Behav Ecol Sociobiol (1996) 38 : 237–244

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Babysitting, dive synchrony, and indications of alloparental care in sperm whales

Received: 8 March 1995/Accepted after revision: 5 November 1995

Abstract Young sperm whales (*Physeter macrocephalus*) serially accompany different members of their social group at the surface while the majority of the group is foraging at depth. The presence of a nearby larger whale is likely to increase the survival prospects of the young animal. In studies off the Galápagos Islands, first-year calves were less likely to be seen at the surface alone than were larger whales, and groups containing calves showed less synchronous diving behaviour – shorter intervals with no larger whales at the surface – than those without calves. This difference in diving synchrony was not solely the result of behaviour by individuals assumed to be the mothers of calves (as they spent a disproportionate amount of time accompanying them). Thus babysitting in sperm whales seems to be a form of alloparental care. Its benefit may have been an important factor in the evolution of sociality in female sperm whales.

Key words *Physeter macrocephalus* · Alloparental care · Babysitting · Diving · Synchrony

Introduction

In the overwhelming majority of mammal species mothers provide virtually all of the care for their young alone (Kleiman and Malcolm 1981). However, in a few species of terrestrial mammal there is some form of paternal care (Kleiman and Malcolm 1981; Woodroffe and Vincent 1994), and, even more rarely, non-parental animals provide care (Riedman 1982; Jennions and MacDonald 1994).

Among marine mammals, an unusual, and perhaps unique, type of apparent alloparental care is found in the deep-diving sperm whale (*Physeter macrocephalus*). In contrast to other cetacean species, young sperm whale calves are not consistently accompanied closely (<c. 5 adult body lengths) by a single adult – the mother. Instead, the young sperm whale moves between the 10–30 different adult females and subadults of both sexes which form its social group (Best et al. 1984; Gordon 1987b; Arnbom and Whitehead 1989).

This serial accompaniment of sperm whale calves has been called "babysitting" (Gordon 1987a). It fits the definition of Kleiman and Malcolm (1981): "Babysitting refers to remaining with the young during the absence of the mother." Babysitting allows greater foraging freedom for the mother, while providing protection for the calf. It is functional in species, such as dwarf mongoose (*Helogale parvula*) (Rood 1986), where young animals cannot easily accompany their mothers during foraging, but when left unaccompanied are at greater risk, usually from predators (Riedman 1982).

During the roughly three-quarters of the day that sperm whales spend foraging, the social group spreads out over several hundred metres of ocean (Whitehead 1989); individual adults and juveniles dive for about 40 min to 400 m or so, with dives being separated by about 10 min of breathing at the surface (Papastavrou et al. 1989). Thus a mean of about three to five of the adults and immatures are visible at the surface at any time, but, depending on the coordination of dive cycles within the group, sometimes there may be no adults at the surface, while at other times ten or more may be visible. On some occasions groups are highly synchronous in their diving behaviour, with almost all animals diving within a 5-min period; at other times dives are staggered so that there are almost always three to five whales visible at the surface (Whitehead 1989). During periods at the surface between foraging dives the whales are almost always separated into clusters of one to three animals (Whitehead 1989). Calves swim from cluster to cluster as the larger whales dive (Gordon 1987b).

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The calf's diversity of associations, which is also apparent during the 25% of the time that the members of the group are "socializing" at or near the surface (Whitehead and Weilgart 1991), seems to start soon after birth (Best et al. 1984; Weilgart and Whitehead 1986).

This diversity of associations may be functional in that infants are accompanied near the surface while mothers forage at depths too great for too long for their offspring to follow (Best 1979; Gordon 1987a, b; Papastavrou et al. 1989). Young sperm whales are potentially vulnerable to predators, especially killer whales (*Orcinus orca*) and large sharks, and the close accompaniment of an adult is likely to increase their safety (Best et al. 1984; Arnbom et al. 1987). Thus this babysitting has been considered a form of alloparental care (Gordon 1987a; Arnbom and Whitehead 1989), additional to the allosuckling (suckling of young by females other than the mother) for which there also is some evidence in sperm whales (Best et al. 1984; Gordon 1987b).

