Adoptive suckling in the Common Seal (Phoca vitulina) on Orkney

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Abstract

A Common Seal breeding colony on Orkney with an average of 87 seals was observed in summer 1985. Three out of seven individually known mothers began adopting foreign pups two to three weeks after parturition. The mothers own pups were not weaned at the time of adoption. Non adopting mothers tended to care more for their infants than adopting. Adopting fed their offspring 5.2d longer (26.7d versus 21.5d). Altogether they gave milk for 32.7d: 1¼ times as long as non adopting.

Introduction

Adoption, defined here as the raising of foreign infants by donation of milk has been observed in various mammal species. Pinniped adoption is reported from the Northern Elephant Seal (Mirounga angustirostis) by Klopfer & Gilbert (1966), from the Southern Elephant Seal (Mirounga leonina) by Carrick & Ingham (1962) and from the Grey Seal (Halychoerus grypus) by Hewer & Backhouse (1960), Smith (1968) and Fogden (1968 & 1971). Fogden (1971) postulates that adoption or inconsistant feeding is the result of severe disturbances on a rookery and leads to a decrease in long term survival chances of all involved animals. According to Smith adoption in Grey Seals mainly occurs, when high newborn mortality rates induce a surplus of milk from mothers having lost their offspring.

On Orkney adoption of Common Seals has been observed before by Rubertus (1983) on Burray and by us on Eynhallow (unpubl.). Van Wieren (1981) reports a single event of a mother feeding two pups in the Dutch Wadden Sea, presumedly twins. Other authors observing Common Seal groups during lactation do <u>not</u> report any occurence of adoption (John 1982, Tougaard in prep., Bach in prep.).

In the present study we examined a Common Seal breeding group on Burray/Orkney with a high proportion of adopting seal mothers. Since several seals could be identified, comparative studies between adopting and non adopting mothers were possible.

Materials and nmethods

Study site. This investigation was conducted in summer 1985 off the coast of Burray, a smaller Orkney island. The haulout site was located on a rocky flat locally known as Wha Taing. Tides are semidiurnal and range varies between 1.1 m (neap tide) and 2.3 m (spring tide). Water temperatures average 0 to 5°C in january and 10 to 15°C in july. Climatic conditions are highly influenced by the gulf current, leading to relatively mild winters and cool and rainy summers with strong winds from westerly directions. During the time of observation, from middle of may to end of july, only 15 days with sunshine and temperatures up to 22° could be recorded.

The observed haulout site (within the tidal range) is characterized by rocky ground partly covered with seaweed, barnacles and limpets. The site is bordered by a small cliff. The seals haul out on various rock terraces emerging at different tide levels within 1 km of the coast-line. An interchange of seals between these terraces was registered (Rubertus 1983 and own data).

Observation. The seals were observed from a hide situated just above the cliff. Since the higher terraces west of the hide were too far we only observed the seals on the "low terrace" (named by Rubertus 1983) which averaged 2/3 of the whole breeding colony. Mean distance between the hide and the seals was 15 m at high tide and 90 m at low tide. The observation itself did not cause any obvious disturbance. We used a telescope with 28-fold magnification and field binoculars (10 x 50). Average observation time was 7 h per day, varying with tidal- and wheather conditions.

The observations included:

- counting of all "hauled out" seals every hour
- estimation of the distance between all individuals and their next neighbour
- records of behaviour: individually known mother-pup pairs were observed for 20 min. Behavioural acts were registered by using the one-zero sampling method (Altmann 1973). By this method the relative frequency of behavioural acts is reflected (% of the sum of all ½ min intervals)
- record of suckling frequency (incl. suckling-initiation, -termination and -refusal) and duration of suckling bouts

The relative frequencies of behavioural acts are compared for adopting and non adopting mothers by using the non parametric U-test after Wilcoxon, Whitney and Mann (Sachs 1984).

Results

Group size and composition

The number of seals hauled out ranged from 22 to a single maximum of 168 individuals on june 4th, averaging 87 throughout the observation time. Most seals hauled out at low tide, in late afternoons with fair wheather. Towards the end of the observation period a decrease of numbers was registered.

Average group composition (mean number + SD): 10 (8) pups, 10 (7) juveniles and 67 (29) adults. On various days up to 10 Grey Seals (Halychoerus grypus) were present within the Common Seal group, though no interactions between the two species could be observed.

