INTRODUCTION

This discussion of juvenile interactions in the common seal *Phoca vitulina* and the grey seal *Halichoerus grypus* necessitates a consideration of the elements in a species' behaviour which contribute to its social structure.

The pattern of spatial distribution of a mammalian species must depend on the balance between the cohesive and dispersive elements in its social behaviour. The animals of a species for which the dispersive element is the stronger will be spaced out, while if the cohesive element is the stronger the animals will form groups. The common seal is of this latter type (VENABLES & VENABLES, 1955; 1957; 1959; Y. NAITO, personal communication); fights have never been observed in this species and mating takes place in

1) I would like to thank Professor S. A. BARNETT for his support and discussion during this study; Drs T. B. POOLE, D. G. KLEIMAN, D. MORUS, and Y. NAITO for their stimulating discussion and criticism of the manuscript; and Drs J. M. CULLEN and M. H. ROBINSON for their advice. Grateful acknowledgement is due to Mr C. DONCASTER, who allowed me to reproduce frames from his film of grey seals and Mr P. WAYRE for allowing me to observe the juvenile seal group in the Norfolk Wildlife Park, Great Witchingham, Norwich. Dr P. BOADEN of Queens University Zoology Department, Belfast, and Mr R. PRATT and the late Mr K. ALLPRESS of Ramsey Island, Pembrokeshire, have contributed to make this study possible. Professor D. R. NEWTH of Glasgow University Zoology Department and Professor P. J. NEWBOULD of the University of Ulster Biology Department have given their support to this study, which was financed by the University of Glasgow Faculty of Science and the Edinburgh Nature Conservancy during 1967-68 and by the Thomas Henry Trust during 1971.

Some of this paper formed part of a thesis submitted to Glasgow University in 1969 for an M. Sc. degree.

the water without any overt competition between males. Lockley (1966) has compared and contrasted common seal social structure with that of its close relative, the grey seal. During the breeding season mature male grey seals space out along the shore and may compete with one another for position (Hewer, 1957; 1960; Hewer & Backhouse, 1960), although their behaviour is cohesive at other times of the year. Female grey seals with pups are also more intolerant towards one another and towards alien pups (Fogden, 1971) than are common seal mothers.

In many species in which the adults fight with or avoid one another, the juveniles solicit one another’s company and play together. Motor patterns occurring in adult agonistic behavior prevail in the juvenile play of these species; the pole-cat, Mustela putorius, is a good example (Poole, 1966; but see Eibl-Eibesfeldt, 1956; Bartholomew, 1959; Peterson & Bartholomew, 1967; Hinton & Dunn, 1967; Loizos, 1967; 1969; Schusterman, 1968; Millar, 1968). It was thought that a comparison of juvenile interactions in the common seal and the grey seal would be interesting because of the differences in social organisation.

Among the Phocidae juvenile interactions have been studied only in the Northern elephant seal, Mirounga angustirostris. In this species the adult males fight during the breeding season. Rasa (1971) observed two types of interaction among weanling dyads on land. One, which she called ‘wrestling’, incorporated motor patterns typical of agonistic interactions between adult males, and was performed usually by two males or by one male initiating an encounter with a female. The author noted that ‘continued rearing and slamming by one individual usually results in the other moving away and terminating the interaction’, which could, however, be renewed if one animal followed the other. The other type of encounter resembled the agonistic encounters of adult females. The behaviour was more typical of female weanlings, but male pups also participated. The interactions were brief, seldom renewed, and resulted in the animals spacing out. The author did not refer to either of these interactions as ‘play’.

Since neither common nor grey seal weanlings were observed to interact with one another very much, juveniles of both species between about six months and five years were studied. Two types of social play by common seals, dyadic play and group play, were investigated. The play patterns of grey seals were observed and compared with those of the common seal.

The seal behaviour referred to as play was characterised by body movements such as leaping and splashing in the water and exaggerated flopping towards one another over the rocks (common seal) and shore (grey seal).
WILD GROUPS OF COMMON SEALS

Observation sites and methods.

The observation sites and information about the observations made at each site are given in Table 1. (Grid references are not included here, but are available from the author on request). The seals were observed through binoculars from the nearby shore. When a full commentary on the behaviour was needed, this was tape-recorded and later transcribed. Otherwise, notes were written directly.

It was not usually possible to distinguish the sexes or individuals.

<table>
<thead>
<tr>
<th>Place</th>
<th>Date</th>
<th>Maximum number of juveniles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1-3 years</td>
</tr>
<tr>
<td>Killunaig, Mull, Argyll</td>
<td>March 18 - April 21</td>
<td>10</td>
</tr>
<tr>
<td>Carlingford Lough, Co. Down</td>
<td>May 27 - June 5</td>
<td>20</td>
</tr>
<tr>
<td>Strangford Lough, Co. Down</td>
<td>June 7-20</td>
<td>20</td>
</tr>
<tr>
<td>Portavogie, Co. Down</td>
<td>June 8-15</td>
<td>6</td>
</tr>
<tr>
<td>Strangford Lough, Co. Down</td>
<td>May 19 - June 29</td>
<td>4</td>
</tr>
</tbody>
</table>

Group structure.


About 100 seals frequented the Ross of Mull during March and the first half of April. Most of these hauled out at one site (Killunaig), but up to 16 appeared at two other sites about 15 miles away. Ten of the Killunaig group were juveniles between 9 months and 3 years old, termed 'small juveniles'. The numbers at Killunaig fluctuated, owing, at least in part, to the weather. Counts were highest in the first week of April (maximum 98 on April 5) and then decreased, although the 10 juveniles were almost always present.


