

SOCIALISATION OF HARBOUR SEAL PUPS (*Phoca vitulina concolor*) AT INDIAN POINT, MT. DESERT ISLAND, MAINE

Susan C. Wilson
Tara Seal Research, 14 Bridge Street, Killyleagh, Co. Down BT30 9QN
E: suewilson@sealresearch.org W: www.sealresearch.org

This material presented in this paper is taken from a report 'Social organization and behavior of harbour seals, *Phoca vitulina concolor*, in Maine. (Part II. Socialisation of harbor seal pups (*Phoca vitulina concolor*) in Maine). Report to the Marine Mammal Commission PB-280 188. Contract no. MM6AC013, April 1978. xi + 103pp. Since this report is no longer readily available, the material has been edited and separated into 3 parts, of which this is part 2.



Adult and pup harbour seals at the nursery site, Indian Point, Mt. Desert Island, Maine, 1976

Introduction

Mothers and pups of the harbour seal (*Phoca vitulina*) form nursing assembles consisting of several mother-pup pairs and sometimes also other seals. Healthy pups normally interact only with their mother until close to the time of weaning. How and when weaned pups integrate into their own peer group and into the wider colony has not been documented.

The purpose of this paper is to trace the ontogeny of the harbour seal (*P.v. concolor*) pup's social responsiveness through the nursing period and for a few weeks thereafter in order to explore how a pup makes the transition from its secluded relationship with its mother to relationships with several of its peers. I will therefore emphasise those aspects of filial behaviour by the nursing pup which resemble aspects of social behaviour among weaned pups.

Study site and methods

The social behaviour of harbour seal pups was observed during the nursing period and after weaning, between April 23 and July 11, 1976.

The principal study area was at Indian Point, Mount Desert Island. This consisted of two sets of rocky ledges about 300m apart in a channel between two islands (Green Island and Black Island). One set of ledges nearest to Green Island, the *nursery site*, remained partly exposed at high tide and was regularly occupied by mothers and pups and a few other seals only during the weeks when pups were being nursed. The other set of ledges, the *mid-channel ledges*, were submerged at high tide, and were occupied on the ebbing tide, and were occupied by adults, juveniles and weaned pups.

Seal pup behaviour was observed daily over high water and the ebbing tide from a vantage point on Green Island. Observations were made through binoculars and photographed using an 800mm lens. Notes were recorded on paper and on to a cassette tape recorder and later transcribed.

Social interactions between pups and other seals were classified according to the nature of the approach and the approached seal's response. A *direct* approach was when the approacher contacted the approachee or went very close to it. The response of the approachee was classed as *positive* or *amicable* if it moved towards the approacher and settled closer to it, made (or reciprocated) naso-body contact with it, or followed it if it then departed. The response was classed as *watching* if the approachee moved its head and looked at the approacher or moved over to make more room on the ledge, *ignoring* if it made no overt response, and *lunging*, *growling* or *flipping* if it made one or more of these defensive responses.

Use of the term *play* and qualifiers such as *contact*, *solo* or *solitary play* follows the usage from previous descriptions of harbour seal behaviour (Wilson, 1974a, 1974b; Wilson & Kleiman, 1974).

Results

Timetable of birth and development

A single mother-pup pair was recorded on April 23 and again on April 27, and a second pup was found abandoned on April 24 (and hand-reared by the author); both pups bore a complete lanugo coat. On May 11, four pups were seen, all of which had shed the lanugo coat. The number of pups increased until May 28, when the highest number recorded was 45; the next highest was 35 on June 2 (Fig. 1). The last occasion on which a sizeable group of mother-pup pairs was seen was June 16, after which not more than 2 mother-pup pairs were seen.

Two healthy pups were seen unaccompanied by their mothers on May 21. Occasional 'lone' pups continued to be seen thereafter, although their number did not begin to increase until June 7 (Fig. 1). The rapid increase in the number of 'lone' pups from 5 on June 11 to 20 on June 16 was coincident with the sudden disappearance of all adult males and females from the study area. Weaned pups congregated in groups at the nursery site until June 17. When the last mothers abandoned the nursery site after June 17, so also did the weaned pups.

