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**Timing of whelping among Northwest
Hooded seals**

**Période de mise bas chez les
phoques à capuchon du Nord-Ouest**

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ABSTRACT

The temporal distribution of births was determined by assuming that the distribution of births followed a Normal distribution and that this could be modelled by following the changing proportion of pups in three age-dependent morphometric and pelage specific stages. Stage data from surveys completed in the Gulf and at the Front were examined. At the Front, the mean date by which pupping had finished was 28 March (SE=2.21, N=8, Range =18 March-4 April). In the Gulf, pupping in most years had finished by the start of April, with the exception of 1994, when the model predicted that pupping continued until May. This late date, and high standard error indicate a very poor model fit to the data. Excluding the 1994 data and Patches 1 and 2 from 2005, births would have finished by 28 March (SE=1.73, N=4, Range=25-31 March). Nursing hooded seals are first observed early in March. This indicates that hooded seal births are spread over a longer time period than seen among harp seals that pup in the same area. From this limited data set, pupping on average should be complete by 2 April. Taking into consideration possible late births, particularly in heavy ice years, nursing should be complete by about the 8-10 April.

RÉSUMÉ

On a établi la distribution temporelle des naissances en supposant que la distribution des naissances suivait une distribution normale et qu'on pouvait la modéliser en suivant la variation de la proportion de nouveau nés à trois stades de développement distincts reliés à l'âge (caractéristiques morphométriques et pelage). Les données sur les différents stades tirées des relevés effectués dans le Golfe et dans la région du Front sont examinées. Sur le Front, la date moyenne de la dernière mise bas était le 28 mars (erreur type = 2,21, N = 8, plage = du 18 mars au 4 avril). Dans le Golfe, les mises bas prennent fin, la plupart des ans, au début d'avril, sauf en 1994, lorsque le modèle a prédit une poursuite des mises bas jusqu'en mai. La date tardive et la valeur élevée pour l'erreur type sont indicatrices d'une très mauvaise adéquation du modèle aux données. Si on exclut les données de 1994 et les aires de mise bas no 1 et 2 pour 2005, on obtient le 28 mars comme date de la dernière mise bas (erreur type = 1,73, N = 4, plage =du 25 au 31 mars). Les premières femelles allaitantes sont observées au début de mars, ce qui indique que les naissances, chez le phoque à capuchon, sont réparties sur une plus longue période que celle observée chez le phoque du Groenland, qui met bas dans la même zone. D'après ces données limitées, les mises bas prennent habituellement fin le 2 avril. Si l'on tient compte des naissances tardives possibles, particulièrement durant les années où les glaces sont particulièrement abondantes, l'allaitement devrait avoir pris fin vers la période s'étendant du 8 au 10 avril.

INTRODUCTION

Hooded seals give birth on the pack ice off the northeast coast of Newfoundland (Front), in Davis Strait and in the Gulf of St. Lawrence (Gulf) (Sergeant 1974). Lactation is short, lasting on average only 4 days, after which the pups are abandoned by the female (Bowen et al. 1985; Kovacs and Lavigne 1992). After weaning the animals can spend up to several weeks on the ice before entering the water and dispersing (Stenson et al unpublished data).

Here we examine the distribution of births from a series of surveys conducted in the Gulf of St. Lawrence (Gulf) and off the coast of southern Labrador and northeast Newfoundland (the 'Front') to estimate variations in the timing of births to determine if a seasonal closure could be established to ensure that all pups had been weaned.