This group numbered about 40. Their movements from rock to rock within the lough were followed throughout the day. One group of about 20 small juveniles was always present on the same rock, except when the rock was covered at high water. The other group, consisting mostly of adults and seals aged about 4-5 years, termed 'adolescents', hauled out on each of three rocks all within 10 miles of the juveniles' rock. The group moved as each rock in turn became covered or stranded by the tide. Probably as a result of all this movement the group was seldom encountered all together.

The division between the two groups was not rigid. For instance, two adults occasion-
ally hauled out with the small juveniles, and small juveniles occasionally appeared with the group of older seals. One identifiable 3-year female sometimes hauled out with one group, other times with the other.


There were about 100 seals in Strangford Lough, separated, at least in the summer months, into three main hauling-out groups.

The adult group consisted of about 60 seals, which hauled out on a group of offshore rocks (about 7 miles inside the lough) during the early summer. About 15 young were born and nursed annually at this site. This adult group seemed to be splintered, however, since the numbers observed daily were erratic.

The small juveniles, numbering about 20, formed a distinct hauling-out group from May to July. They occupied either of two sites near the mouth of the lough, where they were sometimes joined by a few adults or by a few mothers with pups. Another rock, close to one of these sites, was sometimes occupied by up to 10 seals of assorted ages.

A group of up to 18 adolescents sometimes hauled out with the small juveniles, and sometimes independently. During May and June of 1971 they occupied daily the rocks normally used by the small juveniles, although small juveniles were rarely seen that year. This absence of young animals may have been related to a reported finding of about 20 dead juveniles on a nearby shore during the summer of 1970.

During the winter months the Strangford seals hauled out on various rocks in small groups of assorted ages (Arthur Irvine & Gail Creighton, personal communication).

**Portavogie, Co. Down, N.E. Ireland. June 8-July 15, 1968.**

This island is near the mouth of Belfast Lough, and is close also to the mouth of Strangford Lough. The common seals hauling out here (maximum 40) always included individuals of each age class.

These common seal sites in Co. Down are by no means a complete inventory of common seal hauling-out sites on this coast, but are only the sites at which the behaviour of seals was observed in this study.

**Time and place of activity.**

Juveniles at all the observation sites played in the littoral shallows before hauling out to rest on a nearby rock. At Killunaig and Strangford the seals returned from feeding to the rocks soon after high water. They hauled out when the tide was about mid-ebb, after 1-3 hours of play. At Carlingford and Portavogie the seals congregated regularly at rocks exposed either at the beginning of the ebb or at various other times of the tide.

**Dyadic play.**

Dyadic play began by two seals, usually of similar size, approaching each other and coming into naso-naso or naso-face contact. Usually they then submerged, still touching one another. This behaviour, termed pre-rolling contact, ended either in separation or resulted in a bout of play behaviour which involved each animal somersaulting over the other while in continuous
contact, termed rolling by VENABLES & VENABLES (1957; 1959). A rolling bout seldom lasted more than three minutes and eventually resulted either in separation or in further contact. Separation was itself an integral part of the play pattern, each of the pair engaging in solitary play (see below). One of the pair would follow the other until contact was reestablished. Dyadic play would continue intermittently usually for an hour or more.

The tempo of rolling ranged from very vigorous with much splashing and loud vocalisations, such as ‘wooah’, as the seals surfaced, commonest among the small juveniles, to very slow with little splashing and few noises, as in adolescents. Adolescents often became almost static during play, with the two seals floating at the surface and each resting its head against the other. In adolescent play one member of the dyad sometimes had his penis extruded, although attempted coitus was not observed (cf. VENABLES & VENABLES, 1959); rolling by the small juveniles had no sexual components.

There was a relationship between the time spent in a pre-rolling bout and the time spent in the subsequent bout of rolling. This relationship was obtained by extracting figures from the tape-recorded commentary by scoring 1 unit each time the seals in contact surfaced or submerged, and 1 unit each time the words ‘still rolling’ were repeated slowly. By this procedure the amounts of pre-rolling and rolling could be divided roughly into categories of ‘short’ (S), ‘intermediate’ (I) and ‘long’ (L). All ‘long’ periods of rolling were preceded by a pre-rolling phase of ‘intermediate’ length, while ‘short’ and ‘long’ pre-rolling bouts were more likely to result in only a ‘short’ bout of rolling (Table 2). The correlation, expressed by a contingency coefficient (SIEGEL, 1956), between rolling and pre-rolling

### TABLE 2

<table>
<thead>
<tr>
<th></th>
<th>pre-rolling</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S</td>
<td>I</td>
<td>L</td>
<td>Total</td>
</tr>
<tr>
<td>S</td>
<td>20</td>
<td>16.99</td>
<td>17</td>
<td>69</td>
</tr>
<tr>
<td>I</td>
<td>13</td>
<td>28</td>
<td>3</td>
<td>44</td>
</tr>
<tr>
<td>L</td>
<td>0</td>
<td>21</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>81</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

S = short = 1 unit, I = intermediate = 2-3 units, L = long = 4+ units

\[ \chi^2 = 23.3, P < 0.001, \] Contingency coefficient, \( C = 0.39 \)

Lower figures indicate the expected values.
time judged in this manner, was 0.39 (P < 0.001). Whereas only 25% of pre-rolling bouts of intermediate length were not followed by rolling, over 50% of both long and short pre-rolling bouts did not lead to rolling.

The pattern of this relationship was confirmed in juveniles in 1971 by timing the pre-rolling and rolling behaviour. Figure 1a shows how most of the rolling by small juveniles was preceded by an amount of pre-rolling contact fixed between about 10 and 50 sec., but in adolescent play long bouts of pre-rolling contact were often succeeded by long bouts of rolling (Fig. 1b). The adolescents also differed from the small juveniles in separating much more often without rolling after a contact bout (Fig. 1a and b). Within both age groups rolling often occurred without preliminary contact except at the start of a play session.

