DOES HABITUATION TO HUMAN CONTACT OCCUR DURING THE REHABILITION PROCESS OF THE SEAL, *PHOCA VITULINA*?

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2006

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ABSTRACT

The harbour or common seal (*Phoca vitulina*) inhabits many sites around the British coastline, favouring in particular sandy estuaries and sheltered areas of rocky shores. The pupping season of the harbour seal usually falls in the months of June and July and it is around this time when marine-mammal rescue centres such as the Sea-Life Centre and seal hospital at Hunstanton in Norfolk are busy with rescued seal pups. The majority of rescues of pups are due to maternal abandonment, although some are due to injury or illness. Once rescued, seal pups are taken to the centres and put through a rehabilitation process where they are treated for any problems, taught to feed independently and then to compete for food against conspecifics. This study looked at the degree to which rescued seal pups become habituated to human contact during their time in the Hunstanton Sea-Life centre. For four key behaviours (Watching, Smelling, Vocalising and Moving), frequency of the behaviours, reaction distance to human approach and latency to behaviour were recorded. The results show clear changes in seal pup behaviour measured against time spent in captivity in the centre. Visual and olfactory recognition in particular showed a pronounced change over time, but in different directions. Latency to smell increased over time whereas latency to watch decreased. The key factor in the study was that the behaviours did indeed change over the study period and some changes were significant. Habituation was demonstrated by the seals showing expectancy to events such as feeding with cues such as a keeper approaching the pen, the seals used watching behaviour to identify the keeper and smelling to see if the keeper had food (fish). The data shows the seals may associate one with the other. The results of this study are discussed in relation to post-release welfare issues.

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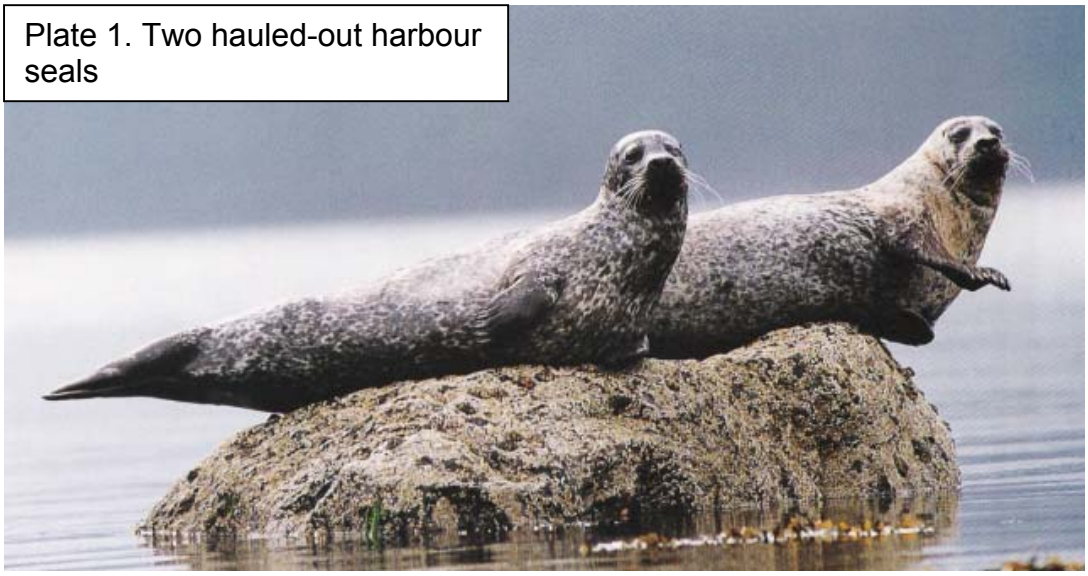
INTRODUCTION

The Harbour seal (*Phoca vitulina*)

The harbour (or common) seal is classified predominantly in the order Carnivora, family Phocidae (Steinway 2003) however as they belong to the group known as the pinnipeds further levels of classification are now commonly applied, e.g. suborder Pinnipedia, tribe Phocini (Wikipedia 2006).

Plate 1. Two hauled-out harbour seals



As can be seen in plate 1. harbour seals are spotted and grey in colour. They are streamlined in shape with for and hind flippers. The head has a distinct brow, large eyes, ears with no external pinna and large whiskers. The brow is a strong distinguishing feature from other seal species, giving them a dog-like appearance (Anon. 1 2004).

The seals can reach up to 2 metres in length and a weight of 140-150 kilograms (Reynolds and Rommel 1999; Steinway 2003), there is a small degree of sexual dimorphism with the females being slightly smaller than the males (Riedman 1990; Steinway 2003). They can live for an average of 20 years in their natural environment (Anon. 3 2006).

Seals are opportunistic feeders so they are able to incorporate a wide variety of fish into their diet (Denhardt and Kaminski 1995). Their diet consists mainly of sandeel and gadoids (cod like fish) with other pelagic fish such as herring also being eaten regularly. Other animals such as cephalopods are also

known to be consumed (Brown and Pierce 1998; Riedman 1990; Reynolds and Rommel 1999; Thompson *et al.* 1996). Harbour seals can undertake dives of up to about 10 minutes when foraging (possible maximum duration 30 minutes (Riedman 1990), females with pups perform short dives of about 1 minute repeatedly over a 1-2 hour period (Bowen *et al.* 1999) .
Harbour seals breed once a year with the pupping season in the UK falling in the months of June and July (Anon. 2 2001). Mating takes place at the time of weaning (possibly to rule out further time out of the water and away from feeding waters) (Anon. 2 2001; Riedman 1990; Coltman *et al.* 1997). The pups are able to swim at birth and can dive within a few days of birth, the mother interacts heavily with the pup possibly as an instructor for behaviours such as foraging although it is not conclusively known whether she herself feeds during the lactation period or not (Bowen *et al.* 1999; Jørgenson *et al.* 2001; Riedman 1990). If the pups learn directly from the mother, this may pose a problem when the seals are brought into a human orientated environment such as a rehabilitation centre before they have learnt skills such as feeding.
During the breeding season harbour seals exhibit a social structure among groups, including dominant males and harems (Riedman 1990; Thompson *et al.* 1989). Out of the breeding season seals aggregate in large groups at haul-out sites however there is little or no social structure evident. A possible explanation is the aggregations are for the purpose of decreased vigilance due to numbers allowing individuals more time for rest in between foraging trips (Riedman 1990; Roberts 1996).

In recent years there has been an increase in seal rescues in throughout the UK (Anon. 5 2000), the seals are brought into rehabilitation centres (as mentioned above) such as the one used in this study. The seals are monitored in the natural environment before being approached (for example if the mother is away feeding the pup is therefore not abandoned), if the animal is in distress then it is captured and transported to the nearest rehabilitation centre.

Reasons for rescue

Injury

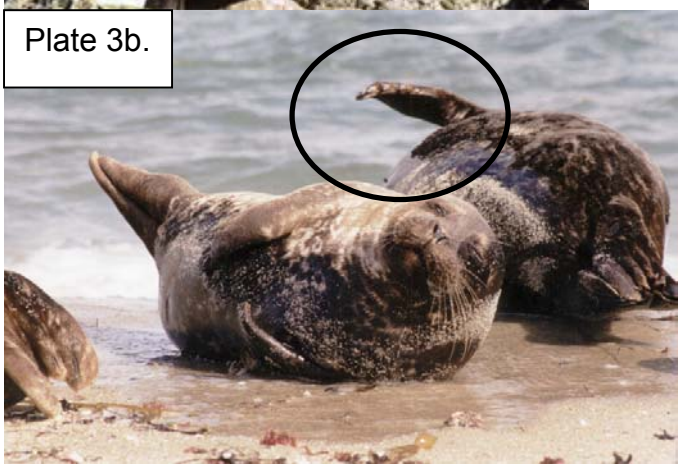
This can include damage inflicted by other seals, accidental damage either directly or indirectly by humans or intended damage by humans or other animals.

Plate 2. Skull of *P. vitulina*

Harbour seals are equipped with large teeth (as can be seen in plate 2.), the molars are tricuspid and have an appearance of carnassials, the canines and incisors are enlarged however there is no developed sagittal crest suggesting that the bite strength is not as great as in other mammal carnivores. This is supported by the fact that the seals eat fish that do not take much restraining so the teeth are needed for gripping the fish while it is consumed, they could however cause damage if used in a fight but the damage would not usually be substantial. The other weapon used in aggression between conspecifics is the claws found on the flippers. A common pose adopted by the seals is lying on one side with one flipper held extended (see plate 3a and b.). Plate 3a. shows aggression with the flipper being held up and probably being waved. Plate 3b. shows seals resting on one side so their flippers are available if need be. Again significant damage would be difficult to inflict but could be achieved if a fight was prolonged (Neumann 1999).

Plate 3a.

Plate 3b.



Accidental damage not linked to conspecifics can include, encounters with boats, fishing lines/nets, man-made structures and debris. Examples of this can be seen in plates 4 a (seal caught in fishing gear) and b (seal with propeller wound on neck).

Plate 4 a.

Plate 4 b.