The average distance between individuals was 1 body length (1.50 m). No sex or age specific variations of this mean distance were recorded, except for pregnant females which tended to rest further apart.

Mother-pup pairs

Birth. Parturition was recorded on 11 occasions, mainly on the rocky shore, but also in the shallow waters in front of it. With one exception birth time did not exceed 30 sec. Two stillbirths and one premature birth were registered. Two mothers rejected any approach of their infant and disappeared soon after parturition leaving their pups doomed to die of starvation. Both pups were soliciting various other seals (not only mothers), though were repulsed without exception.In one of these cases a mother was separated from its newborn infant, while escaping into the water after a disturbance. Altogether 10 infant carcasses were found on the observation site.

Lactation period. The first pup was probably born on 23rd of may since we saw a seal placenta being eaten by a sea gull on this day. On may 28th a pup with lanugo fur was seen. It was found dead on the next day. During the end of may and the first days of june mother-pup pairs were occasionally present but did not remain for longer periods. After june 4th the number of mother-pup pairs increased until reaching a peak on june 19th, then decreased (fig. 1). For individual pups we were unable to determine weaning date, since in late lactation period mother and pup parted, then reunited after a period of time. The first

single pup was recorded on june 8th, followed by others on june 15th. The last birth was observed on june 26th. On july 19th all pups were weaned. The highest number of infants was recorded on june 20th: 32 mother-pup pairs and 16 single pups.

19 mothers and their infants could be individually recognized by their fur patterns. Though we obtained permanent information from only 7 pairs. 8 pairs left the observation site within a few days after birth, 2 pups died. From 2 pairs no data was recorded in the first days, so only partially valuable information was obtained.

Adoption

Two to three weeks after parturition 10 mothers allowed foreign pups to suck, though they were still feeding their own pup. This phenomenon is called adoption. From the 7 permanently observed mother-pup pairs 3 mothers adopted foreign pups. They were enumerated A1 to A3 (A stands for adopting). The 4 mothers which did not permit foreign pups to suck, are called non adoptive and presented as N1 to N4 (fig. 2). The open circle indicates the first day mother and infant were not seen together for at least one hour. Pair A1 was seperated already on the third day after birth. Mother and pup were seen searching for each other. Various times we saw them snufflingon foreign seals before meeting again. In all other cases the pair was seen together (when present on the rookery for the first 9 to 13 days after birth (mean:10.7d, SD:1.5d).

The day a mother was seen nursing her pup for the last time is indicated with a full circle. Pups can be totally weaned already after 15 days (N2) or on the other side can be nursed up to 29 days after their birth (A2). In the period between the first and the final parting, mother and infant were seen together more or less frequently, although there were big individual variations. As shown in fig. 2 this period tends to be longer in the case of adopting mothers (mean:17.3d, SD:4.5) than of non adopting ones (mean:10d, SD:4.8).

Adopting mothers accepted foreign pups while still feeding their own. They continued to nurse foreign pups even after their own had been weaned , up to 8 days in case of pair A3.

In fig. 2 the vertical arrows indicate, whenever a pup known to us sucked at one of the adopting mothers. Not only totally weaned (pup N2 sucked twice at mother A2) but also unweaned (pup N3 at mother A2, pup A2 and A3 at unknown mothers) were observed doing this.

Mother A3 was nursing at least 3 different pups, on the other hand she was also seen rejecting foreign pups. 2 adopting mothers were seen nursing up to 4 pups in a row, one even fed 2 pups at a time. One individually known pup was observed to suck at 5 differnt mothers, while pup N2 exclusively was seen sucking at mother A3.

When a pup was separated from its mother it crawled all over the haulout site, trying to snuffle and to suck at other seals in search of milk. During the first three weeks of the pupping season these pups were rejected without exception. Then on june 22nd, the first adoption was observed. Always the pup approached and tried to contact the foreign mother. The mothers only reacted by allowing these pups suckle. Foreign pups seem to prefer mothers that are surrounded by more than one pup. Up to 5 pups were seen together with one mother. Besides suckling no interaction could be seen.

Interactions

We examined the main interactions between mothers and their own infants, trying to find differences between adopting and non adopting mothers. The interactions that yielded enough data to allow the use of statistic tests were snuffling and interactions related to suckling.

Snuffling is important for recognition of the partner. It was mainly seen:
- within the first hours after birth (both)
- before suckling (pup snuffles teat region)
- after a period of separation (both)
- after a foreign pup had been repulsed (mother)

In this investigation nuzzling is included in the snuffling records. Table 1 shows that the relative frequency of snuffling is significantly higher in non adopting than in adopting mothers.