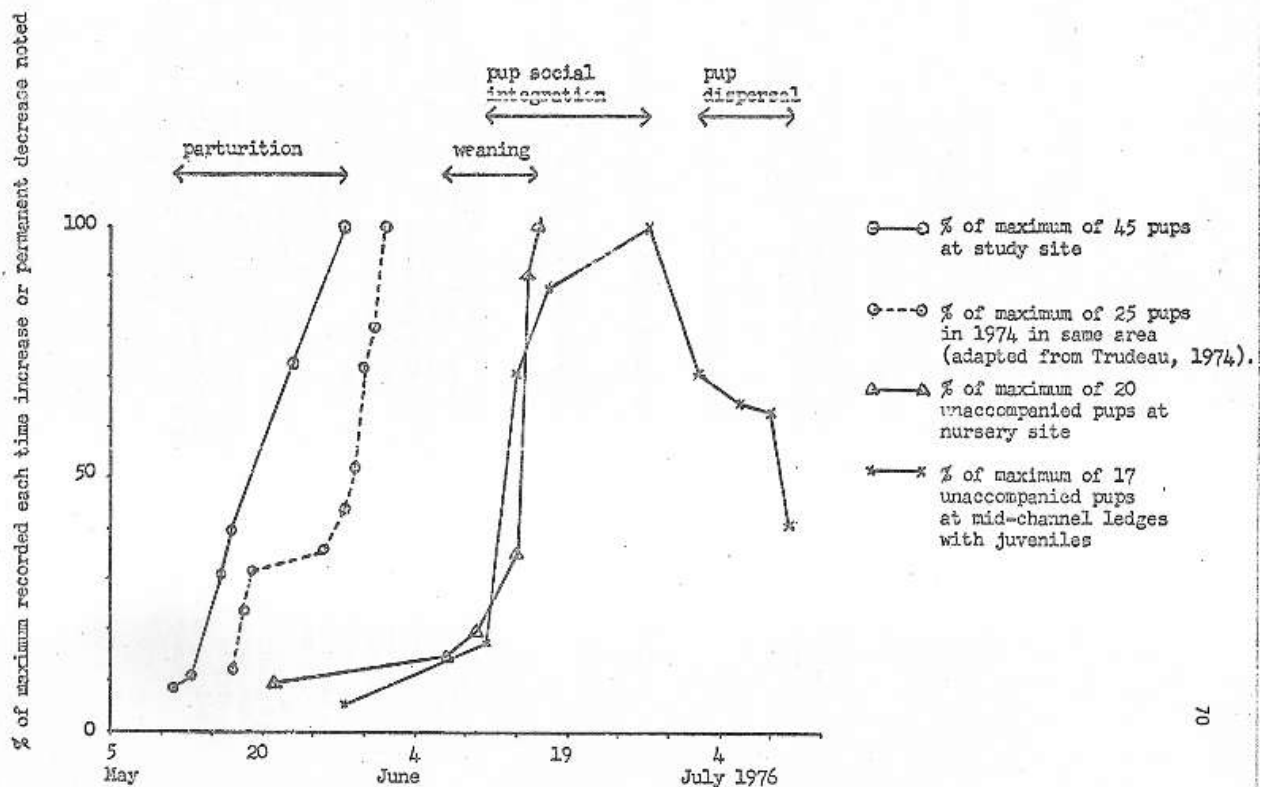


Fig. 1. Timetable of birth, weaning, social integration and dispersal of pups

Weaned pups occasionally joined in the juveniles' haul-out at the *mid-channel ledges* before the *nursery site* was abandoned (1 pup on May 28, 3 pups on June 11, 12 pups on June 14 in addition to 11 pups at the *nursery site* on that date). After June 17 some pups were always observed with the

herd of juveniles at the *mid-channel ledges*. However, the number of pups observed here decreased progressively during the first half of July (Fig. 1).

Behaviour which maintained the social insulation of the mother-pup unit

From birth to 3–4 weeks of age, the pups were constantly in the company of the mother with the exception of brief periods after May 21 when pups were sometimes seen temporarily alone at the *nursery site*.

Social insulation of the mother-pup unit was effectively maintained by the mother's vigilance towards her neighbours, both in the water and on the ledge. Mother-pup pairs swimming around the nursery site co-existed peacefully provided the pairs were separated by about 3 adult body lengths (ABL). If one pair approached closer than this (pups usually initiated such trespassing), the mothers would readjust the distance between them either with or without altercation involving flipping and splashing. Mothers on the nursery site ledge with their pup would watch a newly hauling-out pair alertly and lunge and growl at them if they came too close (within about 1.5 ABL). The pup beside its mother on the ledge was usually passive during these exchanges and was seldom even alert to the newcomers (Fig. 2, 4c,g).

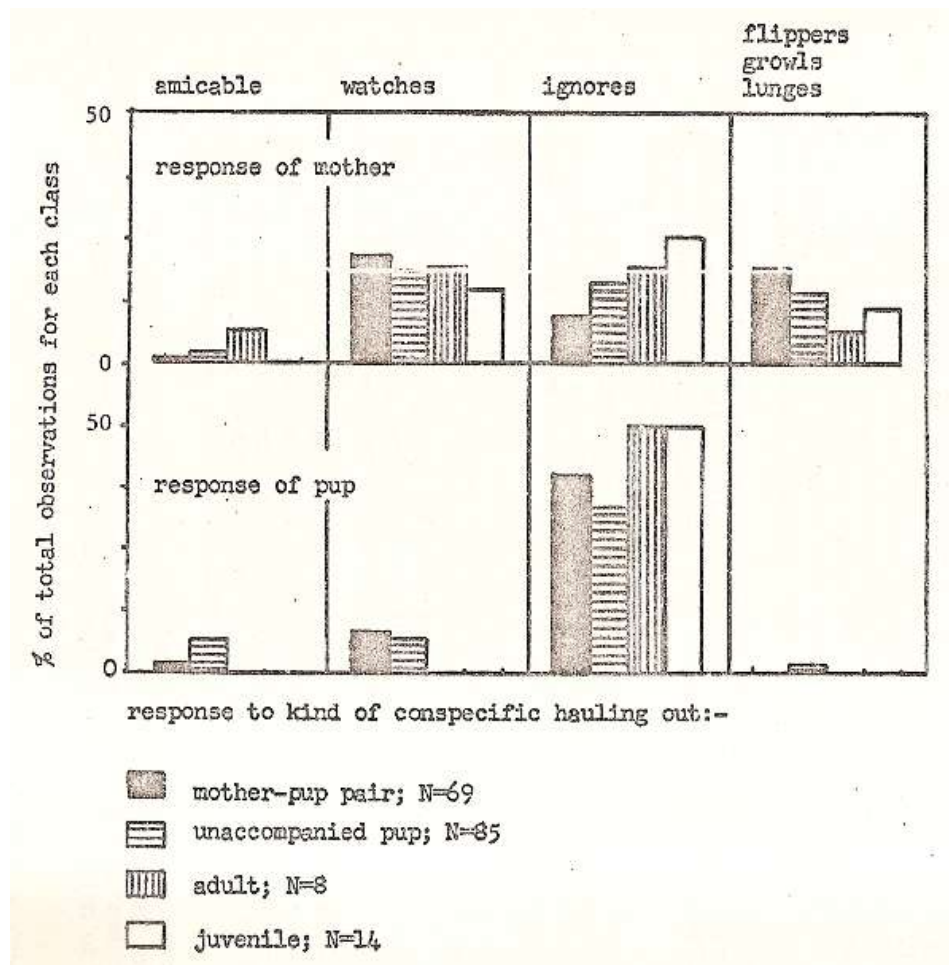


Fig. 2. Response of mother-pup pair to other seals hauling out beside them

Filial behaviour of the nursing pup orientated exclusively towards its mother

Pups displayed complex social responses towards their mothers. A pup would follow or lead its mother in the water, engage in aquatic locomotor play with her, follow her as she hauled out, nurse from her, rest beside her on the ledge, and in the course of all these activities repeatedly nose or nuzzle her on the mouth, neck and flank regions (Fig. 3).

