

Social behaviour of Cape fur seals *Arctocephalus pusillus pusillus* in captivity

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Summary

In this study, a group of 6 South African or Cape fur seal *Arctocephalus pusillus pusillus* housed at the Royal Zoological Society of Antwerp (Belgium) were observed during 300 hours spread over 1 year (June 1990–June 1991). We present a qualitative and quantitative description of the way members of a family structured group of related Otariidae interact in confinement conditions. By establishing the detailed time budget of each individual, we show the importance of the social life in the daily activities of captive fur seals. The mean percentage of diurnal time spent in social interactions is 9.8% versus 1.9% in a group of nonrelated California sea lions *Zalophus californianus* (Waring, 1984). The existence of a behavioural distinct breeding period is confirmed by changes in time budget correlated to the sex and maturity of each individual. The reproductive synchrony developed by captive Cape fur seals kept in the northern hemisphere and the natural breeding period are exactly 6 months out of phase (end of spring).

Introduction

Pinniped ethology, and more particularly their reproduction behaviours, have been deeply affected by a dual habitat (sea and shore). They constitute a precious taxon to understand many aspects of the ethology of the mammals as a whole. Indeed the ecological parameters that determine the diversity of pinniped social structure appear to be limited in number and easier to determine than for terrestrial mammals (social life developing only during breeding period, particularly simple pupping biotope, predators generally absent, food of little importance since the pinniped usually fast during breeding period (Jouventin & Cornet, 1980).

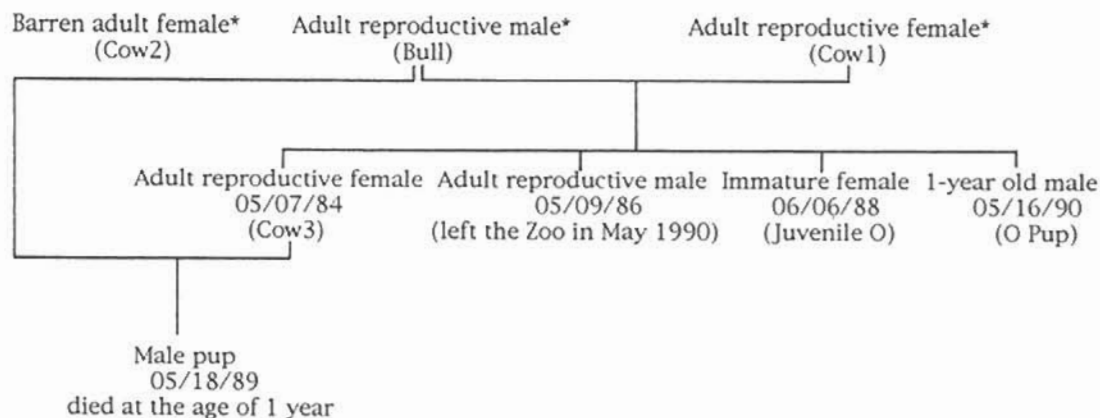
The allocation of time by an animal (activity or time budget) results of the integration of individual survival in a given social and environmental context and of species characteristics (Anderson & Harwood, 1985; Miller, 1991). Many studies give

qualitative and/or quantitative description of diurnal behaviours or major activities of Otariidae (*Arctocephalus tropicalis*: Paulian, 1964; *Eumetopias jubatus*: Sandegren, 1976; *Otaria flavescens*, *Arctocephalus australis*: Vaz Ferreira *et al.*, 1984; *Neophoca cinerea*, *Phocarctos hookeri*: McCann, 1980; *Otaria flavescens*: Campagna & Le Boeuf, 1988) but the detailed activity budget and variations of this pattern have received little attention (McCann, 1983). Studies of pinniped time budgets are limited to Odobenidae (*Odobenus rosmarus*: Miller, 1976) and Phocidae (*Mirounga leonina*: McCann, 1983; *Halichoerus grypus*: Anderson & Harwood, 1985; *Phoca vitulina*: Thompson *et al.* 1989). One purpose of this paper is to use simple methods of behaviour sampling elaborated for primate study to describe the social repertoire and the activity budget of a group of Otariidae. How do highly social mammals adapt their behavioural repertoire to a reduced group? What is the part and the nature of social activities in their life? This information (interaction ethogram and activity budget) can be a useful tool for further studies of behaviour and comparisons between species (Bekoff, 1972; De Waal, 1988).

The second purpose of this paper is to describe changes in the reproductive period of captive Cape fur seals. Reproductive activities of Otariidae are annually synchronized during a brief seasonal breeding period. Cape fur seals are kept in health in zoological parks located all around the world (South Africa, Japan, Portugal, Canada, Germany). How do adult reproductive Cape fur seals react when kept in confinement, in the northern hemisphere, where seasons are reversed?

To answer these questions, we investigated a group of six Cape fur seals housed at the Royal Zoological Society of Antwerp (Belgium). This group was chosen as a family structured group where successful reproduction occurs since 1984.