Among small juveniles, at the transition from pre-rolling contact to rolling, one animal sometimes dived on top of the other. This behaviour might be interpreted as an invitation or persuasion to roll, since of 51 instances 31 were followed immediately, or almost immediately, by rolling.

Only twice did this behaviour result in separation.

One sequence was as follows: ...roll; surface heads together; one dives on top of the other; submerge together; splash; surface heads together; one pushes over and dives on top of it; one dives on top of other; submerge together; splash; surface together; submerge then surface together; separate...

In the adolescents head jerking was used to solicit rolling instead of one diving on the other. Younger seals also used this pattern occasionally. One
small juvenile, however, brought rolling to a halt several times by a small jerk of the head. The same animal would restart rolling by diving backwards over his partner and making a small splash with his foreflipper.

During the intermittent periods of separation, one or both partners of a small juvenile dyad would engage in splashing, porpoising, streaking just under the surface, blowing a bubble chain while sinking below the surface, shaking seaweed in the mouth, and vocalising. If one stretched back to its partner, the other reestablished contact with it. Waving or jerking the head as well as darting the head at the other also led to renewed contact. Circling the other before moving away, rearing high out of the water, or merely turning back to the companion all occurred occasionally, apparently to solicit following. The only play activities engaged in by the adolescents during separation were slapping the surface of the water making a sharp bang (termed rifle-shot splashing), splashing, bubble blowing and vocalising. During these activities the animals frequently surfaced, rose vertically out of the water, and submerged again.

GROUP PLAY

A seal began group play by porpoising or splashing vigorously around a rock, hauling out on the rock and then rapidly returning to the water. Others then converged upon that rock and porpoised, splashed and periodically hauled out until finally none of the group returned to the water. Even when a large group was ultimately involved in this activity, usually only two or three seals played simultaneously. The splashing and porpoising was often directed towards a seal on the rock, and a seal's return to the water was sometimes a response to a seal playing just beneath it. Approaching and momentary contact occurred frequently in the water.

These observations suggested that, although the seals played in a group, each individual's activities were directed specifically towards one other seal, either momentarily or until one of the two finally hauled out.

The effect of group play was an increased speed of hauling-out compared with the normal social haul-out. All age and sex classes of common seals haul out in groups, and it is usual for young seals to porpoise once or twice around the rock before hauling out. Figure 2 shows the hauling-out rate and amount of porpoising for a non-playing group of juveniles (c), a group in which play was brief (b), and a group in which play continued until all seals hauled out (a). During group play both the rate of hauling-out was faster than normal and there was more porpoising. Also, momentary hauling-out, with the seal being on the rock for less than a minute, was repeated frequently. Other play behaviour included streaking just under the surface,
shaking seaweed in the mouth, vocalising and blowing bubbles. The group play of adolescents was only distinguishable from that of the small juveniles by their frequent rifle-shot splashing.

This play, therefore, transforms the normal social haul-out into an integrated group activity by collecting all the animals together, bringing them into contact with one another, and directing their activity so that they haul out as a unified group.

Fig. 2. Wild groups of common seals: haul-out during group play compared with the normal social haul-out. (a) complete group play session (18 adolescents in group). (b) incomplete group play session (9 small juveniles in group). (c) normal social haul-out (8 adolescents in group).

The occurrence of group and dyadic play.

Dyadic and group play were observed among adolescent and small-juvenile groups. Dyadic play by at least one pair of small juveniles usually occurred on any observation day, but it was seen with predictable regularity among adolescents only from the middle of May until the end of June (1971), after which time the adolescents seemed to disperse. Similar seasonal activity among the adolescent seals in Shetland was described by Venables & Venables (1959) as occurring at the same time of the year, although there was an unambiguous sexual element in the Shetland seals' activity which was less evident in the Strangford adolescents' play.

Of the two kinds of play, group play occurred less often than dyadic play, either instead of it or after one or more pairs ceased dyadic play.
Occasionally a pair opted out of group play and switched to dyadic play. Group play often occurred on successive days, and then did not recur for many days, but neither tidal periodicity nor weather appeared to be the cause of this.

Although the seals did not alternate the two types of play, each of which consisted of a well-defined set of components, both had several activities in common (body contact, porpoising, splashing and streaking). Twelve important play activities (A-L) are listed in a 2-act sequence table (Table 3). Dyadic play consists of Acts A-F and J-L, whereas group play is made up of Acts A and G-L.

