24 hour baseline study was also taken of the control pair of otters for comparison.

3. Results

3.1. Baseline One & Familiarization

During Baseline one study and the Familiarization study no clear dominance hierarchy could be established in the experimental pair. The Familiarization studies are not a true indication of the behaviour levels as it was necessary to work on the apparatus during this period. This disturbed the otters who hid in the holt while the work was going on. The otters tended to mirror each other in their behaviours, in location, form and frequency. A frequency distribution of the stereotyped behaviour for both otters clearly demonstrates this (fig.28) During the shaping and conditioning D was clearly dominant at all times displacing C from the slide and often blocking access to the slide.

3.2. Shaping

Otter D, the dominant otter, satiated after about six to ten reinforcements and so failed to shape to the correct response. D also failed to retain magazine training between sessions. However there is evidence that D learned by observation. During the conditioning of otter C, D occasionally went to the top of the slide and performed part of the operant response. As the presence of D on the slide interfered with the conditioning and shaping of the operant in C, the otter exhibiting chronic stereotypy, D was given 2 or 3 fish heads at the beginning of each session to induce satiation. Otter C was shaped to the sliding behaviour by reinforcing successive approximations of the desired behaviour.

3.3. Learning by Observation

D was not shaped by successive approximations to the top of the slide. However, he appeared to learn by observation. During most of the conditioning sessions D was given a number of fish heads at the beginning of the session to keep him out of the way, as stated previously. When D was not satiated he begged at the front of the enclosure while C was being reinforced and picked up reinforcements that missed the top of the slide or were missed by C. In this way D was reinforced for his begging behaviour by obtaining reinforcements that fell down the slide. But when D had not gained a reinforcement for some time in this way he moved to the top of the slide, placing his paws part of the way down. As this behaviour was not shaped by successive approximations, as in C, then it is inferred that D learned by observation. When D was at the top of the slide he did not magnify the hanging response but waited for reinforcement. As D was the dominant otter this effectively blocked access to the slide for C. So D was usually given a large piece of fish, which he took away from the slide to eat. Occaisionally C would manage to obtain this large reinforcement which foiled shaping for the next few minutes.

3.4. Sliding

During the 12 conditioning sessions C only performed the operant behaviour seven times. They occurrence of sliding appeared involuntary and was not produced as a conditioned response to the shaping procedure.

The first slide was produced on the seventh day after C was shaped to the top of the slide. After this first slide only six occurrences of the sliding behaviour occurred in six 45 minute conditioning periods after this. On the second, sixth and seventh occurrences of sliding the otter produced the escape behavior of jumping off the slide before completing the response. This escape behaviour strengthened to the extent that the otter was leaving the slide immediately the sliding behaviour started to occur. Such avoidance/escape responses are extremely difficult to extinguish (Hinde 1977), and so it was judged that as the otter had learned this response it was unlikely that it could be taught to complete the sliding behaviour. The otter also vomited at the top of the slide after the sixth partially completed sliding response. The escape behaviour and the vomiting behaviour both indicated strong aversion to the procedure and the apparatus. The conditioning was terminated at this point for ethical reasons.

3.5. Topographical Analyses of the Sliding Occurrences.

Slide 1

By the 13th day of conditioning otter C had been shaped to the point where he was only reinforced for 'scrabbling' at the top of the slide. The scrabbling behaviour was produced when the otter slipped, in an attempt to halt the sliding. The first slide occurred about 15 minutes into the session when he failed to control the scrabbling behaviour and proceeded down the slide. A topographical analysis of the behaviour from video tape showed this: At the sound of the buzzer and at the subsequent delivery of the reinforcement onto the slide while C was scrabbling, he slipped, backpedalling with fore and hind feet eight times. (fig. 9) He held onto the edges of the slide with his hind feet before turning around, holding onto the edges of the slide with his forepaws attempting to reascend the slide. (fig. 10) In the process of doing so the otter lost his footing entirely and descended the slide. Both head and tail were arched upwards and all legs were rigidly braced against the sliding movement. The angle of the head suggested an attempt to look in the direction of travel. (figs. 11 & 12)

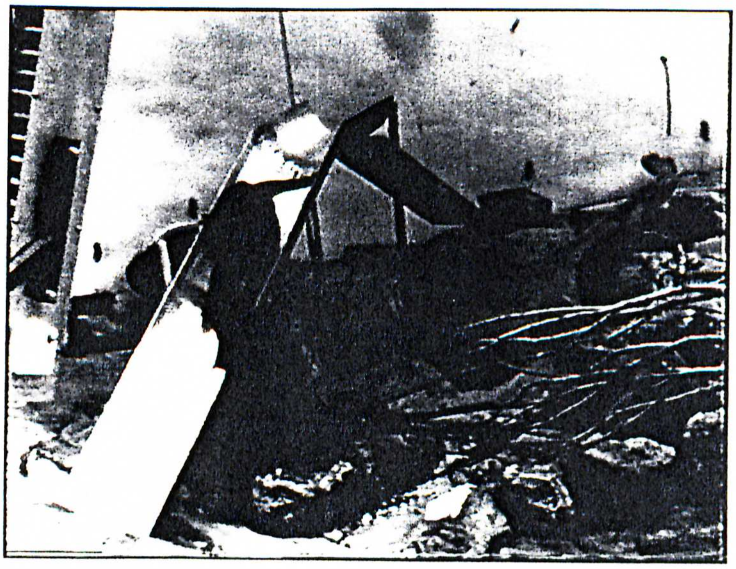


fig 9 Scrabbling behaviour while holding onto edge of slide with right hind foot.

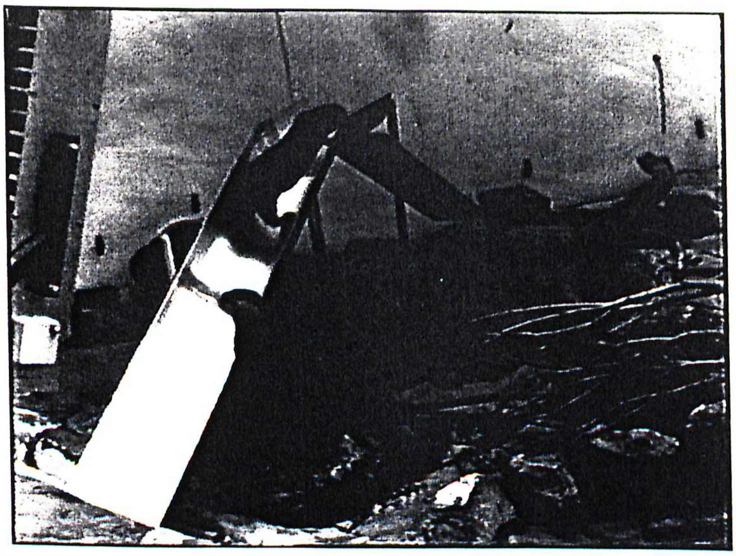


fig 10 Attempting to turn around, holding onto edge of slide with right front paw.

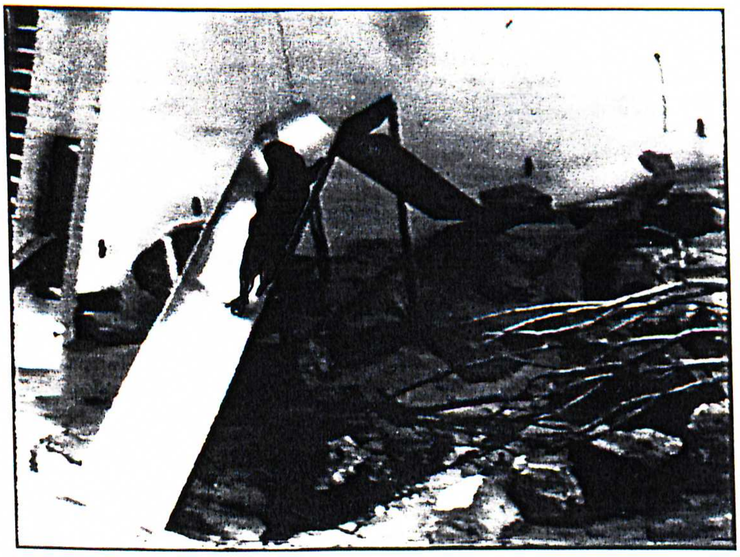


fig 11 Starting backwards descent, head and tail arched back, all legs and toes rigid.

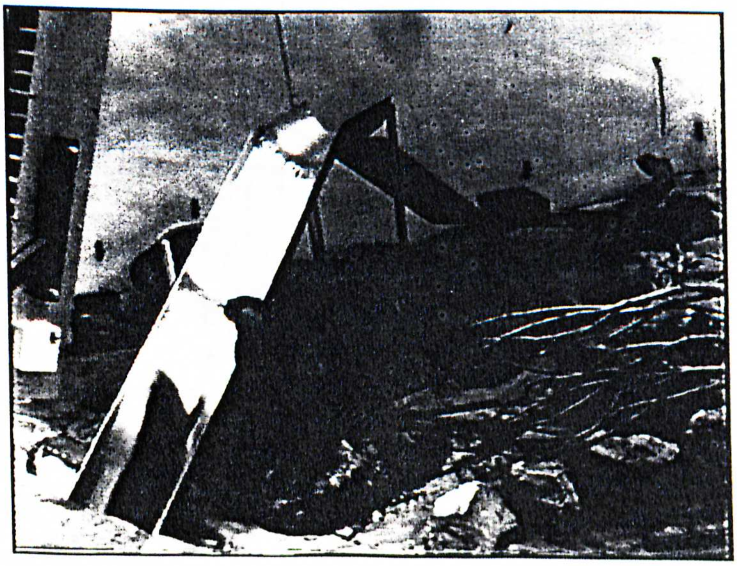


fig 12 End of descent, posture as before.

Slide 2

On the third day of shaping after the initial slide, otter C slid half way down the slide and then jumped off to the left. Unfortunately due to equipment malfunction this occurrence was not video taped and so unavailable for analysis.

Slide 3

Slide three occurred on the 16th of July, 16 days after shaping commenced. The behaviour was very fast and otter C was braced against the movement.

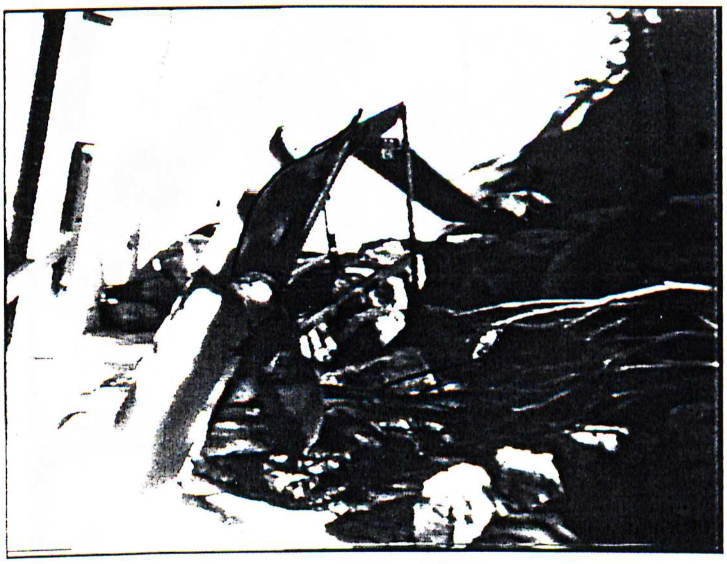


fig 13 Starting descent, otter outstretched, nose pointing downwards and paws braced forwards.

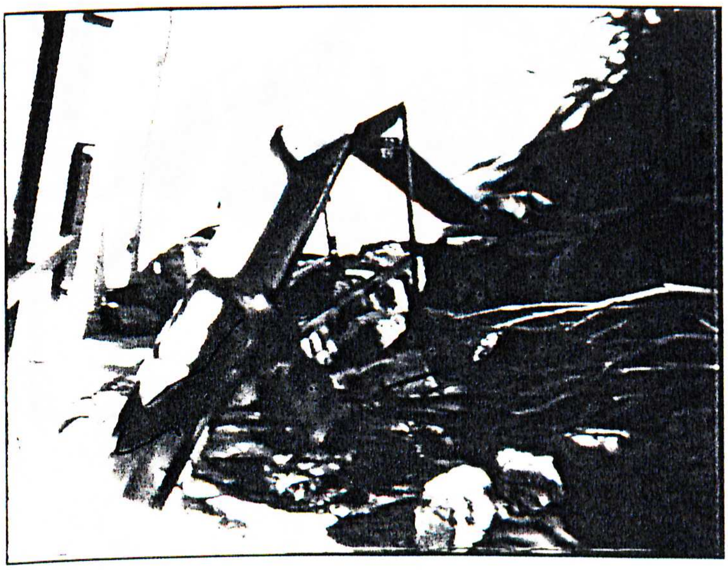


fig 14 Descent, nose and tail down, back hunched and forefeet braced. Hindlegs are underneath the body and general body orientation is against the movement.

Slide 4

Slides four and five occurred on the same day, six days after the initial slide. There was no initial scrabbling behaviour. The otter slid quite slowly with its nose down, back hunched and hind legs gathered beneath it. The forelegs were braced against the movement of the slide. The otter appears to level out somewhat towards the end of the slide.

fig 15 Start of slide

fig 16 Mid-point of slide

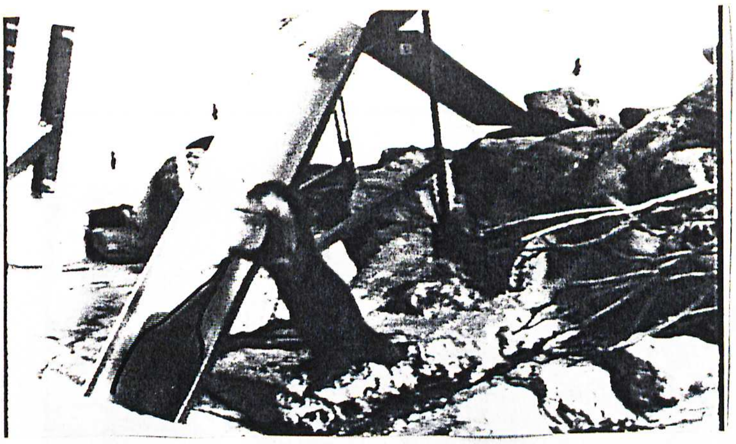


fig 17 End-point of slide

Slide 5

Slide five was similar in topography to slides three and four. However the rate of the slide was slightly faster than slide four. There was no initial scrabbling behaviour. The otter's back was hunched, nose was pointed down and forefeet were braced to the front. The hind legs were gathered underneath the animal and the tail was down. The animal was slightly skewed to the left as it descended the slide.

fig 18 Start of slide.

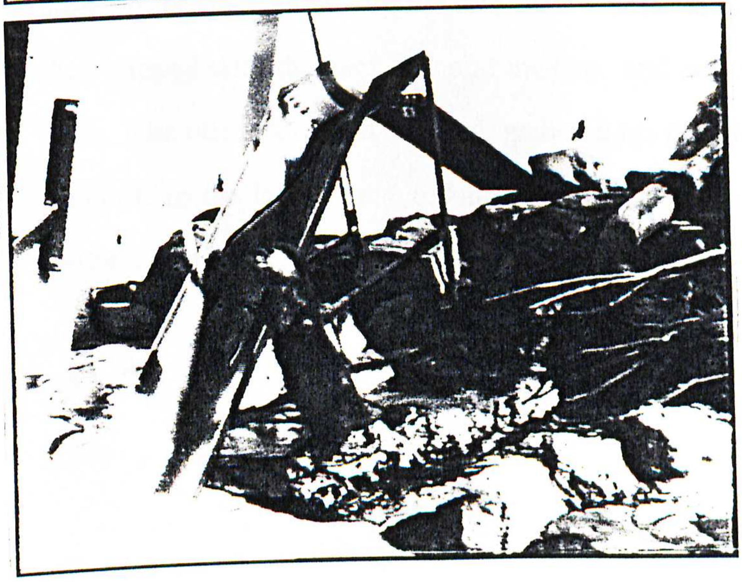


fig 19 Mid-point of slide.

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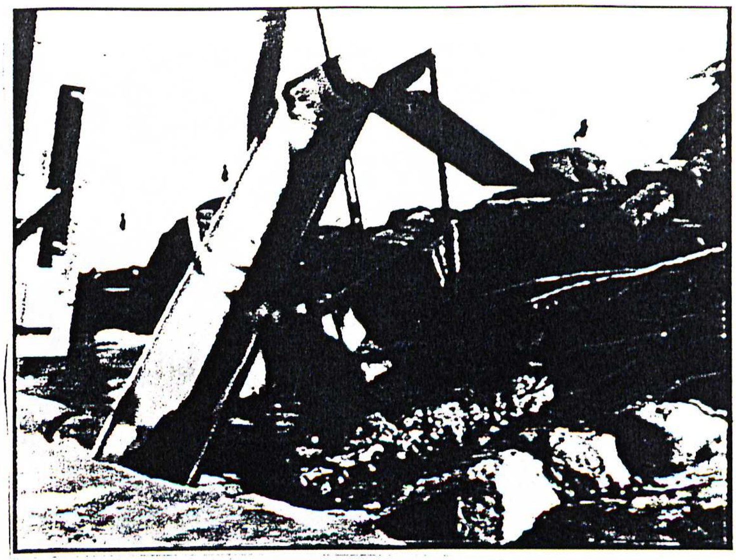


fig 20 End-point of slide, prior to entering the water.

Slides six and seven occurred on the 19th of July, on the nineteenth day of conditioning. As the otter was being reinforced by hand, as it was at the top of the slide, many reinforcements fell onto the slide. Some rolled off, while others stuck to the slide part of the way up and were inaccessible. This session was characterised by increasingly novel efforts by otter C to get the unavailable reinforcements off the slide without descending it. On the two occasions C descended the slide, he jumped off part way. After slide six occurred the otter vomited at the top of the slide. He then continued to respond but on the seventh slide he jumped off to the left as the sliding behaviour started to occur.

Slide 6

Otter C reached past the first sensor according to the reinforcement contingency and then slipping, backpedalled with the forepaws four times with its head up and arched back. He then slipped with the back feet and the head and tail both flicked upwards as he started to slide. The otter then leant forward, gathered his hind legs underneath him, enabling him to jump off to the left. The avoidance behaviour occurred before he reached the join at the centre of the slide.

fig 21 Reaching forward past the first sensor nearly to the join at the centre of the slide. The head is raised as the otter makes direct eye contact with the experimenter.