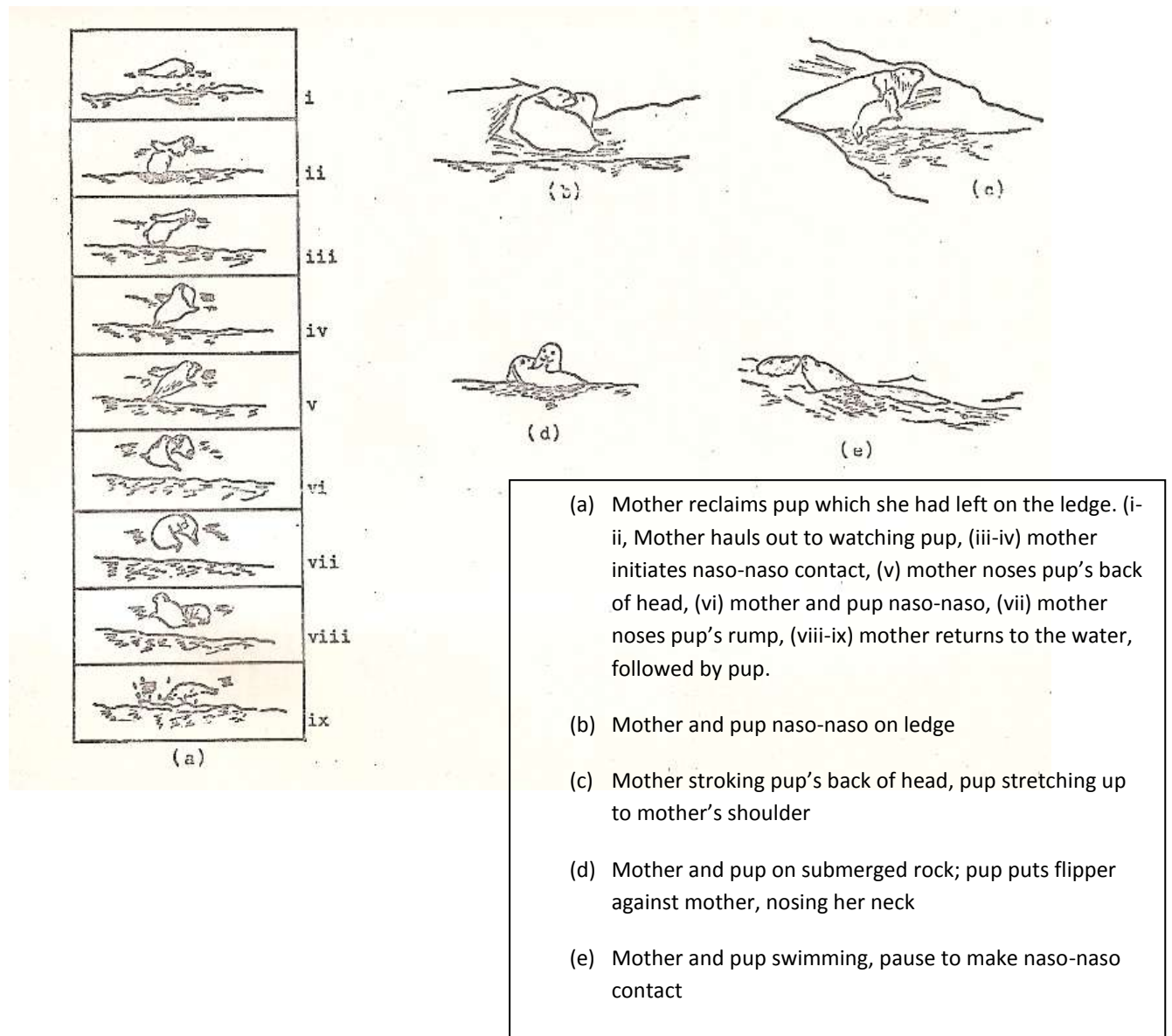


Fig. 3. Interactions between mother and pup.

Aquatic play between mother and pup was rarely observed before June, and then was observed infrequently. It usually took place in the shallow water of the *nursery site*. Play by one mother-pup pair sometimes resulted in several other pairs suddenly surfacing nearby. Most play lasted only a few seconds and involved a brief display of rapid movement combined with splashing and rearing out of the water.