After having described major diurnal activities and interactions displayed, we report the time each individual allocates to these activities; we then pay



(* = arrived at Antwerp Zoo on 08/14/78 at the age of 1 year)

Figure 1. Genealogy of the group of Cape fur seals housed at the Royal Zoological Society of Antwerp (Belgium) in June 1991.

special attention to modifications induced to individual time budget during breeding season. We compare some results with data available in literature for another captive well-known Otariidae, *Zalophus californianus*.

Methods

Study site and subjects

The group of Cape fur seals living in Antwerp is composed of 6 individuals: 4 adults (bull:cows 1, 2, 3) and 2 juveniles (male pup;juvenile female) (Figure 1). They live outside in a park with two pools and a shelter. Observations were performed from outside this park.

Observational techniques

Three hundred hours of observation were spread over one year (from June 1990 to June 1991). We defined a daily period ranging from 900 h to 1730 h. Data collected on five days from sunrise to sundown allow us to consider that this observation period constitutes a good estimation of the fur seals diurnal activities: observation during all daylight hours did not provide new information concerning fur seals behavioural repertoire.

Part 1: Social repertoire:

In the communicative repertoire, we describe the interactive behaviours observed in the group (except vocal communication). Nonsocial behaviour patterns mentioned in time budget (states) are also described. Data were collected 'Ad libitum'

(sensu Altmann, 1974). We quantified interactions by 'all occurrences sampling': all the occurrences of dyadic interactions were reported on a 'sociometric matrix' (a table in which actors were represented by the rows and recipients by the columns and in which the cell entries indicate the frequencies of dyadic interactions) (Altmann, 1974). We defined a sampling duration of 30 min as being the shorter sampling duration for social behaviours in the group under study. Since a longer duration does not provide a higher frequency of interaction. This method provides accurate information about the rate of occurrence of interactions for each individual. During June 1990 and June 1991, 119 'all occurrences' samplings were performed, regularly spread over the daily observation period.

Behaviour patterns, were described as suggested by De Waal (1988): verbal description of behaviour, mention of the contexts, mention of the individual concern and available quantitative data.

Contexts we used can be defined as follows ('actor' is displaying described behaviour, 'partner' is the individual to which described behaviour is directed):

—nonsocial: actor is alone without answering other individual acts and without provoking any answer from others.

—feeding anticipation: fur seals are fed at regular times. When feeding time is coming, they watch out for keeper.

—feeding: fur seals are hand-fed; they cannot be fed all at the same time. Behaviours are generated in this context.