**TABLE 3**

*Possible two-act sequences during dyadic and group play*

<table>
<thead>
<tr>
<th>Act Following</th>
<th>Act Preceding</th>
</tr>
</thead>
<tbody>
<tr>
<td>A&lt;sup&gt;1&lt;/sup&gt;,&lt;sup&gt;2&lt;/sup&gt; Approach/follow</td>
<td>X X X X X X X</td>
</tr>
<tr>
<td>B&lt;sup&gt;2&lt;/sup&gt; Pre-rolling head-head contact</td>
<td>X X X X X X X</td>
</tr>
<tr>
<td>C&lt;sup&gt;1&lt;/sup&gt; Persuasion to roll</td>
<td></td>
</tr>
<tr>
<td>D&lt;sup&gt;2&lt;/sup&gt; Fast rolling</td>
<td></td>
</tr>
<tr>
<td>E&lt;sup&gt;2&lt;/sup&gt; Slow rolling</td>
<td></td>
</tr>
<tr>
<td>F&lt;sup&gt;2&lt;/sup&gt; Static head-body contact</td>
<td></td>
</tr>
<tr>
<td>G&lt;sup&gt;1&lt;/sup&gt; Haul-out</td>
<td></td>
</tr>
<tr>
<td>H&lt;sup&gt;1&lt;/sup&gt; Return to water</td>
<td>X X X X X X X</td>
</tr>
<tr>
<td>I&lt;sup&gt;1&lt;/sup&gt; Brief contact</td>
<td>X X X X X X X</td>
</tr>
<tr>
<td>J&lt;sup&gt;1&lt;/sup&gt; Porpoise/streak</td>
<td>X X X X X X X</td>
</tr>
<tr>
<td>K&lt;sup&gt;1&lt;/sup&gt; Splash/rifle-shot splash</td>
<td>X X X X X X X</td>
</tr>
<tr>
<td>L&lt;sup&gt;1&lt;/sup&gt;,&lt;sup&gt;2&lt;/sup&gt; Separate</td>
<td>X X X X X X X</td>
</tr>
</tbody>
</table>

Act<sup>1</sup> - One animal performs the activity.
Act<sup>2</sup> - Two animals perform the activity in unison.
X<sup>0</sup> - On the condition that the responding animal is already hauled out.

**THE CAPTIVE GROUP**

*Animals and methods.*

The group consisted of six small juvenile common seals and two grey seals, both six months old. Table 4 gives the age and sex of each individual. All the common seals had been hand-reared in a group of pups since soon after their birth on the East Anglian coast. The two grey seals had been hand-reared as a result of misadventure in the sea, and had also lived socially.

The pool, in the Norfolk Wildlife Park, is circular with concrete sides sloping to the floor, and with an island considerably off-centre. This considerable area of 'sloping shore-line' is an effective simulation of the natural hauling-out rocks surrounded by littoral shallows, and allows the expression of normal play behaviour patterns.

During the day the seals' social behaviour was disrupted by their three feeding times and by the presence of visitors. Play usually began about half an hour after their evening feed, when there were no further disturbances.
The seals were therefore observed daily from 1700 hours for about two hours, from March 17 until April 5, 1971. Social interactions, the individuals involved, the nature of the play activity, and the time of activity were observed and recorded from the edge of the pool.

Four of the common seals (Nelson, Beta, Gamma and Delta) wore tags of different colours on their hind flippers, so all were individually recognisable.

### TABLE 4

*The captive group*

<table>
<thead>
<tr>
<th>Name</th>
<th>Sex</th>
<th>Age (years)</th>
<th>Social contacts (totals over 3-week period)</th>
<th>Time participating in group play (min) (total over all play sessions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common seals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nelson</td>
<td>♂</td>
<td>3</td>
<td>32 momentary contact</td>
<td>7 10 12</td>
</tr>
<tr>
<td>Gamma</td>
<td>♂</td>
<td>2</td>
<td>23 momentary contact</td>
<td>6 7 14</td>
</tr>
<tr>
<td>Delta</td>
<td>♂</td>
<td>2</td>
<td>28 momentary contact</td>
<td>8 6 14</td>
</tr>
<tr>
<td>Beta</td>
<td>♀</td>
<td>2</td>
<td>14 momentary contact</td>
<td>5 6 14</td>
</tr>
<tr>
<td>Darky</td>
<td>♀</td>
<td>2</td>
<td>19 momentary contact</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td>Crab</td>
<td>♀</td>
<td>1</td>
<td>10 momentary contact</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td>Grey seals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phi</td>
<td>♂</td>
<td>½</td>
<td>21 momentary contact</td>
<td>3 0 0 0</td>
</tr>
<tr>
<td>Theta</td>
<td>♀</td>
<td>½</td>
<td>25 momentary contact</td>
<td>4 8 11</td>
</tr>
</tbody>
</table>

**Dyadic play.**

Most of the contact play took place between Gamma and Delta and between Nelson and the female grey seal, Theta. The only female common seal to take any part in dyadic play was Beta, who occasionally did so with each of the common seal males for less than a minute. Nelson frequently contacted the male grey seal, Phi, and occasionally played with him. A 5-year female common seal, who had apparently been Nelson’s favourite companion, died shortly before observations began. This may somehow have influenced Nelson in his surprising choice of the grey seals as his preferred playmates. Over the 3-week period, momentary contacts were observed at least once between all combinations of individuals (except Phi with either Gamma or Beta), although momentary contacts were most common between the individuals who usually formed dyadic play partners.

**Play between Gamma and Delta.**

Play between Gamma and Delta differed in its emphasis from the dyadic play of the wild juveniles in that there was less fast rolling, more slow rolling and hardly any pre-rolling contact. There was no individual
play between bouts of rolling. Whereas the wild seals rarely rolled for more than three minutes without a break, Gamma and Delta often rolled almost continuously for an hour or more. Otherwise the behaviour was qualitatively similar to that seen in the wild.

Their play sometimes began with an invitation from one to the other. On different occasions the invitation took the following forms:

1. One approaches other, slides onto his back and nuzzles his throat.
2. They stretch towards each other and rub muzzles. One leans backwards over other in a motionless rolling position.
3. One puts flipper and head across other's back.
4. One approaches the other, swimming on his back, and rolls (on own axis) beneath him.
5. Gamma hauls out. Delta approaches him and nuzzles his hind flippers. Gamma slaps his own side and rests his head against Delta's chest, and Delta puts flipper round Gamma. Gamma is lying on his back with Delta's head on his chest. They drift into deep water and begin to roll.