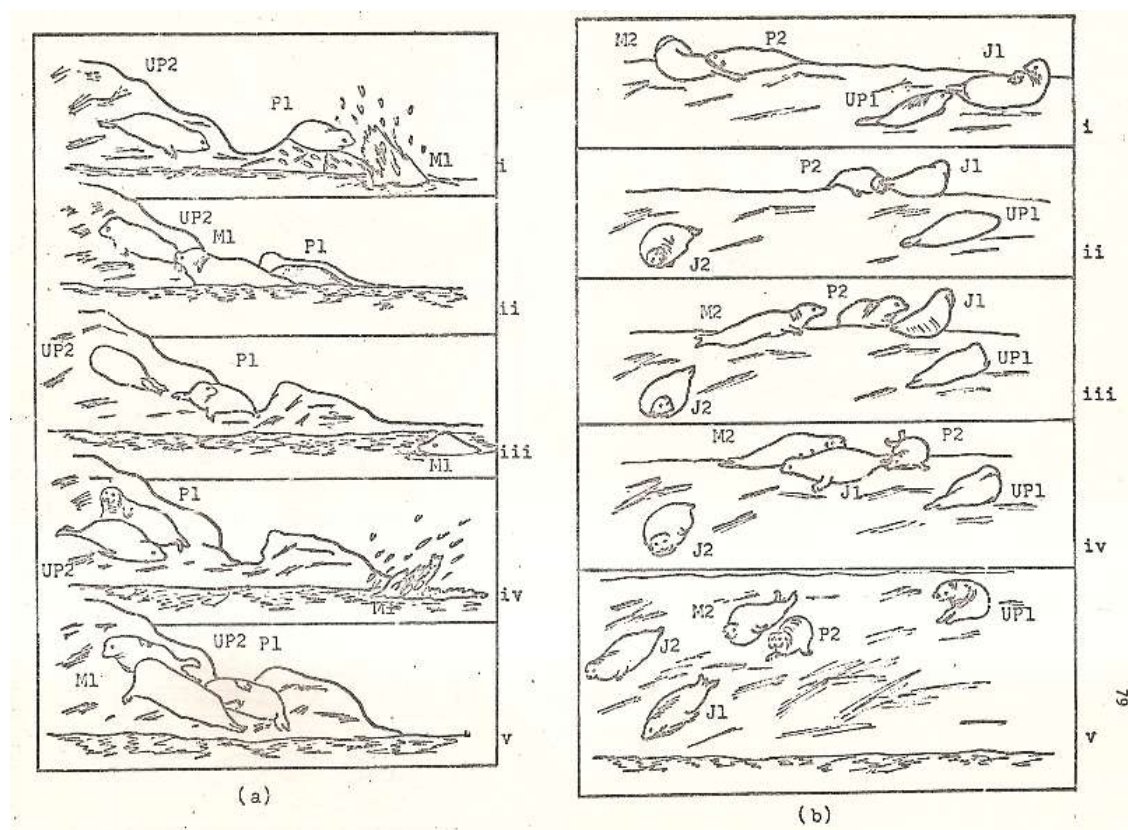
Only two prolonged play bouts were observed, both occurring on June 5. Both bouts culminated in the pair hauling out and the pup of one of the pairs starting to nurse. Both bouts took place in water

c. 1m depth alongside the nursery site ledge; one lasted 28min and the other 7.5min. Independent movement on the part of the pups was prominent in these two bouts. Both pups would dart off in the opposite direction from the mother (14 times) instead of following her (12 times) and often initiated the direction of movement with the mother following behind (22 times). The pups 'streaked' under the water, 'whooshed' along the surface and splashed with fore or hind flippers as they dived. The mothers would sometimes dive on top of the pup. Although both mothers seemed to participate fully, the pups actually executed more play acts (total of 48) than the mothers (total of 22). Sometimes the pair would surface together facing one another. Sometimes rearing high out of the water together, and sometimes making naso-naso contact (15 times). Naso-neck contact was observed only once during these two play bouts.

Breakdown of the social insulation of the mother-pup unit

Towards the end of the nursing period, some pups began to approach other seals besides the mother, in spite of the mother's efforts to prevent such interactions (Fig. 4)

Fig. 4 (a—h). Approaches by pups to seals other than their own mothers



(a). Pup P1 approaches unaccompanied pup P2. I – Mother M1 splashes at her pup P1, ii – mother hauls out beside both pups, iii – mother returns to the water, iv –mother splashes again, v – mother hauls out beside both pups, and all settle down to rest.
 (b) Two pups approach a juvenile. I – unaccompanied pup UP1 hauls out beside juvenile J1 and noses its hind-flippers, J1 flippers at it and moves higher up ledge, ii – mother of pup 2 has returned to water and pup P2 approaches J1, iii – M2 hauls out rapidly to her pup and lunges at J1, iv-v – J1 flees towards water followed by P2, M2, P1 and newly hauled out J2.

- (c) Unaccompanied pup UP1 hauls out near a sleeping mother M2 and pup P2
- (d) Unaccompanied pup UP1 hauls out near a pup P2 and mother M2 who watches alertly
- (e) Two unaccompanied pups UP1 and UP3, one on each side of M2 and P2. i – M2 lunges at UP1, ii – UP1 returns to the water, P2 turns round to watch.
- (f) Unaccompanied pup UP1 hauls out near Mother M2 and pup P2. P2 flipped at UP1 while M2 ignored it
- (g) Unaccompanied pup UP1 hauls out near Mother M2 and pup P2. M2 lunges at UP1 while P2 remains asleep
- (h) i - Pup P1 with its mother hauls out and approaches UP2, UP2 withdraws its head from P1, ii – Mother M1 splashes and P1 looks round at her and returns to water.
- (i) and (j) UP1 hauls out beside UP2 and approached UP2 in each cases raises flipper defensively at UP1

Sometimes a pup would crawl towards the pup of an adjacent pair on the ledge and rest close to it. In this way the character of haul-out clusters composed of mother-pup pairs altered and it became difficult to tell which pup belonged to which mother, and small clusters of pups would form, surrounded by some of their mothers (Fig. 5).



Fig. 5. Clusters of pups forming towards end of lactation period. Left: From L to R, Adult, pup, juvenile, 3 pups Right: From top L, adult and 2 mother-pup pairs, cluster of 5 pups surrounded by mothers of 4 of the pups, mother-pup pair on R.

In the latter part of the nursing period, some pups were left temporarily on the ledge. Several instances of mothers leaving or reuniting with their pups were recorded between May 21 and June 8. Most of these pups were judged to be at least 2 weeks old, although one small (but healthy) pup still wearing the lanugo coat was often left alone.

One method by which the mother left her pup was by hauling out with it and then returning to the water without it. Sometimes she would remain in the water nearby, watching her pup, before finally disappearing. Occasionally the parting would be preceded by a naso-naso or head-head contact. On June 10 a mother-pup pair hauled out beside 3 unaccompanied pups and returned to the water. The pup then hauled out again beside the other three pups, while its mother then hauled out further along the ledge.

A mother reuniting with a sleeping pup might haul out close to it and rest beside it, or engage in mutual naso-body contacts (Fig. 3a). A few unaccompanied pups would haul out alone, although these accounted for only 2% hauled-out pups recorded between May 21 and June 11. Others would haul-out close to pups still with their mothers, forming a pup cluster (eg Fig. 3).

