

## The suckling period of a Grey seal (*Halichoerus grypus*) while confined to an outdoor land area

R. A. Kastelein and P. R. Wiepkema\*

*Zeedierenpark Harderwijk (Harderwijk Marine Mammal Park), Strandboulevard-oost 1, 3841 AB Harderwijk, Holland*

### Summary

In January 1988 a Grey seal cow gave birth to a female pup at the Harderwijk Marine Mammal Park. Mother and pup were kept in an outdoor suckling area. As a safety precaution, they were denied access to the nearby pool during the suckling period. Constant observation of mother and pup produced similar detailed information on suckling parameters as was recorded in the previous year when the same cow and her 1987-pup were kept indoors.

In contrast to the latter indoor situation the following was found in the present study: (1) The mother always smelt the pup before offering the nipples; (2) the mother broke off most of the suckling sessions; (3) Daily suckling time was longer and characterized by more and longer suckling sessions a day than in 1987; and (4) a lower growth rate of the pup. This latter aspect was probably due to an increased activity level resulting from disturbances and a higher energy loss caused by the cold and wet outdoor conditions. Differences in disturbances and in climatic conditions were probably the main factors which caused the differences in behaviour of mother and pup between the 1987 and 1988 suckling period.

**Key words:** *Halichoerus*, suckling, behaviour, reproduction.

### Introduction

Many Grey seal pups (*Halichoerus grypus*) die during the suckling period, both in the wild (Davies, 1949; Coulson & Hickling, 1964; Summers *et al.*, 1975; Anderson *et al.*, 1979; Baker *et al.*, 1980; Baker, 1984) and in zoological parks (Leslie, 1974; Kastelein & Wiepkema, 1988). To determine the causes of this high mortality, the Harderwijk Marine Mammal Park has launched a long term study on the suckling periods of the Grey seals born at the park.

The first step of this study was on the mother and her female pup (born in 1987) which had been moved

into a completely undisturbed indoor quarantine area one hour after birth (Kastelein & Wiepkema, 1988). In 1988 a second female pup was born of the same parents, at the same time of year. This pup was suckled in a more natural outdoor environment. This study describes the suckling period of this pup and discusses the influence of the outdoor environment on several suckling parameters.

### Materials and Methods

#### *Study animals*

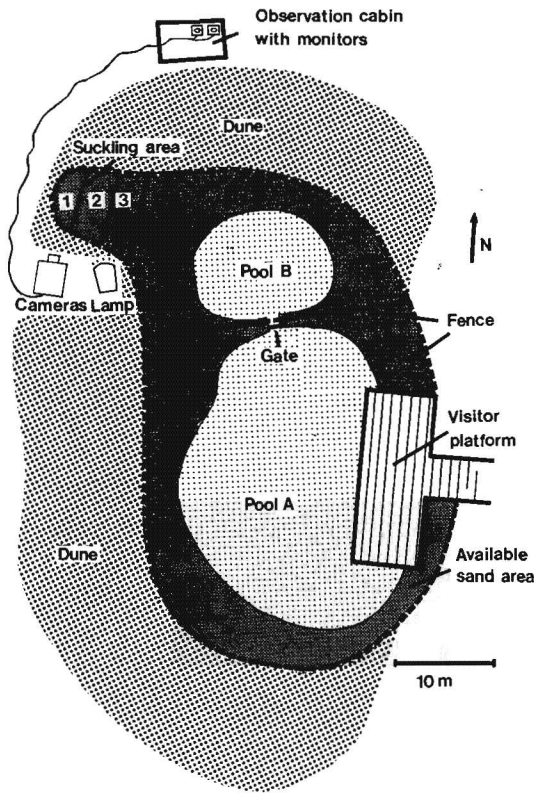
The Harderwijk Marine Mammal Park houses two adult Grey seals. A male (code: HgZH002); estimated to have been born in 1972, found stranded on the Belgian coast in May 1978, and afterwards sent to Harderwijk, and a female (code: HgZH001); born in September 1973, stranded in Belgium in November 1973 and afterwards also sent to Harderwijk. On 23 February 1987 copulation took place and after a gestation period of 334 days, their fourth pup (code: HgZH006) was born on 23 January 1988. This report concerns the behaviour of the mother and this pup during the suckling period.