Suckling was not only seen on the shore but also in the shallow waters offshore. Often the mother was turned by wave action, so the infant lost contact with her teat, in some cases the pup kept suckling for a while even though its head was completely submerged. We saw mothers mainly nursing their pups after the pair had hauled out, after they had crawled in order to change a resting site or after a period of sleeping and before taking to the water.

Suckling was **initiated** by the mother by turning on her side and presenting her teats or even pushing the pup with her front flipper towards the teats. When the pup intended to suckle, it snuffled intensively or even scratched in the teat region to make the mother roll on her side. To express the share of the mother's initiation of suckling, the index I_M / I_M + I_P with I_M as initiation by mother and I_M + I_P as the total amount of recorded suckling bouts per day was formed. This index is significantly higher in the case of non adopting mothers (table 1).

Table 1: Comparison of mother-pup behaviour between adopting and non adopting mothers: * significant, n.s. not significant difference (U-test). Further explanation see text.

Behaviour	Non adopting			Adopting			Signif
	x	(SD)	n	x	(SD)	n	p<5%
Snuffling (in % of all ½ min intervals)	22	(18)	48	12	(8)	29	*
Suckling initiation Index I_M / I_M + I_P	0.5	(0.4)	20	0.3	(0.2)	29	*
Termination of suckling Index T_M / T_M + T_P	0.4	(0.3)	26	0.6	(0.4)	29	n.s.
Refusal of suckling Index R / I_M + I_P + R	0.1	(0.02)	26	0.2	(0.12)	29	n.s.

The **suckling** was **terminated** either by the mother (turning away the teats) or by the pup (releasing the teat and turning away after being satisfied). Like in the case of initiation, an index T_M / T_M + T_P was formed to express the share in termination of suckling bouts. This index is also higher for non adopting mothers (table 1, not significant).

In some cases mothers **refused to nurse** their pup. They turned away their teats when the pup was approaching. We formed the index R / I_M + I_P + R with R as the mothers refusal and I_M + I_P + R as the total amount of actual and attempted (but refused) suckling bouts.

Table 1 reveils that non adopting mothers tend to care more for their infants (more snuffling and suckling initiation) and might show less rejection (termination and refusal of suckling) than adopting mothers do. Repulse of the own pup, in form of up and down movements with front flippers, snapping or even biting, was exclusively observed from adopting mothers, no matter if foreign pups were nearby or not. In fig.2 the first recorded repulses are indicated with flashes.

Suckling duration. Newborn pups were nursed in general within the first 30 or 60 min after parturition for a period of 3 to 5 min. Throughout rearing the grosssuckling time per feeding bout averaged 10:43 min with 8:19 min net suckling time (2:24 min breaks). Mean gross suckling time of the individual mother-pup pairs varied between 9:06 and 14:40 min. No large differences could be recorded between adopting and non adopting mothers (9:11 min respective 8:29 min). 14 suckling events were recorded with one mother nursing 2 pups successively. The average suckling duration was 6:20 min for the 1st pup and 6:15 min for the 2nd pup.

Three times successive suckling of 3 pups could be observed. Gross suckling times were: 1st pup 12:10 min, 2nd pup 7:02 min and 3rd pup 4:50 min average.

Mean gross suckling time of successive suckling in general (sum of 2 pups:n=14, plus sum of 3 pups:n=3) was 14:58 min (mean net 8:37 min).

Statistic analysis (U-test) did not lead to any significant differences neither between successive and exclusive suckling nor between suckling times of the first and the second pup.

Discussion

Birth and mortality

Newborn mortality. The time following parturition is very important for a successful establishment of mother-pup bonds in pinnipeds. This time is dominated by familiarization with the partners scent (Marlow 1975, Burton et.al. 1975) and calls (Peterson & Bartholomew (1969). In the 2 cases when the pups were deserted no contact at all between mother and pup was observed. This behaviour mainly occurs in young mothers, pregnant for the first time. However, when a pup is accepted by its mother, 2 to 3 days are required before amother can savely identify it (Tougaard, pers. comm. and own data). Apparently many infants died within the first days after being born, either for lack of the mothers attendance or because they had been separated, for example due to a disturbance within the first days. In the case of pair A1 the mother barely managed to reidentify its infant after searching for it for 1½ days.