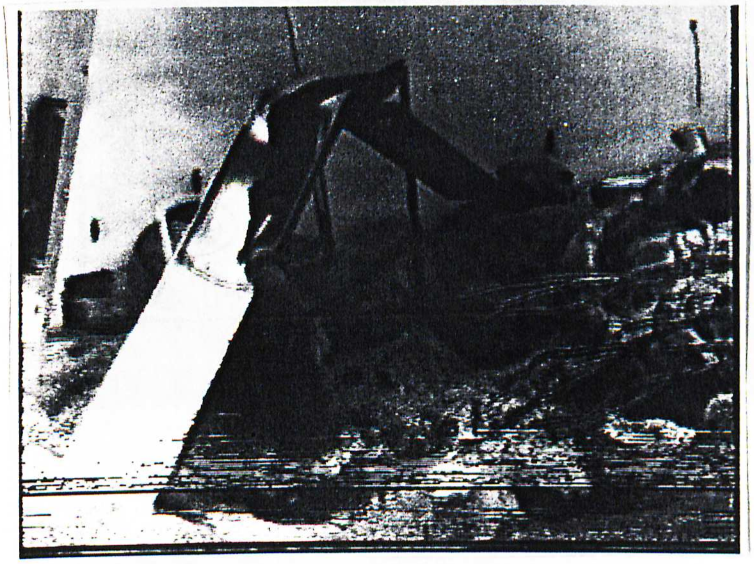


fig 22 Scrabbling with hind legs, head and tail arched back and slipping with forepaws.

fig 23 Jumping off the slide to the left before reaching the join in the middle of the slide.

Slide 7

After slide six the otter did not reach as far down the slide with its forepaws to fulfil the contingency. However scrabbling behaviour occurred with the otter backpedalling with the forelegs once, before slipping with back legs. The otter then gathered its hindlegs underneath the body and avoided sliding by leaping off the slide before the first sensor was reached. This behaviour occurred to the left and into the stream.

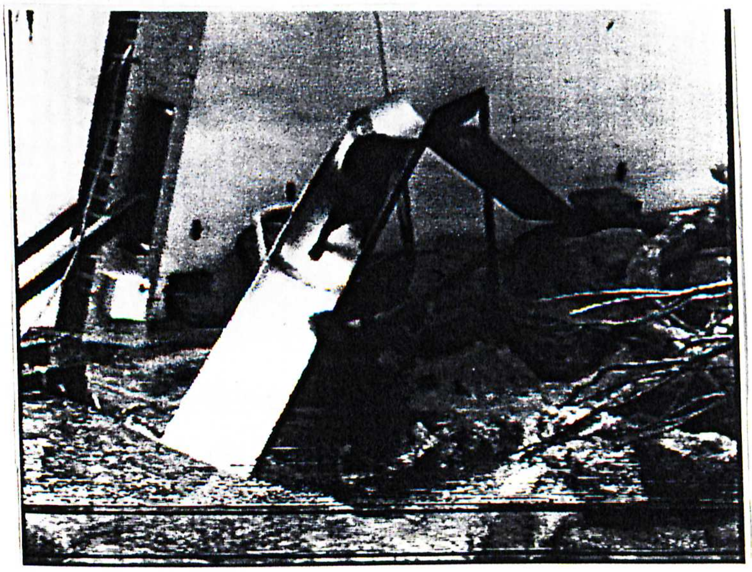


fig 25 Scrabbling at the top of the slide with head arched back.

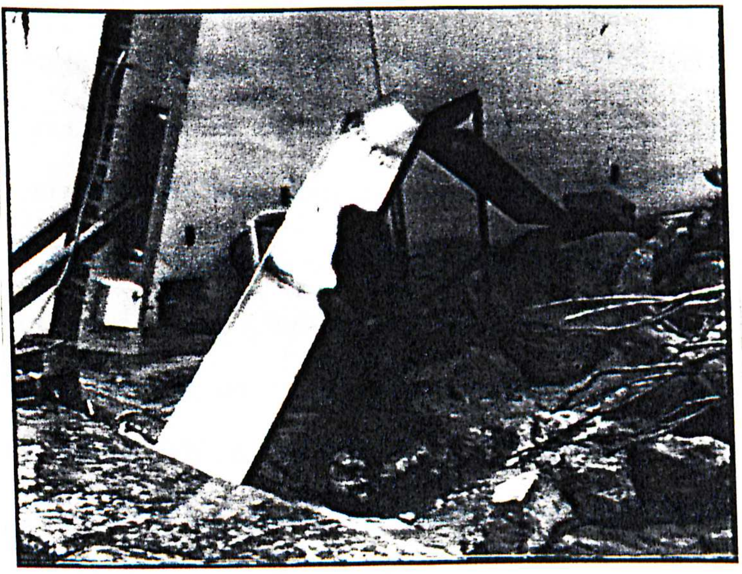


fig 25 Jumping off the slide to the left.

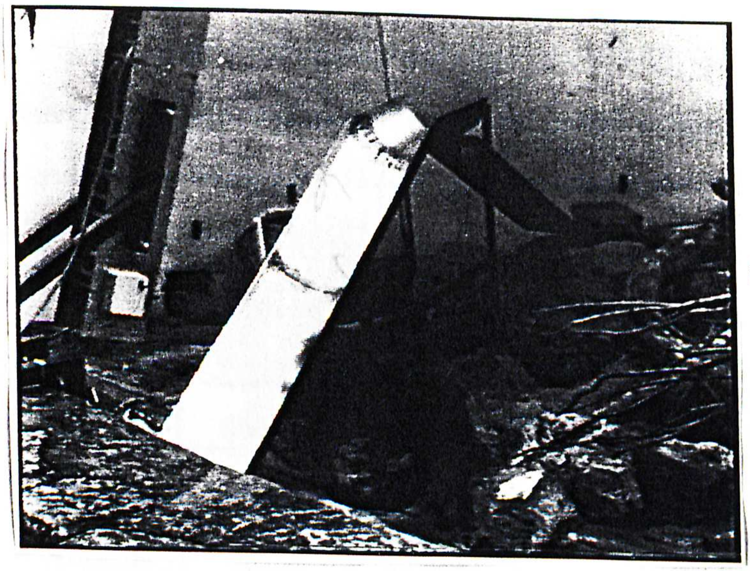


fig 26 Landing in the stream.

The topographical analyses clearly showed that the sliding behaviour demonstrated by C was not natural sliding-as-play behaviour. In all cases the otter was rigid and to a large degree resisting the movement with its paws braced before it. It was not possible to compare the operant response, such as it was, to natural sliding as the natural sliding behaviour was not spontaneously elicited by the introduction of the apparatus.

3.6. Post-Reinforcement Pauses

An estimate was made of the duration of Post-Reinforcement Pauses (PRP) from the video tapes of the shaping and conditioning sessions. It was possible to mention a few PRP's, however the the behaviour patterns were erratic. The three PRP's before the sliding occurrence were averaged, the PRP immediately after the sliding occurrence was measured and the three PRP's after this were averaged. This gave a rough guide to the effect of the sliding behaviour on the level of operant behaviour and showed a lengthening of the PRP post-sliding. This could indicate one of two things. Firstly that the extra reinforcements received by C for sliding lengthened the latency period before the otter performed the operant again. Secondly that the sliding was aversive to the animal and so slide approach was inhibited. Topographical analysis of the behaviour patterns during the PRP show the otter performing exploratory behaviour. This behaviour appears to indicate displacement, however, as the otter is moving faster than normal with only cursory sniffing and fossicking. After the first slide the otter emitted three sharp fear vocalizations.

Table 1 Post-Reinforcement Pauses

	Slide 1	Slide 3	Slide 4	Slide 5	Slide 6	Slide 7
Bef. slide	15.04	14.95	06.76	25.48	15.32	not meas
Aft.slide	22.65	2.01.47	1.23.32	38.71	48.48	85.29
Post slide	24.58	not meas.	18.97	28.16	55.73	not meas

Where there were less than three PRPs the average was not recorded.

3.6.2. S Δ Condition

In the S Δ condition 1 otter C was twice observed running up the ramp to the top of the slide as the keeper was approaching. In the S Δ condition 2, C again was observed performed the operant response of running to the top of the ramp, a behaviour again elicited by the keeper. None of these occurrences fell into the observation scan times and so do not form a part of the frequency data, but were recorded as extra data in the comments column of the checksheet. Although the behaviour did occur, its frequency was negligible.

3.7. Stereotyped Behaviour

Otter C performed nearly twice as much stereotyped behaviour as Otter D. Analysis showed that otters S and F performed significantly less stereotypy than C and D ($\chi^2=6.423$, df=1,p<.05). A 55 minute videotape of C and D's behaviour was analysed for the duration and frequency of sterotyped bouncing. The mean duration of bouncing for otter C was 15.32 seconds (std.dev. 11.51) and for otter D 9.97 (std. dev. 15.16). For all behaviours exhibited during the 55 minute period by C, the mean duration was 8.637 (std. dev. 12.42) and for otter D 8.04 (std. dev. 9.56). Otter D exhibited 404 different behaviour bouts, while otter C exhibited 383. Both otters had a count of 133 stereotyped bouncing bouts. The otters were markedly similar in the duration and frequency of the bouts of bouncing, however there was a difference in the frequency and duration of all the behaviours combined. There was no significant difference in the frequency of stereotypy for otters C and D between Baseline Conditions 1 and 2 ($\chi^2=.749$, df=1,p>.3). There was a change in the topography of stereotypy exhibited by otter C (Fig.27). Stereotyped pacing appeared in the frequencies after the shaping and conditioning phase of the experiment. The level of stereotypy between otters C and D tended to mirror, except in the Familiarization 1 condition. There was a sharp rise in stereotypy exhibited by otter S in the Baseline 2 condition. The keeper reported that the otters other than the control pair were disturbed by the conditioning and shaping phase, an unexpected factor. The data expressed in Familiarization 1 and 2 conditions were not a reliable measure of stereotypy at that time due to uncontrolled variables during the observation times (fig.28).

fig.27

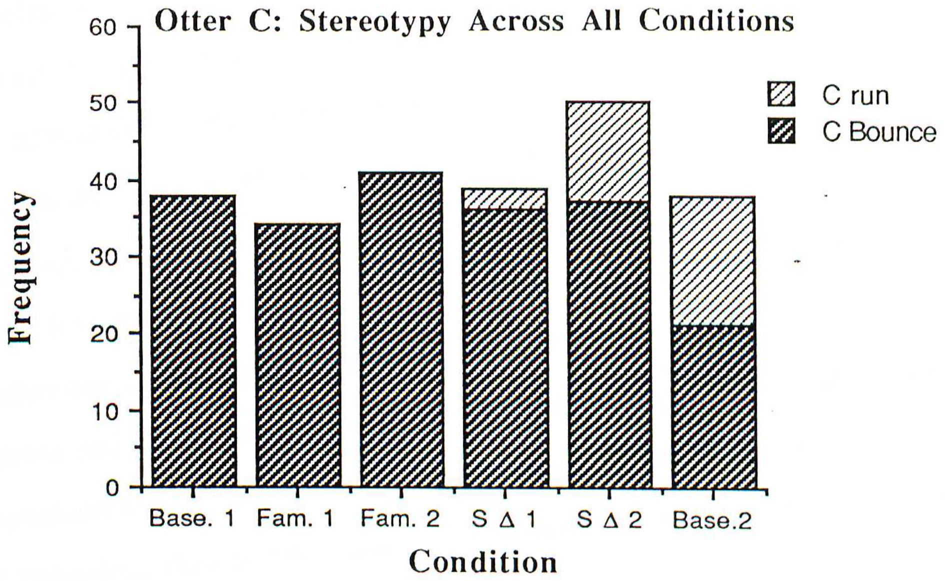
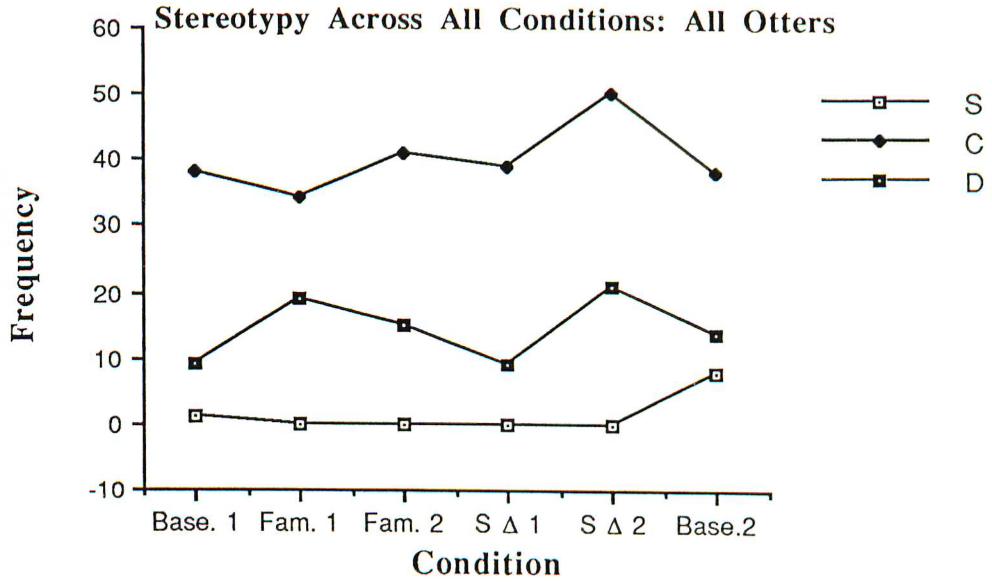
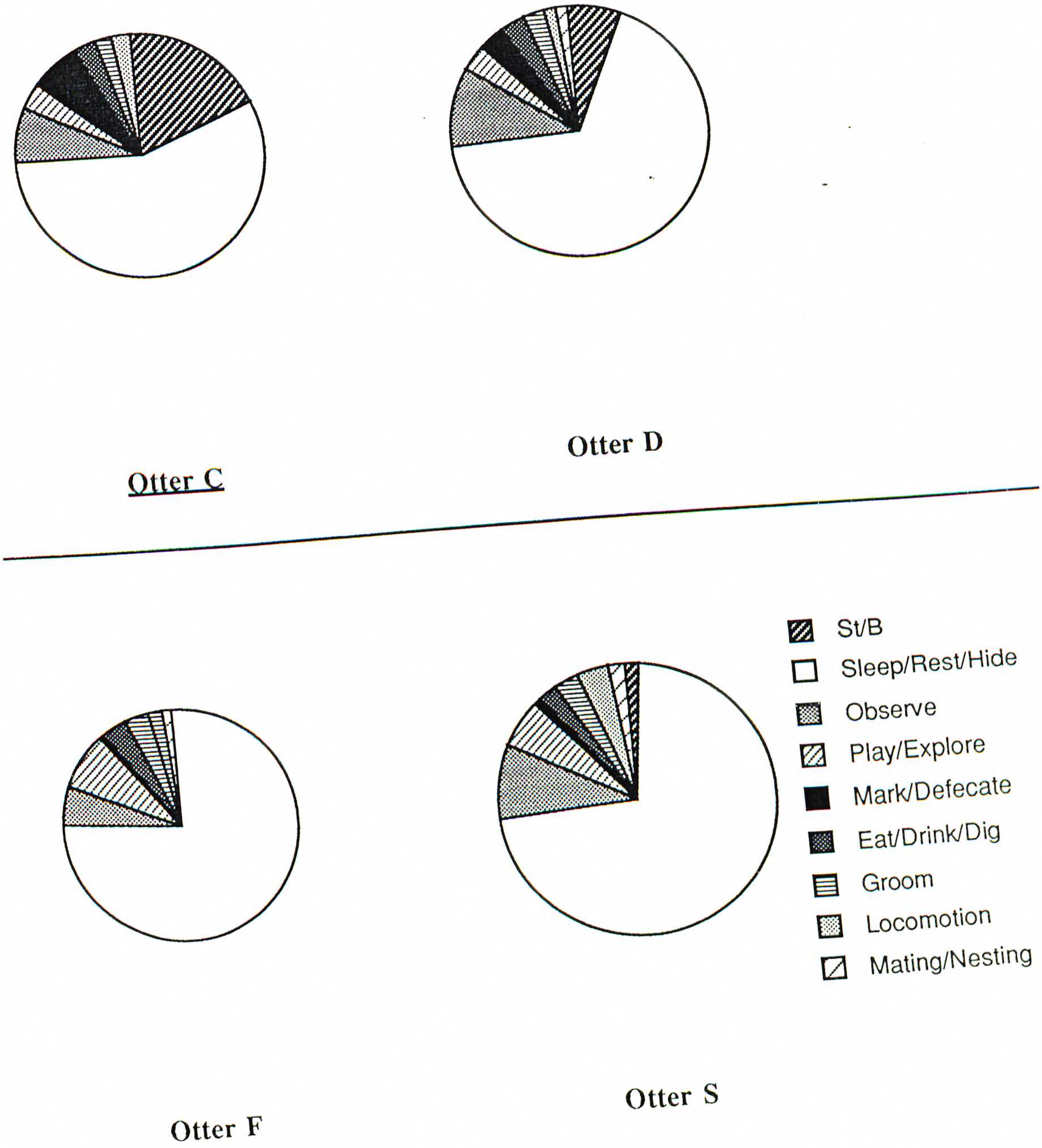

Otter C: Stereotypy Across All Conditions
Frequency
60
50
40
30
20
10
0
C run
C Bounce
Base. 1
Fam. 1
Fam. 2
S Δ 1
S Δ 2
Base.2
Condition

fig.28


Stereotypy Across All Conditions: All Otters
Frequency
60
50
40
30
20
10
0
-10
S
C
D
Base. 1
Fam. 1
Fam. 2
S Δ 1
S Δ 2
Base.2
Condition

3.8. General Behaviours

Pie charts of the general behaviour patterns (fig.29) across all the conditions show that otters C and D spend less time sleeping, resting and hiding-the non-active categories of behaviour. The difference is mainly found in the stereotypy category. The frequency difference between the two groups of otters non-active were behaviours spent exhibiting stereotypy. The other behaviour frequencies were similar. Otter C exhibited less non-active behaviours than any of the other otters. Mating/nesting behaviour in otter C occurred only five times across all conditions and so did not appear in the pie graphs. Otter F showed the least amount of active behaviours. This could be the result of age. Otters C and D showed less 'play/exploring' behaviour than otters S and F. A breakdown of all the behaviour and location frequencies is in Appendix D.