However, calling the serial accompaniment of sperm whale calves by different adults alloparental care makes a number of assumptions which are not proven. Following the definition of Woodroffe and Vincent (1994), alloparental care can be considered as any behaviour by a non-parent which benefits the young and which would not be carried out if the young were not there. Although being close to an adult almost certainly improves the survival of calves, the same is likely true (but to a lesser extent) for other adults and subadults, which also show variable patterns of association with group members (Whitehead and Arnbom 1987). It is not clear that calf association patterns are different from those of other group members. Most importantly, for babysitting to constitute alloparental care, individuals must be shown to change their behaviour in the presence of calves of which they are not the parent, to the benefit of the calves. These issues need addressing before sperm whales can be properly considered to be providing alloparental care through babysitting.

In this paper I use data collected from sperm whales off the Galápagos Islands to examine these questions. Do sperm whale calves show different grouping or spacing patterns than other members of their group? Do groups of sperm whales with calves show different patterns of diving or surfacing behaviour compared to groups without calves? If so, could such changes be due solely to the behaviour of parents?

Methods

Definitions

1. *Calf*: infant in 1st year of life (c. 4–5.5 m in length). Approximately one-third of the groups followed contained calves, usually just one calf, but occasionally two or three. Calves older than 1 year also suckle (Best et al. 1984), and may have restricted diving abilities. However, for the purposes of this analysis, I conservatively restricted attention to only the easily distinguishable 1st year calves.
2. *Larger whales*: whales other than 1st year calves, principally consisting of adult females, and juveniles of both sexes (mostly 7.5–10.5 m long). Adult males occasionally, and briefly, accompanied the groups but constituted only a very small proportion of the population (c. 2%; Whitehead 1993).
3. *Group*: adult female, juvenile, and infant sperm whales which travel together, coordinating their movements and maintaining a fairly stable composition over periods of several days. Groups usually contained 8–30 individuals and consisted of approximately two "units" with stable membership over periods of years (Whitehead et al. 1991). Results of genetic analyses using five microsatellite loci show the units to contain related animals, and are consistent with a matrilineal structure (Richard 1995).
4. *Cluster*: whales swimming at approximately the same speed in the same direction and within 100 m of one another at the surface (Whitehead and Arnbom 1987). Because of fission, fusion and diving, clusters usually maintained stable composition for only a few minutes. Clusters can contain just one animal.
5. *Fluke-up*: flukes (tail) raised above the water surface, usually at the start of a deep dive. Calves rarely fluke-up.
6. *Calf accompaniment rate*: the proportion of occasions that larger whales, when fluking-up in clusters containing one to three larger whales (during hours in which at least one calf was sighted), were clustered with a calf. When calculating calf accompaniment rates for particular identified individuals, only fluke-ups more than 30 min apart were considered.
7. *Asynchronous fluke-up*: any fluke-up, which, when removed from the data set, increased the longest interval between fluke-ups during an hour (Fig. 1).

Field work

Data were collected from the 10-m auxiliary sloop *Elendil* with a crew of 5–6 in the waters around the Galápagos Islands, Ecuador (0°N, 90°W). Research was carried out between 23 February and

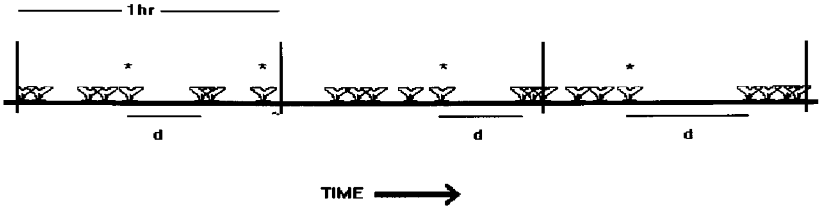

Fig. 1 Diagram showing the temporal pattern of fluke-ups (indicated by *icons of flukes*) in a group over 3 h. Fluke-ups in the same 5-min interval, which are considered simultaneous, are represented by overlapping icons. The maximum interval between fluke-ups, *d*, is marked for each hour. Asynchronous fluke-ups, whose removal would increase *d*, are marked by asterisks