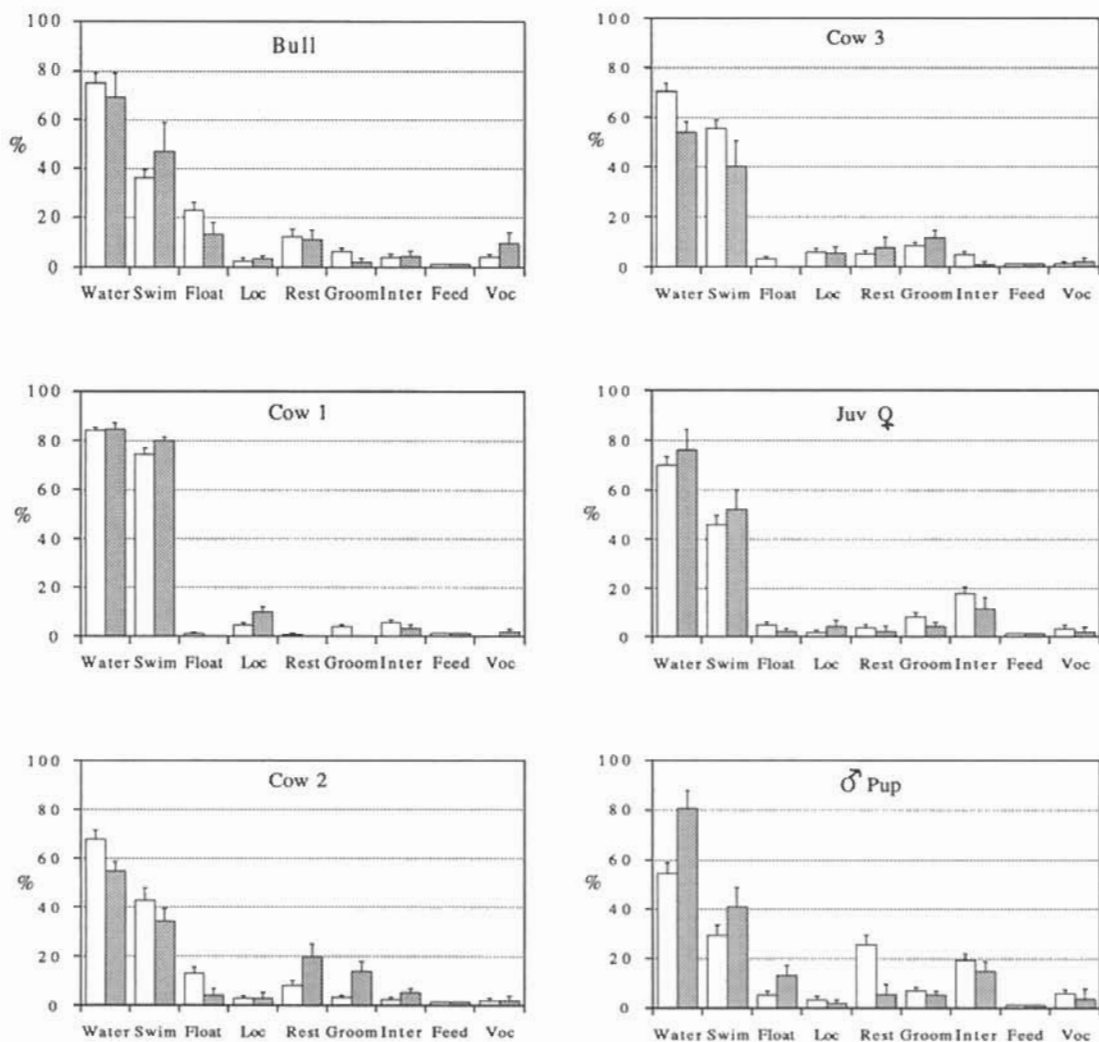


Figure 2. Time budgets of the six Cape fur seals under study outside breeding season (in white; $n=16$ days) and during breeding period (in grey; $n=5$ days). Values are mean daily percentage, error bars represent standard error. Behaviours are described in Table 1.

—post-feeding: concern the period of 1 hour after feeding.

—competition: actor is looking for an object (object manipulation) or an appreciated resting place occupied by partner(s).

—answer to approach: actor is approached by partner(s).

—threatened individual: actor is the object of aggressive behaviours displayed by partner(s).

—social contact wanted: actor is harassing partner, trying to interact with him (one particular case is the invitation to play).

—social contact avoided: actor is trying to avoid or stop interaction with partner(s).

—greetings: individuals have not been interacting for some time because of voluntary or imposed physical separation. When this separation comes to an end, greetings behaviour are displayed.

—play: play is one of the most difficult behaviour patterns to define. Bekoff described play as a social interaction resulting in a decrease of interindividual distance and in which agonistic behaviours may occur as derived acts, but priority is almost invariably given to the play signal. Gentry (1974) who studied play in *Eumetopias jubatus* agrees with this definition.

—invitation to play: some playing bouts may be associated to an invitation context: actor

Behaviour patterns	Description	Contexts, Individual(s) concerned
<i>A. Interactions:</i>		
1 Nuzzling:	Nose is pressed against partner's back or chest; nose movements express olfaction. Partner usually doesn't react or displays a naso-nasal signal.	feeding anticipation, post-feeding, answer to approach, threatened individual, greetings, invitation to play, mother-pup, sexual
2 Naso-nasal signal:	Doesn't imply physical contact between individuals; nose is pointed to partner's face with a brisk erection of vibrissae. Signal can be reciprocal or not (in this case, animals are not facing each other, nose is pointed in direction of indifferent partner).	post-feeding, competition, answer to approach, greetings, play, invitation to play, mother-pup, sexual
3 Rubbing against partner:	Face, sides of snout (vibrissae) or neck and chest are slowly rubbed on back or chest of partner.	answer to approach, threatened individual, play, invitation to play, mother-pup, sexual; never displayed by cows 1 and 2
4 Body swing with guttural staccato vocalization:	Walk always associated to a large lateral swing of chest and head and to a typical guttural staccato vocalization. Actor is slowly locomoting, out of water, and vocalizing with varying rhythm and intensity; vibrissae are strongly erected, mouth is half open. Behaviour directed to partner(s) (playing juveniles or fighting females) or to an appreciated resting place. Partners run away or face bull and show submissive signals (aggressivity inhibition).	competition, greetings, sexual; displayed exclusively by adult bull
5 Open mouth display —with erected vibrissae; —with vibrissae turned down:	Mouth half or completely open, teeth are not exposed, vibrissae are erected; face is pointing to partner. Various threatening vocalizations can be associated.	feeding, answer to approach, threatened individual, play, sexual
6 Chest bumping:	Mouth open and vibrissae briskly applied on sides of snout (aggressive vocalizations can be associated). Head pulled back, actor lunges at partner, preventing him from progressing.	competition, threatened individual, social contact avoided, play, sexual
7 Low position:	Actor remains a brief moment in a low position in front of partner, belly and chest lie on ground. Behaviour always directed to a partner and sometime associated to an open mouth display and aggressive vocalizations.	competition, social contact wanted, threatened individual, play, sexual
8 Partner climbing:	This pattern seems to be a combination of 2 different acts with intermediate forms making it very difficult to distinguish them. Extreme forms are: —actor puts front flipper on partner's back; partner is sitting or lying on soil. —actor climbs on partner's back and takes a position very like sexual mount; posture is maintained for a few seconds; sexual pelvic movements are never noted.	not clearly defined; rather rare posture
9 Biting: —effective biting:	3 types are distinguished (increasing level of ritualization) Results in partner crying. Actor grabs partner's skin in teeth and shakes head with energy; this provokes wounds by skin laceration. Such wounds were inflicted to cow 2 by bull in a sexual context. Biting resulting in brisk reaction of partner (cry, threat, flight) are frequent but wounds are rare. Skin grabbing and head shaking are frequent during play without causing any wounds but only protestations. During pre-, post-copulation and copulation itself, cow nibbles or bites bull at chest or snout. The more ritualized form: a faint bite is directed to partner's face without touching him and without exposing teeth. Very quick movement.	feeding anticipation, feeding, competition, play; displayed only by the 3 younger individuals (born at the Zoo)
—nibbling:	Actor follows partner from a very short distance, stopping and changing direction at the same time.	feeding, answer to approach, violent play, sexual
—attempted quick bite:	Pursuing partner from a distance >2 metres, eventually displaying aggressive signals.	answer to approach, play (for juveniles), mother-pup, sexual (for bull)
10 Linear pursuit:		competition, answer to approach, social contact avoided, play, invitation to play, sexual
11 Pursuit:		social contact wanted, invitation to play, play (juveniles), mother-pup competition, social contact wanted, play, sexual (bull)