Otter C

Otter D

Otter F

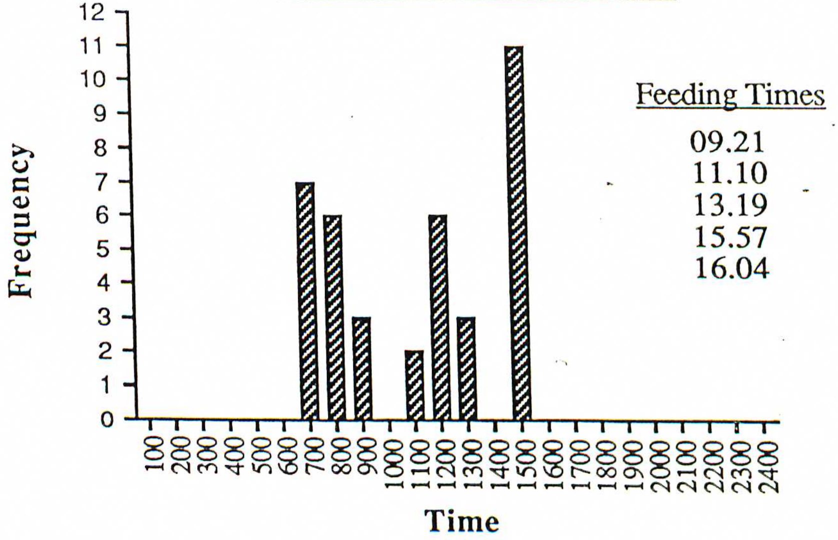
Otter S

fig.29 Pie Graphs of All Otters Behaviours

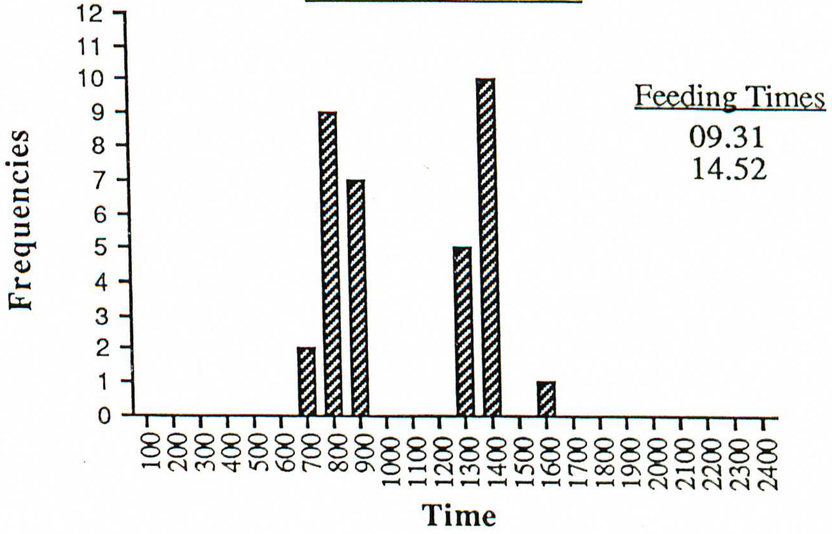
Figures 31 and 32 depict the frequency of stereotypy over the 24 or 12 hours of each condition for otters C and D. They show that the stereotyped behaviour ceases after the final meal of the morning or the evening and that the otters mirror each other, with a lower frequency for otter D. Graphs showing the frequency distribution of all behaviours over all of the 24 or 12 hour conditions are in Appendix E.

fig.30 Otter C: Frequency and Distribution of Stereotypy over all Conditions

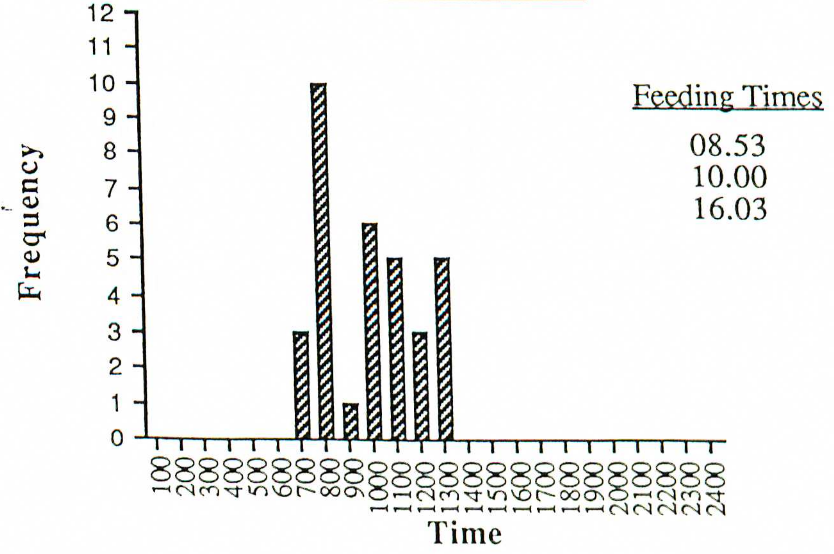
Otter C: Baseline Condition 1



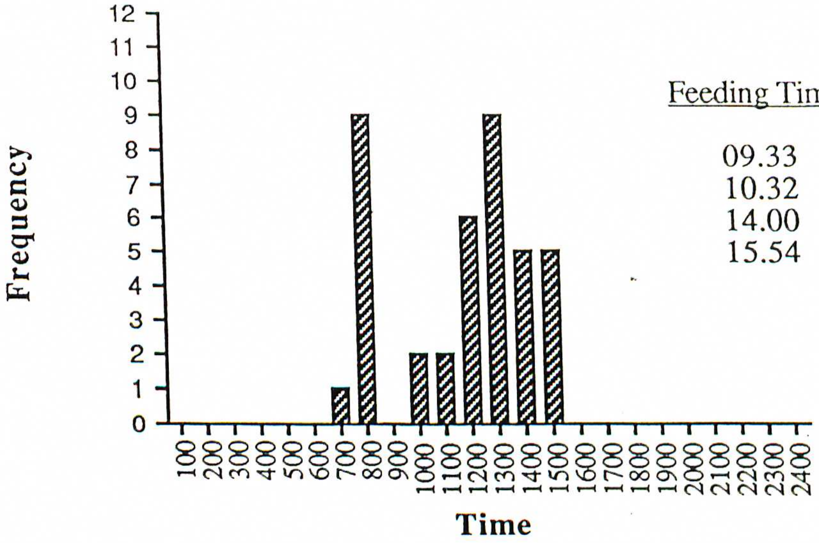
Familiarization 1



Familiarization 2



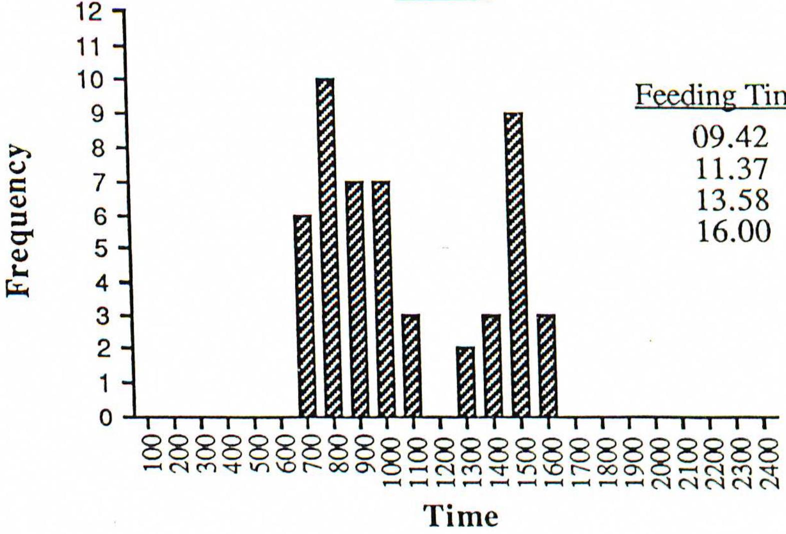
S Δ 1



Feeding Times

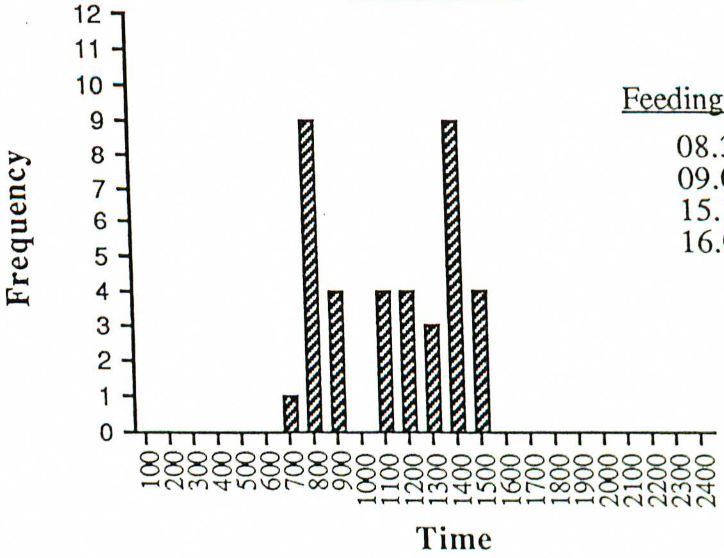
09.33
10.32
14.00
15.54

S Δ 2



Feeding Times
09.42
11.37
13.58
16.00

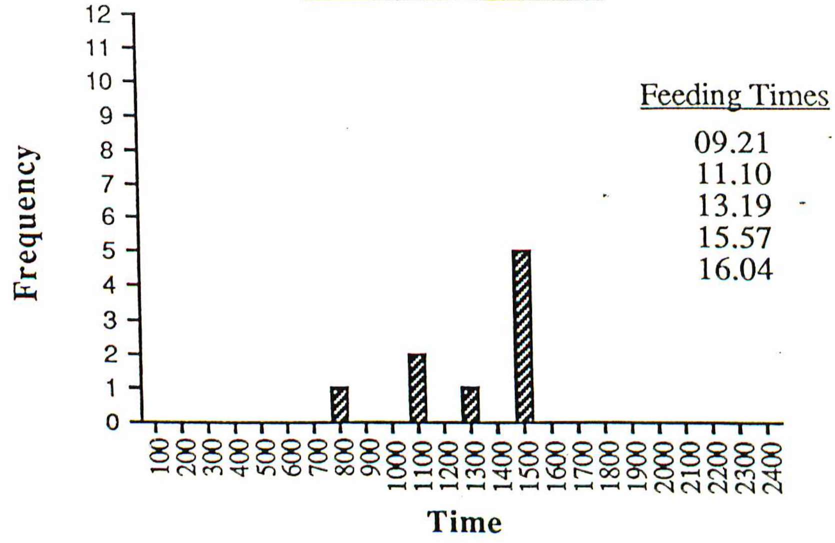
Baseline 2



Feeding Times
08.32
09.00
15.19
16.00

fig.31 Otter D: Frequency and Distribution of Stereotypy over all Conditions

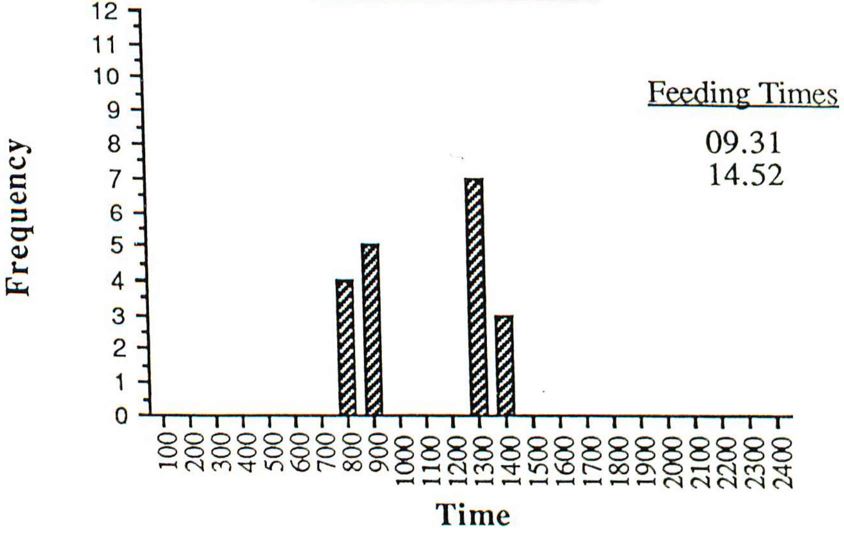
Otter D: Baseline 1



Feeding Times

09.21
11.10
13.19
15.57
16.04

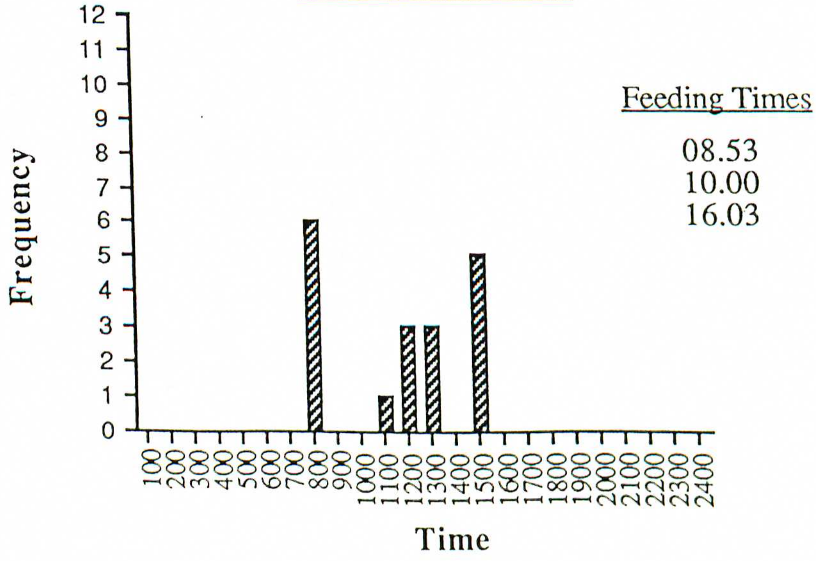
Familiarization 1



Feeding Times

09.31
14.52

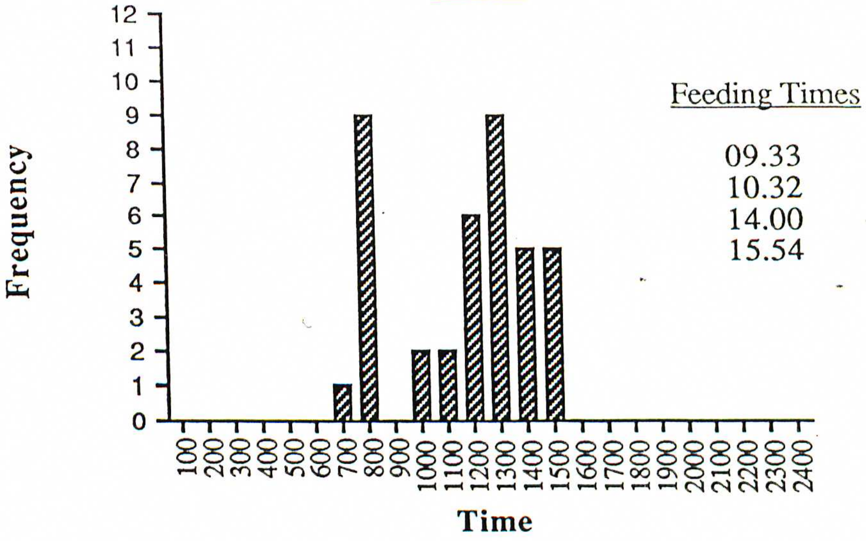
Familiarization 2



Feeding Times

08.53
10.00
16.03

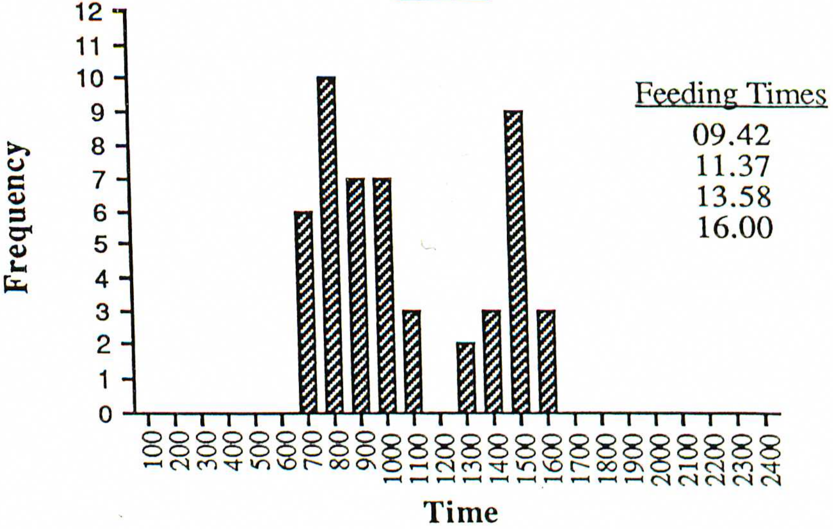
S Δ 1



Feeding Times

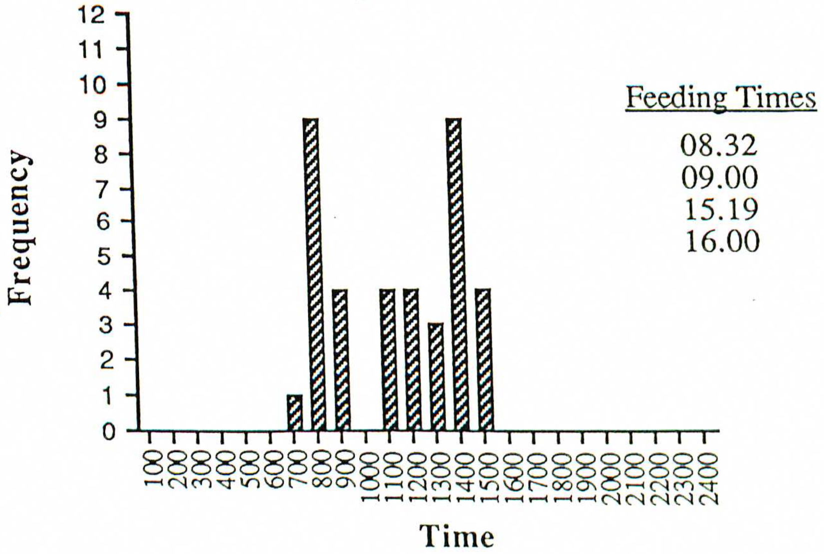
09.33
10.32
14.00
15.54

S Δ 2



Feeding Times
09.42
11.37
13.58
16.00

Baseline 2



Feeding Times
08.32
09.00
15.19
16.00

3.8.1. Play Behaviour

Play behaviour usually only occurred during the periods immediately after the otters were satiated, at about 1100 hours and 1630hours. There was difficulty in distinguishing between play behaviour and fossicking as both tended to be expressed as manipulating small objects. This could also be confused with sham feeding. These behaviours seemed to be a function of the level of stereotypy

Table 2 Frequency of Play Behaviour

Otter	Base. 1	Fam. 1	Fam.2	S Δ 1	S Δ 2	Base. 2
C	1	2	1	1	1	1
D	0	1	4	0	3	0
S	1	-	-	-	-	3
F	3	-	-	-	-	5

Table 3 Frequency of Sham Feeding Behaviour

Otter	Base. 1	Fam. 1	Fam.2	S Δ 1	S Δ 2	Base. 2
C	0	0	0	0	0	1
D	0	0	0	1	3	0
S	1	-	-	-	-	3
F	3	-	-	-	-	5

3.8.2. Agonistic Behaviour

There was very little agonistic interaction between C and D during the shaping and conditioning. In the ordinary feeding feeding situation the otters were non-competitive, often leaving food which the other otter would eat. During the checksheet observations there was no agonistic interactions. Agonistic behaviour usually occurred when the otters were in direct competition for a reinforcement, or D obtained the reinforcement intended for C. However this was unusual as C was generally quicker. However if D obtained the reinforcement intended for C then C would attempt to initiate an agonistic interaction. What interactions did occur were non-contact with C growling at D who was, by this time oriented away from C, placing his body between the reinforcement and C. C stared at the back of D's head with a lowered body position whilst vocalizing. Neither otter would relinquish reinforcements to the other.