20 April 1985 (a total of 30 days spent tracking sperm whales) and 3 January and 28 June 1987 (57 days spent tracking sperm whales). Individual photographic identifications from a study between 11 April and 21 May 1989 were also used in the study of calf accompaniment rates, but records of all observations of clusters of whales were not kept in 1989. The vessel was at sea for 5- to 14-day periods separated by a few days in port resupplying.

Groups of sperm whales were tracked acoustically using a directional hydrophone (Dev-Tec Inc., Pasadena, Calif., USA). This allowed us to locate sperm whales and stay in continuous contact for periods of days, remaining within about 2 km of them during most of the tracking time. Because of confusion when groups aggregated, the actual group being tracked changed approximately once per day, but the same group was often re-encountered after a lag of one, or several, days.

During daylight, the ranges, bearings and composition (maximum number of observed large males, calves and other whales) of all visible whale clusters were recorded every 5 min, together with the number of occurrences of any observable behavioural activities, including fluke-ups. When whales fluked-up close to the boat, their flukes were photographed so that individuals could be identified from distinctive markings (Arnbom 1987). There were 298 individuals identified from 652 high-quality photographs in 1985 and 379 individuals from 1,100 photographs in 1987.

Because of the aggregation of groups, and changes in the groups being followed, the data were broken into 1-h periods, during the great majority of which only one group would be observed. These hourly periods were separated into hours during which calves were observed (showing that the group contained a calf), and those in which calves were not observed (indicating that the group probably did not contain a calf).

In these studies, there were 225 h of observation in which calves were observed, and 476 h of observation in which calves were not observed.

Analysis

To eliminate biases caused by imperfect sighting, for analyses of cluster composition attention was restricted to those clusters sighted < 200 m from the research vessel. Weather conditions off the Galápagos between January and June are almost invariably good, with calm seas and good visibility. Using the number of whales or flukes observed as covariates (see below) should remove any residual biases caused by variation in sighting conditions.

The data were collected in one ocean area during two periods each lasting a few months. Thus the results formally refer to only the groups of sperm whales followed during the periods while they were being followed. Analysis of identification photographs suggests that individual sperm whales spent a mean of about 6 days in our study area near the Galápagos Islands at any time and were part of a population numbering roughly 3,500 animals inhabiting the surrounding waters (Whitehead et al. 1992b). Therefore, to investigate whether the results of the analyses are more generally valid for the population of sperm whales that visits the Galápagos, the studies were divided into 15 periods of 15 days, with the data from each period being considered to be derived from an independent set of whales.

The vulnerability of calves to predators might be expected to be related to how long the calf is left at the surface without larger whales. Thus the maximum length of time in any hour that no larger whales were visible (< 2,000 m from the vessel) at the surface, i, was compared for hours in which calves were, and were not, sighted. As larger groups will generally tend to have shorter periods with no larger whales visible at the surface, the mean number of whales visible at the surface at any time during the hour, m, was used as a covariate. Logarithmic transformations improved the normality of the data in the following regression model:

$$\log(i) = \mathrm{const} + a \cdot \log(m) - \alpha \cdot c \qquad \text{(Model 1)}$$

where $c = 1$ if a calf was sighted during the hour, $c = 0$ if a calf was not sighted during the hour, and a and α are regression coefficients.