Purposeful damage can include the shooting of seals, in the UK it is still legal to shoot seals if they are affecting the fishing process or catch (under the "Fisheries Defence Clause of the Conservation of Seals Act 1970" (Anon. 3 2006). These shooting do not have to be reported and evidence that they still occur can only be seen in seals that survive and are only wounded.

Illness

Main illnesses affecting harbour seals include herpesvirus (Borst *et al.* 1989; King *et al.* 1998), Phocine Distemper Virus (PDV) (Young 2002; Anon 4 2006) and parasites such as sealworm (Aspholm *et al.* 1995) and codworm (Platt 1975) as well as many other worms such as tapeworms etc.

PDV occurs in outbreaks that form epidemics, the first outbreak was in 1988 and the last major outbreak was in 2002 (Young 2002; Anon. 4 2006).

Most illnesses and parasites in seals can be treated with veterinary medicine (however usually designed for domestic animals so dosage often not exact) and in the case of viruses such as the herpesvirus inoculations are sometimes available (Goldstein *et al.* 2004). Deaths of seals usually occur from secondary infections such as pneumonia, which can be treated if caught early (Goldstein *et al.* 2004; Goldstein *et al.* 2005).

Abandonment

From personal experience of seal rescue and the rehabilitation environment it is obvious that the main reason for a seal to be rescued and put through the rehabilitation process is maternal abandonment. The mother leaves the pup to fend for itself before it is ready, in the majority of cases this leads to malnutrition as the pup doesn't know how to forage (Jørgenson *et al.* 2001). Although there have been cases of harbour seals being observed to 'adopt' orphaned or abandoned pups, this behaviour is considered rare (Boness 1990; Childerhouse and Gales 2001; Riedman 1990) and has been observed mainly in the populations of coasts of the Americas (Riedman 1990).

A principal reason for the mother to abandon her pup is disturbance of the breeding ground (Kucey 2005). This can be disturbance by natural predators (not found in UK waters) aircraft, boats (both powered and non-powered) direct human disturbance (e.g. walkers) and other scenarios for example other loud noises such as from munitions testing grounds (Jemison and Kelly 2001; Suryan and Harvey 1999; Thompson *et al.* 1989). Suryan and Harvey's (1999) findings show that the principal disturbance to the seals is the presence of humans and boats, however different seals have different levels of tolerance to the disturbance, this may explain why not all pups are abandoned by their mothers when the colony is disturbed, the abandoned pups may have young, inexperienced mothers.

The reason for the varying degree of tolerance may be the process of habituation.

Problems encountered with seals during rehabilitation

Allaby (2003) in the Oxford dictionary of zoology defines habituation as "A decrease in behavioural responsiveness that occurs when a stimulus is repeated frequently with neither reward nor punishment. The process involves learning to ignore insignificant stimuli and should not be confused with accommodation." - Accommodation is the acceptance of an unfamiliar object or scenario into the already recognised environment (Gray 2002), it is clear how these definitions can be easily confused!

This study is concerned with a change in a behavioural response over time so the definition of habituation applies more directly.

Taylor *et al.* (1998) performed a study on the habituation of seals (both grey and harbour) to unfamiliar humans in a captive environment. The study found that the seals did in fact habituate to the stimulus of the presence of familiar humans (regular handlers/carers) in that they exhibited decreased vigilance compared to the vigilance exhibited when unfamiliar humans were present. In this case the researchers were not interacting with the seals at all (e.g. assisting with feeding etc.) whereas the carers provided a reward for the seals response to them as the stimulus. Unlike Pavlov's studies where the animal was required to perform a specific response to a stimulus, the seals in this study show an unintentional conditioning to the stimulus of the familiar human, they start to ignore the instinct to be wary (Manning and Dawkins 1998). Evidence of this process is seen in many other animals, domestic and wild, vertebrates and invertebrates (Braun and Bicker 1992; Erhard *et al.* 2005; Macphail 1996; Moinde *et al.* 2004; Vilhunen 2006).

The importance of the understanding of habituation comes into play when the rehabilitated animal is due to be released back into the wild environment. Most guidelines, for example Hall (2005) and IAAWS (1992) state that attention must be given to ensure the animal is performing natural behaviours that will help its survival in the wild. Studies have been preformed where the animal chosen has been subjected to a learning process of active predator detection and avoidance, most show an improvement in the survival of the released animal (Mayeaux and Johnston 2002; Van Heezik *et al.* 1999; Vilhunen 2006).

Aims of study

- To define the behavioural reactions to human presence of the harbour seal (*Phoca vitulina*).
- To determine whether any habituation to humans occurs in harbour seals (*Phoca vitulina*) during the rehabilitation process at the Sea-Life centre, Hunstanton, Norfolk.
- To relate any findings to potential welfare issues concerning the release of seals from the centre.

The first aim mentioned is to define behaviours and therefore to compile an ethogram, defined as “a detailed record of an animal’s behaviour” (Allaby 2003). This is so behaviours and therefore reactions can be identified and recorded, it also allows comparative analysis to be performed as the behaviours are within defined parameters and so aids reliability (Martin and Bateson 1993).

The second aim is the main part of the study, the behaviours and reactions of the seals will be measured using time and distance, over a period of time roughly equivalent to that of the rehabilitation process up to the pups joining the adults in the outdoor pool. The results will then be analysed to see if habituation occurs. A similar study was done by Taylor *et al*. (1998) which I have briefly outlined on page 8. The 1998 study produced evidence of habituation but did not look at the effect of the researcher becoming familiar to the seals which is something I hope to achieve in this study.

<u>Null hypotheses proposed</u>

- There is no significant change in the latency to a specific behaviour over time
- There is no significant change in the distance from the recorder when a specific behaviour occurs, over time

- There is no significant correlation of changes between different behaviours

Using literature on the subject and personal communication with other people in the field of seal care/welfare I hope to be able to relate any findings to the subject of release of rehabilitated animals back into the wild.

METHOD

This study looks at the rehabilitation process implemented by the Sea-Life centre at Hunstanton, Norfolk.

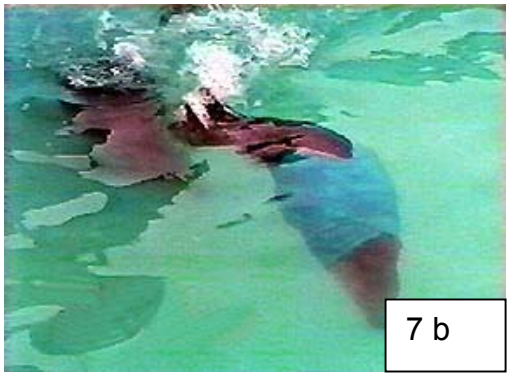
An additional day before the commencement of the study was arranged so the seals behaviour could be just observed and then defined. This day also allowed for an understanding of the routine of the seal hospital and what duties were involved throughout the day.

For the day of the preliminary observations the uniform of the centre was not worn and the recorder was not involved with any care processes of the seals or any other duties with the staff. Commentaries of interactions of the seals with the staff were recorded as were descriptions of each of the seal's 'personalities' (differences in behaviours, repeated behaviours, unusual habits/behaviours). The researcher in this study already had some personal experience with seals and so was able to recognise behaviours seen in many seals. Discussion with the staff also helped distinguish individual behaviours. Table 1. shows the ethogram constructed from the observations made, plates 7 a-f (page 13) show the main behaviours noted.

Ethogram – Behaviour captive seals

Table 1. Behaviours as described on initial day at centre	
Behaviour	**Description**
Yawning	Eyes closed, mouth stretched wide open
Resting	Eyes closed, lying flat, flippers by side – see plate 7e
Watching	Following movement of recorder, eyes open – see plate 7f
Smelling	Eyes open, nostrils open and close more rapidly than when breathing, intake of breath often audible, head extended toward object of interest – see 7c
Movement	Using flippers to propel itself in a direction on the floor of the pen
Swimming	Using flippers to propel itself in a direction in the pen when water present, includes time spent totally submerged – see plate 7b
Vocalisation	Different types observed include – growling, barking, mewing, long call – see plate 7d
Suckling	Either on own belly or attempting to suckle its pen-mate – see plate 7a
Play	Interaction and often chasing each other without use of teeth or claws
Aggression	Biting, lunging toward or use of claws against conspecifics or human

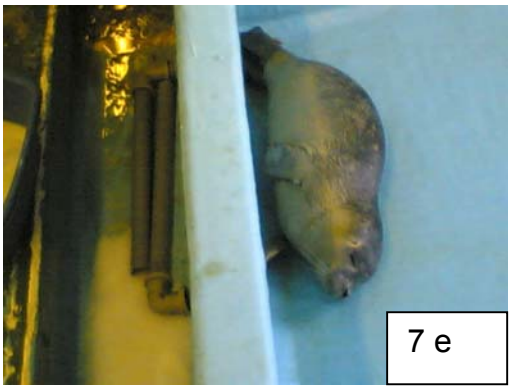
7 a



7 b

7 c

7 d



7 e

7 f

Plates 7 a-f show common behaviours. a = Suckling, b = movement, c = smelling, d = watching, e = resting and f = vocalising.