No agonistic interactions fell into the observation periods with otter S and F. However in those that did occur, S was the initiator and the sole director of the behaviour. The domination of F by S was in all probability due to F's advancing age, failing eyesight and lack of teeth. In these interactions S jumped on F from the top of the moat when F was in the moat while it was empty. F would then struggle with S and attempt to flee while screaming. These interactions occurred immediately before feeding.

3.8.3. Marking

Marking, a territorial behaviour, was exhibited by all the male otters. Otter C's marking was more than twice as frequent as D's. This suggests that C was in a higher state of tension than D, an inference which can also be taken from the relative amounts of stereotyped behaviour exhibited by the two otters. Correspondingly D spent more time sleeping and resting than C.

F was only observed marking twice according to the frequency distributions. however when S, the female otter, sprainted, F always covered the spraint with one of his own. This was often no more than a token, probably to disguise the females scent from potential predators.

3.8.4. Locomotion

It was found that the otters exhibited 4 gaits in all, walking, trotting, running and a galumphing type of run. These tended to mix together as the animal travelled about the enclosure. They often initiated locomotion with a bounding run (galumphing), which slowed to a trot and then a walk, all within a few paces. When the otters were fleeing, their gait was a true run with very little elevation. Normally their run was more elevated, similar to a horses canter. Running was usually directed to the front of the enclosure, in response to keeper or visitor stimulus. The otters rarely fled. The majority of locomotion was in the form of exploratory behaviour.

3.8.5. Exploratory Behaviour

It was found that the otters rarely just walked, trotted or ran. For the most part they moved about the enclosure in an exploratory fashion. This took the form of sniffing the ground and objects while walking. They also made fossicking movements with their front paws on the surface of the enclosure, prying into crevices and under logs etc. In otters F and S this fossicking behaviour was translated into digging. Digging is the method by which *Aonyx cinerea* locates foods such as mussels and other shellfish. The substrate of M.A.C. 001 does not allow digging.

3.8.6. Swimming

The otters spent a very small proportion of their time swimming. (See table 4) This would seem unusual considering their 'amphibious' status. This may be related to two things. Firstly that these are captive otters and so do not need to hunt their food. Secondly, that it is indicative of their well-being as suggested by Harris (1968:107). However C demonstrates the greatest amount of swimming behaviour in both diving and dog paddling forms, so these results do not concur with the literature that reduced swimming behaviour is indicative of dysphoria.

Table 4 Frequency and Form of Swimming

		Otter		
	C	D	S	F
Diving	9	3	5	1
Dog Paddle	6	1	1	0

3.8.7. Begging Behaviour

It was difficult to ascertain whether or not the otters were begging. The otters tended to assume the bipedal position whenever something caught their attention outside the enclosure, be it human, animal, or just a loud noise. When zoo visitors were present this behaviour was often attributed to begging. This 'begging' behaviour magnified according to the number of people outside of the enclosure. If the otters were 'observing keeper' their bipedal position and vocalizations often elicited visitors to throw food scraps into the enclosure. These were usually ignored unless they were a meat. However if visitors threw objects such as coins or sunglasses into the enclosure, the otters would seize upon such objects and play with them. Many visitors disregarded the zoo signs which informed them that the otters bit, and attempted to reach out and touch them. At the M.A.C.003 enclosure where contact was possible, the visitors (usually young boys) were bitten.

3.8.8. Eating

The otters usually ate on the edge of, or in water. The exception to this was when they were fed otter's mince. Both pairs then ate at location A.4, conveying the mince to their mouths with their paws/hands. When eating fish the otters grasped the fish with both paws and ate it from the tail to the head. This is probably due to the tail being the fleshiest part of the fish.

They grasped and ate chicks in a similar way.

Although locations A1, A2 and A4 are not identifiable as near water, in M.A.C.001, locations A1 and A4 are bordered on one side by the moat. In enclosure M.A.C.002 location is also bordered by the moat. So where an otter is identified as being at one of these locations it may well be near to, or at the edge of, the moat. Satiation usually terminated a period of stereotypy. (figs. 30 & 31) The final meal of the morning and evening was followed by a period of mutual grooming, self grooming, marking and sleep or rest.

3.9. Enclosure Facilitation

The holts were the most frequently used areas of the enclosures. This is due to the fact that the otters slept for 15 out of 24 hours. Both pairs of otters shared the same holts throughout the studies.

Table 5 Frequency of Location Use

	Location						
Otter	Top Moat	Moat	Stream	A1	A2	A4	Holt
C	19	18	8	0	0	4	0
D	8	0	4	2	0	15	8
F	2	4	12	0	0	1	0
S	2	2	2	0	1	4	0

The frequency and location of the stereotyped behaviour in C and D resulted in their spending 21.6% and 13.2% of their time at location ‘stream’. The next most frequented area was A.4. This area contained the holt entrance where leaves and other nesting materials were placed by the keeper. The otters also used this area for resting and observing behaviours.

Otters F and S facilitated their enclosure to a much greater degree than C and D. However they spent 13.2% and 11.1%, respectively, of their time in location A.1, at the front of the enclosure. This was due to a number of factors.

a) Anticipatory feeding behaviour

b) Location of Holt entrance

c) Area of soft substrate for digging

3.10. Communicative Intentionality

According to Bates (1979) communicative intentionality is defined as:

> *Signalling behaviour in which the sender is aware a priori of the effect that a signal will have on his listener, and he persists in that behavior until the effect is obtained or failure is clearly indicated. The behavioral evidence that permits us to infer the presence of communicative intentions include (a) alterations in eye contact between the goal and the intended listener (b) augmentations, additions, and substitutions of signals until the goal has been achieved and/or exaggerated patterns that are appropriate only for achieving a communicative goal* (Bates 1979:36)

An unexpected result was the evidence of communicative intentionality in otter C during shaping and conditioning. C effectively signalled to the experimenter by magnifying the shaped response and vocalizing to obtain reinforcement. The behaviour took this form. C ran to the top of the slide and reached part of the way down, while looking down the slide. He then looked up at the experimenter making direct eye contact. If a reinforcement was not forthcoming C would then emit a vocalization and lean further forward down the slide. He would again look up at the experimenter, making eye contact and emitting a louder vocalization. This sequence of behaviours would magnify until the otter had been reinforced. If the otter was not reinforced after several instances of this behaviour sequence he would then descend from the slide via the ramp and search the ground for reinforcements that had previously not been eaten. If the otter found any reinforcements he effectively reinforced himself for the behaviours produced previously. If C did not find any stray reinforcements he would then come to the front of the enclosure and beg.

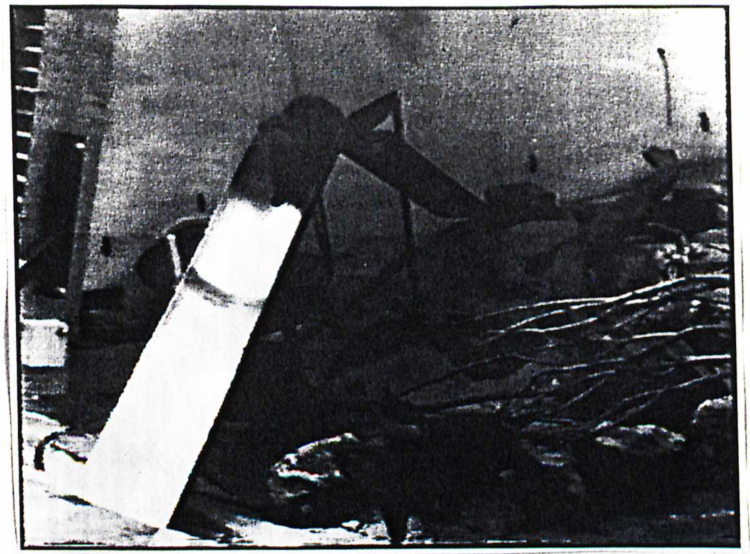


fig. 32 Otter C makes eye contact with experimenter.

fig.33 Performs part of the operant.

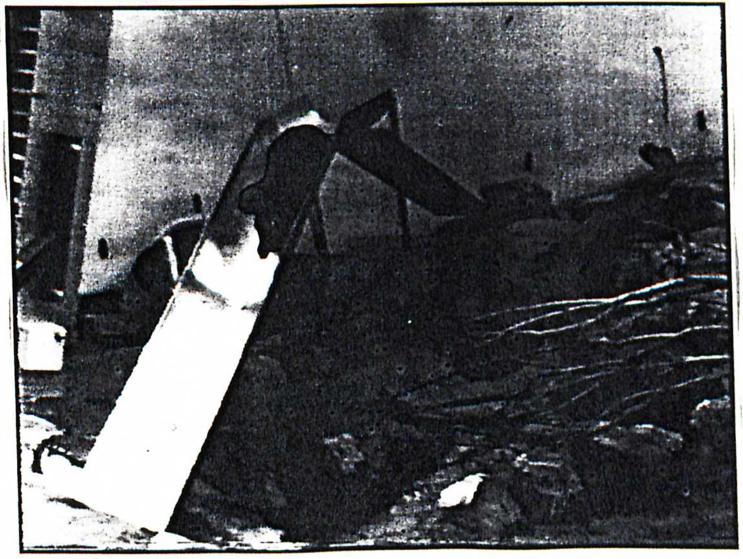


fig.34 Otter again makes eye contact with the experimenter.

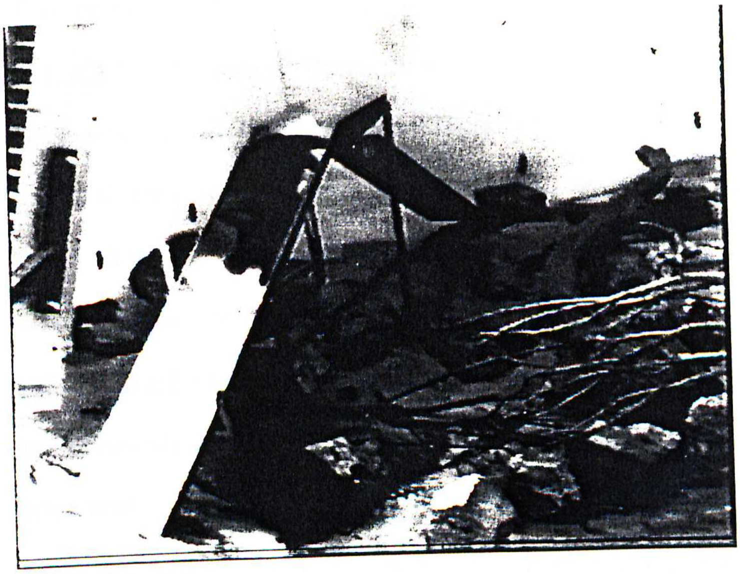


fig.35 Otter magnifies the response until scrabbling, while making eye contact with experimenter.

3.11. Inter-Observer Reliability Trials

Two of the three observers chosen were initially naive of the data collection method used in this study. Observer three, however, had previously spent a number of hours with the experimenter at the otter enclosure while data collection was in progress. All were Psychology graduates who had some idea of ethological methods and the theories driving them. As it was not possible to have all three observers in the field at the same time a sample video tape of one hour was recorded, utilizing the stop watch facility. Otter C was captured, sedated and had a patch of fur shaved off his rump to enable clear identification on video tape as previously stated. The keeper was concerned at the amount of stress this would cause the otter and so it was only done once for the video taping for the inter reliability observers. Even so, two of the inter reliability observers reported identification difficulties and so tended to use behavioural identification instead of physical identification.

The observers were required to identify the behaviours of each otter and their location on the data sheet precisely as the stopwatch reached the five minute increments. Problems occurred using the check sheet which was designed for use in the field when recording observations off video tape. The locations were not as readily identifiable on video. Specifically the stream was obscured by the camera angle as was A1, and the behaviours occurring within A1, by the slide and the camera angle. As a result there were errors in apprehending at A1. The categories 'Observing Visitors' and 'Observing Keeper' were meaningless to two of the inter-reliability observers as neither the visitors nor the keeper were visible on the video. Therefore 'Observing Visitors' was the category used when the otters were seen to be sitting up. Another feature of this study which was generally difficult, was the rapid transition between behaviours by the otters. This was exacerbated by the otters' large behaviour repertoire and the consequently detailed check sheet. The experimenter became adept at identifying the behaviours during the reconnaissance period prior to the study and during the course of the study. This experience was not available to the inter reliability observers and so identifying and checking the behaviours was correspondingly more difficult. Kappa's coefficient of concordance for nominal data was used to check the reliability, as recommended by Lehner (1979:133). This method is more reliable than the "percentage agreement" method as it takes chance agreement into account.

$$\text{Kappa} = \frac{(P_o - P_e)}{(1 - P_e)}$$

P_o = Observed proportion of agreements
P_e = Chance proportion of agreements (Lehner 1979:133)

3.11.1. Observer One

Observer one achieved a low kappa score of .548. She reported difficulty in apprehending Otter D and its behaviour whilst in it was in location A1. However she only made one error out of two possible errors at that location. She was also unable to apprehend whether the otters were observing visitors or the keeper when the otters were sitting up. The rapid behaviour change of the otters foiled accurate recording on two occasions where the the otters changed behaviour seconds after the observation period elapsed. Observer 1 tended to use behavioral clues to identify the otters while they were exhibiting Stereotype/bounce and Observing Visitors at the location 'stream' as the marking of Otter C is not visible at that location. At other times when the marking was visible she used the appropriate physical cue.

3.11.2 Observer Two

Observer 2 found some of the behaviour categories ambiguous, such as the difference between Groom/rub and Groom/roll. He also noted that it was not possible on the video to determine whether the otters were observing the Zoo visitors or the keeper and so allocated the observing behaviours to the 'Observing Visitor' category. He reported difficulty in identifying the otters, but did not use behavioural cues as did Observer 1 but followed the otters from when the marking was visible. He also reported difficulty in following the otters' rapid behaviour changes. Despite these difficulties Observer 2 only made 2 errors, one an apprehending error in location A1, where the behaviour was obscured by the slide and the other where it was not clear what the otters were observing, the Visitors or the keeper. Observer two achieved a very high kappa score of .87.

3.11.3 Observer Three

Observer three had no difficulty identifying the otters using physical cues. However she obtained the lowest score of all the observers with a kappa of .46. The errors made by observer three were different to those of the other observers as she had prior experience of the data collection procedure. This priming effect enabled her to use auditory cues to supplement her observations and as a result attributed the otters' observing to the keeper rather than the visitors, but misapprehended on one occasion. She expressed her difficulty in distinguishing between behaviours, as the stereotypy of Otter D was slower than that of Otter C and was interspersed with bouts of observing the keeper. Three of this observer's errors were due to the effect of latency, and two were due to the priming effect of previous informal observations. One error only was due to misidentifying the behaviour.

Otters are extremely quick moving animals. This caused a considerable number of latency of observation errors in these trials. This, however does not necessarily reflect on the data collected by the experimenter. The aim of the instentaneous scan technique is a random sampling of the behaviour, at a predetermined point in time. As long as the observer is randomly sampling the behaviours and not selecting the behaviours, a more or less accurate picture of the animal's behaviour pattern is achieved. However this technique is limited as it does not tell us about the duration of the behaviours (Lehner 1979:123).

4. Discussion

Stereotyped behaviours are not all elicited by the same stimuli. This is indicated by the large number of different causal theories and the wide variety of forms of the behaviour. It is necessary to examine each case according to its topography, and to apparent environmental factors affecting topography and cause, in order to treat each case appropriately. The results indicated that the stereotyped behaviour of C, D and S was a superstitious behaviour. However this behaviour was not necessarily superstitious in a Skinnerian sense. According to Skinner (1948) the stereotyped response emerges purely through the accidental juxtaposition of reward and response. The superstitious behaviour of the otters however, was part of a "species typical pattern(s) of appetitive behaviour related to feeding" (Timberlake and Lucas 1985).

The stereotyped behaviour exhibited by otters C, D and S was a ritualized form of bipedal observing behaviour. Bipedal observing behaviour is a phylogenetic characteristic of all otters, apart from *Lutra lutra*, the sea otter which is wholly aquatic (Van Blaricom & Estes 1988). This ritualized observing behaviour may or may not have been the result of locomotor frustration as hypothesized by Hediger (1950). Stereotyped behaviour patterns in animals are seen as ritualized initiatory locomotor behaviour, a response expressing frustration or avoidance as a result of environmental deprivation (Hediger 1950, Meyer-Holzaphel 1950,1968). The otters' stereotypy was not, initially, part of a locomotor pattern. However the otters gave every indication of frustration at being subjected to an arbitrary feeding routine and the inability to forage for their own food. Otters C and D produced fossicking behaviour which probed cracks in the substrate, a species specific hunting behaviour They also produced sham feeding behaviour utilizing small sticks and stones. The results of this experiment indicated that the stereotypy ceased once the otters were satiated.