feeding, competition, sexual, social contact avoided (cow 2 and 3); never displayed by the bull

cow 1 never plays this way

adult usually play with a juvenile

invitation to play (actor is playing in front of partner and brings him to interactive play); this play can last hours; cows 1 and 2 never play this way

non social, feeding anticipation, social contact avoided, play; all individuals under study
non social, feeding anticipation; all individuals under study

non social, post-feeding all individuals under study.
1 grooming item in water has a mean duration of 4.24 s (SD = 1.28 s, n = 40 items of different types); 1 grooming item outside water has a mean duration of 8.133 s (SD = 5.6 s, n = 120 items of different types). Grooming sessions can be defined as associations of grooming items separated by time intervals shorter or equal to 1 min; sessions duration is highly variable

non social, post-feeding, social contact avoided; all individuals under study

non social, post-feeding, social contact avoided; all individuals under study

Shying or even running away from threatening or approaching partner.

Pre-copulation: swimming and vocalizing bull pursues the cow in oestrus for hours (with many interruptions); when cow can't flee, she faces bull and displays agonistic behaviours: biting, chest bumping, open mouth, vocalizations; Copulation: initiated by bull; irregular pelvic movements and bull vocalizations are noted. Cow keeps on trying to escape. Copulation ends by bull going away. No typical post-copulation activities are noted.

Nibbling partner's body and flippers, jumping one after another, chasing each other, rushing at each other, swimming, ... Playing sessions are interrupted by grooming sessions, interactions with other partners or stays in water.

—pursuing partner (linear pursuit and flight). This can also be a group play; cows and juveniles run and slip on belly from a pool to the other.

—mock fighting: chest bumping, nibbling, biting, vocalizing ...

A small object (leaf, stone, object thrown or given by hand by the public) is manipulated by mouth and thrown away by a brisk movement of head and neck. The object is taken and thrown again, sometimes in water. This often attracts attention of a partner and results in interactions.

Locomoting in water by front flippers movements; hind flippers act like a 'rudder', regular respiration occurs at surface with nose or mouth.

Plantigrade locomotion out of water; 4 flippers used as legs; belly does not touch ground. Walk: 4 flippers moved one after another; gallop: hind flippers are moved together.

—the 'palm' of a front or hind flipper is used to rub snout, back, side or neck,

—claws of the 3 digits of hind flippers are used to scratch back, side or neck,

—incisor teeth are used, like a dog, to scratch back or side,

—body is rubbed against supports: the ground, by waving posterior part of body, the fence or a rock. Face sides (with vibrissae) are rubbed against supports.

—body vertical in water, snout sides are rubbed with 1 or 2 front flippers,

—lying at surface of water, emerged part of body (side, back or belly) is rubbed with the 'palm' of front flippers. We can also mention strong shaking (like a wet dog) outside water or in it (concerning emerged part of body)

Floating in water at surface without moving flippers, immobile or slowly drifting; eyes are closed, respiration occurs regularly at surface. We noted typical postures:

—body maintained upside down vertical in water; hind flippers emerge folded at surface.

—body parallel to surface, 1 front flipper is emerged

—body floating parallel to surface, both front and (1) hind flipper(s) emerge folded on side, or belly. The 4th flipper is equilibrating body in water.

Lying on belly, side or back, eyes closed; the animal doesn't have to sleep. We also observed a sit resting posture already noted for Otariidae by Miller 1991 as 'upright resting position'. Resting is frequently interrupted by alert periods or grooming sessions.