Table 1. decribes the principal behaviours observed and gives a brief description of each. Some of these behaviours are illustrated in the plates 7a-f. The behaviours chosen to be recorded in this study were:
Watching (Plate 7d)
Smelling (Plate 7c)
Vocalisation (Plate 7f)
Movement (Plate 7b)
This is because these were obvious behaviours performed on a reaction to a stimulus, usually a person. Aggression was also displayed but only when a person got into the pen with the seal and this is not part of the recordings.
To rule out recorder bias only one person (author) was to record the reactions of the seals.

The rehabilitation process (seals)

When the seals first arrive at the centre they are assessed for reason for rescue, age, sex, condition, and the potential to be carrying any harmful diseases, (example of assessment form in appendix 1). The seals are then tube-fed a solution of electrolytes to ensure they are not dehydrated and/or fed if necessary. In the hospital there are a series of pens in which the seal are placed (see plate 5.). The seals are given any veterinary attention needed, as stated above the most common cause of admission is malnutrition due to abandonment by the mother. In this case the seals are gradually 'taught' how to eat fish, depending on age the seals are first fed fish soup via a tube, then force-fed whole herring, then hand fed herring (they take the fish voluntarily from the feeders hand), the herring are then just deposited in the pen (only when water present) and then the final stages are to teach the seals to compete for food, when at the required weight

Plate 5 – View from back of individual pup pen

Plate 6 – Outdoor seal pool

(>20kg) they are put in a larger pen with one or more other young seals and fish is put in the water. The final stage is the seal is moved to the outdoor pool (see plate 6.) with other adult seals and have to compete fully for fish. When the seal is eating and behaving well in the outdoor pool and is at the required weight (50kg) they are released into the wild at a suitable location.

The set-up of the hospital is as follows:
A treatment/food preparation room (approximately 6 x 8 metres)
Door through to pens – 5 standard pens (2 m wide, 3 m long) along side each other with a gangway running across the front. A large pen (pup pool – 6 m wide, 3 m long) at the far end and then a door to the outside.
The pens can be filled and emptied with sea water independently when needed (once high tide had been water was stored in holding tank till needed). They are constructed out of fibreglass and painted, there are windows at 10cm from floor through to the neighbouring pen, the windows are approximately 50cm x 50cm

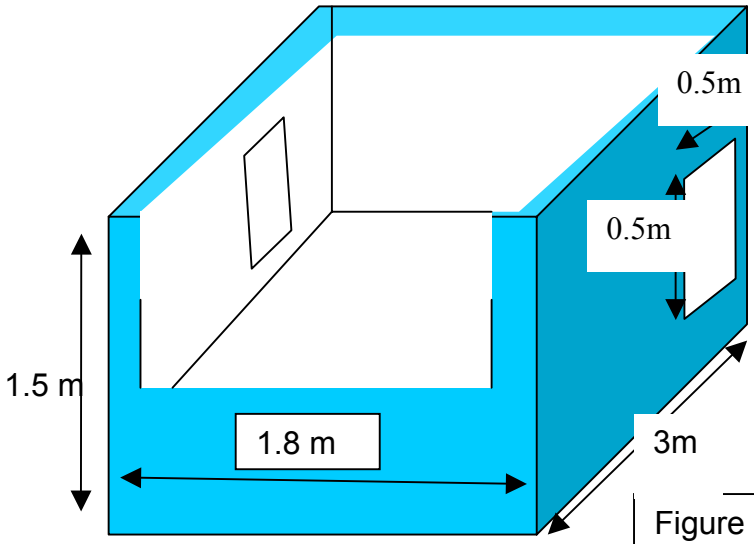


Figure 1.
Diagram of pen showing low front end (nearest gangway) and windows in each side. The front has groves either side where a board can be slotted in to make the front higher. A photograph taken from the back of the pen can be seen in plate 5.

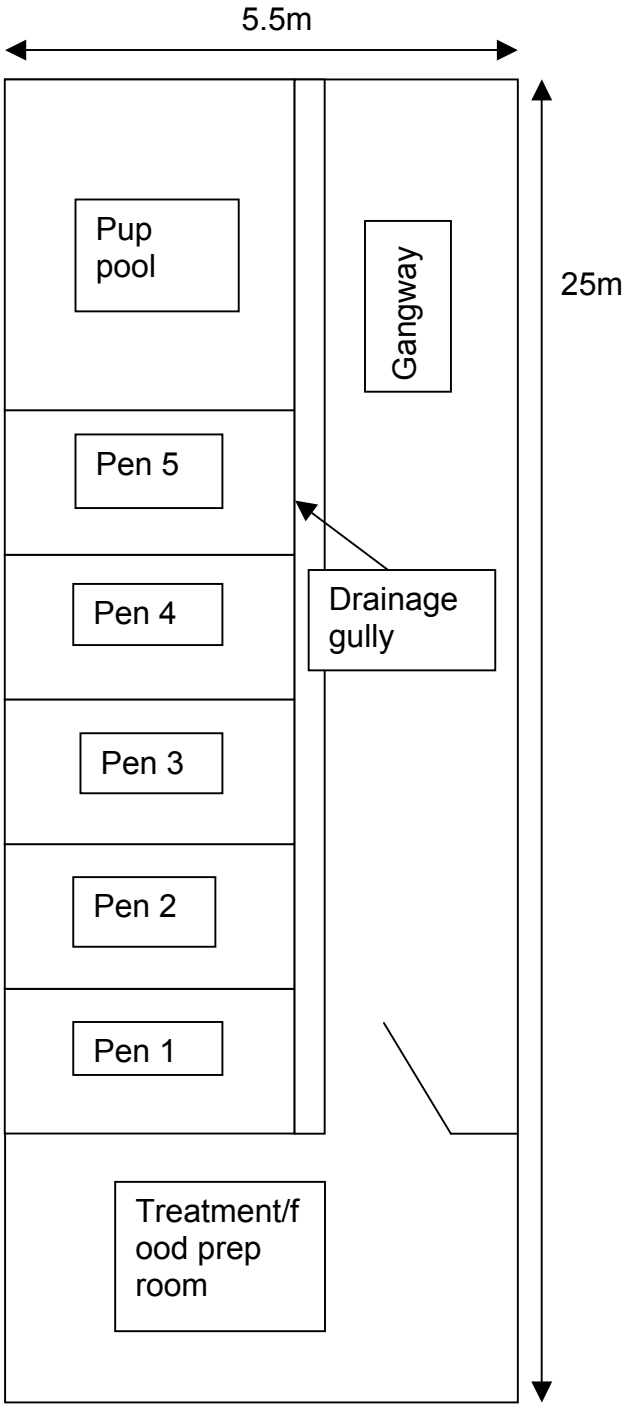


Figure 2.
Diagram showing the basic floor plan of the hospital

Each pup was in a pen (illustrated in figure 1.) and the pens are arranged in the way shown in figure 2. Due to the pens high sides the recorder was not visible to the pups unless standing directly in front of the pen.

The seals

Table 2. Details of the seals observed in this study.

Seal name	**Sex**	**Date of Rescue**	**Age at rescue**	**Reason for rescue**	**Status at end study**
Rolo	Female	4/07/05	14 days	Abandonment	Died – 1/08/05
Polo	Female	4/07/05	10 days	Abandonment	Pup pool
Smartie	Male	1/07/05	7 days	Abandonment	Died – 26/07/05
Aero	Female	24/06/05	5 days	Abandonment	Died – 23/07/05
Munchie	Male	27/06/05	7 days	Abandonment	Hand feeding
Breakaway	Female	30/06/05	14 days	Abandonment	Force feeding
Drifter	Male	03/06/05	14 days	Abandonment	Pup pool
Milkybar	female	23/7/04	14 days	Abandonment	Euthanized – 2/08/05
Fruit Pastille	Female	10/08/05	2 months	Malnourished, injured	Force feeding

Recording Behaviour

Measurements were taken of the latency to a behaviour occurring and the distance from the recorder when that behaviour first occurred. This was done by the recorder stepping in front of a pen, as far away as possible from the pen (on the far side of the gangway) and at that instant starting to record. The recorder then moved gradually closer to the pen (approximately 0.5m every 2

seconds) for a time limit of ten seconds (it was noted on the preliminary day that if a reaction to a human being present was going to happen it would in the first ten seconds). The data was recorded on a check sheet (see appendix 2). The latency to behaviour was recorded in seconds and the distance of the seal to the recorder at the point of a behaviour occurring was recorded in metres.