#### *Study area*

The Grey seals were kept in an outside freshwater pool with a surface area of 530 m<sup>2</sup> and a maximum depth of 1.2 m (Fig. 1). The pool also housed five Harbour seals (*Phoca vitulina*). Two peninsulas were built so that the pool could easily be divided into two parts by means of a fence. In the dunes a sheltered sandy hollow was dug to serve as a pupping and suckling area. Large stones were placed between this suckling area and the pool to prevent the pup from going into the water.

The isolated sandy area enabled mother and pup to be left in peace during the suckling period. Two TV cameras made it possible to watch and listen to the animals constantly. The area was artificially lit during the night. The images could be observed on monitors in a trailer on the other side of the dunes (Fig. 1). The behaviour of mother and pup was recorded

\*Ethology Section, Department of Animal Husbandry, Agricultural University, P.O. Box 338, 6700 AH Wageningen, Holland.



**Figure 1.** The pool in which Grey seals and Harbour seals are kept, and which could be divided into two areas by means of a fence and a gate.

every 15 minutes between 08.00 and 18.00 hours, and every hour between 18.00 and 08.00 hours (maximum recording rate per day:  $10 \times 4 + 14 \times 1 = 54$ ). Since the beginning of every suckling session was announced by the pup vocalizing, and since these sounds served as a warning to the observers, who were continually present in the observation room, all suckling sessions could be monitored. The following parameters were recorded:

- Rest or activity
- Together or separate (a distance of less than 1 m was counted as being together)
- Number and time of vocalizations (barks).
- The moment and length of a suckling session (i.e. time that the mouth of the pup was in contact with the nipple).
- Which animal ended a suckling session by moving away.
- Position of mother and pup. For this purpose the pupping/suckling area was divided into three sections by an imaginary grid (Fig. 1).
- Miscellaneous data (such as rate of moult)

—Four times per day the weather conditions were recorded (air temperature, wind force, wind direction, and precipitation).

During the suckling period the mother was offered a quantity of Herring (*Clupea harengus*) and Mackerel (*Scomber scombrus*) once a day, and left-overs were removed later on. This way of feeding scarcely disturbed the animals and enabled the mother's food consumption to be recorded. As is done every day of the year, her food consumption was also recorded for some time before the birth and after weaning. The pup was weighed about every 3 days during the suckling period.

All correlations ( $r$ ) in this study are based on the Spearman rank correlation procedure (Siegel, 1956).

## Results

Because the male started to harass the female 5 days prior to delivery, they were separated. Grey seal males often try to copulate just before birth and thus before oestrus (Boness & James, 1979; Kastelein & Wiepkema, 1988), and it was decided that the female would be under less stress if left alone. Pools A and B were divided by a gate and fence, and the female was placed in pool B with two Harbour seals (*Phoca vitulina*).