During fast rolling there was less close body contact than during slow rolling. For fast rolling both the seals had their muzzles in contact with the other's tail while they both somersaulted backwards, thus forming a vertical wheel turning at right angles to the surface, partly above and partly below the water. During slow rolling they were in a head-to-head position, twisting round each other as they somersaulted backwards, mostly just beneath the surface. During a lull they often perpetuated rolling by one lying with the back of his head against the other's chest, side or throat, or by one jerking himself backwards over the other, from which positions rolling recommenced. Slow rolling often resulted in almost static contact, in which the pair adopted any of several definite postures:

1. One's head resting against the other's cheek, side of neck, throat or side (Fig. 3a). This posture was sometimes reciprocal.
2. It was common for one to have his flippers round the other.
3. When lying on their back or side, they sometimes held one or both foreflippers vertically out of the water (Fig. 3c).
4. Twice one was observed to hold the skin of the other's chest in his teeth.
5. Sometimes they lay motionless in the rolling posture (Fig. 3b).
6. Their heads were often close together in the positions shown in Figure 3d and e. Direct muzzle-to-muzzle contacts were also frequent, either facing each other, or with one seal with his back to the other, stretching his head back until their muzzles met.
Play between Nelson and Theta.

Nelson usually invited Theta to play by swimming on his back to her and extending his head towards her until she nosed his face, throat and back-of-head. Theta initiated play herself by such nosing contacts. They spent considerable time at the edge of the pool in close contact, flippers often round each other, Theta nosing or muzzling him and often sucking at his skin. Once their tongues were actually in contact. This contact behaviour usually resulted in rolling, which was similar to the slow rolling of Gamma and Delta.

Fig. 3. Captive common seals: some postures during the very slow or static phase of rolling.

Group play.

Five complete and three incomplete group play sessions were observed. The time span of a session ranged from 40 to 95 min. The two grey seals and the yearling common seal, Crab, contributed little. Play began by one seal hauling out. The others gathered round it and began to porpoise. Hauling-out and returning to the water occurred throughout. This hauling-out was peculiar to group play, since on the other days the common seals did not haul out at all during the observation period. Play ended when all playing seals had hauled out. Hence the group play of these captive animals resembled that of the wild seals.
When an individual hauled out other than finally, it left its hind flippers dangling at the water's edge, and often turned to watch the water. It returned to the water when (1) another muzzled its hind flippers, (2) another hauled out beside it, (3) another swam past it, perhaps splashing, streaking or porpoising, or (4) apparently spontaneously. From beginning to end of a play session at least one seal was engaged in these activities. On some days the individuals staggered their play more than on others (Fig. 4). Individuals directed their play towards another which was also playing or which had just hauled out finally, but these associations changed frequently. Such associations were more distinct when the play was staggered. For example, on March 26 and 27 the same associations were formed in the same chronological order: (1) Gamma and Delta (2) Delta and Beta (3) Delta and Darky. On April 5 the associations in chronological order were: (1) Beta and Gamma (2) Darky and Gamma (3) Gamma and Delta (4) Delta and Darky. On March 29, when there was considerable overlap in individual play, there were seven associations: (1) Nelson and Phi (2) Nelson and Gamma (3) Nelson and Delta (4) Darky and Beta (5) Delta and Gamma (6) Darky and Delta (7) Delta and Beta, but all of these were brief. On March 24, when there was the greatest overlap in individual play, there were no definite associations at all.

Evidently individuals sometimes contacted two or three others in rapid
successession before hauling out. Over all the group play sessions some associations were clearly preferred, namely, Gamma and Delta (four), Delta and Beta (three), and Delta and Darky (four). Of these, only Gamma and Delta formed dyadic play partners. It is possible, therefore, that new dyadic play associations develop during group play.

On the three occasions when group play was discontinued, only one seal made any prolonged attempt at group play. On two days Delta with Gamma and Nelson with Theta were rolling just before the porpoising and hauling-out was begun, once by Darky and once by Beta. On the third occasion, Gamma began the play while Nelson and Theta were rolling. Beta and Darky did not respond to him, while Delta seemed anxious to join him only in dyadic play. This underlines the distinctness of the two kinds of play: when a seal is disposed to perform one type of play, it is evidently not interested in the other, and its preference is unlikely to change on that day.

Possibly the seals’ readiness for rest affects its predisposition towards the play patterns. The captive group seldom hauled out in the early evening when there was no group play; this suggests a closer connection between the seals’ disposition for rest (haul-out) and group play than between rest and dyadic play. Figure 5 shows the relationship between the number of momentary haul-outs by an individual and the individual’s play time (for group play among the captive group). The number of haul-outs clearly increased with the play time up to about 30 min. (Bravais-Pearson’s relationship factor $\gamma = 0.752$ up to 30 min.), but for longer play times this relationship did not hold ($\gamma = 0.496$ up to 50 min.). This suggests that

![Fig. 5. Captive common seals: group play — relationship between number of momentary haul-outs by an individual and length of time it participated in play.](image)
frequent momentary haul-outs signal readiness to continue play for a short
time (up to half an hour); individuals which are not yet ready to rest haul
out less often relative to their longer play time.

WILD GROUPS OF GREY SEALS

Animals, observation sites and method.

Table 5 lists the observations recorded at each site. At all the sites the seals were
observed through binoculars from a cliff overlooking them. A commentary on the
behaviour was tape-recorded and later transcribed.