Postweaning mortality. According to Drescher (1979) and Reijnders (1978) 60 to 65% of juvenile seals in the Wadden Sea die within the first year of life. Beside the above mentioned mortality of newborn pups a second mortality after weaning is recorded in the Common Seal and other species of phocid seals (Laws 1953, Drescher 1979). The reason for this mortality is the postweaning fast resulting from the problem of young seals to adapt to self-supply after lactation (Drescher 1979, Fedak & Anderson 1982, Bowen et.al. 1987).

Adoption

Fogden (1971) suggests that adoption or "inconsistant feeding" in the Grey Seal (Halychoerus grypus) is a sign of disturbance caused by human activities (i.e. presence of an observer) and by crowding on a rookery with limited space (within a cove). Fogden observed that mothers waiting offshore did not succeed to relocate and identify their pups when hauling out. Many mothers deserted the breeding site, leaving hungry pups gathered at the shore-line. This caused increased aggression when remaining mothers hauled out. Pups crawling around the beach and begging for food lead to a highly confused situation and caused the break down of many mother-pup bonds and a strong increase of inconsistant suckling. This inconsistancy only leads to temporary benefits for the involved pups but decreases the long term chances of survival since none of the pups is provided with a full milk quota, as Fogden points out. She counted many underdeveloped and dead infants.

Our observations lead to different conclusions for Common Seals: Adoption was not observed before the own pup had reached the age of about two weeks (fig. 2). Since the lactation period varied between 16d (N1) and 28d (N3), mothers evidently only allow foreign pups to suck, when their own pup is almost ready to be weaned. They keep on feeding the own pup with rates that are not significantly lower than before the foreign pup's acceptance, so no disadvantage was observed, on the contrary, mothers A1 to A3 tend to feed their offspring for a longer time than mothers N1 to N4 (26.7d versus 21.5d average).

Smith (1968) concludes for Grey Seals on Orkney and Hebrides that with an increase of newborn mortality, opportunities for adoptive suckling arise. This cannot be stated for our observations. Mothers of dead pups tended to desert the rookery instead of feeding an orphan-pup. Common Seal adoption on Orkney does not seem to have any correlation with newborn mortality.

Adopting mothers donated milk for a period 1¼ times longer (32 to 35d) than non adopting mothers (16 to 28d). The extended nursing period might give the pups more time to increase fat reserves before weaning and thus might moderate the effects of the postweaning fast.

Except for the reports of a Common Seal mother feeding two pup in the Lauwerswal (van Wieren 1981) and a mother nursing foreign pup in captivity (Reijnders, pers. comm.) no records o adoption outside of Orkney are known to us. On the Orkney island adoption of foreign pups seems to be a common phenomenon. It ha been observed before on the same site by Rubertus (1983) and o Eynhallow by us (unpubl. data).

Adoption as a sociobiological phenomenon

A possible explanation for the occurence of adoption is the **reduction of the discrimination mechanism**. Hébert (1988) argues that in some cases it can be too complicated for a mother to evolve a strong enough mechanism of discrimination between own and foreign offspring. The costs of raising a foreign young could be smaller. Though snuffling as a mean of discrimination was significantly reduced in adopting mothers (table 1), a discrimination mechanism could not be totally absent, at least not within the first three weeks, when mothers still rejected any approach of foreign pups. However it is possible that, after the own pup has reached a certain stage of development, costs of discrimination and rejection are higher for the mother than gains (own pup's increased survival rate).

Common Seal adoption cannot be considered as **altruistic behaviour**. All explanations on altruism (Hamilton 1964, Trivers 1971, Wynne-Edwards 1962) require a rather stable group size and group composition (little genetic exchange with the exterior). Apparently Common Seals (especially juveniles) spread over large distances (Bonner et.al. 1974, Wipper 1975) so group composition is considerably unstable (Tougaard, in prep.).

At the present stage of knowledge it cannot be said whether Common Seal adoption increases or decreases the fitness of the adopting mother. Though we observed a prolonged lactation of the own offspring no statement on milk ingestion rates can be given. No records on the fate of the observed seals were taken after the end of july. If future studies reveal an increase of survival chances in own and foreign pups, adoption can be termed as **cooperative behaviour**, since all involved individuals win in fitness (Brown 1975).