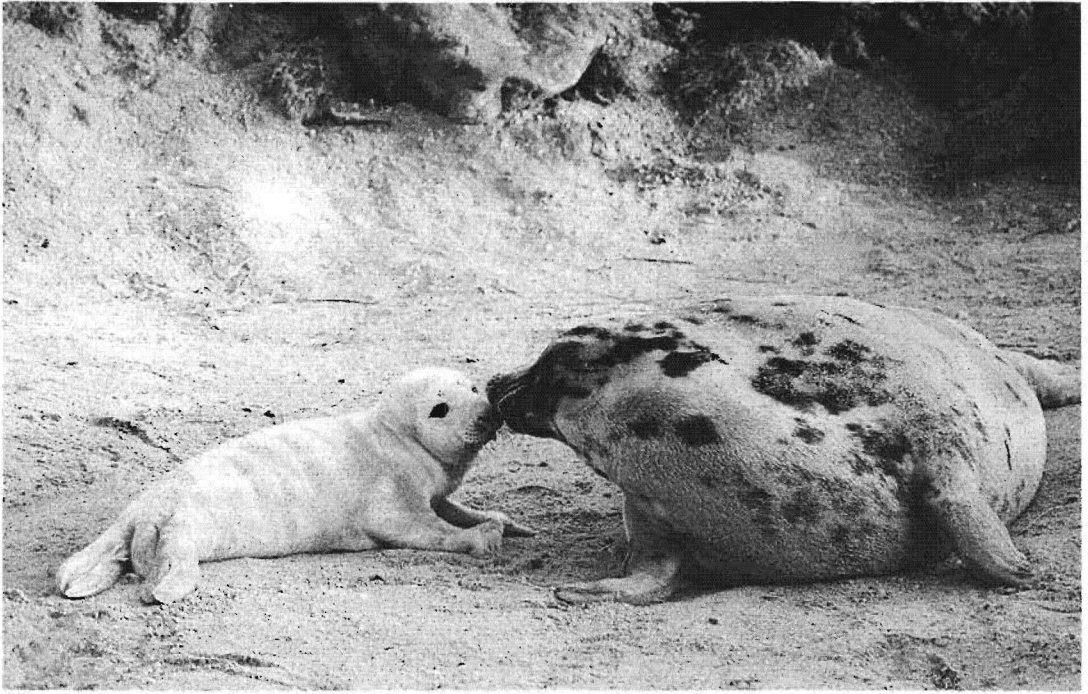
The pup was born on 23 January 1988 between 06.15 and 06.30 hours, on the sand between pool B and the pupping/suckling area (Fig. 1). Within 15 minutes after birth the pup was carried into the suckling area and the mother followed. To prevent them from leaving, a fence was placed between the suckling area and the pool. The mother came on heat 17 days after giving birth. Her labia were swollen and she became restless and began to dig under the fence. On day 18 she stopped suckling her pup. On day 20 the female was allowed to re-enter pools A and B. Copulation with the male began within 5 minutes after this.

### Suckling ritual

One and a half hours after birth the young started to vocalize and the first suckling session occurred 5 minutes later. The suckling ritual was basically the same as described by Kastelein & Wiepkema (1988). However, some parameters were different: before each session the pup vocalized quite often (average: 59, SD: 51, N: 120), before the mother smelt the pup (Fig. 2) and offered it her nipples (Fig. 3).

### Encounters between mother and pup

Mother and pup were left to themselves in the suckling area after birth. However, they were only lying next to each other 19% of the times that their behaviour was recorded (Fig. 4). During the first 2 days mother and pup were together relatively often without any suckling taking place. Of the 202 scored



**Figure 2.** The Grey seal mother smelling her pup before a suckling session.



**Figure 3.** The Grey seal mother and pup during a suckling session. Note the other nipple above the pup's head.

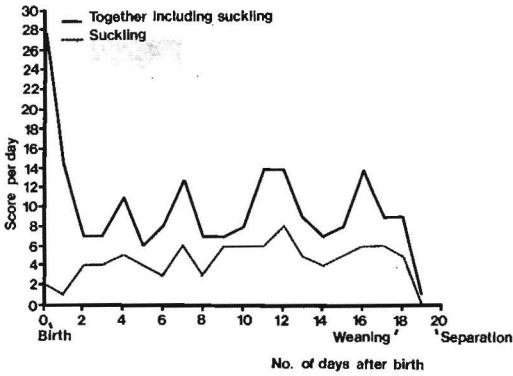


Figure 4. The number of observed occasions a day that mother and pup were found together, and the number of times a day that suckling took place during the suckling period (maximum possible score per day: 54).