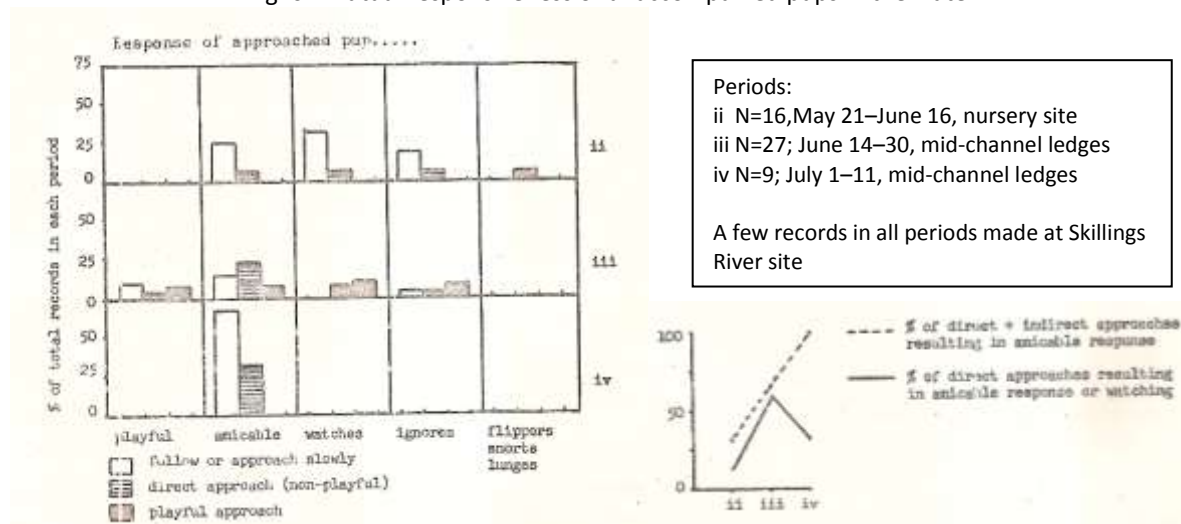
Social behaviour of unaccompanied pups at the nursery site (period ii, May 21–June 16)

Two-thirds of observed approaches made by one unaccompanied pup to another in the water involved following or approaching slowly without making contact (Fig. 6). Only one direct approach resulting in direct amicable response was seen. On the ledge, unaccompanied pups displayed more attention to one another than had pups still with their mothers: they now tended to *watch* rather than *ignore* an approaching pup (Fig. 4h; Fig. 8, compare i and ii). They were occasionally defensive (Figs. 4j; 8ii).



Fig. 7. One unaccompanied pup hauls out beside another

Fig. 6. Mutual responsiveness of unaccompanied pups in the water



Unaccompanied pups displayed some interest in the few juveniles which hauled out at the nursery site (Fig. 8a). Juveniles were slightly more likely than pups to respond *defensively* to a pup's approach (Fig. 8, compare (a)-I(ii) with (b)-I(ii); also see Fig 4b).

Pups were seen to haul out beside adults more often during this period than later. Adults rarely responded *amicably*. They were most likely to *watch* the pup and would also *ignore* it or respond *defensively* (Fig.8b-II; Fig. 9).

June 10–11 were the first days on which pups formed a cluster without using a mother-pup pair, adult or juvenile as a 'focus'. From June 14, large clusters of pups formed, but these clusters seemed amorphous and included mother-pup pairs, juveniles and adults intermingled with unaccompanied pups.

Six brief instances were observed, between May 21 and June 5, of aquatic *solo* locomotor play by a pup orientated towards hauled-out mother-pup pairs or adults or, in one case, an adult male in the water. These *solo* play instances included rapid swimming ('streaking') just under the surface (4x), splashing (2x), twisting and somersaulting (1x), bobbing up and down (1x) and head-tossing (1x).

Social integration of weaned pups into peer groups (period iii; June 14–30)

In the water, the percentage of *playful* and other direct approaches, and of *playful* and other *amicable* responses, was greater during periods iii and iv than during the immediate post-weaning period (ii) (Fig. 5). On the ledges pups also made more direct approaches to one another, more of these direct approaches evoked an *amicable* response from the approached pup, and an approached pup was more likely to respond *amicably* in periods iii and iv than in period ii (Fig. 8a and b). Juveniles were now more responsive to pups approaching them than they had been earlier at the nursery site (Fig. 8b-I(iii)).

Fig. 8. Social interactions involving hauled-out pups.