The maximum length of time with no larger whales visible at the surface is likely principally the product of group size and diving synchrony. Therefore, to examine coordination in diving among members of a group, for each hour the longest interval between consecutive dives (fluke-ups), d, (Fig. 1) was plotted against the number of dives made by the group during the hour, n. In a random process, d should be roughly inversely proportional to n. Thus the following regression model was fitted to the data:

$$d = \mathrm{const} + b/n - \beta \cdot c \qquad \text{(Model 2)}$$

The residuals from both models were significantly ($P < 0.05$) autocorrelated with a lag of 3 h for model 1, and 1 h for model 2. Therefore, the models were fitted again with consecutive hours deleted in such a way that no remaining hourly data were collected less than 4 h apart for model 1 (leaving 64 h of data with calves present, and 160 without calves present) and 2 h apart for model 2 (leaving 116 h of data with calves present, and 226 without calves present). The residuals from the models with the new data sets were not significantly autocorrelated. Analysis of residuals suggested that the other assumptions of both regression models were reasonably satisfied.

In order to investigate which individual whales were contributing most towards reducing the intervals between dives, asynchronous fluke-ups (as defined above, Fig. 1) were examined for groups containing calves and for hours with at least six recorded fluke-ups (indicating that a majority of the group was likely diving). The individuals making the asynchronous fluke-ups were identified from fluke photographs whenever these were available.

Results

During all 5-min scans, calves were seen alone (rather than in clusters of size two to three whales) 31% of the time, compared with larger whales which were seen alone 43% of the time (Fig. 2). A paired t-test (using 15-day periods as units) showed that calves were seen alone (rather than in clusters of two to three whales) significantly less than larger whales ($t = 2.658$, 6 df, $P = 0.038$, including only those 15-day periods with > 20 observations of clusters containing a calf < 200 m from the boat).

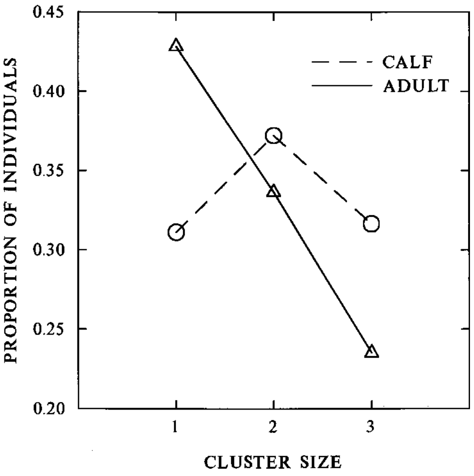

Fig. 2 Proportion of calves (- - ○- -) and larger whales (– ▲–) sighted less than 200 m from the boat in clusters of size 1–3

Table 1 Regression analyses of dependency of group surfacing behaviour on the number of whales present and the presence of calves (model 1), and group dive synchrony on the rate of diving and the presence of calves (model 2)

Model 1 (dependent variable: log (maximum interval with no whales at surface))					
Variable	Coefficient	*t*-value	*P*		
Constant	3.12	21.8	<0.001		
Mean whales present (a)	-0.23	-5.4	<0.001		
Presence of calf (α)	0.23	2.3	0.022		
Source	Sum of squares	*df*	Mean square	*F*-ratio	*P*
Regression	19.1	2	9.6	26.1	<0.001
Residual	80.9	221	0.4		

Model 2 (dependent variable: maximum inter-dive interval)					
Variable	Coefficient	*t*-value	*P*		
Constant	19.68	19.2	<0.001		
Dives per hour (b)	56.65	11.4	<0.001		
Presence of calf (β)	2.49 min	2.2	0.028		
Source	Sum of squares	*df*	Mean square	*F*-ratio	*P*
Regression	14065	2	7033	75.2	<0.001
Residual	31702	339	94		

When alone, calves were as likely to be the only animals visible in a 5-min interval (14.5% of the 117 observations of calves alone in a cluster) as larger whales (12.7% of 2427 observations of larger whales alone in a cluster). When other clusters were visible with a lone calf, the distribution of the ranges between a lone calf and the nearest cluster (median 235 m, $n = 100$) was similar to, and not significantly different from (Kolmogorov-Smirnov test, $P > 0.1$), the distribution of ranges between a lone larger whale and the nearest other cluster (median 217 m, $n = 2118$).