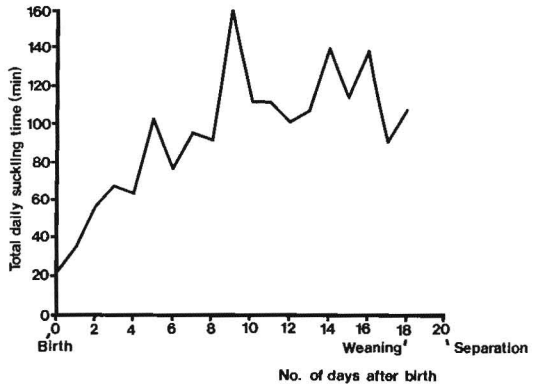


Figure 6. The total suckling time per day during the suckling period.

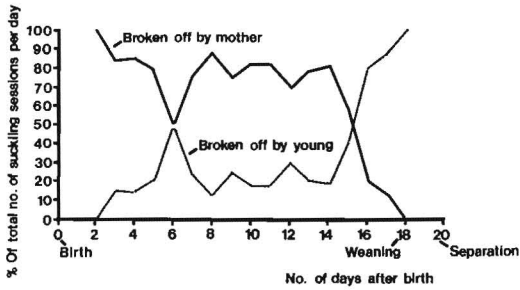


Figure 5. The daily proportion of suckling sessions broken off by the mother and by the pup during the suckling period.

cases of their being together during the whole suckling period, 89 of them were while suckling (44%).

Until day 15 most of the suckling sessions were broken off by the mother (Fig. 5). After day 15 most of the sessions were broken off by the pup.

*Suckling parameters*

By recording the duration of each suckling session it was possible to calculate the total suckling time per day during the whole suckling period (Fig. 6). The total daily suckling time increased steadily during the first 9 days after which it stabilized around 120 min/day ( $r=0.80$ ,  $p<0.01$ ).

The duration of the separate suckling sessions increased significantly ( $r=0.56$ ,  $p<0.0001$ ) over the whole suckling period from 4 to 24 minutes on average (Fig. 7A). Simultaneously the duration of the intervals between successive suckling sessions decreased significantly ( $r=-0.40$ ,  $p<0.0001$ ), from 190 to 140 minutes on average (Fig. 7B). This latter

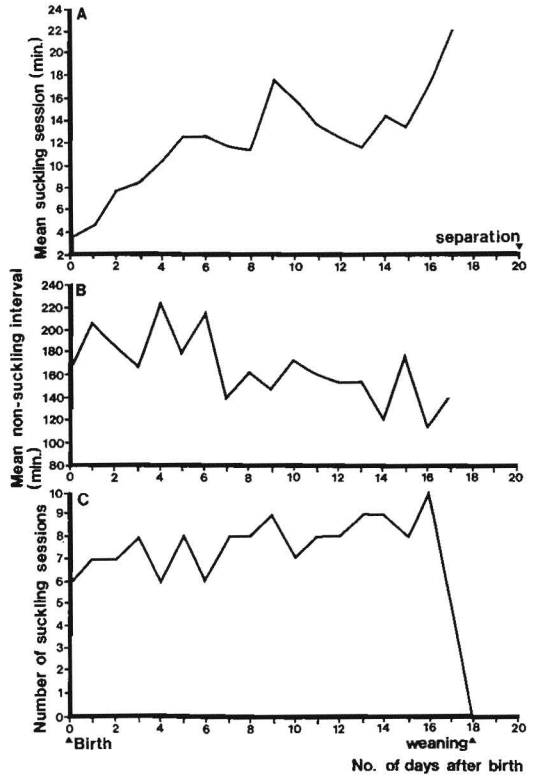
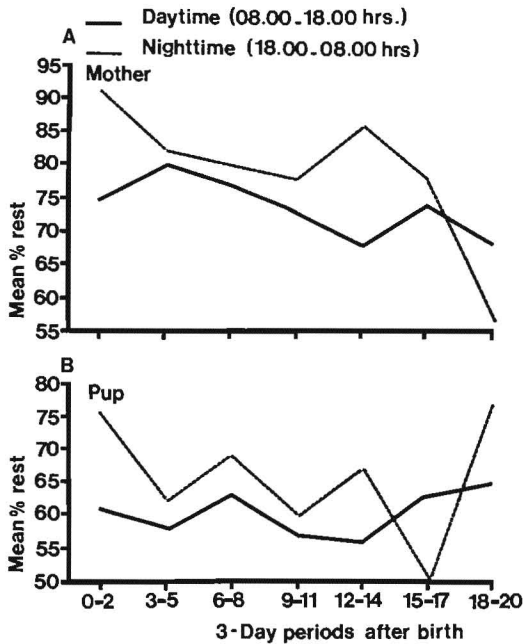