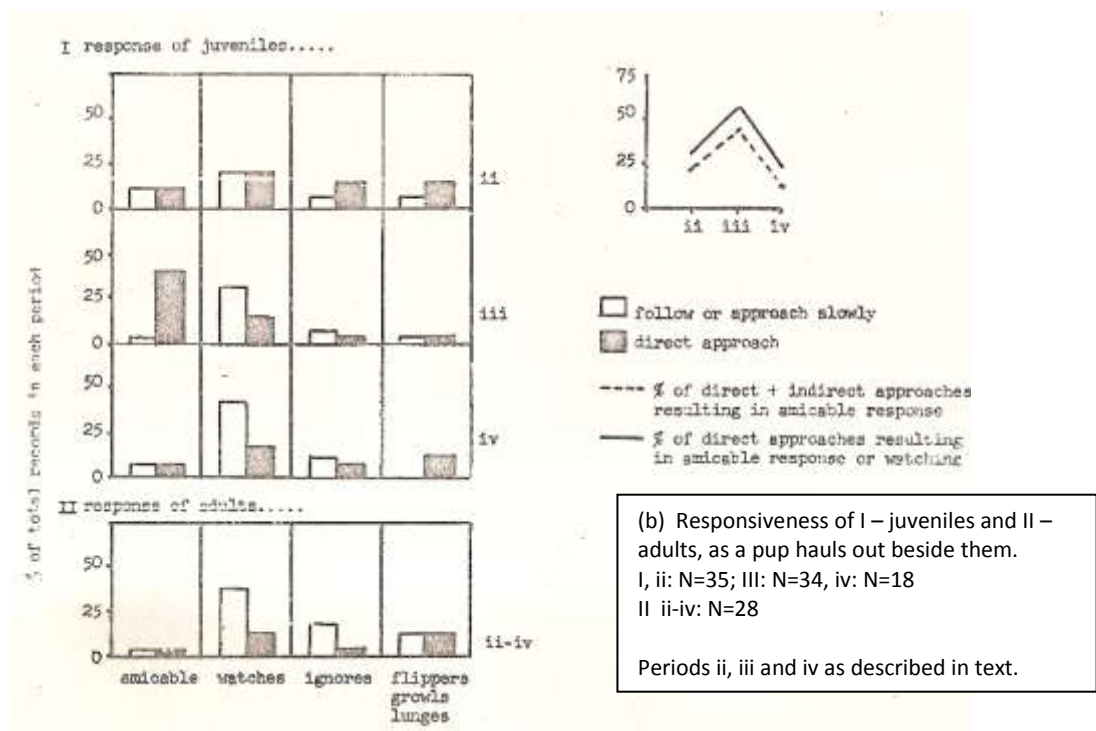
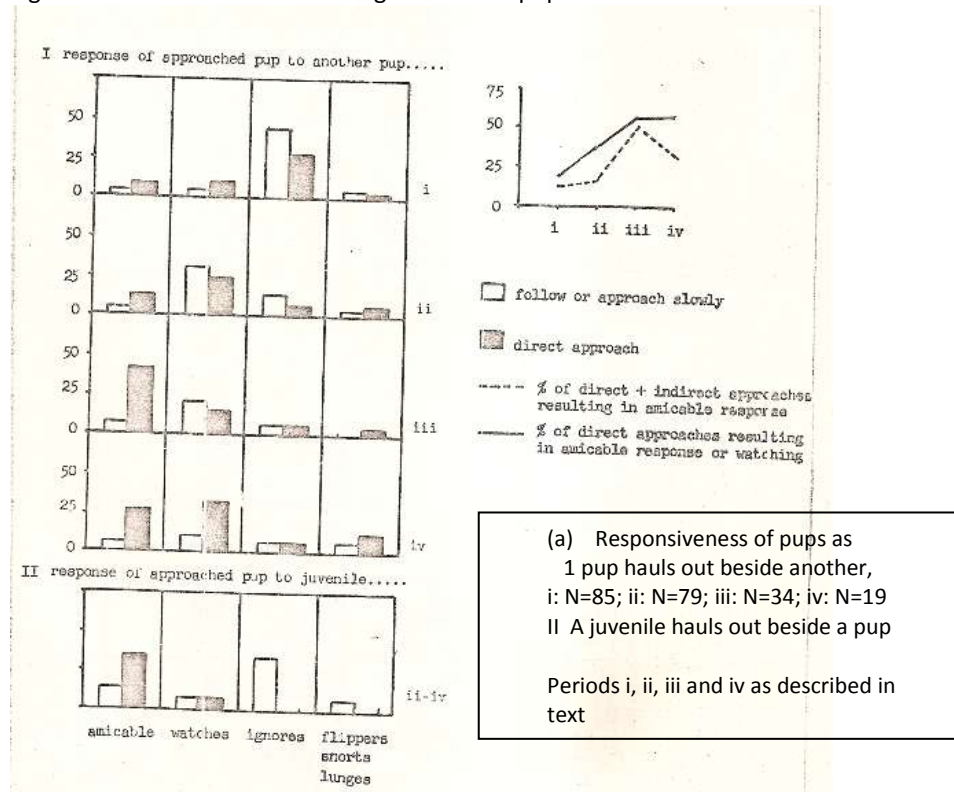




Fig. 9. A group of 3 unaccompanied pups approach and follow an adult male

Altogether, 11 instances of play were observed (4 between June 20-27 and 7 on June 18 at Skillings River). Only one instance involved two pups in continuous 'rolling' contact. The other 10 occasions all involved *solo* locomotor movement, such as porpoising (7x), high diving (4x), rearing out of the water (4x), streaking (2x) and a 90° turn (1x). Associated with these instances were splashing (24x), lateral body shaking (1x) and 4 instances of flopping on and off the rock. The Skillings River episode involved a group of 6 pups which had hauled out over a half-hour period, and had mingled amongst other seals (4 juveniles, 2 mother-pup pairs and 1 adult). Then a 7th pup splashed and porpoised beside the ledge and all the pups returned to the water. The *solo* play was displayed by these 7 pups as they hauled out gradually again over the next half-hour. One juvenile participated briefly in this play and then, after it had hauled out, it seemed to become the 'focus' for the continued play and subsequent haul-out cluster of 4 pups.

The ontogeny of group behaviour by pups (periods iii to iv; June 14–July 11)

Until June 14 not more than two pups were seen to associate together in the water. From June 14 group movement by pups in the water seemed to burgeon quite suddenly. The first groups of 2–6 pups were observed between June 14–16 at both *the mid-channel ledges* and the *nursery site* (Fig. 9), and on June 17, 9–11 pups were seen to move in the water as a group and haul out together beside the juveniles at the *mid-channel ledges* (Table 2).

When a group of pups entered the haul-out area at high tide, they would space out equidistantly and surface and submerge simultaneously. Pups did not usually begin to haul out until well after the juveniles had begun their haul-out (between 9–52 min later; mean 28 min; N=8). The first pups to arrive from the sea almost always hauled out on the first ledge to emerge on the falling tide, joining the first-formed and largest juvenile cluster. However, if the main juvenile haul-out occurred on a different ledge, so also did the main haul-out of pups. Only on two occasions pups initiated a haul-

out cluster. The rate of hauling-out (seals/min) for groups of pups and juveniles observed averaged between 0.13 and 0.41, with the highest rate being that of pups between June 14–22.