When calves were present, the maximum interval during an hour with no larger whales visible at the surface was significantly shorter than when calves were not present (model 1; Table 1). As shown in Fig. 3, this was especially the case when there were a mean of about three to five larger whales at the surface. A mean of three to five whales visible is typical off the Galápagos, representing a foraging group of size 15–25 (as whales are at the surface about one-fifth of the time while foraging: Papastavrou et al. 1989). As all observations were made in 5-min intervals, the minimum recordable gap was 5 min, and so the results presented in Fig. 3 suggest that, with more than a mean of about five whales visible at the surface, calves were rarely alone at the surface for more than about 5 min.

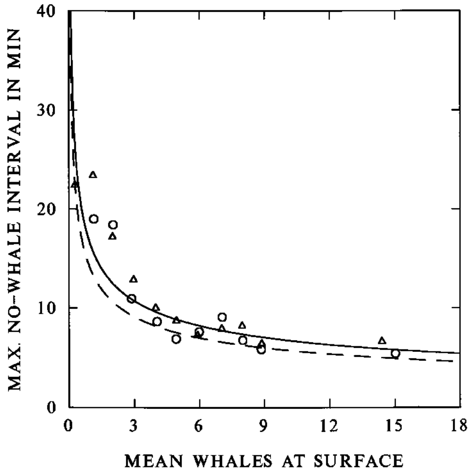

Fig. 3 Maximum interval with no larger whales visible at the surface during any hour plotted against the mean number of larger whales visible at the surface at any time during the hour, with *curves* from a regression model, for hours in which calves were (- - - -) and were not (——) sighted. For each mean number of larger whales visible at the surface in an hour (in range 1–9) the mean maximum gap without larger whales visible is given for groups with (○) and without (▲) calves. Hours with a mean of >10 larger whales visible were combined for the calculation of mean values (but not in estimating the regression curves)

The length of the maximum interval without larger whales visible at the surface during an hour is largely a consequence of diving synchrony. Groups with calves showed more regularly spaced dives than those without: the longest interval between dives of members of a group within an hour was a mean of 2.5 min shorter for groups with calves than for those without, a significant difference (model 2; Table 1; Fig. 4).

When a categorical variable defining the 15-day period during which the data were collected was added to the regression analyses, its influence was significant for the analysis of the maximum gap without larger whales at the surface ($F = 2.08$, $df = 14{,}207$, $P = 0.014$ for model 1), but not for that of maximum interval between consecutive dives ($F = 1.00$, $df = 13{,}326$, $P = 0.445$ for model 2). This suggests that there was little additional variation in the synchrony of diving behaviour with time or the identities of the whales present, beyond that explained by the number of dives within an hour and the presence or absence of calves. However

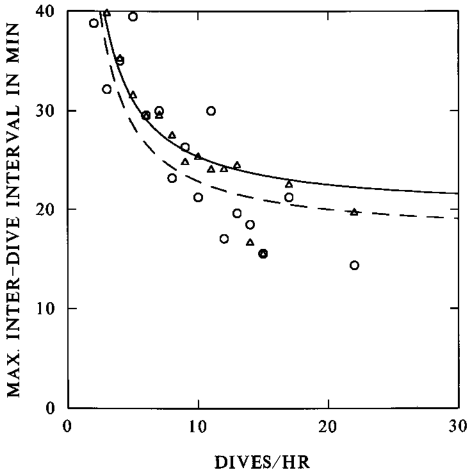

Fig. 4 Maximum observed inter-dive interval of a group in any hour plotted against the number of dives observed from the group during the hour, with *curves* from a regression model for hours in which calves were (- - - -) and were not (——) sighted. For each number of dives in an hour (in range 3–15) the mean maximum inter-dive interval is given for groups with (○) and without (▲) calves. Hours with 16–19 dives were combined for the calculation of mean values (but not in estimating the regression curves), as were hours with 20–25 dives

the surface behaviour of the whales, which includes nonforaging periods, appears to have varied between groups and/or with environmental conditions (including perhaps season).