Recordings were made nine times a day (seen in figure 3. below):

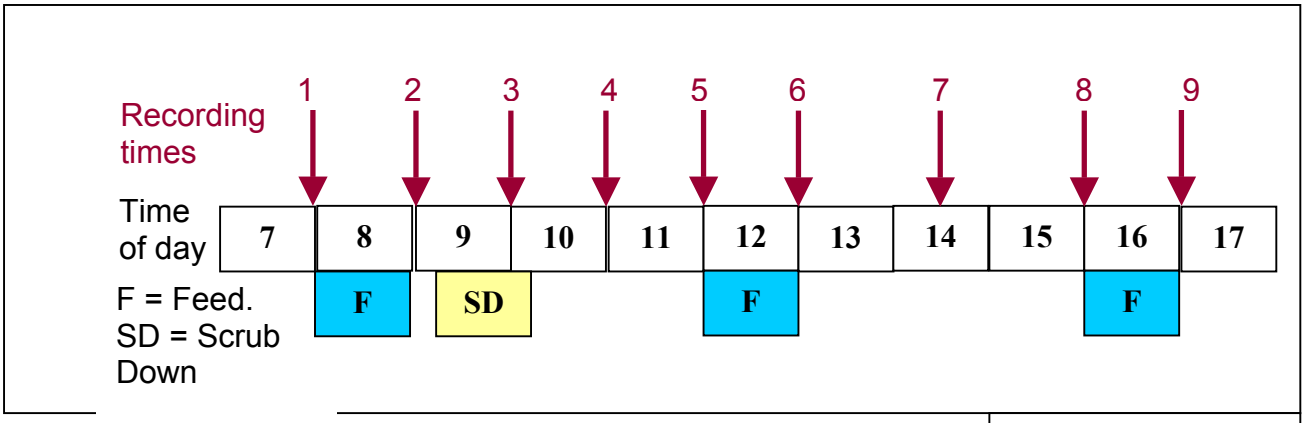


Figure 3. Diagram showing pattern of recording times

1. Early morning – the recorder was the first to see the seals in the morning, before morning feeding
2. After 8am feed
3. After scrub down – the pens were thoroughly cleaned each morning
4. Mid-morning – after the seals have had two hours with little or no human contact
5. Before midday feed
6. After midday feed
7. Mid-afternoon – again the seals would have had little contact for at least an hour or two
8. Before 4pm feed
9. After 4pm feed

These recordings were made every Tuesday and Thursday for 8 weeks between 19th July 2005 and the 1st September 2005.

The recorder wore the uniform of the centre (green polo shirt and black trousers) to help against bias because the study is to find out about habituation not familiar and unfamiliar humans. General observations made showed that this worked as reactions to the recorder were no different than for other keepers. This was tested by asking another keeper to repeat the recordings.

The recorder was involved in all activities with the seals, cleaning, feeding, treatment and other general duties in the hospital.

Other aspects of the environment considered:

- Other people were asked to stay away from the seals when recordings being taken
- Above the back of the pens are windows for the general public to view through, It was checked that the seals could not see the public from the pens (the glass was tinted and the windows were set 6cms back from the pens making the angle difficult)
- The boards slotted in the front of the pens when they were filled with water may obscure the view of the recorder from the seal however it turned out that this did not actually pose a problem
- It was possible to be very quiet in the gangway so the seal was not aware of the recorder until they stepped in front of the pen (the wellington boots worn as standard aided this)

The data was then compiled and analysed using appropriate methods. These methods included tabulating the data then examining graphs formed from the data (in software package Excel) to see if there were any trends present. If the graphs indicated any trends over time in the data then a statistical test for correlation was performed using the statistical package SPSS.

RESULTS

Preliminary observations

From first hand observations obtained by the observer as they got to know the 'personality' of the seals it was clear that changes in their behaviours and reactions to the recorder altered over the summer data was collected.
The seals more readily looked and smelled for humans and vocalised more frequently. Some seals were happier with the presence of humans, displaying clear and extrovert behaviours. Others were less happy and were quieter and less comfortable with humans coming nearer, rarely looking up or smelling.

Four of the nine seals measured provided data for the whole of the study period, the other five either died during the study period (three due to outbreak of seal herpesvirus, one to unknown reasons) or only arrived at the hospital a few week before the end of the study period (the seal that arrived late also had some vision problems so the data is not accurate).

Results from data

Date	Days from start
19/07/05	1
21/07/05	3
26/07/05	7
28/07/05	9
02/08/05	14
04/08/05	16
09/08/05	19
11/08/05	21
16/08/05	26
18/08/05	28
23/08/05	33
25/08/05	35
30/08/05	40
01/09/05	42

Table 3
As the recordings for this study were taken on the Tuesday and Thursdays of the weeks of the study, days from the start of the recordings are used in the results.

Frequency

Graphs in figures 4-7 (on pages 22 and 23) show the frequencies of each of the behaviours recorded. The first data set looks at whether there is a change in frequency of behaviour over time. Two of the four behaviours measured showed positive correlations, the first is movement which shows a significant change in frequency over the study period (Spearman's correlation: Rs = 0.738, df = 12, P = 0.003), showing an increase in frequency. There were in fact 102 instances of movement toward the recorder and 1 instance of movement away. The second is vocalisation which although not a significant correlation (Spearman's correlation: Rs = 0.512, df = 12, P = 0.061) is only 0.011 away from significance, this can be considered close. An explanation for the non-significance of the vocalisation data is the drop-off seen on the graph (see Figure 5). With the data past day 33 excluded the result is highly significant (Spearman's correlation: Rs = 0.908, df = 9, P = 0.000) showing an increase in number of vocalisations over the study period.

Latency

Graphs in figures 8 – 11 (pages 24 and 25) show the means of latency to behaviour data the four seals that gave data for the whole study. The graphs (Figures 8-11) show the linear relationship for each behaviour with the R_2 value for each trend line. The data shows the latency to the four behaviours over time. Two of the behaviours shoed a positive correlation with time, indicating a significant change in that behaviour over the study period, the first was watching behaviour (Spearman's correlation: Rs = -0.662, df = 12, P = 0.01), the graph (figure 8) shows a decrease in latency – the seals were taking less time to perform the behaviour toward the end of the study than at the beginning. The second significant behaviour was smelling (Spearman's correlation: Rs = 0.574, df = 14, P = 0.032), with this behaviour the latency increased, the seals took longer to smell the recorder over the study period.

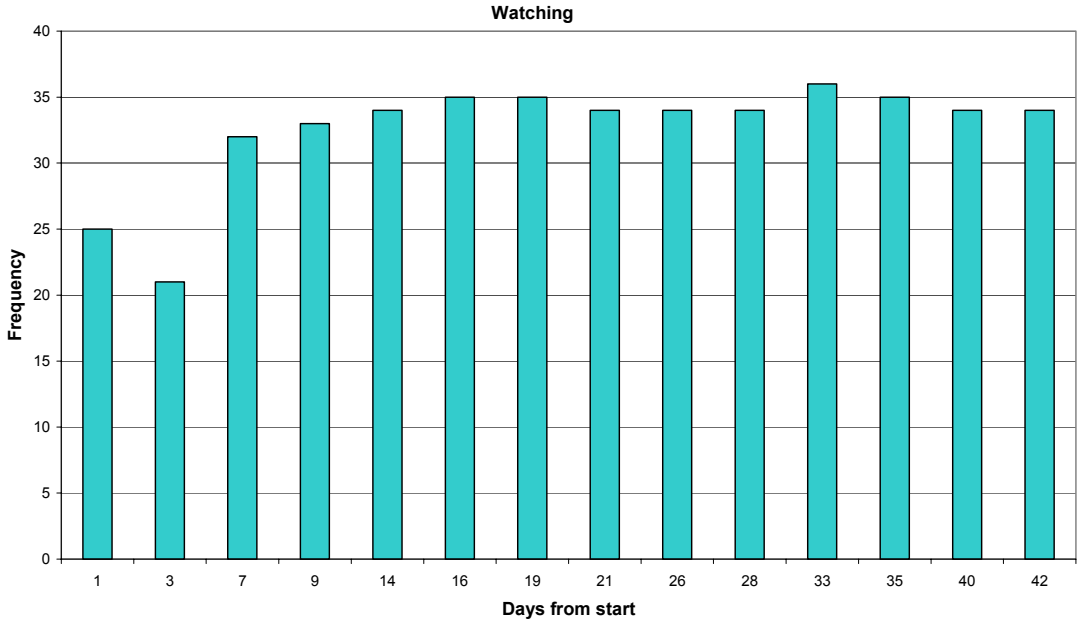


Figure 4. Frequency of watching behaviour during recording times, over the study period.