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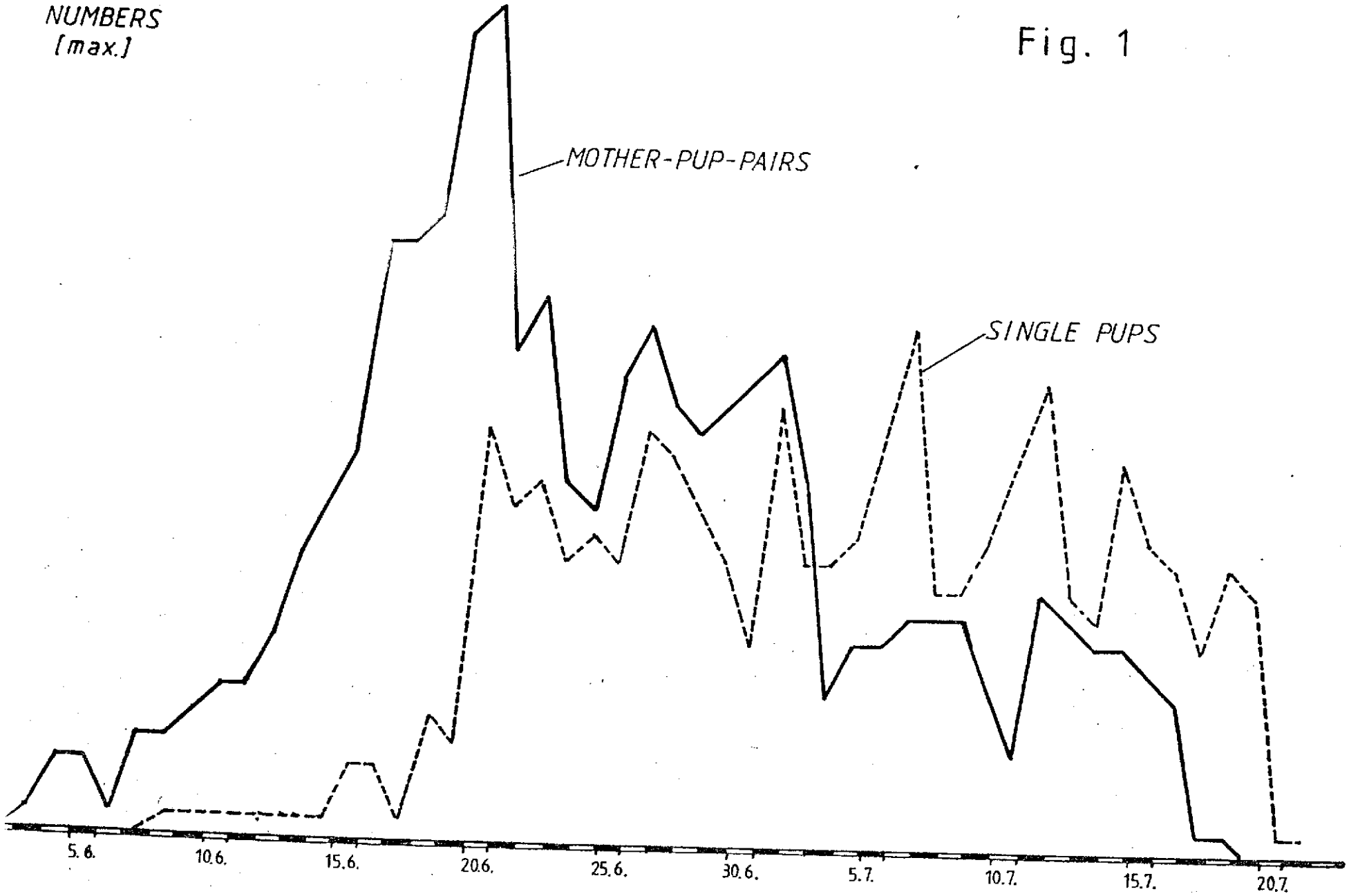
Fig. 1 Daily maxima of mother-pup pairs and single pups hau
out in front of the observation hide at low tide.

Fig. 2 The 7 permanently (regularily) observed mother-pup p
given as A1 to A3 for adopting mothers and N1 to N4
non adopting mothers. Further explanations see text.