Thus when groups contained a calf they showed an overall decrease in diving synchrony (as indicated by the longest interval between dives), and consequently shorter intervals without larger whales visible at the surface. However, the above analyses do not rule out the possibility that the changes in group behaviour could be due entirely to parental behaviour. Mothers might arrange their dives to be as little synchronized as possible with the rest of the group, and no other group member changes its behaviour because of the calf.

How prominent would such maternal behaviour have to be in order to account for the difference in synchrony between groups with and without calves? What proportion of asynchronous fluke-ups (those that decrease the longest interval between fluke-ups during an hour – see definition in Methods; Fig. 1) would have to be made by mothers to produce the observed difference in synchrony between groups with and without calves? Model 2 was run after removing (randomly) various proportions of the asynchronous fluke-ups made during the hours when calves were sighted. With about 45% of the asynchronous fluke-ups removed there was no difference in the synchrony of groups with and without calves (Table 2). This suggests that mothers would have to deliberately make 45% of the asynchronous fluke-ups to account for the difference between groups with and without calves.

Table 2 Difference in maximum inter-dive interval between groups with and without calves with different proportions of asynchronous fluke-ups randomly removed during hours with calves (from model 2 – mean of 6 runs for each proportion removed)

Proportion of asynchronous fluke-ups removed	Difference in max. inter-dive interval (without calf – with calf)
0%	2.5 min
30%	0.8 min
40%	0.2 min
50%	−0.3 min
100%	−3.0 min

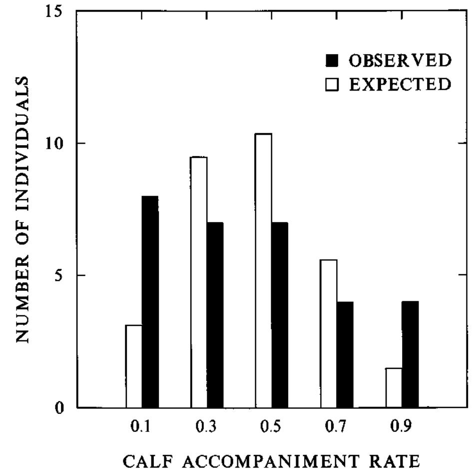

Fig. 5 Distribution of calf accompaniment rates (proportions of occasions accompanied by a calf when in a cluster of 1–3 larger whales) of individuals identified on 4 or more occasions (during hours in which calves were sighted), together with expected distribution assuming the same mean accompaniment rate for all individuals

Who were the mothers? Gordon (1987b) found that calves, although clustering with a variety of other adults, show a particularly strong association with one adult, presumably the mother. Figure 5 shows the distribution of calf accompaniment rates (see definition above) for the 30 individuals identified on at least four occasions. Also shown is the expected distribution of these rates assuming that all these individuals had the same probability of being seen with a calf on each occasion (calculated using the binomial distribution). There is a significant difference in calf accompaniment rates between individuals ($\chi^2 = 63.7$, $df = 29$, $P < 0.01$), with some rarely accompanying calves, and a few almost always doing so (Fig. 5). Following Gordon (1987b), I tentatively assume that animals who very frequently accompanied calves were likely mothers. When the seven animals with calf accompaniment rates greater than or equal to 0.7 were removed from the data set (combined calf accompaniment rate = 0.81), then there was no indication of a difference between the calf accompaniment rates of the other animals ($\chi^2 = 26.8$,

$df = 22$, $P = 0.25$). There were never more of these animals (with calf accompaniment rates greater than or equal to 0.7) identified during an hour (in which at least one calf was sighted) than the number of calves sighted.