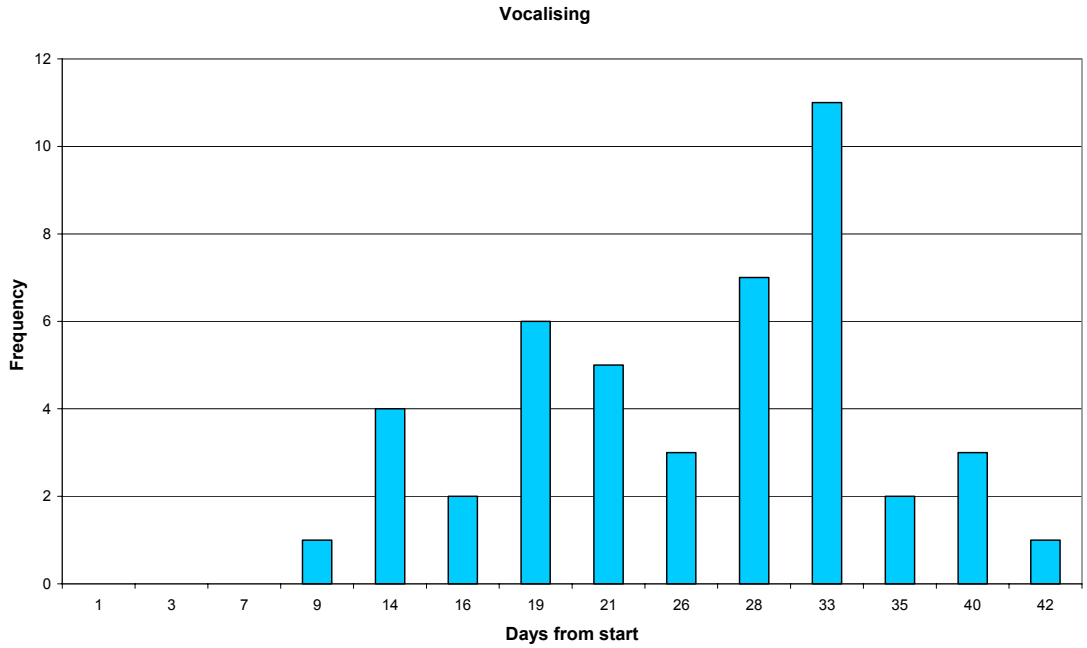


Figure 5. Frequency of vocalisations during the recording times, over the study period

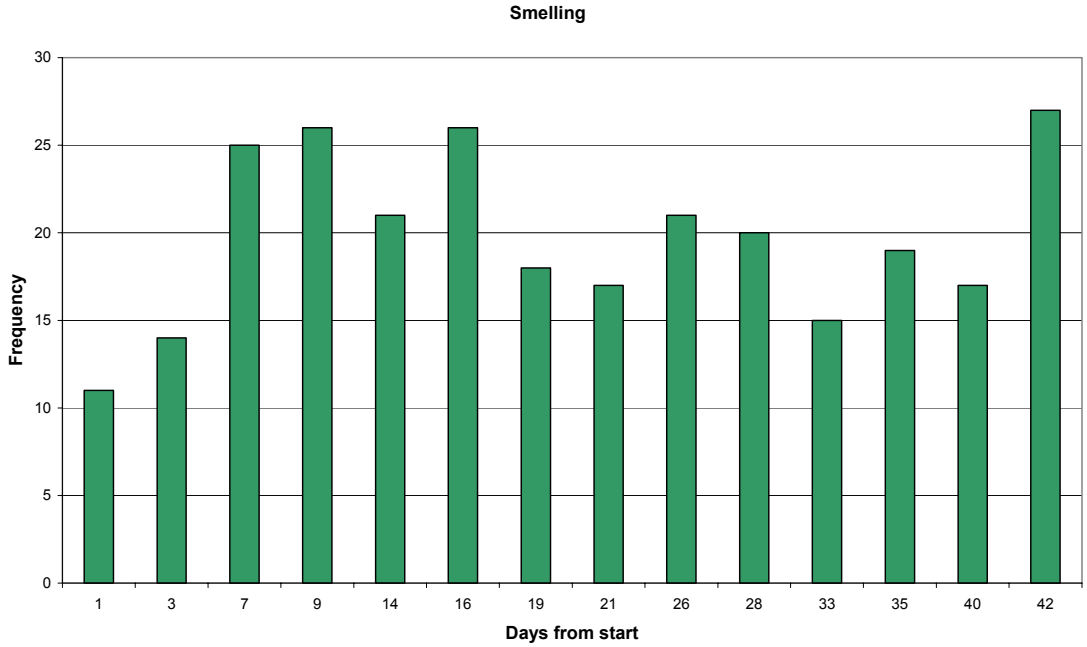


Figure 6. Frequency of smelling behaviour during recording times, over the study period

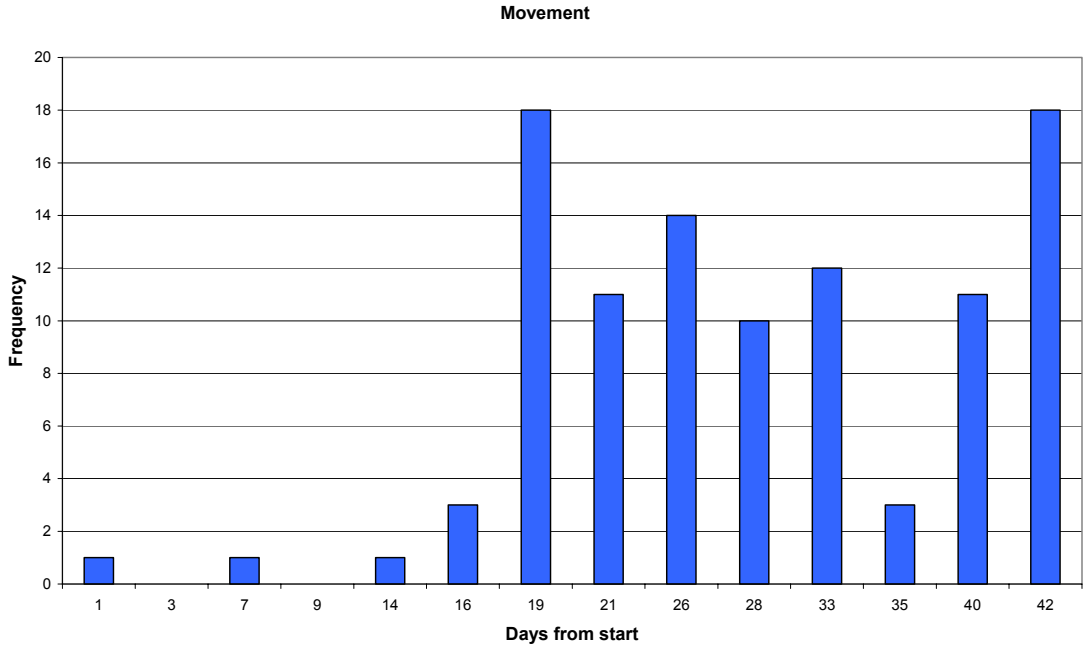


Figure 7. The frequency of moment toward or away from the recorder during recording times, over the study period

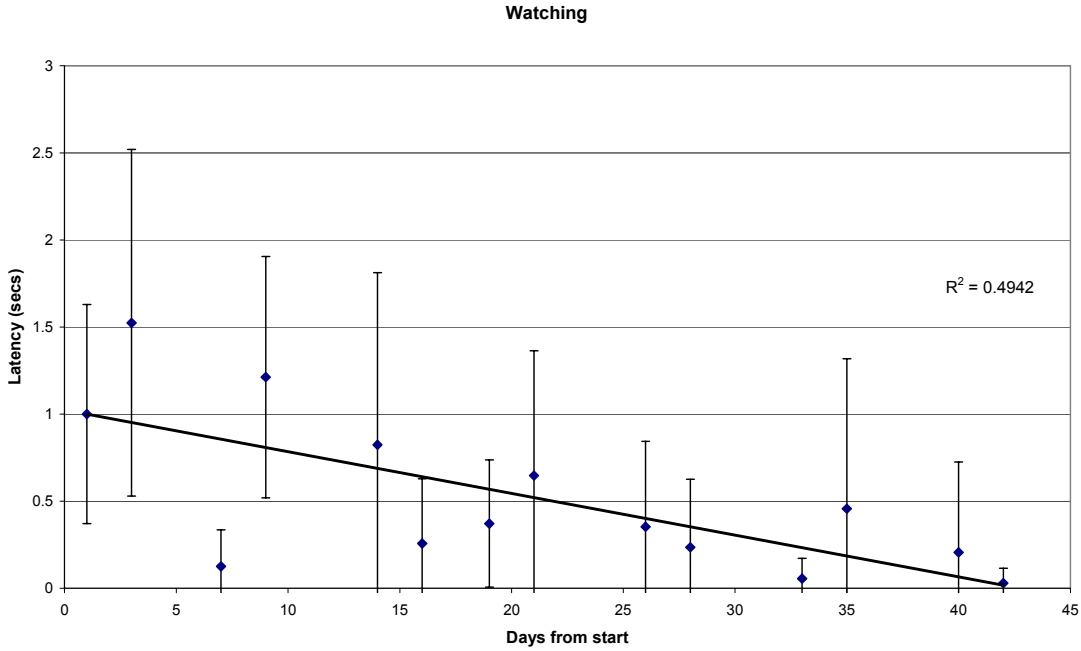


Figure 8. Showing latency till watching behaviour, linear relationship displayed. Means of four principal seals used (±SE).