The main hypothesis of the experiment was not tested as the sliding-as-play behaviour was not produced and, therefore, could not be put under operant contingencies. A topographical analysis of the sliding behaviour that was produced, showed an unnatural behaviour. The otter was braced against the sliding movement, attempting it seemed to brake with the forepaws. The form of this behaviour became increasingly distorted and turned into an escape/avoidance response. This indicated that the procedure was aversive to the animal. It also may indicate that the behaviour is not as robust as previously reported.

Even though the operant response was not shaped to contingency in either C or D, an effect was still found. The overall level of the stereotypy in C was not lowered but there was a topgraphical change in the behaviour. The previously constant bouts of bouncing behaviour were interspersed with a single, non repetitive, pace or run along the edge of the moat. Although this behaviour was not abnormal stereotypy, as defined by Baumeister (1973), it formed part of a sequence of stereotypy and was, during periods of high intensity bouncing topographically invariant. When the stereotypy was more relaxed, and so less repetitive the pacing also varied in length and form, occasionally breaking off into exploratory behaviour. This clearly demonstrates that stereotyped behaviour can be brought under operant control. To this level the study was successful in demonstrating that the behaviour can be shaped. This is despite the failure to produce sliding in a natural form, or to produce the operant response of sliding according to S-R contingency.

Although the sliding behaviour occurred seven times it only satisfied the operant definition of the behaviour, not the descriptor. Clode (1989) had a similar result. In both cases the animal performed the desired behaviours (digging and sliding). The digging behaviour produced was not a goal directed behaviour in the sense that the animal was searching for food and also the sliding behaviour was inadvertent and did not fulfill its descriptor of sliding-as-play behaviour. If the behaviours produced in these studies *were* purely defined by their consequences ie:

a) the fennec excavating a substrate with its front paws

and b) the otter traversing a slope in a sliding manner

then this would mask the function of the behaviour.

The failure to teach C to slide can be attributed to two effects. The main effect was an apparatus effect. A problem was the angle of the slide. According to the literature 37 degrees was an optimum angle, and this was the shallowest angle possible in the enclosure without raising the bottom of the slide out of the water, as recommended by Duplaix-Hall (1973). As the otter was highly resistant to sliding and produced escape/avoidance response behaviour, this was obviously too steep. Fifteen degrees would be ample to start with, and the level could be raised once the sliding behaviour had been established. The other effect was neophobia. It took several days before the otters climbed onto the slide during the week of familiarization. The slide was an artificial construction of galvanized iron, not mud or snow like natural slides. The alien nature of this inhibited the familiarization process. Familiarization only occurred when the experimenter covered the ramp and the platform of the slide with beach sand, covering the scent of varnish and steel and rendering it less alien. The otters also use sand for grooming purposes.

According to the literature chimpanzees and human infants who exhibit stereotypies as a result of being reared in a barren environment are neophobic and slow to learn. (Menzel 1963, Baumeister, Menzel *et al* 1963(a), 1963(b) and Forehand 1969) However otter C was quick to learn the reward-contingent behaviour of climbing the ramp and reaching down the slide. Judgement on the speed of learning and/or habituation is considered only in relation to the rate of familiarization in this study. The lack of sliding has to all intents and purposes been accounted for by the apparatus effect as stated above and not due to reduced neuronal development resulting from rearing in a barren environment.

There are inherent problems in the use of operant conditioning in the zoo situation. Traditional laboratory operant conditioning uses naive animals, and utilizes the Skinner Box. The Skinner Box is a superb piece of apparatus developed through trial and error (Timberlake & Lucas 1985). Extraneous visual stimulation is not present and extraneous noise is masked by 'white noise'. This is certainly not the case when teaching otters how to slide at the Adelaide zoo. The otters are not naive subjects, their stereotypy has been inadvertently reinforced for a long period of time simply by the keeper/feeding S-R contingency. This is completely unavoidable. Uncontrolled variables were; weather conditions, equipment malfunction, maintenance work by the keepers and ground staff and, of course, the zoo visitors. The conditioning and shaping of the otters drew large crowds of visitors to the enclosure. The S-R contingency of the otter which was about to slide elicited 'oohs' and 'aahs' from bystanders. Although the study was both educative and entertaining to the public, and valuable as such, the excitement generated did little to facilitate the actual procedure.

The form of a stereotypy is clearly linked to species-specific appetitive or locomotive behaviour patterns. However the effect of the geographical environment upon the topography of the behaviour is underestimated as are other factors such as learning and dominance. Clode (1989) found that the fennec fox lowest in the dominance hierarchy exhibited the highest frequency of stereotyped pacing. However she concluded that in this context the gender factor determined the relative frequency of the behaviour as wild studies show that male foxes exhibit more range patrolling behaviour than females. It is difficult to separate the dominance/gender variables. Studies on the common otter and the North American river otter do not report gender differences in behaviour patterns. This study found that the male experimental pair exhibited a greater frequency of stereotyped behaviour than the female in the 'control' pair. However no direct comparison can be made due to the social and geographic differences. A study on all five of the groups of otters at the Adelaide zoo could determine this, if only for the Asian small-clawed otter in captivity. Such a study could also determine the dominance/subordinate effect in the production of stereotypies.

If the animal lowest on the dominance hierarchy exhibited the greatest amount of stereotypy, then the frequency of the stereotypy could be caused by a displacement of aggression into a seemingly meaningless behaviour, the purpose of which is to regulate the motivational state. This concurs with Hediger's frustration hypothesis but the cause is not located in the frustration of a pure escape response to a restrictive environment. Instead it is an expression of frustration in the animals inability to escape the expression of dominance by its cohorts. This frustration, in the zoo situation, would also be exacerbated by arbitrary feeding schedule.

At the beginning of the study one of the original experimental pair, otter B was translocated to Melbourne Zoo. While this otter was at Adelaide Zoo it exhibited stereotyped bouncing behaviour. Carla Litchfield, a postgraduate student in the Psychology Department, University of Adelaide, visited Melbourne Zoo and made half an hour of non-systematic observations on the pair of otters (*Aonyx cinerea*) which she reported in a personal communication. (Appendix F) She observed that the enclosure at Melbourne Zoo was considerably different to that at Adelaide in "respect to size, topographical features and layout" (pers. comm. Appendix F fig.1) The enclosure at Melbourne Zoo was surrounded by an approximately 5 foot "Colourbond" fence which forced the otters to look up at the zoo visitors.

These otters exhibited a "propping" form of stereotyped behaviour which was oriented towards zoo visitors in anticipation of food (Appendix F figs.5, 6a). If the visitors did not feed the otters they would often leave the area and continue on with other activities. It was noted that the zoo visitors fed the otters with scraps of bread and chips, effectively reinforcing them for this behaviour. They also "propped" at the entrance of the enclosure in anticipation of being fed by the keeper. There was a small gap at the top of this door enabling them to see out (fig. 2a Appendix F). The otters also jumped up towards the visitors while they propped at the fence to enable them to get closer to the visitors (fig.4 Appendix F). Litchfield (1990) reported that this behaviour could be seen as analogous to the bouncing behaviour exhibited by the otters at Adelaide Zoo (pers. comm.) So at some time during the intervening months Otter A's stereotypy changed from stereotyped bouncing to stereotyped propping and jumping-up. This indicates that the behaviour was mediated by the geographical environment.

4.1. Future Studies

Future studies could look at any number of variables affecting stereotyped behaviours as there are four enclosures exhibiting fourteen otters at Adelaide Zoo. A comparison between more than two groups could identify the dominance factor affecting stereotypy. Or alternatively the two groups of otters exhibited where n>2 could be observed comparing level of stereotypy and dominance. Alternatively spatial and social density variable differences between the four groups could be analysed in terms of stereotyped behaviour. However there is still an inherent difficulty in identifying individuals.

In this study operant intervention affected the topography of the stereotypy. This study could probably be repeated with greater success if the apparatus was modified to reduce the angle and if it was made more naturalistic. This naturalistic aspect is important to reduce the environmental impact and to encourage familiarization and subsequent use of the apparatus. A variable apparatus could be constructed that allowed the otter to be shaped on a very low angle or just a runway. The slide could then be raised by small increments which should then subsequently modify the topography of the behaviour to sliding. A suitable intervention could be providing the otters with objects to encourage manipulative play, the most common form of play found in this study.

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Appendix A

Behaviour Checklist

Animal	Cond:	Day:	Hour:													
Locn.	R. Holt	L. Holt	Tree	Top Moat	L. Moat	R. Moat	Stream	A1	A2	A3	A4	Slide	Ramp	Feeder	Comm.	
Behav.																
running																
walk																
dog paddle																
diving																
Play with other																
Play with object																
Expl.																
Obs. visitors																
Obs. obs.																
Obs. Keeper																
Su B																
St/B. Circles																
St/B. Paddle circles																
Sliding																
Voc. chirp																
Voc. scream																
Eating																
Drink																
Spraint																
Gr. Rub																
Gr. Roll																
Gr. Allo																
Gr. Self																
Mark																
Resting																
Sleep																
Mating																

Appendix B

Zoo Sign

The University of Adelaide Psychology Dept.

in conjunction with

The Royal Zoological Society of S.A.

We are trying to enrich the otters' environment in several ways. We will be rewarding the otters' play behaviour (which includes sliding) and noting how this changes their other behaviours.

Appendix C

Research Application

RESEARCH APPLICATION

1. RESEARCHER: Rachel Mellowship
University of Adelaide, Phone:
Psychology Department

2. SUBJECT: Honours Psychology
University of Adelaide

3. TOPIC: Reinforcing play behaviour in Asian Small-clawed Otters (Amblonyx Cinerea).

4. SUPERVISOR: Dr. Frank Dalziel

5. OBJECTIVE:

1) To alter, in some way, stereotyped behaviour by reinforcing play behaviour.

2) To determine whether there are topographical differences in play behaviour when reinforced, as opposed to natural spontaneous play behaviour.

6. SUMMARY: The form of the study shall be as follows:

1) A 24 hour baseline study of the otters' behaviour will be conducted using video equipment and behavioural check lists. This will be replicated with a control group.

2) A slide will be introduced to the enclosure and the otters' response will be observed and quantified as above.

3) The otters will be shaped, using food reinforcement delivered into the moat, to using the slide. Their behaviour will be quantified as above.

4) Reinforcement will cease and the behaviours will be recorded quantitatively and qualitatively as above.

The quantity of food reinforcements shall be subtracted from the daily food allowance.

If there is agonistic behaviour between the otters during reinforcement then that phase of the study shall cease immediately.

The materials will be supplied by the University of Adelaide. However access to power and some storage for equipment is required.

The study should commence in early May and end about July.

7. PUBLICATION OF RESULTS: The proposed study is an Honours Thesis and so a copy will be held at the Barr Smith Library and the Zoo shall also be provided with a copy. However it may be published at some later date.

8. REQUEST FOR FUNDING: Only require some staff time and access to power. The University shall provide other materials.

Signed: Rachel Mellowship
10th April, 1990

Appendix D

Frequency Tables of All Behaviours and Location Use

	Otter 'c'		Otter 'd'	
	Frequency	Percentage	Frequency	Percentage
Running	12	0.9	3	0.2
Walking	6	0.5	14	1.1
Dog Paddle	6	0.5	1	0.1
Diving	9	0.7	3	0.2
Play	7	0.5	8	0.6
Explore	39	3	40	3.1
Observing	97	7.5	134	10.4
Stereotypy	240	18.5	87	6.7
Eat	34	2.6	37	2.9
Drink	4	0.3	7	0.5
Spraint	4	0.3	6	0.5
Groom	25	1.9	33	2.6
Mark	78	6	33	2.6
Rest	134	10.3	240	18.5
Sleep	591	45.6	628	48.5
Nest	5	0.4	13	1
Hide	5	0.4	7	0.5
Totals	1296	100	1294	100

	Otter 'f'		Otter 's'	
	Frequency	Percentage	Frequency	Percentage
Running	3	0.5	7	1.2
Walking	5	0.9	7	1.2
Dog Paddle	0	0	1	0.2
Diving	1	0.2	5	0.9
Play	8	1.4	4	0.7
Explore	38	6.6	29	5.1
Observing	30	5.2	50	8.7
Stereotypy	0	0	9	1.5
Eat	19	3.3	11	1.9
Drink	1	0.2	1	0.2
Spraint	2	0.3	4	0.7
Groom	19	3.3	18	3.1
Mark	2	0.3	0	0
Rest	91	15.8	69	12
Sleep	345	59.9	344	59.9
Mating	3	0.5	6	1
Nesting	6	1	7	1.2
Hiding	1	0.2	1	0.2
Dig	2	0.3	1	0.2
Total	576	100	574	100

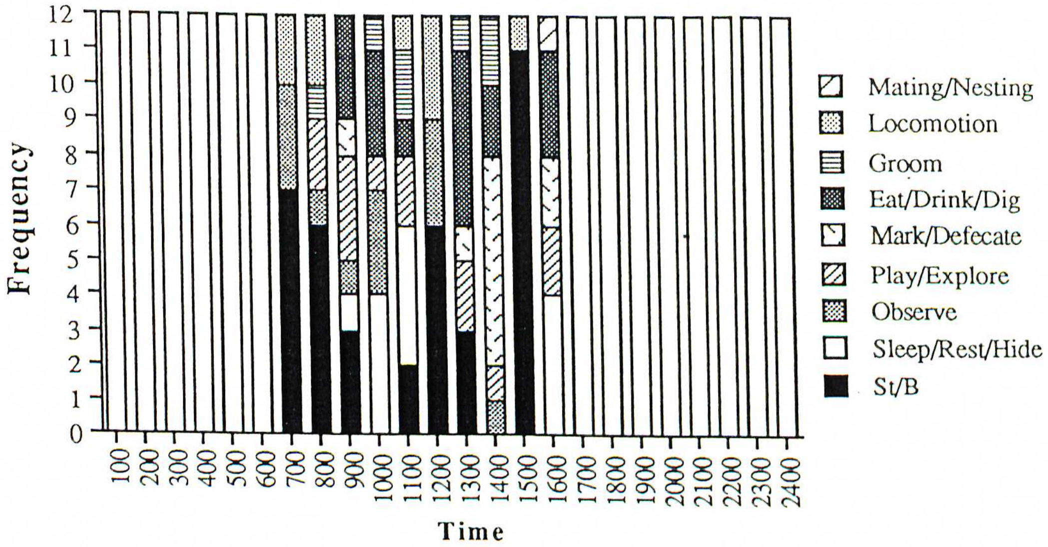
All Location Frequencies

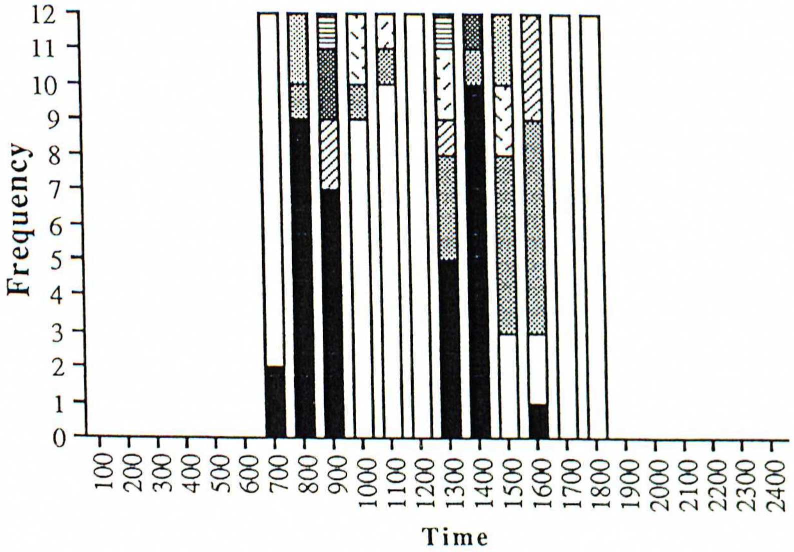
	Otter 'c'		Otter 'd'	
	Frequency	Percentage	Frequency	Percentage
Holt	742	57.3	865	66.8
Top Moat	22	1.7	13	1
Moat	36	2.8	15	1.2
Stream	280	21.6	171	13.2
A1	34	2.6	44	3.4
Tree Branch	51	3.9	11	0.9
Log	16	1.2	17	1.3
A4	110	8.5	138	10.7
Slide	2	0.2	16	1.2
Ramp	3	0.2	4	0.3
Totals	1296	100	1294	100

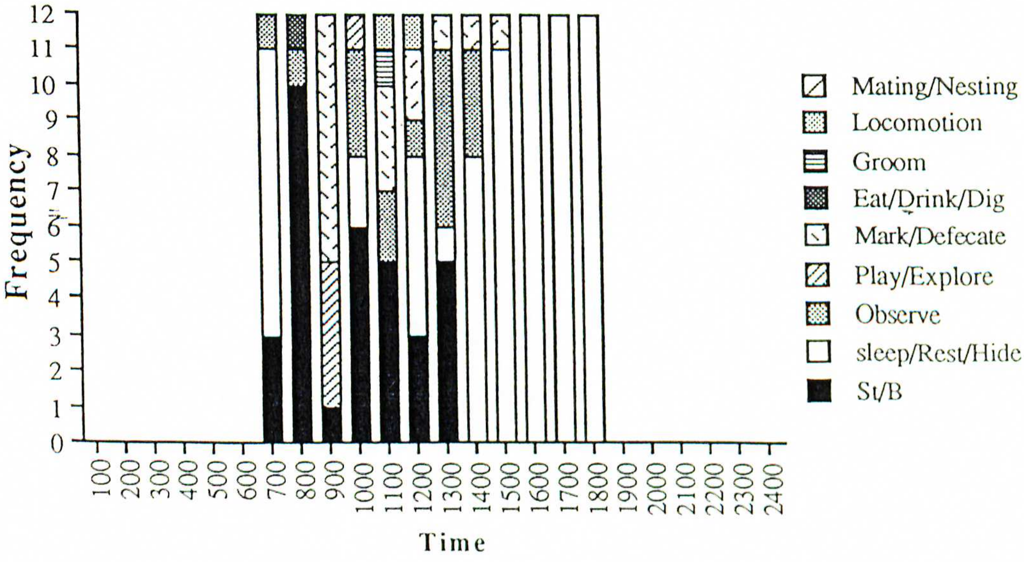
	Otter 'f'		Otter 's'	
	Frequency	Percentage	Frequency	Percentage
Holt	382	66.3	383	66.7
Top Moat	11	1.9	8	1.4
Tree	0	0	14	2.4
Moat	19	3.3	20	3.5
Stream	21	3.6	10	1.7
A1	76	13.2	64	11.1
A2	29	5	32	5.6
A3	12	2.1	13	2.3
A4	20	3.5	25	4.4
Log	6	1	5	0.9
Totals	576	100	574	100

Appendix E

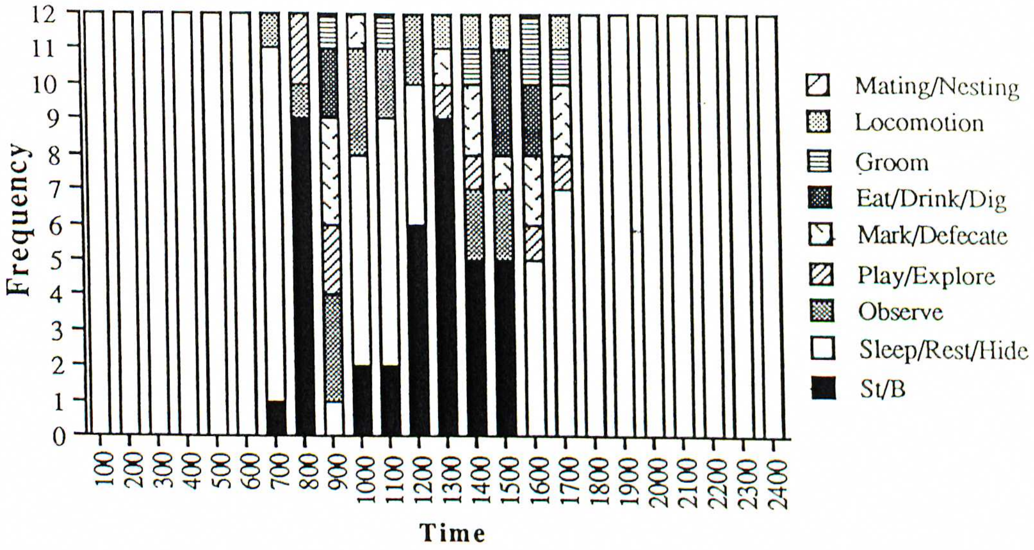
Frequency Histograms of All Otters Behaviours, Over All Conditions.