Figure 7. The length of the mean daily suckling session (A), the mean daily non-suckling interval (B) and the total number of suckling sessions per day (C), during the suckling period.

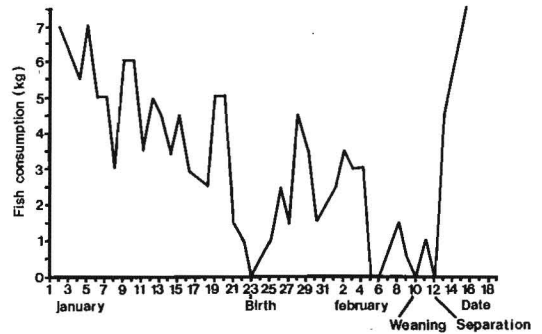


**Figure 8.** The mean percentage of time spent resting by mother (A) and pup (B), per 3 day period, during the suckling period.

decrease is associated with the increase in the number of suckling sessions per day (Fig. 7C). The length of a non-suckling interval was negatively correlated ( $r = -0.21$ ,  $p < 0.05$ ) with the duration of the next suckling session. No significant correlation could be found between the duration of a suckling session and the length of the non-suckling interval immediately following. Finally there was an interesting positive correlation ( $r = 0.36$ ,  $p < 0.0001$ ) between the durations of successive non-suckling intervals, indicating that long (or short) non-suckling intervals tended to cluster. Long non-suckling intervals tended to cluster during the night, and short ones during the day.

#### Activity

Both animals spent a lot of time resting. The mother rested a little more during the night than during the day (Fig. 8A). The amount of time spent resting decreased during the suckling period both during the night and in the day time. The mother started to dig more intensively near the fence after each suckling session as weaning approached (i.e. she came noticeably into oestrus, 15 days after she gave birth). The pup spent less time resting than the mother (Fig. 8B), and its activity level was fairly constant during the whole suckling period. Like its mother it rested a little more time during the night than during the day. The high activity level during



**Figure 9.** The mother's daily food consumption before, during, and after the suckling period.

the night on day 16 was probably caused by the snow that fell that night. In general the pup was more active in periods with rain than in periods without precipitation.

#### Food consumption of the mother

The food consumption of the mother showed strong fluctuations before, during and after the suckling period (Fig. 9). While in January she consumed on average 3.4 kg per day, her intake decreased to zero on the day of birth. During the suckling period her food intake was relatively low, but increased strongly after copulation which occurred immediately after she was allowed to go into the pool with the male.

#### Use of space

During the first 15 days both mother and pup spent almost 90% of their time in area 3, the area closest to the pool (Figs 1 & 10). The mother spent a lot of time lying on the ridge looking towards the pool which contained the male. The pup was very keen on a particular spot in area 3. After a suckling session it almost always returned to or near a specific stone. On day 16 the pup became more interested in its surroundings and spent more time in area 1 and 2. The mother followed to a certain extent, but usually not further from the pool than area 2. She hardly ever went to area 1 (Fig. 10).