Table 1. Increase in pup cluster size at the nursery site in mid-June

Date	No. pups in cluster	Behaviour notes
June 11	5	First 4 pups hauled out singly. The 5 th hauled out with a 6 th , which returned to the water and hauled out further along beside two juveniles
June 14	9	4 pups mixed with 4 juveniles, 5 mixed with 2 juveniles, 1 adult female and 1 adult male
June 15	11	2 adults, 2 MP pairs and 4 juveniles also in group. After 1 st pup, pups approached ledge in 2 groups of 6 and 4. 1 st group hauled out in 27.5 min, the second in 11 min.
June 16	8	Amongst 8 MP pairs
	12	Amongst 6 juveniles and 1 adult.
		2 pups hauled out, returned to water, hauled out 1 hr later. 5 pups hauled out in 10.5 min. 10 min later 3 pups hauled out over 2 min. 25 min later 2 pups hauled out in 2 min.

Table 2. Ontogeny of group movement in water by pups in mid-end June

Date	Site	Group size and movement in water	Haul-out unit
June 14	<i>Mid-channel ledges</i>	5 pups	Haul out together beneath juveniles
		4 pups	Haul out together between pups and juveniles
June 15	<i>Nursery site</i>	6 pups	Haul out together
		4 pups	Haul out together
	<i>Mid-channel ledges</i>	7 pups, but only 2 together	4 pups haul out singly 3 pups haul out singly on 2 nd ledge
June 16	<i>Nursery site</i>	Groups of 2, 5, 3 and 2 pups	Pups seemed to approach the site and haul out in these groups
June 17	<i>Mid-channel ledges</i>	C. 9 pups appeared together at hw, moved between different ledges, surfacing and submerging in synchrony. Twice spit into subgroups, av size 4 pups, range 3–6. After 1 hr pups disappeared for 30 min	11 pups reappeared after 30 min and formed 2 haul-out clusters of 6 and 5 pups beneath juvenile haul-out group.
June 18	<i>Skilling's River</i>	No apparent group on initial haul-out. Group of 4 pups come in, surfacing and submerging synchronously and entice other 6 pups back into water. Locomotor play by pups in group ensues	Pups haul out again, one at a time except for 4 together
June 20	<i>Mid-channel ledges</i>	4 pups at hw; disappear	Later rapid haul-out by pups as soon as they re-enter area
June 22	<i>Mid-channel ledges</i>	5 pups on two occasions after start of haul-out	Haul out, moving from one ledge to next
June 24	<i>Mid-channel ledges</i>	3 pups at start, then suddenly group of 9 together. Mixing of juveniles and pups in water as they move from ledge to ledge. Av size sub-group 4.5, range 3–6	Move from ledge to ledge as they haul out
June 28	<i>Mid-channel ledges</i>	Two groups of 5 and 7 pups	3 haul out non one ledge, 2 remain in w. 5 haul out on 2 nd ledge, 2 remain in w

Dispersal of pups from the study area (period iv, July 1–11)

From the beginning of July there was a progressive decrease in the number of pups hauling out with the juveniles at the *mid-channel ledges* (Fig. 1). Less interaction among pups and between pups and juveniles was seen and play was not seen at all. Fewer approaches by one pup to another in the water were observed to involve contact, although the approacher would always respond positively in some way, such as following the approacher (Fig 6, iv). On the ledges, a direct approach by a pup was as likely as before to evoke *watching* or a positive response by the approached pup, but generally pups were less overtly responsive to neighbours hauling out (Fig. 8a, iv). There was also a marked drop in overt attention paid by juveniles to pups hauling out beside them (Fig. 8b, iv)

Discussion

The harbour seal pups in this study displayed to their mothers many of the social initiatives and responses they later displayed to their peers. Thus around the time of weaning it appeared to be not the pup's social responsiveness *per se* which changed, but rather orientation of that responsiveness. The following list of social responses directed by pups towards their mother which appear to transfer to other conspecifics after weaning:

- approaching, following or leading in the water
- naso-naso and other naso-body contacts in the water
- all components of aquatic locomotor play
- approaching and watching a ledge occupied by other conspecifics
- hauling out in the wake of the mother
- orientation and naso-body contact with the mother immediately after haul-out

During most of the nursing period, the pups showed little or no inclination to interact with any seal other than their mother and that social orientation, combined with the mothers' behaviour to deter other mother-pup pairs or other seals from approaching too closely, maintained an effective social insulation of the mother-pup unit within the social group during periods i and ii. It was noted during period iii that some pups began to orientate their social behaviours towards other pups while still with their mothers, while some pups appeared not to socialise with other pups even when unaccompanied by their mothers. The behaviour of these pups was characterised by:

- hauling out alone
- Ignoring or lunging and flipping at approaching seals (usually pups)
- Hauling out nearby other seals or following slowly in the water without making a direct approach

These pups which were slow to socialise in their peer group may have been the youngest pups at that time, i.e. those born latest (Fig.1).

The social behaviour of pups towards other pups was characterised by:

- Pups still with their mothers approaching other pups and becoming part of a pup haul-out cluster

- Unaccompanied pups following one another from the water on to the ledge to form a pup cluster
- Pups, with their mother or not, approaching other seals and initiating naso-body contact
- Locomotor play orientated towards other pups or juveniles

Weaned pups which approached, investigated or played beside other seals received the most positive feedback from other pups – some juveniles responded positively, whereas adults seldom did. Thus the behavioural mechanism by which weaned pups began to aggregate in peer groups in the vicinity of juvenile groups becomes understandable.