The sexes of the juveniles are quite unmistakable on account of the dimorphism in
pelage marking and body shape (DAVIES, 1949). Individuals were fairly easily identified

<table>
<thead>
<tr>
<th>Place</th>
<th>Date</th>
<th>Animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fitful Head</td>
<td>Sept. 1967</td>
<td>2 males (about 4 yrs and 1 yr) and 2 females (about 3 yrs and 4-5 yrs). 4 yr male always played with 3 yr female (6 recorded play bouts), and the yearling male with the 4-5 yr female (2 recorded play bouts, and they often slept together on rock).</td>
</tr>
<tr>
<td>Shetland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Wildnerness</td>
<td>Oct. 1967</td>
<td>Number of animals present uncertain. 11 male-female and 4 male-male play bouts recorded. One brief bout only between 2 females. Most were 1-2 years, and a few 3-4 years.</td>
</tr>
<tr>
<td>Pembrokeeshire</td>
<td>Aug.-Sept.</td>
<td></td>
</tr>
<tr>
<td>Ramsey Island</td>
<td>1968</td>
<td></td>
</tr>
<tr>
<td>Bay Ogof Hén</td>
<td>Aug. 28- Sept. 12 1968</td>
<td>21 males and 11 females. 56 male-male and 18 male-female interactions recorded, 5 of which were brief playful contact and the rest were exploratory. Some were 2 yrs, but most were 3-6 yrs.</td>
</tr>
<tr>
<td>Aber Foel Fawr</td>
<td>Sept. 13-19th</td>
<td>The same seals were here as at Ogof Hén together with newcomers. 14th 7 recorded interactions were exploratory 15th 15 &quot; recorded interactions were exploratory and the rest playful. 16th 7 of 32 recorded interactions were exploratory and the rest playful. 17th Of 18 interactions, 13 exploratory and rest playful. 18th Of 11 interactions, 6 exploratory and rest playful. 19th Of 10 interactions, 4 exploratory and rest playful.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(On 17th-19th only some of many interactions could be recorded.)</td>
</tr>
</tbody>
</table>
by their pelage markings, facial features and size. Grey seal juveniles are therefore potentially more rewarding subjects for the study of play and social structure than are common seals.

The autumn assembly of juveniles at Ramsey Island (1968).

Juveniles appeared round Ramsey Island only occasionally during August 22 to 28. Then from August 28 until September 12, juveniles appeared in increasing numbers in the creek of Bay Ogof Hên at the north end of the island. On the ebb they hauled out on a shingle beach inside a cave at the inner end of the creek, and interacted with each other as they swam in and out.

These interactions were brief and tentative. Normally, one seal approached another, their noses and cheeks coming together for a few moments. Both seals often lay horizontally at the surface, and their heads were sometimes above and sometimes below the surface. Then either they separated, sometimes parting and sometimes one following the other (58 times altogether), or one jerked its head sharply at the other, its mouth open, and then they parted (16 times).

Only one meeting between any two seals was witnessed (except for three pairs which were seen to meet twice and one pair which was seen to meet five times). Although eight of the seals which had arrived by September 2 stayed in the creek for a week or more, the other five of these early seals and all but one of the later arrivals visited the cave for one day only.

Meanwhile juveniles were seldom seen elsewhere around the island. Then, on September 12 two males played together in Aber Foel Fawr, a shingle beach on the south end of the island. From the 14th Aber Foel Fawr was full of juveniles and Bay Ogof Hên was almost deserted. On the 14th and 15th all the interactions observed were tentative, but from the 16th onwards play was the prevalent form of interaction, although there were still a few tentative meetings.

Dyadic play.

Dyadic play was the only kind of play observed. It occurred usually between two males or between a male and female, but play between two females did occur occasionally.

The seals played in close body contact, both on the shingle at the water's edge and in the water. In the water the pair sometimes separated and then followed each other until contact was reestablished.

Play began at the water's edge by one seal laying its head over the back of another's head, by way of invitation to play (Fig. 6). Play did not proceed until the 'invitation' was reciprocated. The following extract from field notes illustrates this.

A is a male of about five years and B is a male of about three years. A lays head over B; they are lying slightly apart; A lies down beside B, his head flat on the ground; B just looks at him; A edges nearer him and lies perfectly still, his head and neck extended towards B, who still does not move; A puts head under B's chin; B tentatively puts head and flipper over A; immediately they put their flippers round each other and are carried off by a wave...
Throughout a play bout the 'invitation' was repeated by each seal. If one partner did not keep this up, play gradually came to a stop. This was illustrated by the following extract from field notes.

C and D are males of about four years. C puts head over D; lie together; D puts head over C; C puts head over D; C puts head over D; D puts head over C; C puts head over D; D stretches back; C leaps onto D and puts head over him; separate; C leaps onto D and puts head over him; C puts head over D; D screws up his face, showing his teeth; C puts head over D; D stretches back; lie together. ... C leaps on to D and puts head on him; lie together; C leaps on to D, putting head over him; lie together; C leaps on to D and puts head on him; C puts head over D; lie together; D strokes C; C puts head over D; separate ...
While one seal had his head resting on the other's back, the other often stretched his head back as if 'struggling', jerking his head back, his mouth slightly open (Fig. 6b). At other times both seals lunged gently at each other while lying side by side.

An additional play pattern was observed occasionally between seals judged to be three years or more. Two seals playing on the shingle would rear up with their chests together, lunging at each other's cheeks. This behaviour resembled the agonistic rearing up and lunging of adult males. Sometimes one of the pair put his flippers round the other's body. The behaviour was regularly punctuated by the head-over-back invitation.

After playing on the beach for a time, dyads would sometimes enter the water. One seal would leave the other and head for the water with exaggerated body movements such as lashing its hind quarters from side to side and

Fig. 7. Grey seal aquatic play: sequence of very slow rolling.
rearing out of the water as it entered the sea. Often it would stop at the water’s edge and look back at its companion.