#### Growth of the pup

During the study the weight of the pup changed as shown in Table 1. The pup gained 1.3 kg per day on average. Urine was seen a few times, but no faeces were observed during the suckling period. After weaning the pup visibly lost weight (quantity unknown) until it had learned to eat fish. Then it started to gain weight again.

#### Moult of the pup

When the pup was 13 days old it started to moult on its head and paws. Moulting was complete by day 25.



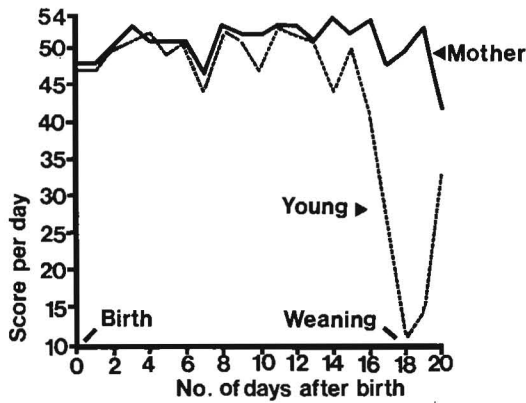


Figure 10. The use of area 3 of the suckling hollow (see Fig. 1) during the suckling period (maximum possible score per day: 54).

Table 1. Weight changes of the pup and the weight of the placenta

Occasion	Days after birth	Weight pup (kg)	Weight Placenta (kg)
Birth	0	16	1.5
—	3	20	
—	6	23	
—	10	29	
—	13	36	
—	17	38	
Weaning	18	—	
To sea	87	41.5	

#### Environment

The average daily temperature was around 6°C and hardly varied during the suckling period (range: 4 to 9°C). The average daily windforce increased a little towards the end of the suckling period (from 3 to 5 on the Beaufort scale). The precipitation was high, but decreased a little towards the end of the suckling period (it rained every day, on average 20% of each day). January and February 1988 were the wettest months of this century.

#### Events after weaning

In order to monitor the pup's food intake after weaning, it was placed in an indoor quarantine area (which is described in Kastelein & Wiepkema, 1988). The pup was force-fed from day 20 on, and started to eat fish voluntarily from the hand on day 64 after birth. In order to prevent future inbreeding, it was released on April 18, 1988 (age: 86 days) on the sand

bank 'Engelse Hoek' in the North Sea (north of Holland). This was possibly the first release of a captive born Grey seal into the wild.

#### Discussion and conclusions

This discussion focuses on the comparison of data from the present study (the '1988 pup') with those of the suckling period of the pup born in 1987 (Kastelein & Wiepkema, 1988). This latter pup spent its suckling period in an undisturbed, dry indoor facility with a constant and relatively high temperature; it will be referred to as the '1987 pup'.

#### Suckling ritual

The fact that the 1988 pup called for its mother much more often than the 1987 pup probably related at least partly to the different surroundings in 1988. The mother often spent time inspecting the environment before she offered her nipples to the pup. The mother always smelt the 1988 pup before suckling; this olfactory identification or 'nosing' was practically absent with the 1987 pup. She seemed to identify the pup in the outside environment not just visibly and acoustically, but also by smell. Maybe this was related to the mother being subjected to a range of outside odours. In the indoor situation, the smell of the pup could have filled the entire space, and might have been the only smell. This suggests that the performance of 'nosing' is modulated by external cues. In the wild, Grey seal mothers always 'nose' their pup before suckling (Davies, 1949; Fogden, 1968, 1971; Burton *et al.*, 1975).

The mother often moved her flipper back and forth when the pup approached to find the nipple. This behaviour has also been observed in young Harbour seals (*Phoca vitulina*). At the seal rehabilitation centre in Valdez, Alaska, orphaned Harbour seals were seen trying to suckle at each other's nipples. In such occasions the pup that presented its nipples also flippers at its poolmates (Kastelein, 1989; personal observation).