C: Baseline Condition 1 (24hr)

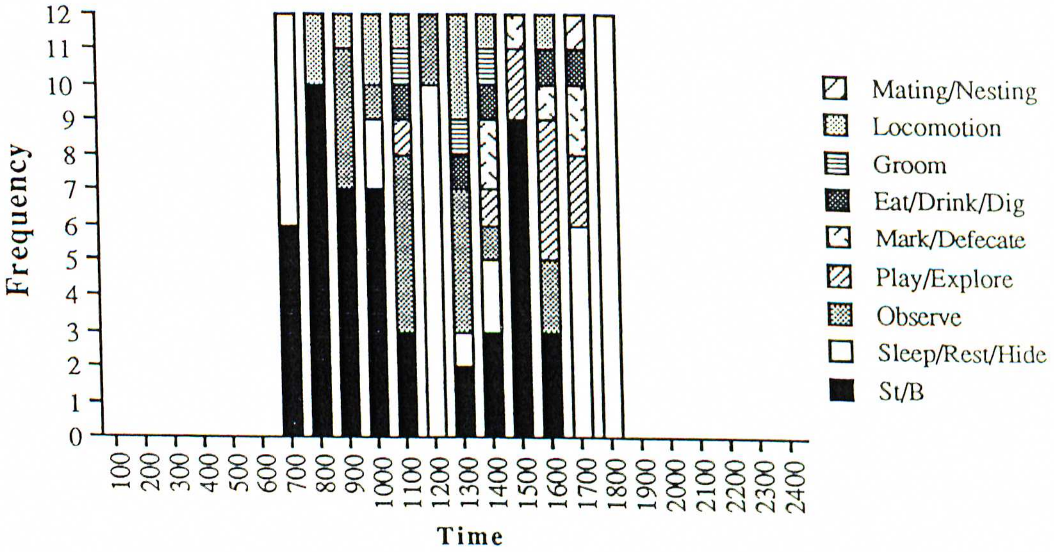

C: Condition Familiarization 1 (12hr)


C: Condition Familiarization 2 (12hr)

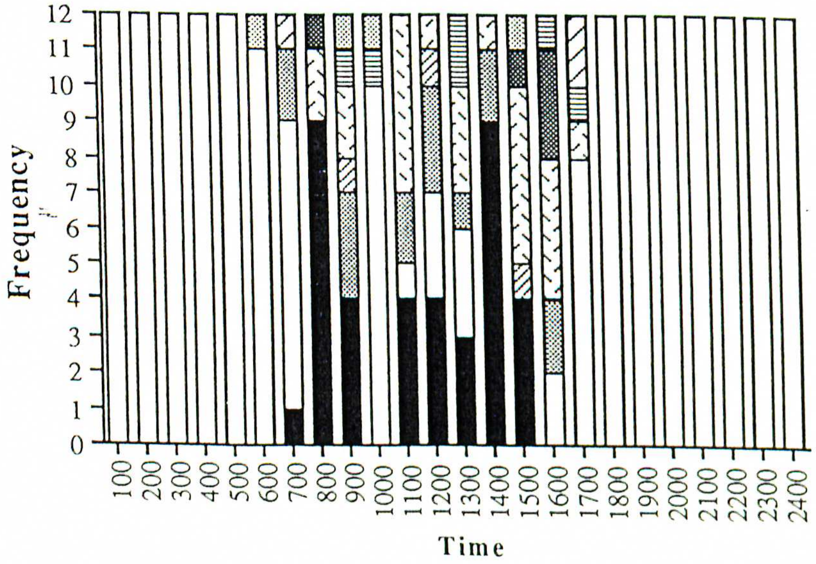
Otter C: Condition S Δ 1



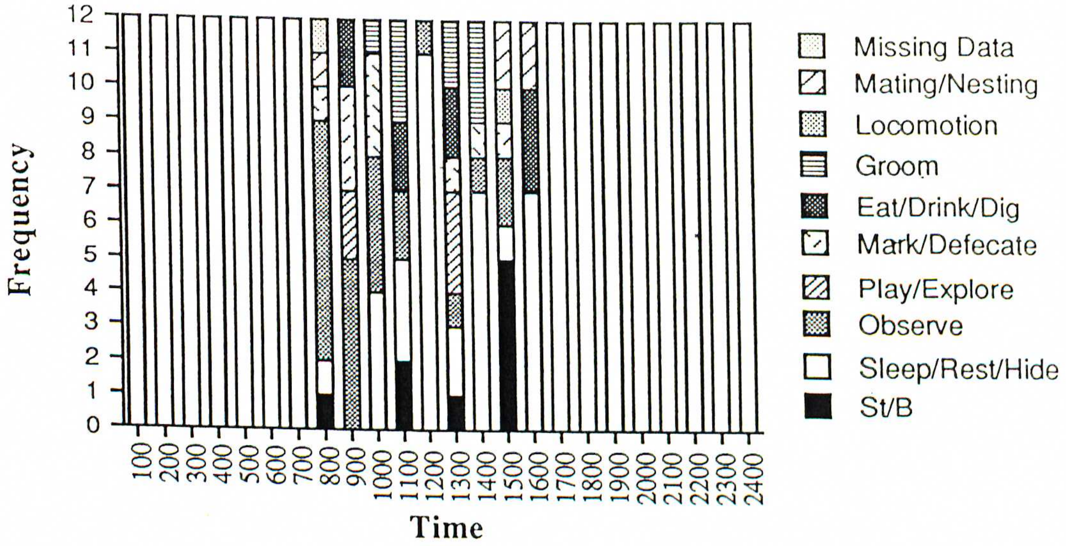
Otter C: Condition S Δ 2 (12hr)



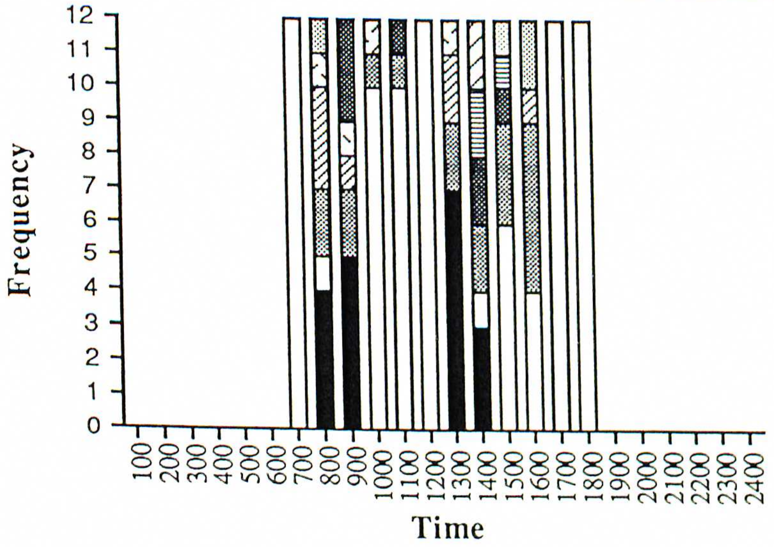
Otter C: Baseline Condition 2



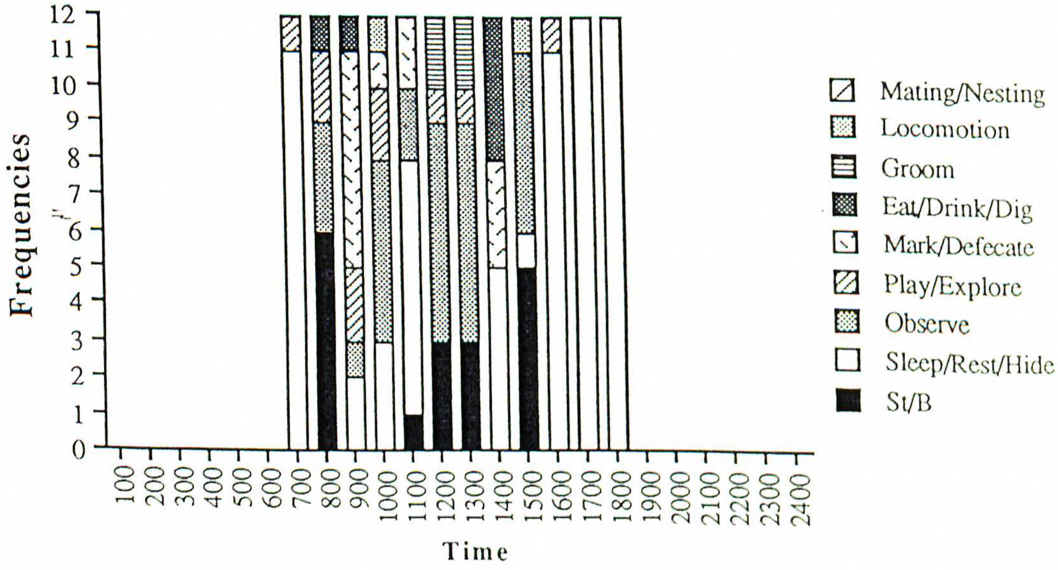
Otter D: Baseline Condition 1 (24hr)



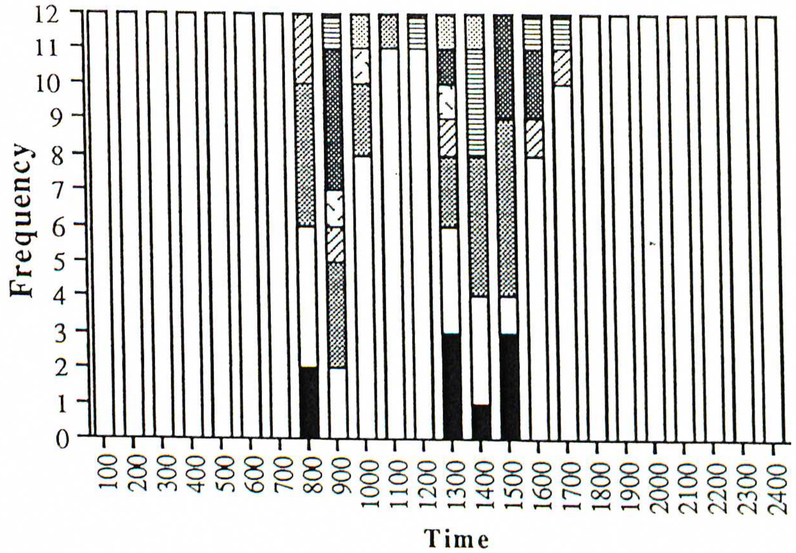
Otter D: Familiarization Condition 1 (12hr)



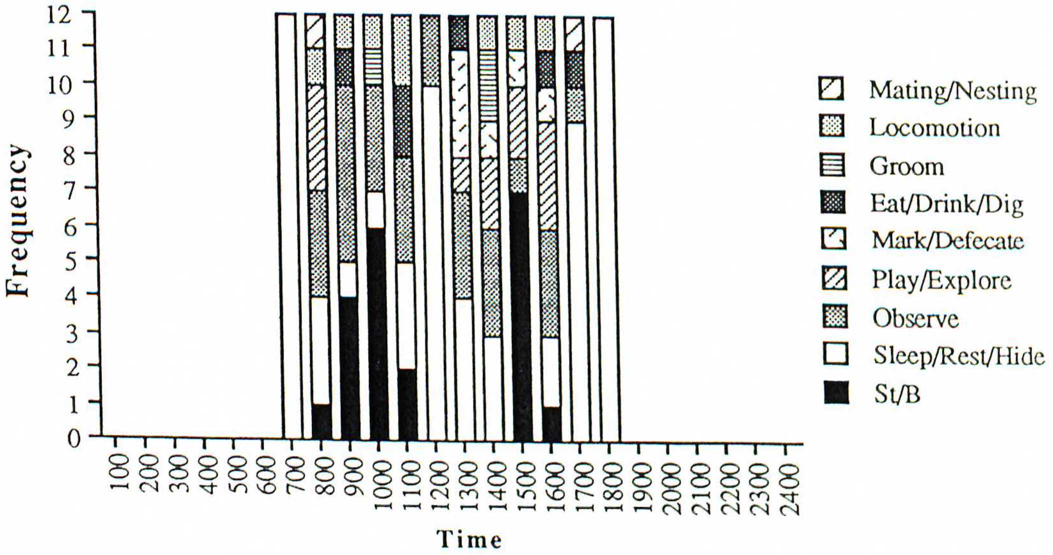
Otter D: Familiarization Condition 2 (12hr)



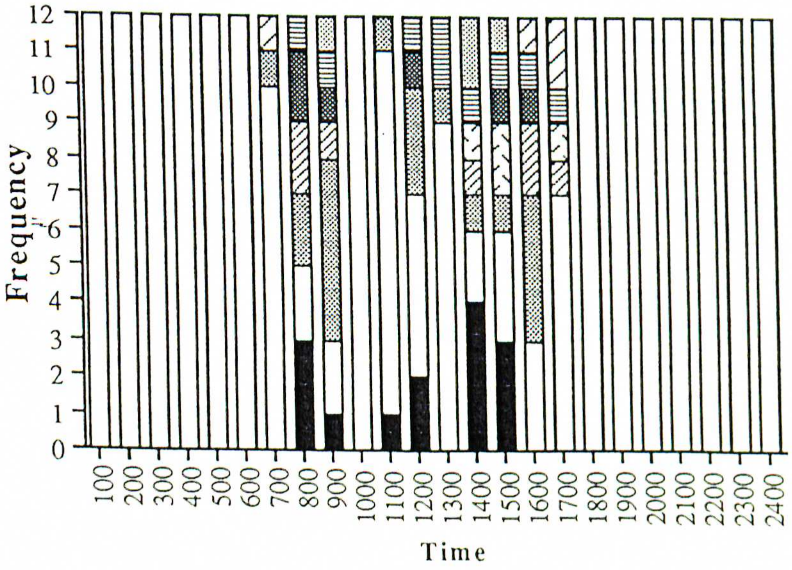
Otter D: S Δ Condition 1 (24hr)



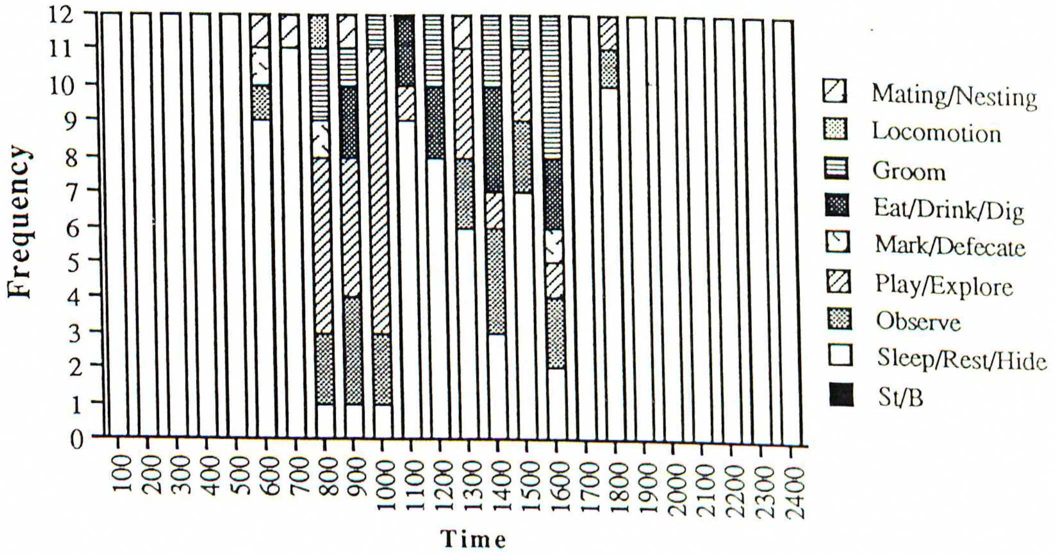
Otter D: S Δ Condition 2 (12hr)