12 Flight or shying:

13 Mating:

B. Play behaviours:

—in water:

—out of water:

—manipulative play:

C. Non social behaviours:

14 Active swimming:

15 Terrestrial locomotion:

16 Grooming movements:

—out of water:

—in water:

17 Floating:

18 Resting out of water:

displaying typical play patterns is harassing non-playing partner(s).

—mother-pup: concerning interactions typically occurring between mother-young pairs.

—sexual: interactions between bull and a cow during pre-copulation sequences.

For most behaviours, we note several contexts.

Part 2: Time Budget:

To investigate the fur seals' time budget, we used the 'instantaneous or scan sampling' method (Altmann, 1974) which is a regular record of each individual's state. Seven states were defined, using social repertoire as starting point: resting in water ('float' in Figure 2), resting out of water ('rest'), active swimming ('swim'), terrestrial locomotion ('loc'), grooming activities ('groom'), feeding ('feed'), interacting ('inter'). Animals are observed one after another in as short time as possible (average duration of a scan is 44s, SD=19s, n=150 scans). This method provides a good examination of the time spent in each state (Altmann, 1974; Dunbar, 1978; McCann, 1983). The probability for an action to be recorded is directly influenced by the proportion of time this action takes up.

Between June 1990 and June 1991, 378 scan samplings of the group were done (21 days); 90 concern the breeding period (5 days in May and beginning of June). Samplings were spread every 30 min over the daily observation period. Approximately the same number of scans were devoted to each 30 min of the daily observation period for each individual.

Statistical analysis

To reveal eventual analogies between activity patterns of fur seals under study, time budgets were processed by the program NTSYS (Numerical Taxonomy and Multivariate Analysis system, Rohlf, 1989). We calculated similarity coefficients (Euclidian distance) for each pair of individuals using their time budget as similarity criteria. All the coefficients constitute a triangular matrix that was processed by the unweighted pair-group method (U.P.G.M.A.) (Rohlf, 1963). It involves calculating the arithmetical average value of the similarity existing between the individual to accept in a group and each member of this group. The method is processing by clustering individuals as the similarity criteria decreases. The graphic form of this similarity matrix is a dendrogram associating similar individuals. Clusters were tested with Student's t-tests.

Results

Part 1: Social repertoire:

Interactive behaviours displayed by the fur seals under study from June 1990 to June 1991 are described in Table 1. Nonsocial activities mentioned in time budget are also reported in this table. The mean distribution of major interactions displayed outside breeding season is shown in Figure 3.

Part 2: Time budget:

Allocation of time to 7 mutually exclusive nonsocial activities outside and during breeding period for each individual is shown in Figure 2, such as the mean time spent in water and the time spent vocalizing.

The dendrogram obtained by pairing individuals in function of the allocation of time to diurnal activities outside breeding period is represented in Figure 4. Associations shown in this graph can be confirmed by t-tests. Bull and cow 2 patterns are alike ($P>0.05$ for main behaviours). Spending more time to passive occupations (resting and grooming), they locomote less than the females (swim: $t=6.23$, $DF=62$, $p<0.05$; loc: $t=-2.08$, $DF=62$, $p<0.05$) and interact little. The activity patterns of cows 1 and 3 have in common a higher percentage of time spent swimming, locomoting and interacting (they do not differ for active states; $p>0.05$). Juveniles are similar regarding their numerous interactions ($t=-0.37$, $DF=30$, $p>0.05$) and important proportion of time spent grooming; but they differ by the time spent resting (significantly higher for the younger male; $t=-5.3$, $DF=30$, $p<0.05$).

Some modifications are noticeable when reproduction period takes place (Figure 2) though most of these changes are not significant with a t-test.

For bull, we noted an increase of locomotion (in and out of water), interactions and vocalizations; passive states decrease.

Behavioural modifications linked to cow 2 oestrus (though barren, she's mating each year) are linked to pre-copulatory activities. Harassed all day long by the bull, she threatens often (interactions increase); he prevents her from going into the pool (time spent in water—float and swim—decreases).

Cow 1 mated at the very beginning of the breeding season (on 05/02/91 and on 05/03/91); during our observation of the breeding period, she was no more in oestrus. We therefore considered her as a post-oestrus female. Changes noted (increase of time spent locomoting; decrease of time spent resting and grooming) seems essentially linked to the