When a pair moved into the water their play changed to rolling. This most nearly resembled the common seals’ slow head-to-head twisting round each other, but the rolling was modified by the persistent head-over-back-of-head behaviour. Contact with very little movement often developed from a bout of rolling. This seemed to be comparable to the almost static contact during common seal play: muzzle-to-face contact and resting the muzzle against the other’s head or side of neck were common (Fig. 7).

**Individual relationships.**

From September 14 to 19, 1968, on Ramsey Island, the daily interactions of four males were observed as they contacted other animals, male and female, on successive days. These contacts ultimately resulted in play, each seal with two, three or four others. These observations suggest that the seals did not play until they had become acquainted, and that each seal selected only a small number of playmates. Several instances of choice between two or more individuals for a play partner were seen. Juveniles in the Red Wilderness site (Table 5) sometimes stopped playing with a companion in order to resume play with a former playmate. Reunions involved putting flippers round each other and muzzle-to-muzzle contact. The four juveniles at Fitful Head always associated in the same to male-female pairs for play and rest (see Table 5).

**DISCUSSION**

**Dyadic play.**

Common seal dyadic play occurs in essentially the same form between mother and pup (Wilson, 1973), in small juveniles, in adolescents and in adults, occasionally outside the mating season (pers. obs., 1968), and apparently during the mating season as a prelude to coitus (Venables & Venables, 1957; 1959). Although the juvenile play of many mammalian species is composed, in part, of motor patterns also occurring in adult agonistic behaviour, fights have never been recorded in the common seal, and dyadic play in this species seems to be composed of patterns not found in other functional contexts.

The aquatic dyadic play of grey seals is very similar, and also appears in all age classes (Lockley, 1966), although pre-coital behaviour is different (pers. obs. at Ramsey Island, 1967). Unlike common seal play, grey seal dyads do play on the beach, using behaviours, in part, which resemble agonistic patterns.
The rolling between Nelson (the 3-year common seal male) and Theta (the 6-month grey seal female) indicated that head-to-head rolling is a common factor of the play of both species.

The motor patterns used by grey seals in male-to-male, female-to-female, and female-to-male agonistic encounters (described by Hewer, 1967; 1960; Hewer & Backhouse, 1960; Fogden, 1971) are similar to the comparable patterns of elephant seals. However the two types of interaction among weanling elephant seals which resemble these adult patterns (Rasa, 1971) were not observed among small grey seals. Comparable behaviour to the elephant seal pup's 'wrestling' plays only a minor part in the play of adolescents. This suggests that the dispersive element in grey seal breeding organisation may be relatively newer in the species' history than in the elephant seal, and only superimposed upon an earlier, Phoca-type cohesive organisation.

The Kurile harbour seal Phoca kurilensis is a rare and locally distributed sibling species of Phoca vitulina. During the mating season the males have been observed to fight in the water, seeming to use the same rolling pattern as in the play of common seals and Kurile seal juveniles. The fighting certainly includes biting (Y. Naito, personal communication). Possibly this is an instance where fighting has exploited pre-existing play motor patterns rather than vice-versa, as in many other mammals.

The degree of mutual intolerance among adult grey seal males varies from population to population. There is more agonistic behaviour observable on the Island of Shillay than on Oronsay (both in the Hebrides) and more on Oronsay than on Ramsey Island in Wales (Hewer, 1960). If these differences are genuine (and not merely habitat contingent with male competition being carried on away from the breeding grounds), they may be reflected in the extent to which agonistic motor patterns (such as rearing up chest to chest, lunging) are incorporated in play. A long-term study of the ontogeny of play, preferred companions and mutual intolerance among marked individuals of the grey seal could tell us more precisely how these juvenile interactions affect territorial competition among males and selection of breeding sites by females.

At this stage, we can only speculate why the grey seal has a species characteristic signal to invite and maintain play, while the common seal has not. In common seals the pre-rolling contact, the 'improvised' invitation signals seen in the captive group between Gamma and Delta and between Nelson and Theta, and the 'persuasion' to roll seen in the wild seals may all fulfill a similar function to the grey seal invitation, but the uniformity and the persistence of the latter is more conspicuous and predictable than
any of the possible common seal counterparts. The grey seal invitation cannot prevent misinterpretation of the approaching animal's intention (as it does in other mammals, such as the chimpanzee (Loizos, 1967)), since the signal is not given until the pair are already in contact. Approach by young grey seals was always either exploratory or playful. What is uncertain is the approached seal's response, and this is clarified by whether or not it reciprocates the signal.

One function of dyadic play is to bring two animals into close physical contact. Naso-tail contact, which was almost continuous during head-to-tail rolling of common seals, may be related to the production of scent from the anal gland (Ortmann, 1960). Naso-tail contact was less obvious in grey seal play. Muzzle contact with the face, back-of-head, throat and chest regions occurs during pre-rolling contact and head-to-head rolling of common seals, and during all play of grey seals. Since the seal's muzzle is usually above the surface during slow/static aquatic play of both species (Fig. 3 and Fig. 7) it is possible that these areas of contact produce scent, although there have been no anatomical studies to confirm this.

Exuberant movement is a dominant aspect of the dyadic play of small juveniles, while among the adolescents there is less vigorous movement and more close contact with either very slow movement or no movement at all. It has been suggested that the exuberant movements may have a catalytic effect on the formation of social affinities (Desmond Morris, personal communication), that is, if young seals merely nuzzled each other in a tranquil manner, the bond between them might not be so strong. This argument may also be valid for pre-coital play, where bond formation has a more conspicuous function than in juveniles. Also during a play interaction the two animals come into repeated naso-body contact far in excess of what would be necessary to learn or check individual identity. I am unable to comment on the possible function of this, there being insufficient information on the role of scent perception in the development of juvenile pinnipeds.