#### Encounters between mother and pup

Like the 1987 pup, the 1988 pup spent a lot of time with its mother during the first couple of days after birth. This could be of importance for the mother-pup bond. In 1988, the mother and pup spent 15% more time per day together than in 1987. This could be due to the disturbances in the outdoor environment, which caused the mother to move around more frequently in the hollow, and thus spent more time (often moving) within a range of 1 metre from the pup.

Until day 15, the mother broke off most suckling sessions, thereafter it was the pup that moved away first. Because the mother came on heat on day 17, the change in the pup's behaviour could be due to a hormonal change in the mother (Engelhardt &

**Table 2.** Suckling parameters of a Grey seal pup at the National Zoo, Washington D.C. (adapted from Wilson *et al.*, 1985)

Week	Average no. of suckling sessions per day	Average duration suckling session (min)	Average non-suckling interval (min)	Body weight (kg)
1	5.2	5.5	276	16 (birth)
2	6.1	8.9	234	
3	10.0	9.6	144	50 (weaning after 20 days)

Ferguson, 1979) which might have influenced the production and quality of the milk (Iverson & Oftedal, 1989). In 1987, the opposite was seen, since then it was the pup which stopped almost all suckling sessions. No good explanation seems obvious for this difference. Maybe the larger number of disturbances in the outdoor environment made the mother more restless and caused her to stop the sessions before the pup was fully fed. In both years, the mother was prevented from leaving the suckling area. The behaviour of Grey seal mothers during the suckling period varies per region and sometimes per year. In Orkney, U.K., when Grey seal density is high, mothers go into the sea after each suckling session. If the density is low, the mother remains with the pup on land during the entire suckling period (Fogden, 1971). In the Baltic, the female only remains on the ice during the night (Curry-Lindahl, 1970). On Sable Island, Nova Scotia, females stay on land during the entire suckling period and oestrus occurs on average 15 days after birth. The pup is weaned around 17 days after birth (Boness & James, 1979).

#### *Suckling parameters*

The total daily suckling time of the 1988 pup was on average much longer than that of the 1987 pup. This was the result of a higher average number of suckling sessions per day of, on average, longer duration (Fig. 7). This difference in suckling time could be explained by the fact that the 1988 pup was outside in a cold and wet environment and needed more milk than the 1987 pup, just to keep warm. However, individual metabolic differences between the two pups could also have played a role in the milk requirements.

Wilson *et al.* (1985) described the suckling period of a Grey seal and her pup in an outdoor facility (recording between 07.00 and 17.00 hrs). They also report that the total daily suckling time increased during the suckling period (Table 2). As in the present study, they found an increase in the number of suckling sessions per day, and an increase in the duration of the suckling sessions during the suckling period.

The non-suckling interval is partially influenced by external factors such as disturbances in the environment of the mother and pup. First of all, when the

pup is woken up by a disturbance, this may increase the tendency to look for the mother and to suckle. Secondly, the mother often offers her nipples to the young after a disturbance. For instance, immediately after the weighing of the pup, the mother often offered her nipples to it. On Orkney it has also been observed that when the pups were disturbed while sleeping, they started to call for the mother, which resulted in short non-suckling intervals (Fogden, 1971).

The negative correlation between the duration of a non-suckling interval and the duration of the immediately following suckling session suggests two possibilities that do not exclude each other. Firstly, a pup may interrupt a non-suckling interval soon after the suckling session because it is for some reason more hungry than at comparable points in time. This could explain the occurrence of an extra long suckling session immediately thereafter. Secondly, some external disturbance may have interrupted an ongoing non-suckling session during which mother and pup calm each other down (a mutual pacifying effect or function of suckling).