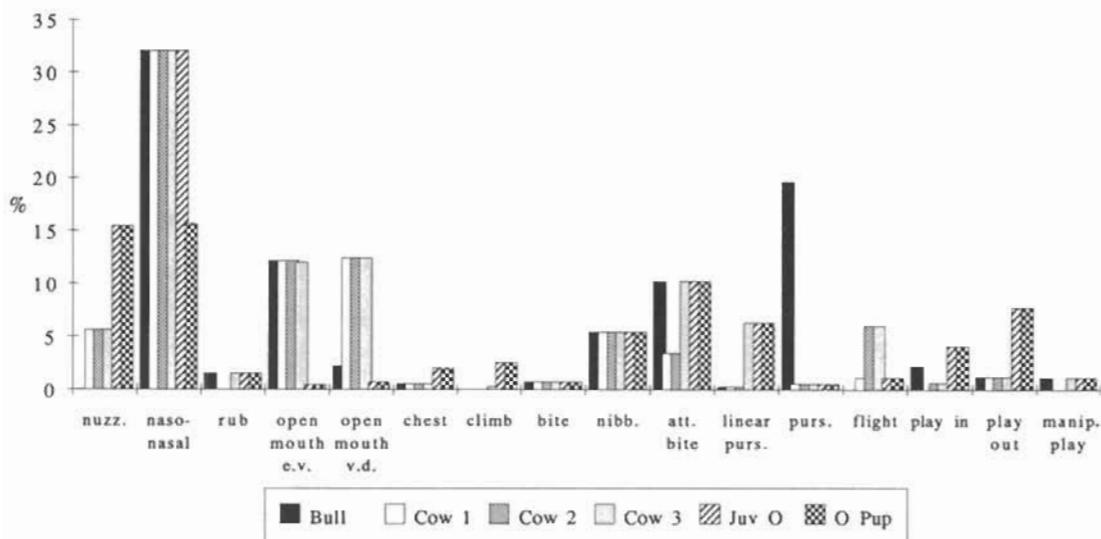


Figure 3. Interactions displayed by the Cape fur seals under study (as percentage of the occurrences of all the interactions in which the concerned individual is taking an active part). Behaviours are described in Table 1.

high level of excitement of the group characterizing the breeding period.

The last weeks before cow 3 gave birth, we noted a significant decrease of the time she spent in water ($t=2.54$, $DF=19$, $p<0.05$) (swimming and floating). Grooming and resting increased.

Juveniles essentially show an increase of time spent swimming. Passive states (resting and grooming) decrease such as the time spent interacting. During reproduction activities, adults will indeed interact more with each others and less with juveniles.

Discussion

Nuzzling and naso-nasal signal are behaviour patterns frequent in the three Pinniped families. These investigations are combinations of tactile and olfactory perception (King, 1983). Nuzzling is considered by Ross, who studied captive *Arctocephalus p. pusillus* (1972), as a submissive signal. At Pieterburen (Seal Research and Rehabilitation Center, The Netherlands), nuzzling, the only interaction between recovering common and grey seals, is interpreted as a reinsurance signal. Both these functions show up in our group but we interpret this signal as a general social investigation; it probably allows the nuzzling seal to identify partner (and may be to get information on its physiological or psychological state). Due to decreasing inter-individual distance, this contact must occur in a submissive context to inhibit eventual aggressivity from partner. Nuzzling is also frequent between

individuals that have not been interacting for some time; a function of greetings can be pointed out.

Very like nuzzling in context, naso-nasal signal also seems to belong to a large partner identification repertoire; it's the most often observed interaction in the group we studied. We think this pattern also carries a submissive connotation inhibiting aggressivity that could follow the decrease of interindividual distance. We can note that pinnipeds are spending an important proportion of time in water with body immersed; partner identification by smelling hind quarters, like Canidae, is impossible (olfaction does not happen under water where nostrils are closed by muscles). Pinnipeds should then be able to get olfactory information from a nose-to-nose investigation (Miller, 1991).

Females *Neophoca cinerea* and *Phocarctos hookeri* are rubbing themselves against males during pre-copulation interactions (Marlow, 1975). This interaction clearly results in an inhibition of partner's aggressivity.

During pre-copulatory sequences, the bull under study continually pursues cows while swinging body and vocalizing. When context is not sexual, this display is directed to the shelter (empty or occupied by partners); the consequence is the flight of cows and the installation of bull at the free place; a resting session usually follows. This display is also directed to individuals interacting with intensity (play or fight); display consequence is the decrease of aggressivity levels and eventually the separation of interacting protagonists. Rand (1967) attributes a role of 'referee' to wild *Arctocephalus p. pusillus*

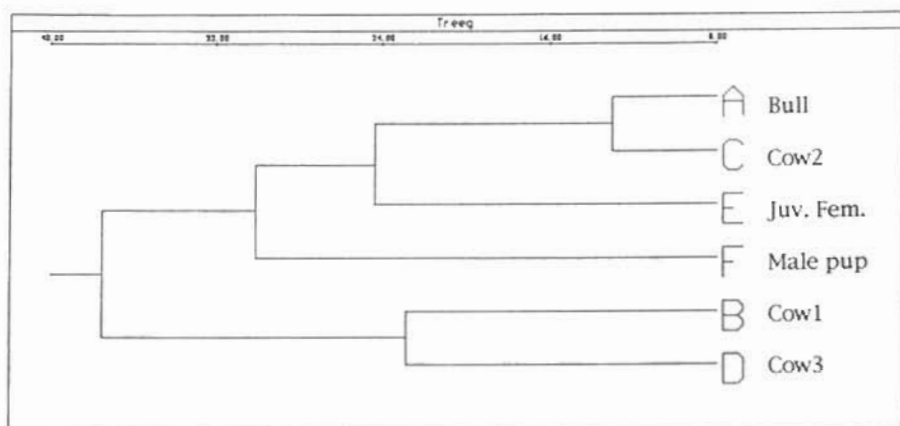


Figure 4. Dendrogram representing the triangular matrix of Euclidian distances between each pair of individuals compared in function of their time budget outside breeding period.