Of the three distinguishable stages in the contact phase of common seal play, rolling results from pre-rolling contact and static contact results from rolling, suggesting that exuberant movement (which occurs only during rolling) must precede sustained naso-body or body contact. That the two young males in the captive group had almost entirely eliminated the pre-rolling contact and the solitary phase of dyadic play, and reached the sustained contact phase much more readily than wild juveniles of the same age, suggests that individual recognition may be important in determining how long is spent on each phase of play. Gamma and Delta were always
together in a relatively small enclosure, and were two out of a group of only six conspecifics. The wild seals selected playmates from a group of about 25 animals of a similar age which probably disperse widely twice a day when the group leaves the hauling-out rocks.

**Group play.**

Group play occurs in the common seal but was not observed in the grey seal. The result of group play was (i) all the seals in the group hauled out rapidly one after the other on to the same rock, and (ii) animals that were otherwise seldom observed to interact made brief naso-naso or naso-tail contact with one another. Both of these effects contribute towards bringing all the individuals together into a unified group. Possibly hauling out as a single unit might benefit the young and inexperienced animals as an anti-predator device. Certainly when one animal edges restlessly towards the water on perceiving an intruder, the whole group will be in the water in a few moments. More probably, however, the more efficient elusion of predators is just a side benefit of the unified group. The cohesive group structure may be essential to the development of the adult social organisation in which the mature females are mated without male-male competition.

Dyadic play in grey seal juveniles did not occur until they had become acquainted. Common seal acquaintances must be formed partly or wholly during group play. Grey seals were observed to gather at Ramsey Island at the end of August. Their tentative encounters suggested that they were scarcely acquainted at that time. Exploratory encounters were observed between about 90 dyad combinations within the group before any play was seen. This introductory time lasted about three weeks. The introductory period is perhaps a substitute for common seal group play.

This species difference suggests that whereas group cohesion and relationships between dyads are both important to the common seal, dyad relationships (mostly between two males or a male and female) are much more important than group cohesion to the grey seal.

**SUMMARY**

Juveniles of the common seal, *Phoca vitulina*, have two kinds of aquatic play:

1. Dyadic play, in which muzzle-to-body and body contact between two animals is combined with exuberant somersaulting movements. The somersaulting behaviour is usually preceded by a contact phase with very little movement. A play bout may end with a period of sustained, almost static contact.

2. Group play, which resembles the normal social haul-out activities, but each activity is repeated several times in a playful manner. Although several animals may be leaping and splashing simultaneously, each animal temporarily orients his play towards one other, whom it may contact briefly.
All play by juveniles of the grey seal, *Halichoerus grypus*, is preceded by each animal of the dyad giving a stereotyped invitation signal, which must be repeated continually by both animals throughout play: each animal in turn lays its head over its partner's back. For the initial phase of play which takes place on the beach, the two animals lie beside one another, each lunging gently at the other's head, in between head-over-back signals. Adolescents may occasionally rear up and lunge at each other in a manner similar to the fighting of adult males. After playing on the beach, the pair may enter the water, where their play is similar to the dyadic play of the common seal.

The aquatic somersaulting over one another by two animals in continuous body contact seems to be a pattern not found in these two species in other functional contexts.

Common seal group play serves to (i) integrate the individuals into a unified group, and (ii) acquaint individuals. Although grey seals apparently do not have group play, behaviour which is probably functionally analogous was observed, in which the seals became acquainted over a 3-week period in early autumn before any play occurred.

REFERENCES


RÉSUMÉ

Les jeunes du Phoque *Phoca vitulina* se servent pour leur jeu dans l'eau de deux sortes d'activité:

1. Jeu à deux, c'est à dire où deux animaux se touchent l'un à l'autre, museau au corps, gambadant vigoureusement en faisant des culbutes l'un sur l'autre. Avant de se culbuter de cette façon, les deux généralement se touchent doucement l'un à l'autre, presque sans gambader. Quelquefois le jeu finit par rester en contact pendant longtemps presque sans mouvement.

2. Jeu en groupe, qui ressemble à l'activité des phoques quand ils se hissent de l'eau en groupe d'une façon normale, mais chaque partie constitutante de cette activité s'exécute avec enjouement, se répétant plusieurs fois. Quoique plusieurs animaux sautent en s'agitant dans l'eau simultanément, chaque animal s'associe provisoirement avec un seul autre en orientant vers lui son jeu et se touchant brièvement à lui.

Quant aux jeunes du Phoque *Halichoerus grypus* il y a toujours un certain signal essentiel par tous les deux animaux qui précède leur jeu, et ce signal est répété sans cesse par tous les deux pendant le jeu: chaque animal s'étend la tête sur le dos de son camarade. Pour la première partie du jeu, deux animaux se couchent sur la plage, se donnent l'un à l'autre, entre les signaux tête-sur-dos, des coups lents et doux du museau. De temps en temps les plus âgés, en s'élevant, font un jeu qui ressemble au combat des adultes masculins. Après quelque jeu sur la plage a lieu, souvent un jeu se passe dans l'eau pareil au jeu à deux de *Phoca vitulina*.

Cette façon de se rouler dans l'eau en culbutant l'un sur l'autre ne se trouve pas dans ces deux espèces dans d'autres contextes fonctionnels.

Le jeu en groupe de *Phoca vitulina* se sert de (i) intégrer les individus dans un groupe uni, et (ii) faire des rapports parmi les individus. Bien que *Halichoerus grypus* ne joue pas en groupe, un façon de se comporter avec un fonction pareil fut observé où les jeunes se rencontraient pendant trois semaines au commencement de l'automne, avant de jouer.