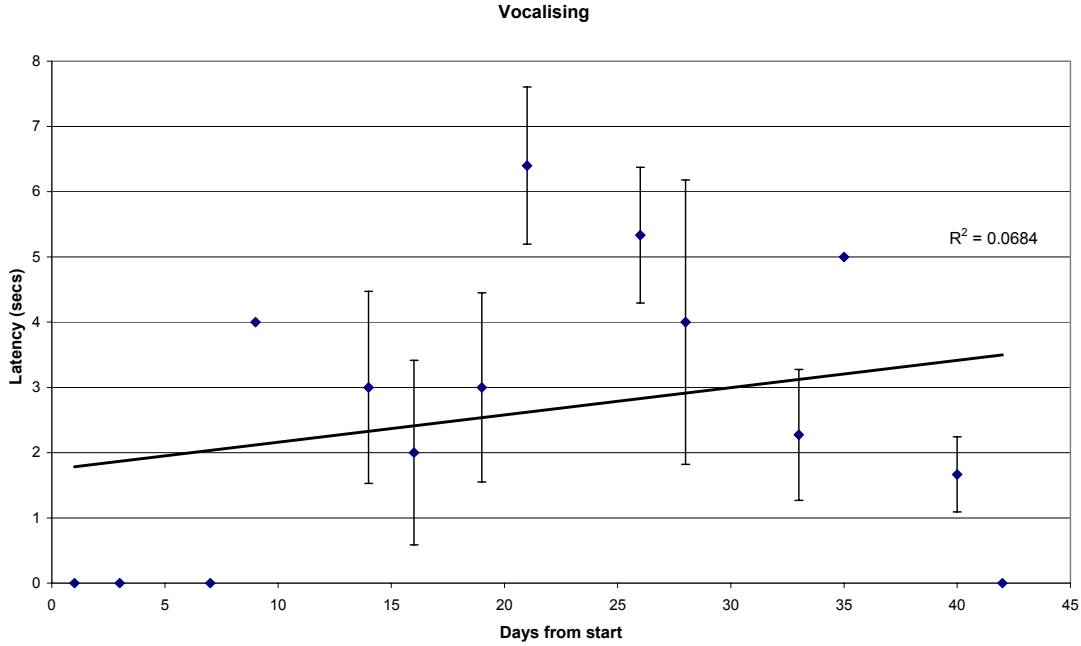


Figure 9. Showing latency till vocalisations, linear relationship displayed. Means of four principal seals used (±SE).

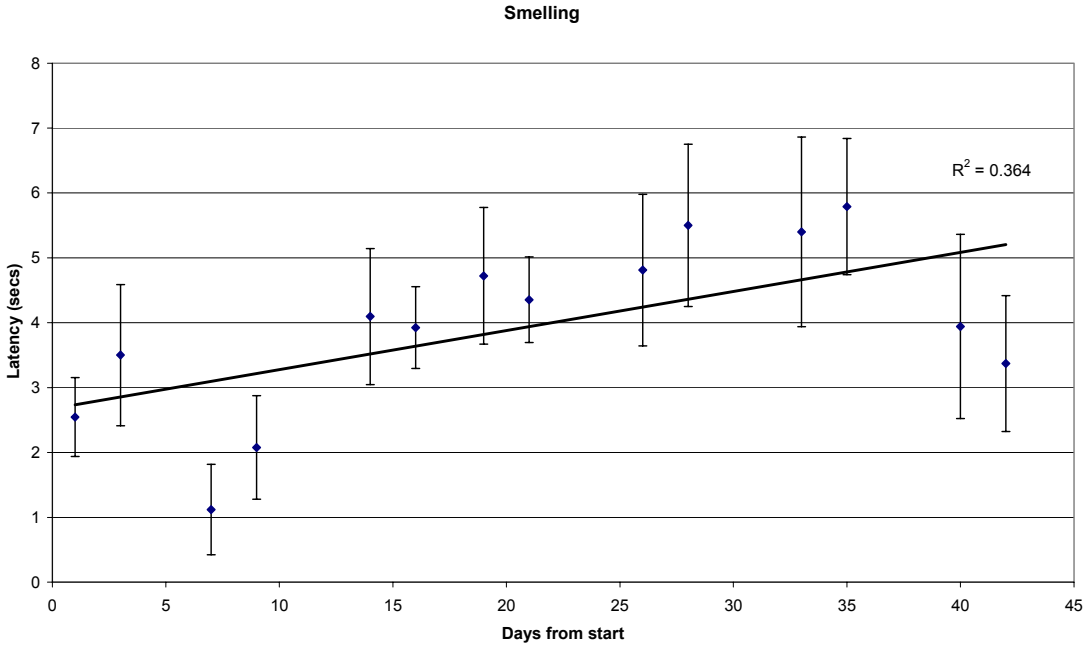


Figure 10. Showing latency till smelling behaviour, linear relationship displayed, means of four principal seals used (±SE).

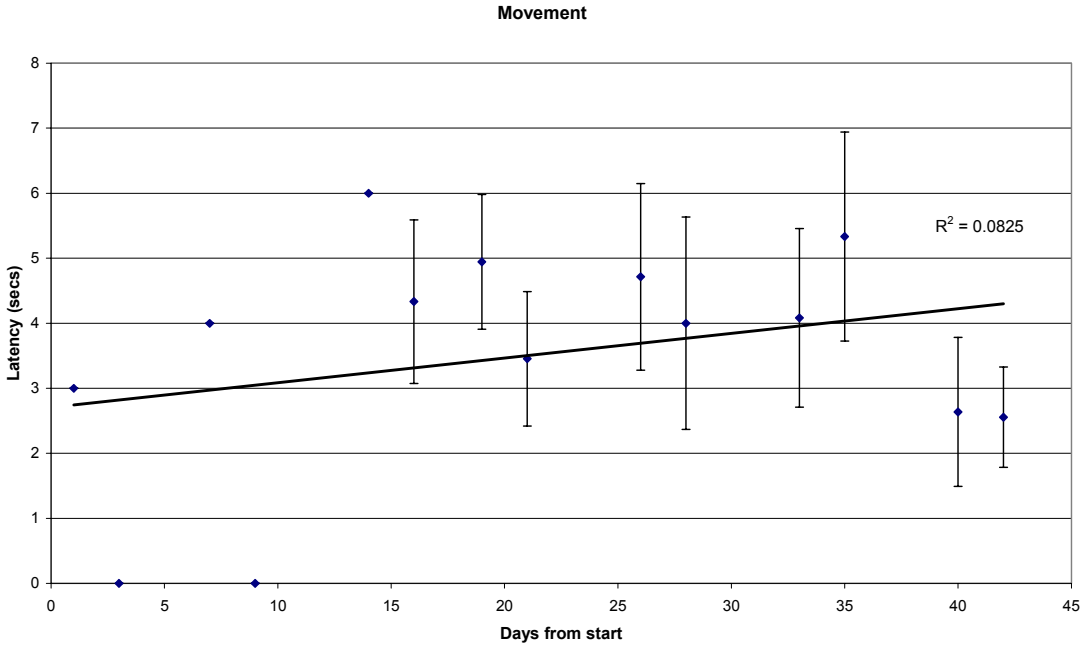


Figure 11. Showing latency to movement of the seals toward or away from the recorder, linear relationship displayed, means from four principal seals used (±SE).

Distance

Graphs in figures 12 – 15 (pages 27 and 28) show the changes in distance to the recorder when the behaviour was first performed. The data shows the changes in the reaction distance of the seals over time. As with the other measures detailed above, two of the behaviours showed a significant change over time. The first to show a positive correlation was watching behaviour (Spearman's correlation: Rs = -0.644, df = 12, P = 0.013), the distance decreased over time. The second positive correlation is smelling behaviour (Spearman's correlation: Rs = -0.640, df = 12, P = 0.014), the distance to the recorder of smelling behaviour also decreased over time.

During the last week of the study (days from start 33 and 35) two of the seals were taken out of the individual pens and put together into the pup pool at the end of the centre (see figure 5). The tests noted above were repeated with the data for the last week extracted, there were three major changes in the outcomes of the tests. The first was that the frequency of watching behaviour became significant (Spearman's correlation: Rs = 0.803, df = 10, P = 0.002), there was an increase in frequency. The second was that the frequency of vocalisation became significant (Spearman's correlation: Rs = 0.755, df = 10, P = 0.005), again the frequency increased.The third was that the latency to watching behaviour became not quite significant (Spearman's correlation: Rs = -0.545, df = 10, P = 0.067), however there was a general decrease in latency.