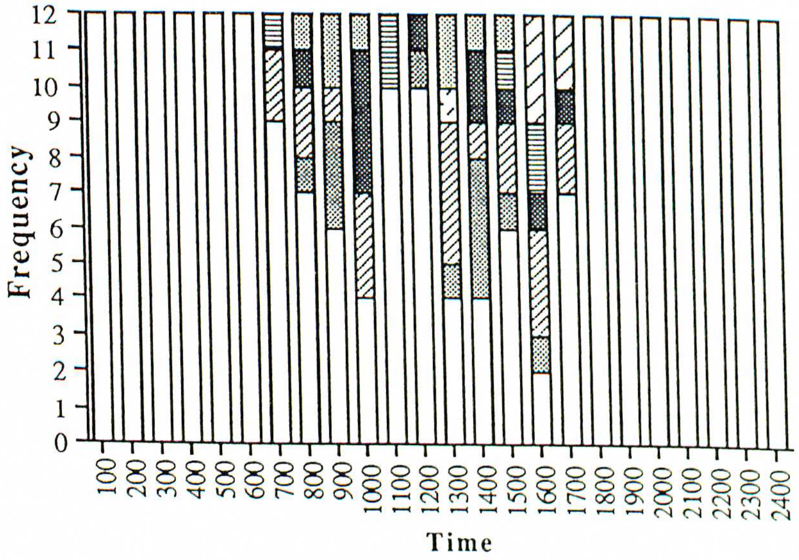
Otter D: Baseline Condition 2 (24 hr)



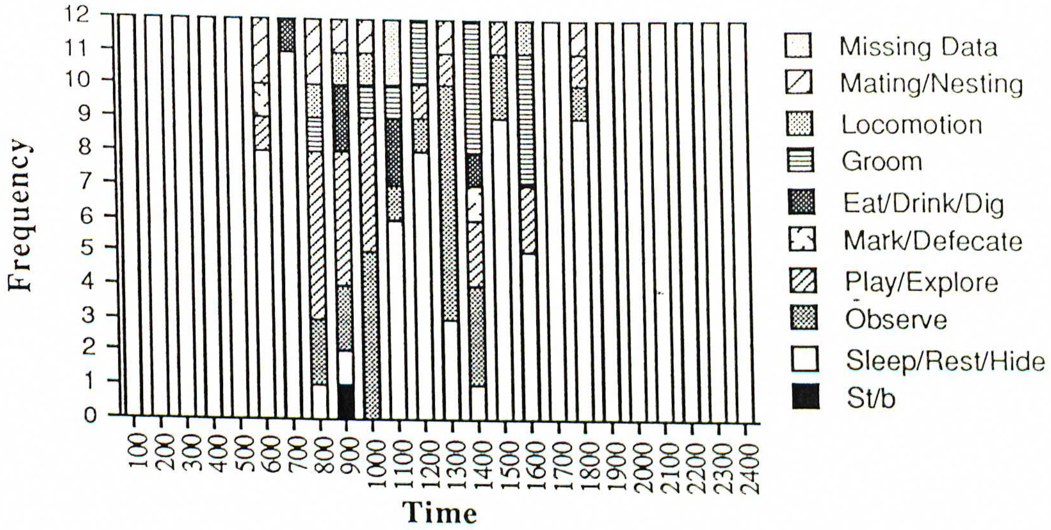
Otter F: Baseline Condition 1 (24hr)



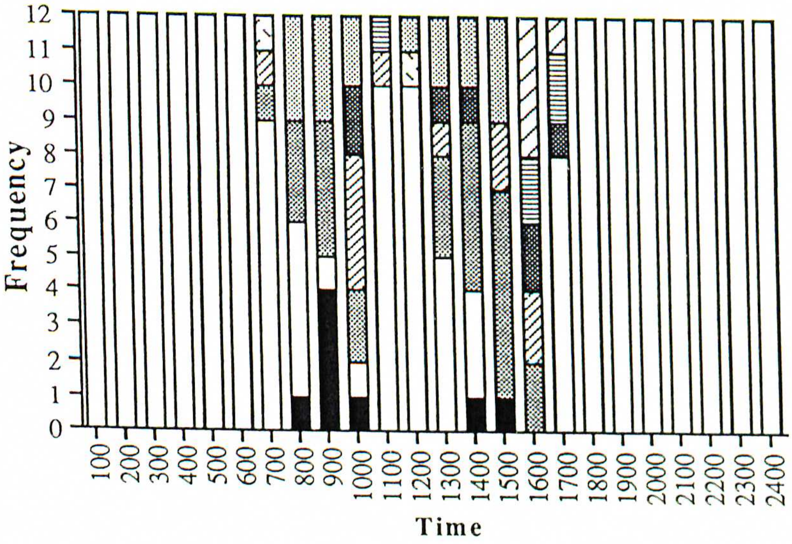
Otter F: Baseline Condition 2 (24hr)



Otter S: Baseline Condition 1 (24hr)



Otter S: Baseline Condition 2 (24hr)



THE UNIVERSITY OF ADELAIDE
BOX 498, G.P.O., ADELAIDE, SOUTH AUSTRALIA 5001

Department of Psychology

30th September 1990

Dear Rachel,

the following observations were made on Saturday 21st September 1990 at the Melbourne Zoo (approx. 2.30 p.m.). I hope you find the behavioural descriptions, photos and diagram of some use.

All the best!!

Carla Litchfield

Telephone (08) 228 5333 FAX: (08) 22-40464 Telex: UNIVAD AA 89141

(2)

Non-systematic observations of Oriental small-clawed otters (*Aonyx cinerea)* at the Melbourne Zoo.

Carla Litchfield, University of Adelaide

Two male Oriental small-clawed otters are on display at the Melbourne Zoo. The oldest is ten years old (born 1980), and the youngest is three years old (born 1987). The younger of the two was transferred from Adelaide Zoo approximately 3 months ago. The otters share their enclosure with two binturongs (*Arctictis binturong*), or "bear cats". The older of the two binturongs (born 1976) is a male, and the younger (born 1977) is a female.

Although the two species share some similar distributions throughout Asia (e.g., India, Borneo and Palawan Islands), Oriental small-clawed otters are amphibious (aquatic and terrestrial), whilst binturongs are largely arboreal. Binturongs (family: Viverridae; subfamily: Paradoxurinae) are one of two carnivores (the other being the Kinkajou, *Potos flavus*) with a prehensile tail (Duplaix and Simon, 1976). The "bear cats" are primarily nocturnal, and are reported to spend their days asleep in tree hollows, empty burrows or rock crevices (Wemmer, 1984). As can be seen from figure 1, the enclosure provides the binturongs with a large tree, two hollow logs and a rocky "cave". Neither binturong was active during the half-hour observation session, with one asleep in the "cave" (see figure 8b) and the other curled up asleep on the ground near the logs. The otters did not interact with the binturongs in any way.

Duplaix (1984) states that otters belonging to the *Lutra* species, and the Giant otter are "mouth-oriented" (e.g., using their jaws to catch fish underwater), whilst the Oriental short-clawed otter is "hand-oriented" (e.g., using its forepaws to grab at prey). Oriental short-clawed otters have partly webbed forepaws, with short dextrous fingers and tiny vestigial claws. As Duplaix (1984) points out, the "finger-otter's" (as they are called in German) acute sense of touch allows it to search out prey with its sensitive forepaws (p.117). The "digging" that was observed in the two otters at the Melbourne Zoo, may have been an example of such searching for prey (see figures 7a and 7b). This "digging" behaviour involved using both forepaws to feel under the wooden slabs, with the whole forelimbs disappearing into the crevices. Sand and other materials from under the slabs were swept out to the sides. In each instance, the otter was lying down with the body positioned directly in front of the wooden slab. These slabs were layed out in stepwise formations at the lower edges of the rise leading to the central hillock of the enclosure. The single tree, logs, rocks, patches of bamboo, cave and pond were all located on the hillock (as is represented by the central "tear-drop" shaped area on figure 1).

The enclosure that houses the Oriental small-clawed otters at the Melbourne Zoo differs quite markedly from the enclosure (used in your study) at the Adelaide Zoo. The enclosures differ with respect to size, topographical features and layout. The Melbourne Zoo enclosure is much larger, as in fact it needs to be, since it also houses the two binturongs. Binturongs are bigger than otters (at least twice the head-body length, and three to four times heavier), are solitary animals, and since they occupy different ecological niches to otters they have different living requirements (Wemmer, 1984).

The differences in the Adelaide and Melbourne Zoo enclosures are reflected in behavioural variations between the two pairs of otters. As can be seen from figure 2a, the Melbourne Zoo enclosure is surrounded by an approximately five-foot high fence. This five-foot drop along the fence at the visitor viewing areas requires the otters to look up, and the visitors to look down (see figure 6a). Whenever new visitors arrived arrived during the half-hour observation session, both otters raced over to the fence, and either propped up against the fence (i.e., standing up on the back legs with forepaws resting against the fence), or stood slightly back from the fence on their hind legs (see figure 5). However, once so positioned they did not remain passive. Instead they were observed to launch themselves up off the ground towards the visitors. Figure 4 shows one of the otters in mid-jump. Has this jumping up behaviour been reinforced by visitors to the otter enclosure? Although a "PLEASE DO NOT FEED" sign is displayed prominently, a number of visitors were observed to feed the otters with scraps of bread and chips. The visitors only fed the otters when they were directly below, and in either propping or jumping positions. During the half-hour observation session, a keeper walked through the pathway behind the otter enclosure. The otters moved to the small doorway opening onto the pathway, and propped themselves against the entrance (see figure 2a).

The jumping-up behaviour of otters at the Melbourne Zoo may be analagous to the bouncing observed in otters at the Adelaide Zoo. Bouncing may bring the otters closer to the eye-level of the visitors. To reach eye-level at the Melbourne Zoo, the otters have to position themselves higher up on the central hillock. However, this removes them from close proximity to the visitors. Thus, to be close to the visitors, who sometimes (perhaps often) feed them (somewhat like being on a Variable Ratio schedule), the otters must be directly below the visitors, and then jump upwards to further close the gap. Some bouncing was also observed in the Melbourne Zoo otters, but not to the extent of the otters at the Adelaide Zoo.

During the half-hour observation session, the otters spent only a small amount of time engaged in swimming. It was merely one of many behaviours observed. The two otters at the Melbourne Zoo spent all their time together, engaging in similar behavioural sequences. This was not surprising, since Oriental small-clawed otters are known to be social animals, living in extended family groups in the wild (Wemmer, 1984).

REFERENCES

Duplaix, N., and Simon, N. (1976). *World Guide to Mammals.* London: Treasure Press.

Duplaix, N. (1984). Otters. In D. Macdonald, *All the World's Mammals: Carnivores.* New York: Torstar

Wemmer, C. (1984). Civets and Genets. In D. Macdonald, *All the World's Animals: Carnivores.* New York: Torstar

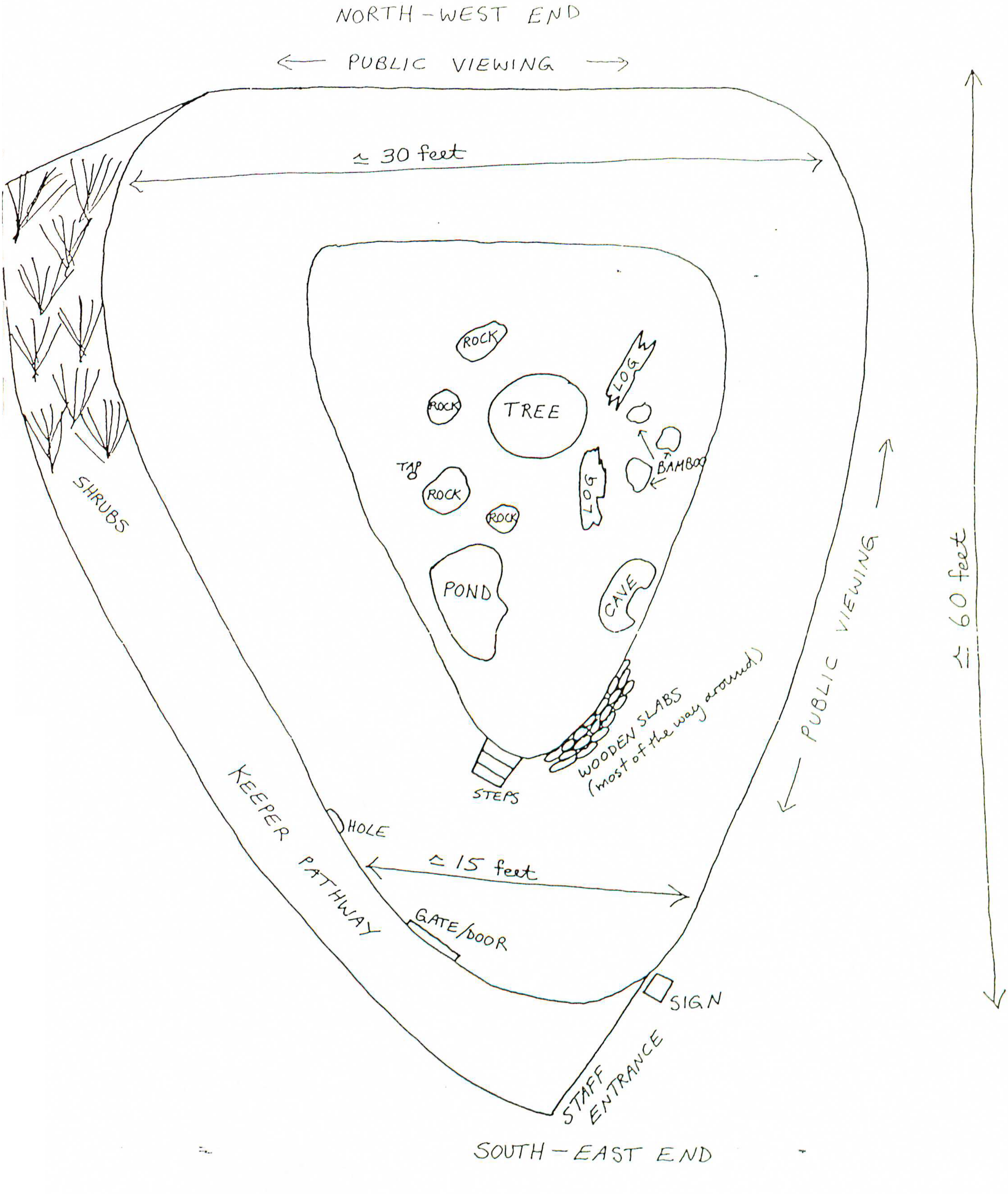


Figure 1: Diagram of the enclosure that is shared by two Oriental small-clawed otters and two binturongs. Estimates of the enclosure's dimensions, and diagramatic representations of the various topographical features are given.

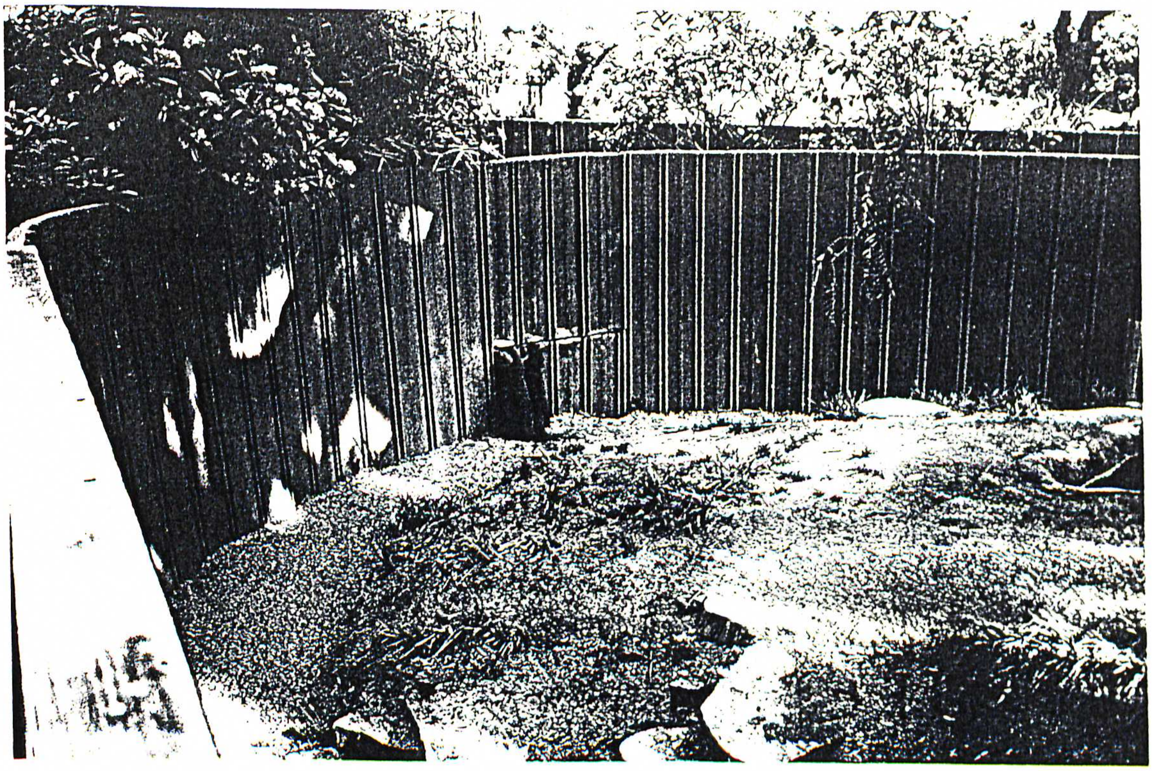


Figure 2a: View of the otters "propping" against the entrance to the enclosure. On the far right, the edge of the pond is visible. Some of the wooden step-like slabs can be seen in the foreground.