Of the 38 asynchronous fluke-ups in which the individual was identified, only one was made by an individual who had been identified with calves on three or more occasions: this animal, identification number 101, which was identified making one asynchronous fluke-up, was identified with a calf on seven out of ten occasions. The individuals who had been identified making asynchronous fluke-ups had a similar combined calf accompaniment rate, 0.32 (26/81), to the overall population, 0.29 (123/425). There was no significant difference between these proportions ($\chi^2 = 0.33$, $df = 1$, $P > 0.5$). If 45% of the asynchronous fluke-ups were made by mothers who had a mean calf accompaniment rate of 0.81 (see above – this estimate changes little with variation in the number of assumed mothers in the calf accompaniment data set: four assumed mothers gives a rate of 0.88 and 11 assumed mothers a rate of 0.72), then the calf accompaniment rate of individuals making asynchronous fluke-ups should be about 0.52 ($0.45 \times 0.81 + 0.55 \times 0.29$), considerably more than the 0.32 observed from asynchronous individuals. (If all calf-accompaniment occasions by individuals identified as making asynchronous fluke-ups are assumed independent then this difference is statistically significant: $\chi^2 = 13.31$, $df = 1$, $P < 0.01$).

Thus I tentatively conclude that the mothers of calves were not making considerably more asynchronous fluke-ups than the rest of the population, and that the behaviour of these mothers was not the sole cause of the difference in synchrony between groups with and without calves.

Discussion

Much of the behaviour of sperm whales is veiled for a visual observer above the water surface. This is especially the case when they are foraging at depth. However, even though sperm whales are visible above the water surface between deep dives more consistently than many other cetaceans (Beale 1839), there are times when adults, as well as calves, are close to the surface, but not visible. Additionally, surfacing calves at ranges of several hundred meters may be missed, especially in rough weather (although this is rare off the Galápagos). Thus there will have been some hours in which calves were present but not observed, and some calves classified as alone may have been closely accompanied by an adult a few meters below the surface. Thus the results presented in this paper will have underestimated the rates at which calves are accompanied, and also the differences between the behaviour of groups containing calves and groups that do not.

Despite this, the results show that calves were alone proportionally less often than adults, and that groups containing calves staggered their dives more than those which did not. This seems to have reduced the periods during which calves were unaccompanied at the surface, and so likely increased their safety. Thus a change in communal behaviour takes place in the presence of calves which is likely to be of benefit to the calves.

The analysis of calf accompaniment rates and asynchronous fluke-ups suggests that this change in communal behaviour is not solely the result of the actions of mothers. This conclusion is tentative because it depends on the unproven, although reasonable, assumption that individuals spending disproportionately more time with calves are their mothers. If this assumption is accepted, then, babysitting in sperm whales is alloparental care.

However the babysitting is not necessarily altruistic. Subtle changes in the coordination of dives within a group are unlikely to have much feeding cost. A measure of sperm whale feeding success, the defecation rate (Smith and Whitehead 1993), was virtually identical for groups with (42/1053 = 0.041 defecations/fluke-up) and without (28/689 = 0.040 defecations/fluke-up) calves. Another potential cost of babysitting is that the less synchronous diving in groups with calves will mean that an adult or juvenile has fewer companions at the surface at any time, and thus by changing the dive schedule to offer protection to the calf, the larger whale may itself be more vulnerable to surface predators. This cost is likely small as adult sperm whales are thought to be generally safe from even the most powerful predator in the ocean, the killer whale (Jefferson et al. 1991). In contrast, the benefits to the calf, which is likely related to many members of the group (Richard 1995) and is threatened by predators (Best et al. 1984; Arnbom et al. 1987), may be important.