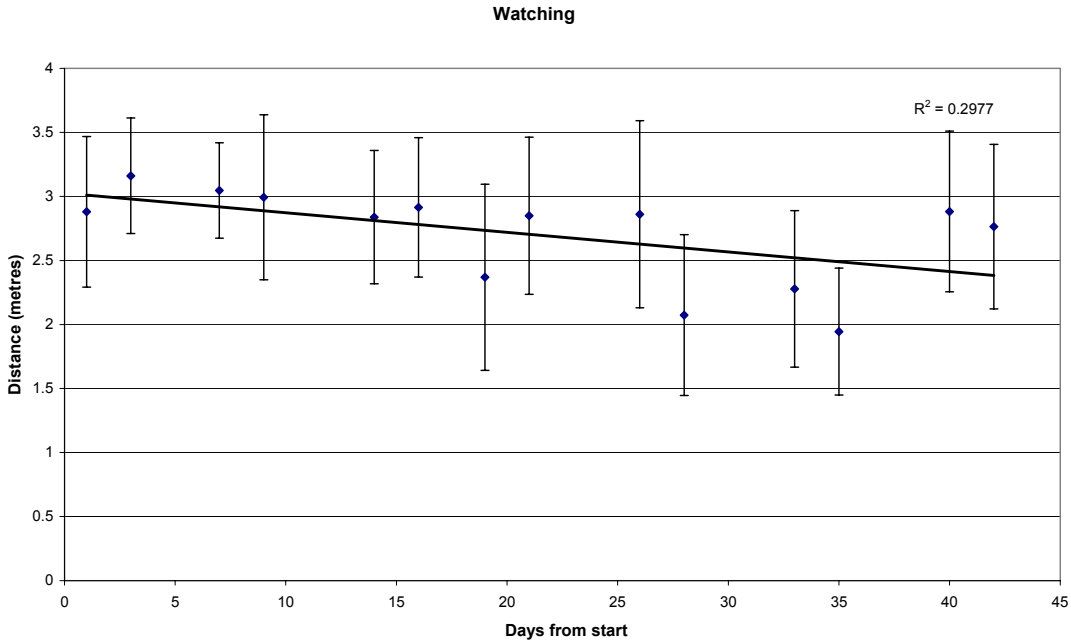


Figure 12. Showing mean (±SE) distance from recorder of the seals when watching behaviour first occurred.

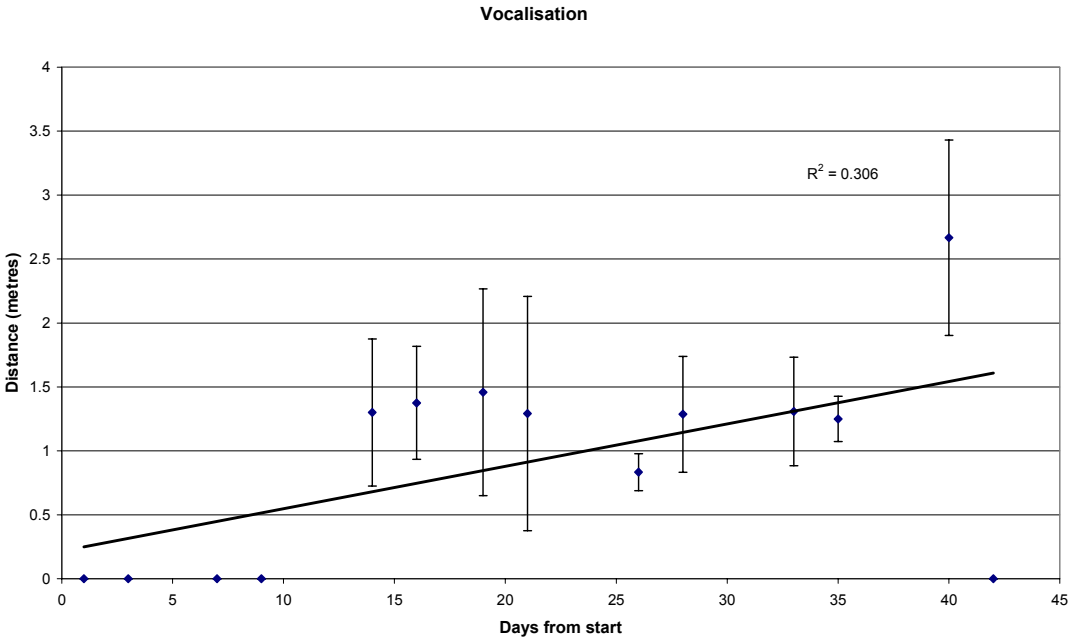


Figure 13. Showing mean (±SE) distance from recorder of the seals when vocalisation first occurred.

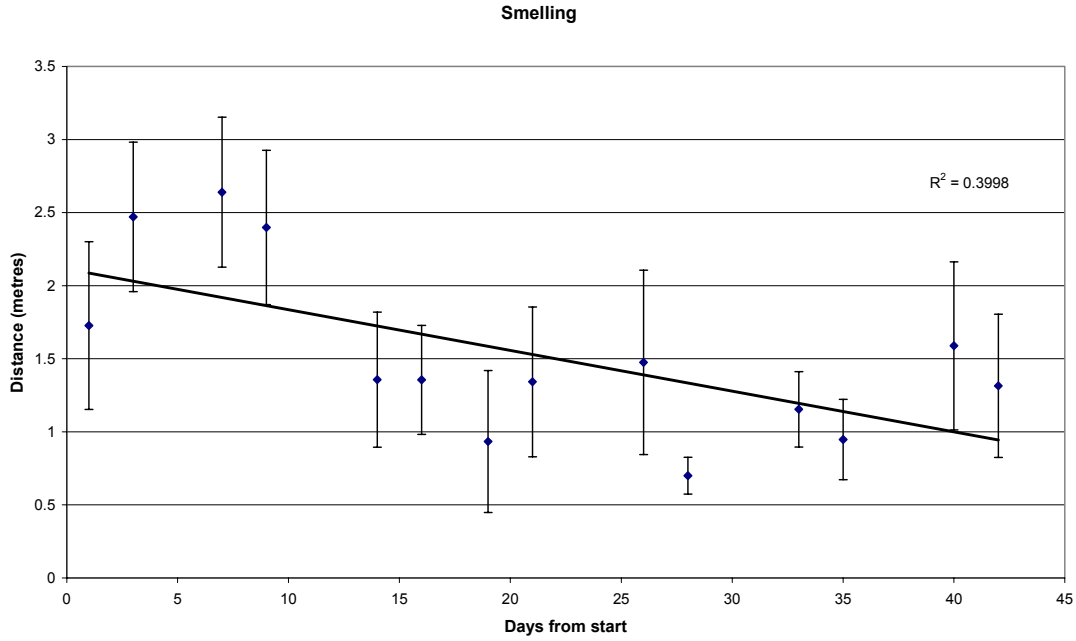


Figure 14. Showing mean (±SE) distance from recorder of the seals when smelling behaviour first occurred.

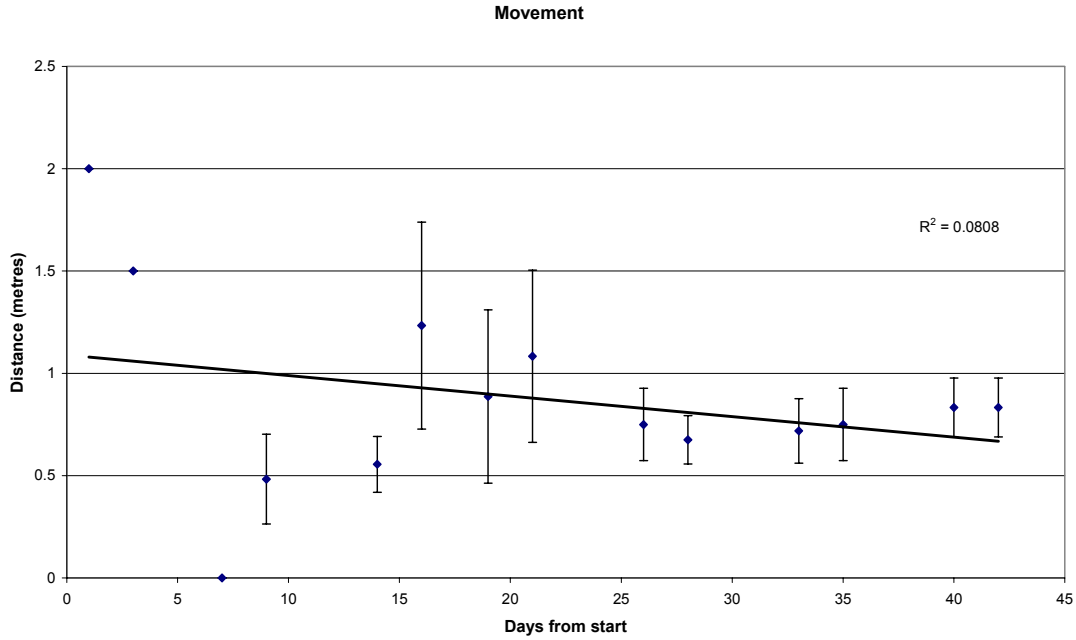


Figure 15. Showing mean (±SE) distance from recorder of the seals when movement toward or away from the recorder first occurred.