bulls: female fights are usually interrupted by a wavy walk and guttural staccato vocalization ('honking') of the bull. A similar display is reported for nearly all Otariidae species (*Eumetopias jubatus*: Sandegren, 1976; *Neophoca cinerea*: Marlow, 1975, *A. forsteri*: Stirling, 1970). Major mentioned contexts are female courtship (sexual partners synchronization), territoriality, agonistic encounters, or male intervention in females' fights. It seems that this display carries a strong dominant connotation expressing male dominant status to preserve order in harem, to appropriate a resting place, to face another territorial male or during pre-copulatory sequences. Anyway, we think that erected vibrissae are a submissive signal (see further) that could be associated to mitigate the strong aggressive connotation of this behaviour.

Most Pinniped species display open mouth threats with a particular position of vibrissae. It seems to be a deep ritualization of biting: only opening mouth towards partner in a typical agonistic repertoire (Stirling, 1970; Miller, 1975; Sandegren, 1976). Vibrissae erection is described as a typical submissive signal for some Arctocephaline species (*A. forsteri*: Miller, 1975, *A. gazella*: McCann, 1980). On the opposite, this signal is noted as typically dominant for Otariinae: *Eumetopias jubatus* by Sandegren (1976), for *Otaria flavescens* by Campagna & Le Boeuf (1988), for *Zalophus californianus* by Peterson & Bartholomew (1967). Nevertheless, the dominant connotation is usually based on this major argument: during territorial encounters, opponents erect vibrissae. But we think that the intention conflict between flight and attack shouldn't be neglected; this dilemma may lead to a combination of dominant elements (posture, vocalization, gesture) and submissive elements (vibrissae erection). Taking these

observations into account, we define the open mouth display as a threat or defensive signal with a submissive connotation to inhibit opponent aggressivity (vibrissae erected), and with a dominant connotation to warn opponent (vibrissae turned down).

For *Eumetopias jubatus* (Sandegren, 1976), chest bumping is considered as a typical submissive act, physical contact being maintained with dominant individual, especially in a sexual context. We also observed a function of inhibition of partner aggressivity; this explains the high frequency of this pattern for juveniles which usually occupy low hierarchical positions.

A low posture is observed for *Eumetopias jubatus* females during sexual display (Sandegren, 1976). The significance of lying down in front of partner with various agonistic signals may be to express fear or submission, or to show the will to rush on partner to attack. The low number of observations doesn't allow us to support one of these hypothesis more than the other.

Partner climbing is always associated with a general excitement atmosphere in the group under study. For young wild *Arctocephalus p. pusillus* and *Eumetopias jubatus*, a 'mount' is frequently observed at the end of playing sessions (Rand, 1967; Sandegren, 1976); following these authors, this amount is of sexual kind. This doesn't seem to be the case in our observations.

As for open mouth display, biting (typical aggressive signal) can be simplified and ritualized. It can carry information ranging from dominance to high intensity submission (Sandegren, 1976). Nibbling is often mentioned in a pre-copulation context (*Eumetopias jubatus*: Sandegren, 1976) or in a strong submissive context (*A. forsteri*: Stirling, 1970). This signal is observed in Canidae.

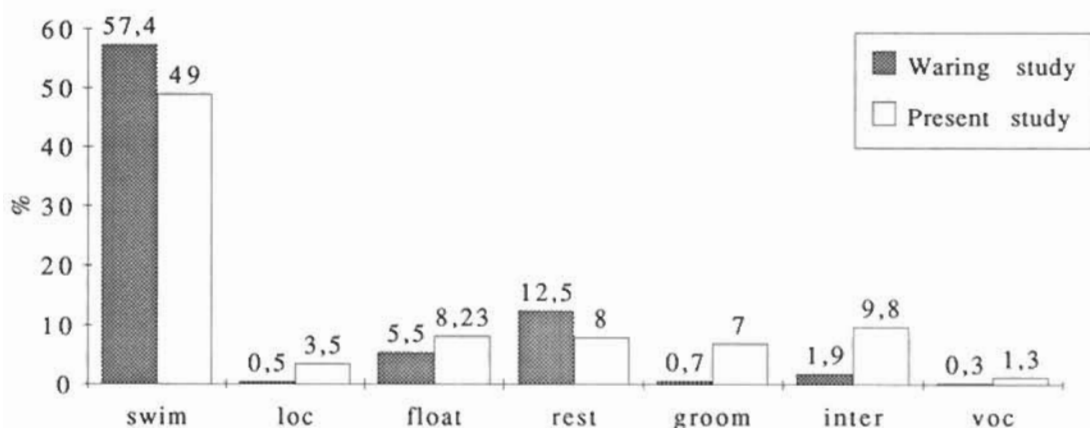


Figure 5. Allocation of time to diurnal activities by captive California sea lions and Cape fur seals. Results of Waring (1984) study, in grey, are mean values for 7 nonrelated sea lions aged 9 to 15 years; our results, in white, are mean values for 6 fur seals aged 1 to 13 years.