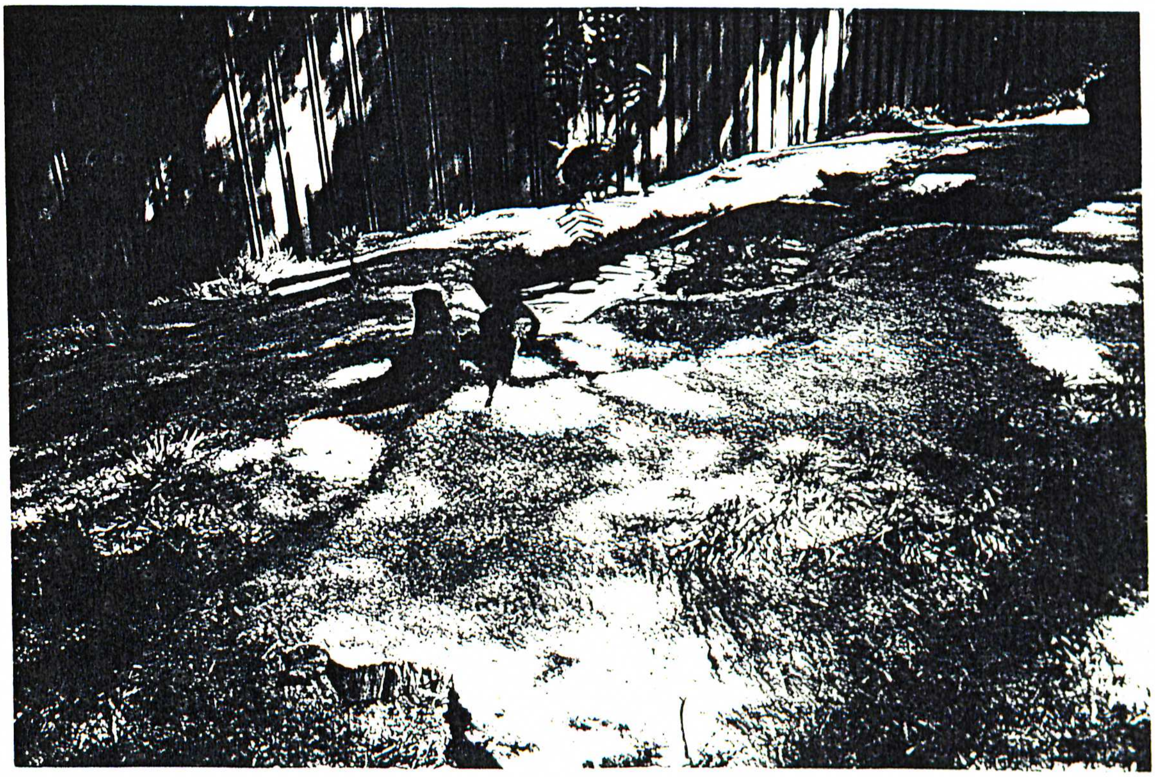


Figure 2b: View of the small pond, which is the only body of water in the enclosure.

Figure 3: Photograph of the signs displayed to the public outside the enclosure.

Figure 4: View of one of the otters in mid-jump, in front of the south-eastern fence, where most of the visitors congregate and look down at the otters.

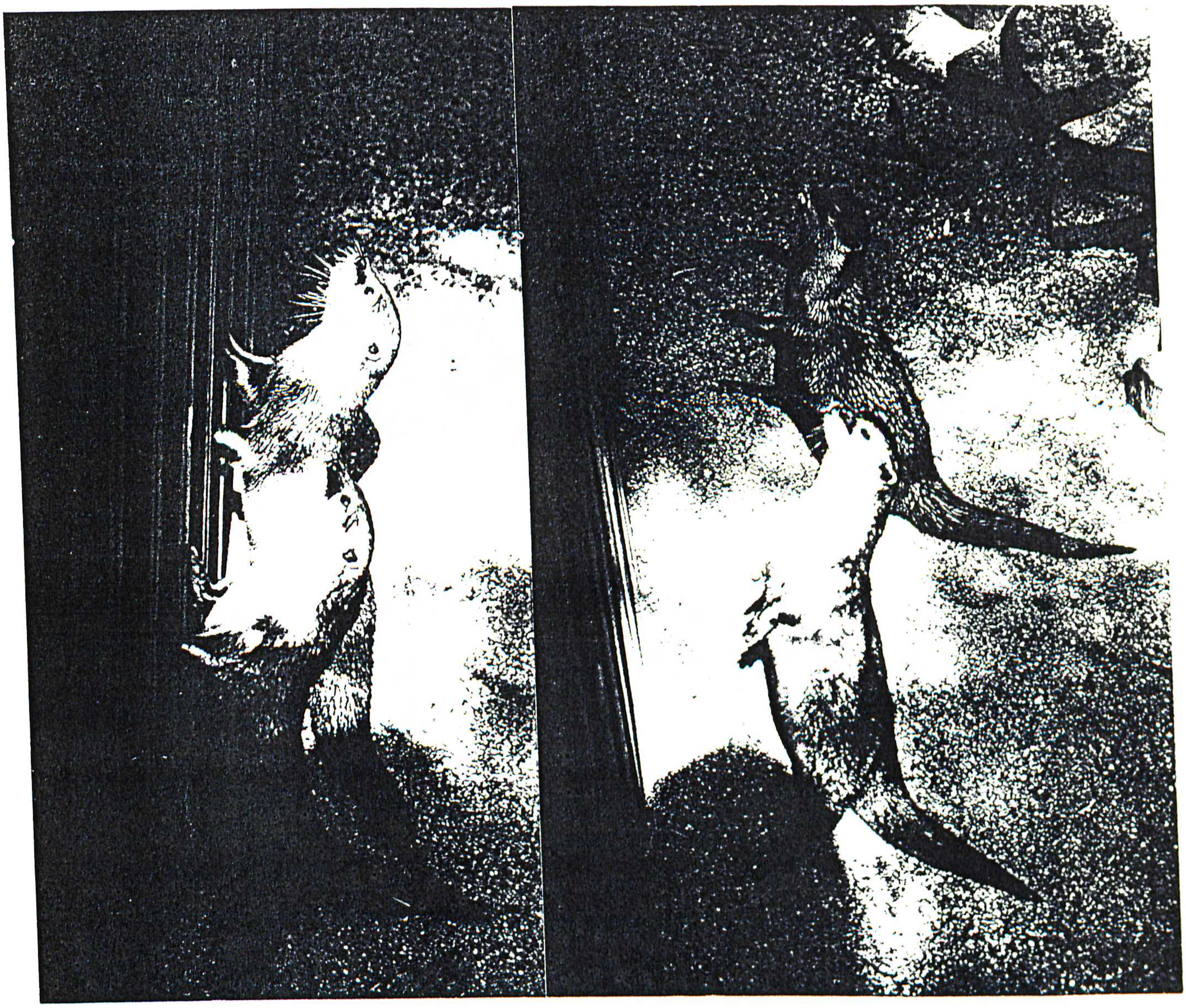


Figure 5: Photographs showing the two otters "propping" against the fence and standing back from the fence. In both cases they are looking up at the zoo visitors.

Figure 6a: Looking down at the otter from above. The approx. five foot drop along the fence forces the otters to always look up at visitors.

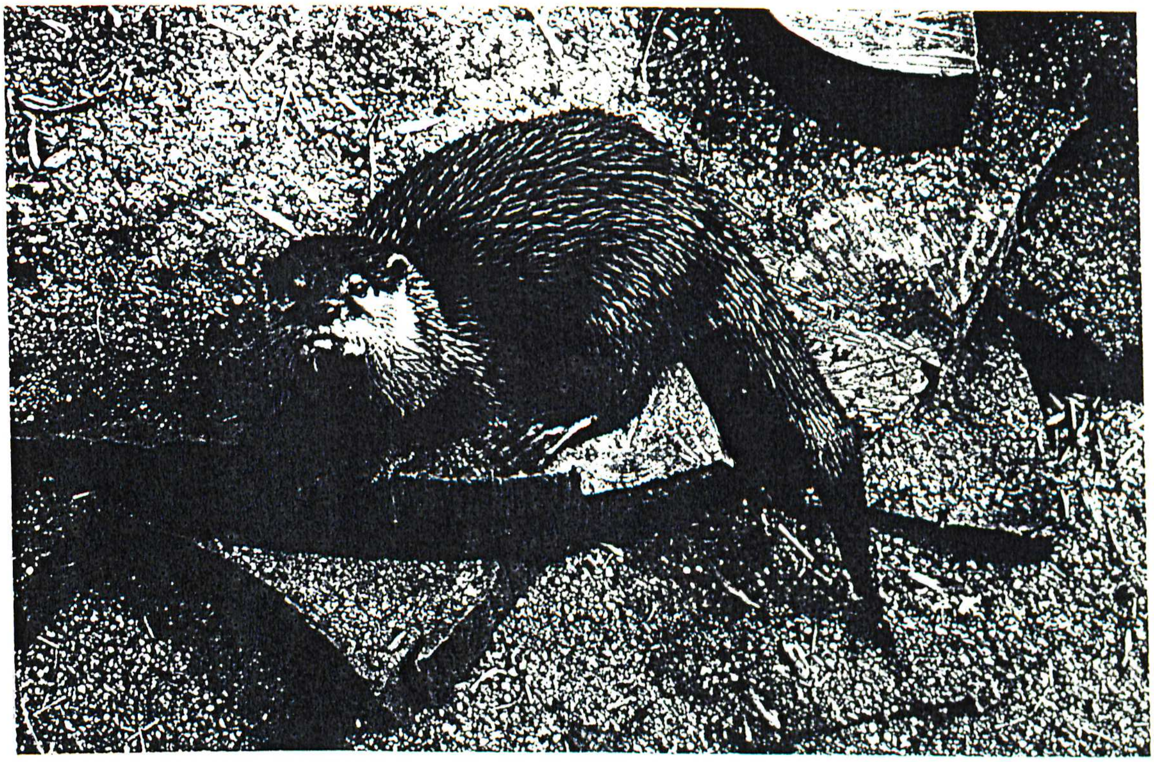


Figure 6b: One of the otters resting on a wooden slab. These slabs create a step-like fromation rising towards the rise of the central hillock in the enclosure.

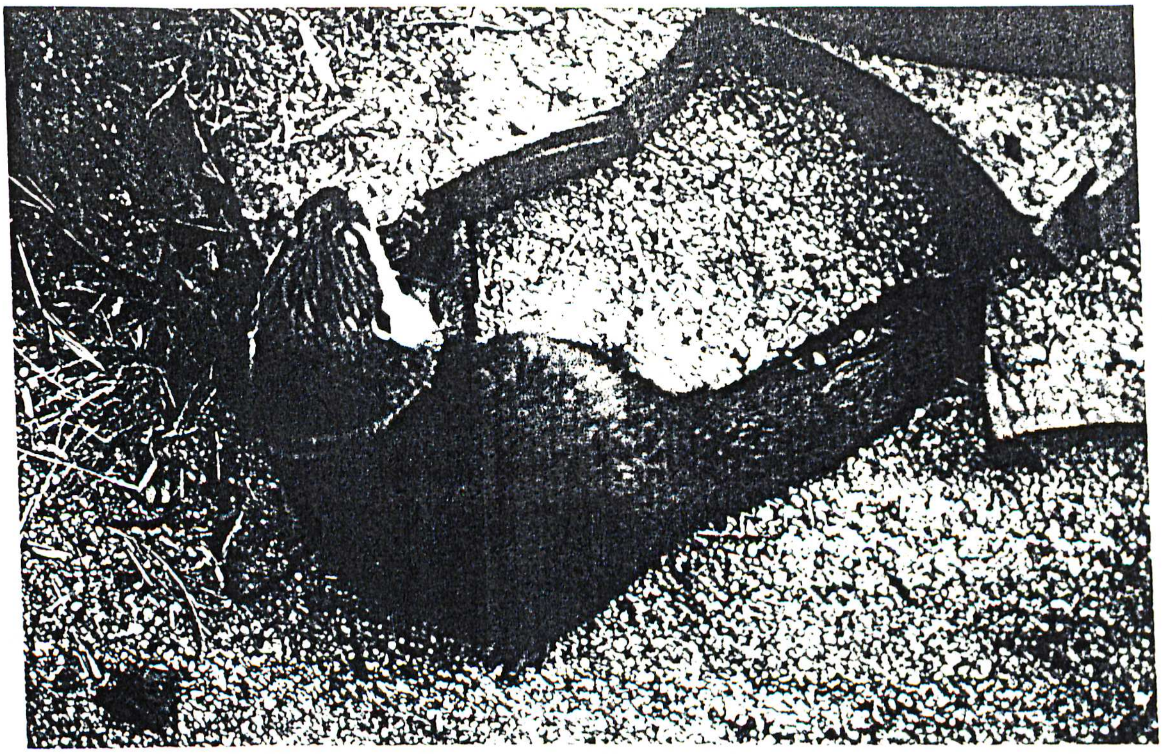


Figure 7a: A view of the "digging under the wooden slabs" behaviour observed. The otter would lie directly in front of a wooden slab, with its forepaws wedged in the gap underneath the slab. The forepaws would sweep the sand out towards the sides.

Figure 7b: Photograph showing both otters "digging" under the wooden slabs.

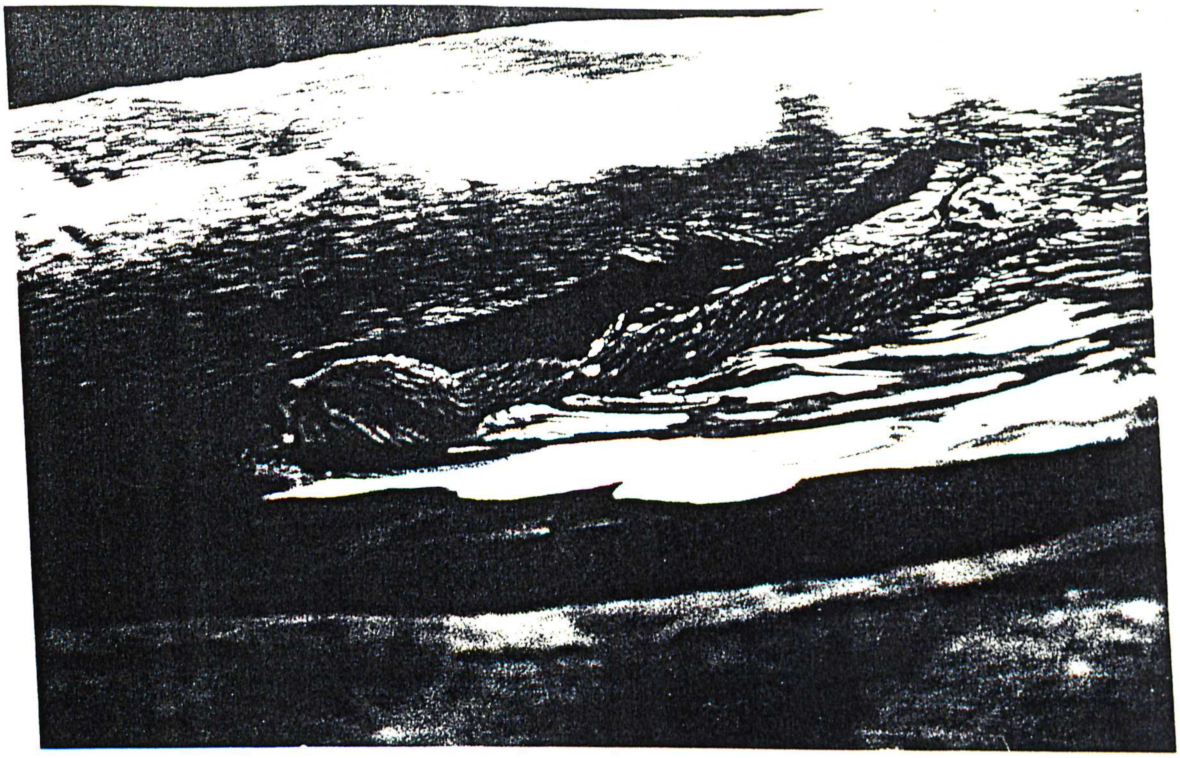


Figure 8a: Swimming in the small pond was only one of the behaviours demonstrated by the otters. Not much activity appeared to be centred around the body of water, especially when visitors were watching.

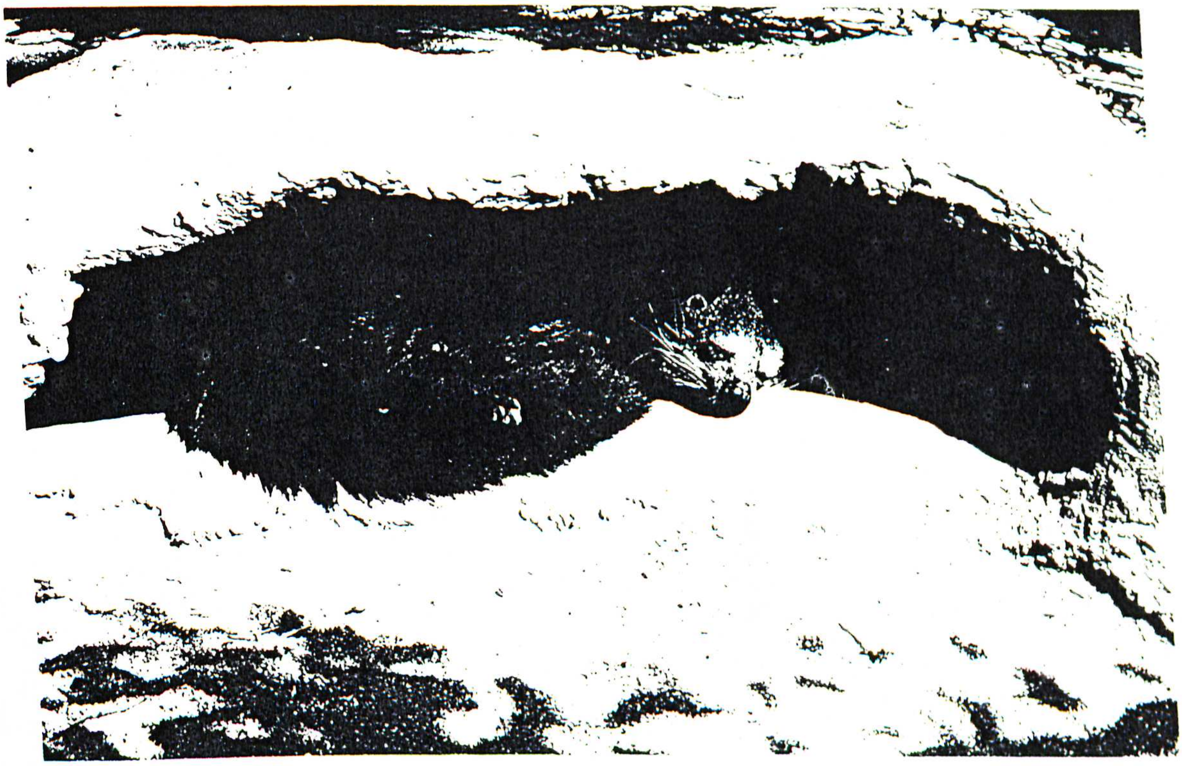


Figure 8b: View of one of the binturongs sleeping in the "cave".