DISCUSSION

The results for this clearly study show a significant change in the behaviours watching and smelling – this is visual and olfactory recognition of the recorder. Other changes, although not statistically significant can be seen in the data for example frequency of vocalisations

Vigilance in harbour seals has been the subject of previous studies (e.g. Terhune and Brillant 1996; Taylor and Davis 1998) however as described before, Taylor and Davis (1998) looked only at latency to haul out and Terhune and Brillant (1996) looked at vigilance in the natural setting, neither detail the reaction to humans in the captive setting. A possible explanation for the results gained from the watching behaviour data may be that the seals came to expect something from the human (e.g. food) and so acknowledged the recorder sooner to find out if they were carrying the tell-tale stainless steel food bowl (always used whether the seal was being hand, force or tube-fed). The frequency to watching increased so the seals acknowledged the recorder more often towards the end of the study and although the latency to watching was not significant there was a general decrease. This means the seal were watching more often and were performing the behaviour faster towards the end of the study – this is strong support for the theory that the seals are showing expectancy. The fact that in the natural environment the vigilance decreases (Terhune and Brillant 1996) and in the captive environment watching appears to increase, again aides the theory that the seals are expecting something. As for recognising the feed bowl, Taylor and Davis (1998) stated that the seals were able to distinguish between distinct objects and humans. A possible explanation for the seals not reacting quickly at the start of the study to an unfamiliar may be explained by the results of a study done by Cassini (2001) who studied the reactions of South American fur seals to tourists and found that if the people approached the seals quietly and calmly there was almost no reaction at all on behalf of the seals. As stated in the method (page 19), efforts were taken in this study to remain as quiet as possible.

Olfaction in phocids is an important sense, often used for pup/mother interaction, communication and identification, the olfactory system is fully developed in pinnipeds and a vomeronasal organ is present (Hoelzel 2002; Reidman 1990). At the start of the study the seal were quick to display smelling behaviour, the latency then however increased and the distance decreased (the seals waited till the recorder had got closer) this may be because the seals were able to identify the recorder visually. However the latency then decreases and distance increases toward the end of the experiment which indicates that seals are again anticipating something and the smelling may be to see if the recorder is holding fish (food) for the seal. Although this may be speculation support comes from the behaviour of domestic animals, a dog for example is a clear case of how a series of visual (or other) cues can lead to the dog expecting a specific outcome (Cooper et al 2003). This may be a form of classical conditioning, where over time a certain stimulus is programmed by the brain to elicit a specific response (Gray 2002). Whether an example of classical conditioning or not the expectancy of an action shows habituation to the presence of humans as the seal becomes no longer concerned with the human but more with whether the human is about to supply a reward (food). The increase in vocalisations and indeed increase in distance when the vocalisations occur (the seal does not wait for the recorder to approach further) may be a result of the seal actually trying to attract the attention of the recorder in the hope of a reward. The data revealed an increase in frequency of movement of the seals, observations made show that this movement was in almost all cases (except one) toward the recorder, this again could be to attract attention. This theory has been demonstrated in young children (Eisenberger *et al*. 1998) and has been applied to theoretical models in a study by Balkenius (2000). Observations by the recorder noted that some seals were more likely to be noisy and seeming almost demanding, especially near feeding times. During the last week of the study two of the seals were put together in the pup pool (see figure 2., page 16 for location in centre) which was full of water for the majority of the time. During this time the data shows a drop in vocalisations, this may be due to the increased competition, the seals are more concerned with getting to the fish first rather than attracting attention. Another explanation could be that the seal were

vocalising underwater, using the vocalisations for competition with each other and because they are underwater they could not be heard by the recorder (Kastak and Schusterman 1998).

The definite changes in behaviour discussed above can have implications on the seals after their time in the rehabilitation centre. Most of the seals that are rehabilitated at Hunstanton are released when they reach the appropriate age, weight and are able to feed and defend themselves (against other seals in food competition). Seals that are never going to be able to do all of these are found a place in a centre around the UK and spend their lives in captivity.
If the seals are comfortable with human contact and in fact see humans as a source of food, this may cause a problem post-release. If an animal is 'used' to human contact and sees the humans as givers of rewards then it is more likely to approach humans again when back in their natural environment (Rodriguez *et al.* 1995).
A problem experienced personally was when on a release and once the seals were set free from the boats they didn't want to leave and the people involved with the release had to actually 'shoo' the seals into the water and away from them. The seals appear daunted by the openness and are reluctant to give up the familiar contact with humans.
However the principal problem that can occur is with fishermen, the seals are not afraid of approaching the human fishermen and as they have fish see them as the source of food they have known at the rehabilitation centre. The fisherman in UK waters (as with a lot of places) are experiencing low fish stocks (Beddington and Kirkwood 1995) and some of these fishermen are turning to seals and accusing them of decreasing their catch by stealing fish (Moore 2003; Bjørge *et al.* 2002). There are active methods used to discourage the seals and keep them away from the nets, these include gunshots into the air, explosives (including cracker shells and bottle rockets), alarms on the nets and acoustic harassment devices that emit randomly pulsed loud sound in the seals sensitive hearing frequency (12-17 kHz), (Jefferson and Curry 1996). Passive methods include specially designed nets to decrease the likeliness of the seal getting entangled and/or getting at the fish (Lunneryd *et al.* 2003). However under the "Conservation of Seals act –

Fishery defence clause" fishermen are not required to report shootings of seals that have been allegedly stealing from their nets (Anon. 3 2006) therefore it is not possible to get an accurate picture of the number of shootings and fishermen may feel that they are able to do this to protect their catch without fear of being reprimanded. This is where a seal that is happy to approach a human could be in danger compared to a seal which as a natural wariness of humans.

Other dangers to the seals of approaching humans/boats can be injury such as being tangled in nets and being hit by propellers (see plates 4 a and b, page 6), this causes harm or death to the seal but is also a nuisance if nets or boats are damaged.

In the UK seals are a common tourist attraction and popular for people who enjoy nature photography (Street 2006). Seals are the UK's largest carnivore and can be aggressive, however due to their 'cute' appearance as pups many people forget this and often try to approach them. A seal that is used to humans may allow someone to get closer than a seal who has spent all of their life in the wild, this increases the risk of the person being bitten (they are closer to the seal and therefore have less chance of getting out the way) especially if the situation includes a mother and pup due to the mother defending her offspring (Lawson and Renouf 1987).

There are a few ways to possibly reduce the occurrence of habituation in seals the most obvious one is to reduce the contact with humans through the rehabilitation process, this can be done by limiting access to the seals to certain persons and the use of automatic feeders (although this can only be done when the seals have learnt to feed on fish from the water, not by hand etc.). Automatic feeders have also been linked to enrichment and may enhance creativity and competition skills (Swaisgood *et al.* 2001). Studies have been performed on discouraging bold behaviour towards humans and actually have involved anti-predator training (including humans) (Bremner-Harrison *et al.* 2004; Van Heezik *et al.* 1999; Vilhunen 2006). A conference held in April 2002 (Anon. 6 2002) discussed the subject of pinniped rehabilitation and in the case of one presentation the need for "a procedure of gradual alienation from humans" (Androukaki et al. 2002). More recent

guidelines written for the release of rehabilitated animals states “at no time during the rearing process or at any stage of rehabilitation should the animal associate disturbance (or humans) with food. When entering an enclosure, the animal should immediately react by fleeing. If this is not the case, efforts should be made to frighten them.” (Hall 2005). However these guidelines are not listed as recognised methods but include common practices. There are several pinnipeds rehabilitation centres around the UK and almost all of them use different methods to rehabilitate their seals (pers. obs.).

A personal opinion is that the seals in this study showed definite habituation and this is supported by the data collected. However the study did not look at the second part of the process where the seals move to the outdoor pool, although human contact is if anything increased in this situation. The data provides a good result as a pilot study for a research project that needs to be larger. The sea-life centre at Hunstanton is part of a group of centres across Europe so the sample size of centres could be increased therefore increasing the seal sample size. As the centres also rehabilitate the other species commonly found in UK waters (the grey seal, *Halichoerus grypus*) it would also be of interest to include these in further study. It would also be of interest and possible importance to be able to track the success of the seals that are released after going through the rehabilitation process.

CONCLUSION

The results from this study show a definite change in the behaviour of the seals studied. There were significant changes in watching and smelling behaviours and also significance in the frequency of behaviours over the time the seals were studied. This behaviour, with information from previous studies on the subject, can then be related to habituation. More specifically habituation to human contact, for example the expectancy of food.

This habituation to humans and therefore reduced fear of humans than non-rehabilitated seals could prove detrimental to the seals after their release. This is especially true in the context of fisheries interactions with the current state of depleted fish stocks and the tension therefore created between the seals and fishermen, who blame the seals for the reduced stocks.

Following this study it is recommended that care is taken during the rehabilitation process to minimise the habituation of seals to humans.

To support these findings further it would be advantageous to perform a further study – extending the study size in number of centres, seals and possibly species, and use tagging techniques to monitor the seals post-release. If the larger study produces similar results then a set of standard guidelines could be drawn up to govern the rehabilitation process.

ACKONWLEDGEMENTS

This study has been a great experience, if a bit smelly at times. I would like to thank the staff at the Hunstanton Sea-Life Centre, especially Kieran, Chris, Tina and Emma for all their instruction on how not to get bitten when force feeding a seal and their understanding when I was well and truly in the way of their normal day to day tasks.

My tutor, Dr Toby Carter has been an excellent source of support, helping me more then once to see the light at the end of the tunnel. Other people I would like to thank for advice and direction include Lucy Kirk, Dr Shelia Pankhurst and my long suffering partner Stuart.

APPENDIX 1
(Example assessment record)

APPENDIX 2
(Check sheet)

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