Young Otariidae are known to manipulate objects (algae, small rocks) (Rand, 1956, 1967; Paulian, 1964; Marlow, 1975). The main function of this behaviour seems to be, as usually for play, to develop agility that will later allow them to capture prey. Manipulative play is also associated with natural curiosity and 'explorer' disposition of young pinnipeds. An additional function could be for young fur seals to manipulate and taste new kinds of food before weaning time. We think this behaviour could explain the progressive weaning observed for *Arctocephalus p. pusillus* in the wild.

Among the main nonsocial activities displayed by fur seals under study, grooming movements seems to have a common function of drying and maintenance of the isolating fur. Similar grooming items are mentioned in literature by Rand (1967) for wild *Arctocephalus p. pusillus* and by Stirling (1970) and Marlow (1975) for other species. We can note that, unlike Canidae and Felidae, pinnipeds never lick themselves and never lick another individual, even their own pup (Rand, 1967, Marlow, 1975, King, 1983).

Floating postures we described are mentioned for many species of wild and captive Otariidae (Rand, 1956, 1967; Peterson *et al.*, 1968; Stirling, 1970; Shaughnessy & Chapman, 1984). Major hypothesis proposed to explain this behaviour are resting in water, slowly digesting, thermoregulating through flippers (sensitive surfaces playing an important role in heat exchange between body and environment) (Rand, 1956, 1967; Bartholomew & Stirling, 1970; Riedman, 1990). Concerning thermoregulation, we noted that flipper emersions were more frequent in extreme air temperature (February 1991: -6°C , June 1990: more than 30°C). For resting out of water, air temperature and flippers position are also

correlated: in high temperature, flippers are extended perpendicular to body, in low temperature, flippers are kept along or under body. This relation was mentioned for other *Arctocephalinae* (Stirling, 1970; Gentry, 1973).

The limits of the repertoire we established are evident; the number of individuals is reduced and captivity introduces artifacts such as stereotyped behaviours (stereotyped swim) or the lack of typical territorial displays. But the interest of observing confined animals to complete the ethological description of a species has already been proven (Bekoff, 1972) especially if these kinds of data cannot be collected easily on the field. Captive studies have the great advantage of better observability: all the individuals under observation are known and always in view. Sex, age and relationship of animals are often known; group size is reduced. Observation of captive animals can judiciously complement research in the field. Indeed, if we consider the few data available in literature, we see a close similarity between social behaviour of confined Cape fur seals and of other (wild) Otariidae. We can then confirm the conclusion of Gentry (1975) who said: 'the groups (of Otariidae) have quantitative and qualitative differences in the expression of the same behavioural repertoire, rather than having different repertoires'.

Considering individual time budgets, we discriminate in our group 3 tendencies: out of breeding season, the bull and the barren cow are characterized by a high percentage of time spent resting. Nonbreeding Otariidae bulls are indeed seldom gregarious and interact little. Female Otariidae interact most often with their relatives (pups from precedent years) which was mentioned for *Zalophus californianus* (Riedman, 1990). Cow 2 having no

relatives in the group, spends significantly less time interacting than cows 1 and 3. Reproductive females are much more nervous individuals displaying mostly active behaviours (locomotion) and spending very little time resting in the day. Juveniles are alike regarding their immaturity (interact significantly more than all the others) but they differ in sex and age: female is a sub-adult and male is still a pup (lot of time sleeping).

From a similar research performed by Waring (1984) with captive *Zalophus californianus*, we can compare the allocation of time to various activities (Figure 5). The more interesting point is the higher level of interactions and vocalizations in our group. The three individuals captured as juveniles in the southern hemisphere (South Africa, 30°S) (bull, cow 1 and 2) have displayed in Europe (50°N), an annual reproduction synchrony since 6 years. This artificial reproduction period is 6 months out of phase with the cycle of wild population in southern hemisphere. The more noticeable variation of adult social activity during this period is an increase of time spent interacting, vocalizing, and locomoting outside water. For the pregnant female, the proximity of parturition is also associated with a modification of activity budget (time spent resting increases notably as active states lessen).

Simple sampling methods elaborated for Primates study (Altmann, 1974) are now known to be well adapted to the study of highly social species of marine mammals (Sandegren *et al.*, 1973; McCann, 1983; Campagna & Le Boeuf, 1988). These type of standardized data are needed as basis for further behaviour investigations (Bekoff, 1972; Gentry, 1975; De Waal, 1988).

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