The positive correlation between successive non-suckling intervals (separated by one suckling session) indicates either a rhythm or periods in which suckling is characterized by clusters of successive, long non-suckling intervals, alternated with periods with many relatively short intervals. Since there were 13% more suckling sessions during the daytime (between 08.00 and 20.00 hrs) than during the night (between 20.00 and 08.00 hrs) this could explain the correlation found. The 1987 indoor pup showed no daily suckling cycle. Probably disturbances caused by people, seals and birds during the day triggered some more suckling sessions during the daytime in the 1988 outdoor situation. On Orkney night-time suckling was also observed. However, details such as those in the present case study and the 1987 case study could not be compiled for practical reasons (Fogden, 1971).

#### *Activity*

Both in 1987 and in 1988, the mother spent more time resting than the pup. However, on most days of the

suckling period in 1988 both mother and pup spent less time resting than in 1987. This was probably due to disturbances such as wind, rain, and sounds from people and other animals in the park. The relatively large proportion of time spent on active, energy costing behaviour by the 1988 pup may account, at least partially, for the relatively long average daily suckling time.

#### *Food consumption of the mother*

The food consumption of the mother around, during, and after the suckling period in 1988 is very similar to that in 1987. The mother was very fat at the beginning of the suckling period, and became thinner towards the end. This means that her food intake did not compensate for the energy lost in metabolism and milk transfer. After the pup was weaned her food intake increased dramatically, presumably to compensate for the weight loss that occurred during the suckling period. The similarity in the pattern of food intake in the 1987 and 1988 suckling periods implies that it is regulated by endogenous parameters as suggested by Kastelein *et al.* (1990). Whether lactating females in the wild change their food intake during the suckling period has not yet been studied in detail (Davies, 1956; Curry-Lindahl, 1970). However, they also seem to reduce their food intake, since at North Rona, Scotland, over 80% of the female's energy reserves are used during suckling to feed a pup (Fedak & Anderson, 1982).

#### *Use of space*

Although mother and pup had more space in 1988 than in 1987, they mainly used only a small portion of the available suckling area (area 3). After day 16 the young started to investigate areas 1 and 2 and was, to some extent, followed by the mother. Around that day the pup started to break off most of the suckling sessions (Fig. 5). Perhaps because it was hungry, the pup stayed awake and started to explore its surroundings. On Orkney the pups were usually asleep, unless they were hungry or disturbed. The pups only moved a few metres during the whole suckling period. As the suckling period is so short in Grey seals, most of the milk's nutritional value is generally used for growth and very little for movement (Fogden, 1971).

#### *Growth of the pup*

The average weight gained by the 1988 pup was 1.3 kg a day. The 1987 pup gained on average 2.1 kg a day. The weight increase of the 1988 pup resembles more closely the weight increases that are found in field studies (Amoroso *et al.*, 1950; Coulson & Hickling, 1960; Fogden, 1971; Mansfield, 1977). In the wild, there is a positive correlation between growth rate and subsequent survival (Coulson &

Hickling, 1964). The difference in weight gain between the 1987 and 1988 pups could be due to individual metabolic differences, but it seems more likely to be mainly due to the wet and cold environment in which the 1988 pup had to spend more energy to keep its body warm (January and February 1988 were the wettest months of the century). The 1988 pup was also more active than the 1987 pup, which was probably due to the disturbances in its environment. The pup was never observed producing faeces during the suckling period, so the only way it could have lost weight would be by respiration and by urinating. Like the pup in the present study, wild Grey seal pups loose weight after weaning because they need to live on their fat reserves until they are efficient at catching fish (Davies, 1949; Coulson & Hickling, 1964).

#### *Moult of the pup*

The 1988 pup's moult was fairly similar in rate and period to that of the 1987 pup, and both within the range found in the field. There is often a great individual variation in the start and length of moults within one breeding site and during the same year (Davies, 1949; Curry, 1970).

#### *Recommendations*

More studies of this kind under a variety of conditions are needed to determine the proportional impact of rain, temperature and disturbances on the pup's suckling behaviour and its growth.

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