It seems likely that the change in orientation of the pup's social responsiveness around the time of weaning may be endogenous rather than being triggered by a change in the mother's behaviour. In elephant seals (*Mirounga angustirostris*), Rasa (1971) observed that while a 'pod' of pups, socialising and playing together, gradually formed around the time of weaning, some pups joined the 'pod' immediately after weaning, while other pups spent a few days hauling out alone when rejected by other adult females. Similarly, Kaufman et al. (1975) noted that nursing pups of the Weddell seal (*Leptonychotes weddelli*) *appeared to lack an attraction toward each other*. However, *Pups did associate when the females were not with them, particularly after weaning*. Weaned pup dyads were occasionally observed to play together and groups of 3–4 pups lying in body contact on the ice were frequently seen. Grey seal (*Halichoerus grypus*) pups are interactive with their mothers similarly to harbour seals (Wilson, unpublished data) but seem not to interact socially with other pups in the immediate post-weaning period. Their post-weaning behaviour resembles that in the list above of the harbour seal pup 'slow developers' - although yearling grey seals are highly socially interactive and playful (Wilson, 1974b; unpublished data).

This study found that

- most of the small amount of play observed took place in the 3rd week in June
- pup haul-out rates were higher between June 14–24 than later (i.e. pups followed each other more closely as they hauled out)
- the overt indices of positive social interaction amongst pups and between pups and juveniles reached a peak during the 2nd half of June and thereafter declined
- the number of pups at the study site gradually decreased during July, suggesting some pup dispersal

These data suggested that active social integration of weaned pups at Indian Point occurred most intensively during a relatively narrow window lasting about 10 days when most of the pups would have been approximately 3–4 weeks of age. Following this, levels of close social interaction seemed to end and the pups began to disperse from the study site when they were approximately 4½–6½ weeks of age. Observations suggested that since some pups were starting to approach their peer group before weaning, pups can be ready for the socialisation phase as young as three weeks of age. This synchrony of pup weaning, social integration and dispersal may be possible in harbour seals because of the well-synchronised timing of births within the colony.

Social integration of weaned pups at Indian Point seemed to take place with a minimum of play, and juveniles at this site played very little also. The occurrence of play appears to vary in harbour seal populations thus far observed, possibly being frequent between mothers and pups, less frequent in weaned pups, but very common in juveniles (Wilson, 1974a,b; Wilson and Kleiman, 1974).

While it is common for the female of many mammal species raising single young within a group or herd (such as otariids as well as phocid seals, many ungulates and primates) to insulate herself and her neonate for a few days post-partum (Bartholomew, 1959 and Peterson and Bartholomew, 1967 provide examples from otariids), it seems that phocid seals are unusual in maintaining this social insulation for the entire nursing period (Kaufman et al., 1975; Rasa, 1971). The explanation for this socially insulated mother-pup bond in harbour seals may be associated with the relatively short nursing period in which so much growth of the pup must occur to maximise post-weaning survival. If nursing mother-pup pairs were constantly approaching one another, they would be constantly disturbing one another's resting and nursing. Peaceful resting and nursing are presumably conducive to fluent milk flow and rapid pup growth. The alternative suggestion by Knudtson (1974) that *such a socially insulative bond lays a part in creating a harbour seal social system in which adults interact only rarely outside of sexual encounters.....in what might be called a seal 'society of strangers'* is not consistent either with observations of social behaviour around a harbour seal haul-out site (Venables and Venables, 1954; 1957; 1959; Wilson, 1974b; 1978) or with observations of social play predominating in juveniles during their 4–5 years of sexual immaturity (Wilson, 1974b; 1978).

This study has shown that pups seemed to stay close to their natal site in the first post-weaning weeks, congregate into pup-only groups after weaning, and follow and stay close to groups of juveniles at the haul-out site. It was suggested earlier (Wilson, 1978) that pups may benefit from following juveniles to suitable foraging grounds. Possibly pups may learn some aspects of foraging behaviour from the older juveniles. I suggest that post-weaning movements, social affiliations of pup groups and pup dispersal will vary from one colony to another, and may depend on local food resources suitable for pups and other age groups in the post-weaning period.

References

- Bartholomew, G.A. 1959. Mother-young relations and the maturation of pup behaviour in the Alaska fur seal. *Anim. Behav.* 7:163–171.
- Kaufman, G.W., Siniff, D.B., and Reichle, R. 1975. Colon behaviour of Weddell seals, *Leptonychotes weddelli*, at Hutton Cliffs, Antarctica. *Rapp. P.-v. Reun. Cons. Int. Explor. Mer* 169:228–246.
- Knudtson, P.M. 1974. Birth of a harbour seal. *Nat. Hist.* 83: 30–37.
- Peterson, R.S. and Bartholomew, G.A. 1967. The natural history and behaviour of the California sea lion. *Amer. Soc. Mammal Spec. Pl. No. 1.* 79pp.
- Rasa, O.A.E. 1971. Social interaction and object manipulation in weaned pups of the northern elephant seal, *Mirounga angustirostris*. *Z. Tierpsychol.* 29: 82–102.
- Venables, U.M. and Venables, L.S.V. 1954. Behaviour of a breeding colony of common seals, *Phoca vitulina*, in Shetland. *Proc. Zool. Soc. Lond.*
- Venables, U.M. and Venables, L.S.V. 1957. Mating behaviour of the common seal, *Phoca vitulina*, in Shetland. *Proc. Zool. Soc. Lond.*
- Venables, U.M. and Venables, L.S.V. 1959. Vernal coition in the common seal, *Phoca vitulina*, in Shetland. *Proc. Zool. Soc. Lond.*

Wilson, S.C. 1974a. Mother-young interactions in the common seal, *Phoca vitulina vitulina*. Behaviour 48: 23–36.

Wilson, S.C. 1974b. Juvenile play of the common seal, *Phoca vitulina vitulina* with comparative notes on the grey seal, *Halichoerus grypus*. Behaviour 48: 37–60.

Wilson, S.C. and Kleiman, D.G. 1974. Eliciting play: a comparative study (*Octodon*, *Octodontomys*, *Pediolagus*, *Phoca*, *Choeropsis*, *Ailuropoda*). Amer. Zool. 14: 341–370.