Fig. 1


NUMBERS
(max.)
MOTHER-PUP-PAIRS
SINGLE PUPS
5.6.
10.6.
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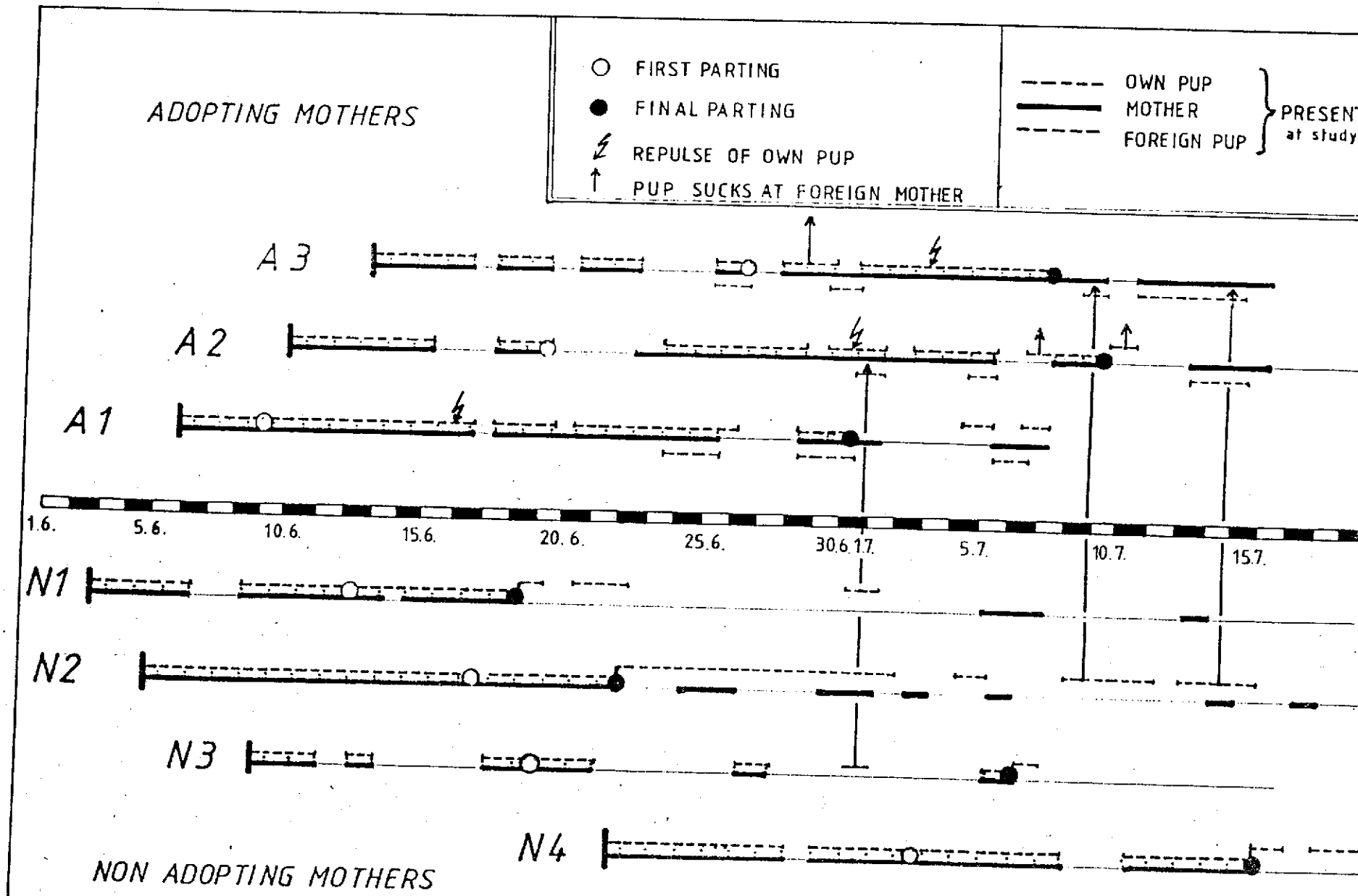
25.6.
30.6.
5.7.
10.7.
15.7.
20.7.

Fig. 2


ADOPTING MOTHERS
FIRST PARTING
FINAL PARTING
REPULSE OF OWN PUP
PUP SUCKS AT FOREIGN MOTHER
OWN PUP
MOTHER
FOREIGN PUP
PRESENT
at study
A 3
A 2
A 1
1.6.
5.6.
10.6.
15.6.
20.6.
25.6.
30.6.1.7.
5.7.
10.7.
15.7.
N1
N2
N3
N4
NON ADOPTING MOTHERS