Could the protection of calves through babysitting be a major evolutionary force for sociality in female sperm whales as suggested by Best (1979), Gordon (1987a) and Arnbom and Whitehead (1989)? Consider a hypothetical population of deep-diving, but solitary, pre-sperm whales. If an innovative female remained with her mother during the overlapping parts of their reproductive lives, and the mother and daughter staggered their dives, then the offspring of both would likely have better survival, increasing the direct and inclusive fitness of both mother and daughter. They might also start to suckle each others' offspring, as suggested by the evidence described by Best et al. (1984) and Gordon (1987b). Gregarious babysitting, if it had a genetic or cultural component, would then spread until entire matrilines were living together and babysitting each others' calves. If the benefits of large group size were substantial enough, selection could favour the permanent or temporary merging of unrelated matrilines, a situation which is indicated by results on the structure and stability of sperm whale groupings (Whitehead et al. 1991). An upper limit on such gregariousness might be set by the spatial arrangement of food resources (Best 1979).

Candidates for the principal function of sociality in female sperm whales, other than babysitting and communal defence of calves, include communal foraging, communal vigilance and defence of adults against predators, communal knowledge of the distribution of ephemeral resources and allosuckling. The absence of any similar social structure in male sperm whales (e.g. Whitehead et al. 1992a) argues against any principal function that simply improves adult survival or nutrition. However, if there are circumstances in which one mother cannot supply all the milk that a calf needs, allosuckling could also be an important evolutionary pressure for sociality in female sperm whales.

The key element in this scenario of the evolution of female sociality through babysitting is the necessity of leaving calves unaccompanied at the surface during foraging. Thus similar babysitting behaviour might be expected in other deep-diving social cetaceans, perhaps especially the beaked whales of the genera *Berardius* and *Hyperoodon*. Unfortunately little is known of the social behaviour of these species. Reports of apparent babysitting in species of wild cetaceans which do not make such prolonged deep dives are qualitatively different from the repeated serial accompaniment of calves by sperm whales. For instance, killer whale calves rarely leave their mothers' side during the first 6 months of life, but later may be accompanied by a few other particular members of the social group in the absence of the mother (Haenel 1986; Jacobsen 1986).

A number of proximate mechanisms could lead to the greater diving asynchrony found in groups containing calves. For instance larger whales might tend to delay dives if there is a nearby calf, but no other adults at the surface. Such behaviour, with little or no cost, could be promoted by kin selection. It is feasible to collect field data to test whether such delays occur.

In conclusion, babysitting sperm whales seem to show alloparental care, reducing their dive synchrony when with calves, and thus likely increasing protection of the calf while permitting mothers greater foraging freedom. The benefits of this behaviour may have been instrumental in the evolution of sociality in female sperm whales.

Acknowledgements The research was principally funded by the Natural Sciences and Engineering Research Council of Canada, the International Whaling Commission, M. Clark, the Green Island Foundation and the Dalhousie University Research Development Fund. World Wildlife Fund kindly loaned equipment. I am grateful to all those who took part in the research at sea but especially to Tom Arnbom, Amelia Brooks, Leesa Fawcett, Cheryl Hendrickson, Bill Lambert, Katherine Lynch, Vassili Papastavrou, Sean Smith, Caroline Smythe, Jennifer Staniforth, Susan Staniforth, and Susan Waters. I thank the Charles Darwin Research Station, and especially Günther Reck, Sylvia Harcourt and Henk Kasteleijn, and the Galápagos National Park Service for support and assistance. Tom Arnbom, Susan Dufault and Susan Waters analyzed the individual identification photographs. Juan Black helped greatly in Quito and Godfrey Merlen and Gayle Davis came to our rescue several times. This analysis was stimulated by insightful comments by Janet Mann on another manuscript, and improved by reviews from Jenny Christal, Shannon Gowans, Andrew Horn, Marty Leonard, Janet Mann, Kenny Richard, Fritz Trillmich and three anonymous reviewers.

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Communicated by F. Trillmich