MATERIALS AND METHODS

Temporal Distribution of Births

The temporal distribution of births was modelled by assuming that the changing proportion of pups in three age-dependent morphometric and pelage specific stages pupping could be used to model the birthing ogive, assuming that this distribution could be described by a Normal distribution. The proportion of pups in each of three age-dependent morphometric and pelage specific stages was determined repeatedly throughout the whelping period as described in Stenson et al. (1997). Bluebacks were classified as Newborn, Thin and Fat (Bowen et al. 1987). Stage durations were Thin ($\mu = 1.15$ d, $SE=0.157$, $n = 45$), and Fat ($\mu = 2.36$ d, $SE = 0.107$, $n = 63$), were obtained from Bowen et al. (1987). Bowen et al. (1987) were unable to estimate the duration of the Newborn stage, but suggested that it only last for about 3 h. Assuming a 40% coefficient of variation, resulted in Newborn ($\mu = 0.12$ d, $SE=.05$). Stage data were available from surveys flown in both the Gulf and at the Front and include both published and unpublished data (Hammill et al. 1992, 1997; Stenson et al. 1997; Stenson et al. 2006; Hammill unpublished).

The distribution of births was determined, assuming that the timing of births followed a Normal distribution and is described in detail by Stenson et al. (2003). This algorithm was implemented using SAS IML code and can be obtained at: http://www.mat.ulaval.ca/pages/scs/gd/macro_sas.html).

Changes over time in the proportion of animals at different stages were included in the model. We assumed that pupping was complete when $\geq 99.9\%$ of births had occurred.

RESULTS

Stage data used in the analyses were collected at the Front and in the Gulf of St. Lawrence. The raw data from 2004 and 2005 are presented in Tables 1-4. At the Front, the mean date by which pupping had finished was 28 March (SE=2.21, N=8, Range =18 March-4 April)(Table 5). In the Gulf, pupping in most years had finished by the start of April, with the exception of 1994, when the model predicted that pupping continued until May. This late date, and high standard error indicate a very poor model fit to the data. Excluding 1994 and the combined patch surveyed in 2005, the season of births in the Gulf ends by the 27 March (SE=1.79, N=5, Range=25 March -2 April). Excluding the 1994 data and Patches 1 and 2 from 2005, births would have finished 28 March (SE=1.73, N=4, Range=25-31 March).

DISCUSSION

Hooded seals have received considerably less attention than harp seals, as a result our information on many aspects of the biology of this species including pupping are limited. Although data are limited there is a good indication that the timing of pupping can vary significantly among concentrations and/or years. For example, the date of complete pupping was early April in 1990 while pupping may have continued until May in the Gulf. However, in general pupping in both the Gulf and at the Front ended around 27-28 March. If weaning occurs 4 days after births, then there should be a very low probability of observing nursing pups on the ice between 31 March and 1 April. Bowen et al (1987) also examined the distribution of pupping in hooded seals from the Front and Davis Strait, but used a different model to calculate the proportion of births that had occurred. In his Figure 8, it appears that pupping has ended by about 25 March, which would result in weaning by about 29 March, which is similar to our observations.

Nursing hooded seals are first observed early in March (e.g. Bowen et al 1987, Stenson et al 1997, Hammill et al 1992; Stenson unpublished data, Hammill unpublished data). This indicates that hooded seal births are spread over a longer time period than seen among harp seals that pup in the same area (e.g Stenson et al 2003).

Among harp seals differences of about 10 days in the timing of pupping are observed between animals born at the Front and animals born in the Gulf (Sergeant 1991). Slight differences are also observed in the timing of pupping between the Northwest Atlantic herds and animals in the White Sea and West Ice (Sergeant 1991). Such differences do not appear among hooded seals in the Northwest Atlantic. From this limited data set, pupping on average should be complete by 2 April. Taking into consideration possible late births, particularly in heavy ice years, nursing should be complete by about the 8-10 April.

Given the timing of births observed among hooded seals, if a decision were made to allow the hunting of weaned bluebacks, a closed season from early March until the second week of April would be required to ensure the likelihood that nursing pups were not present.

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Table 1 Numbers of hooded seal pups in individual age dependent stages at the Front during March 2004.

	Date	New	Thin	Fat	Solitary	Total
Southern	9 March	10	125	14	2	151
	10 March	15	48	22	4	89
	16 March	0	37	193	200	430
	19 March	0	0	12	195	207
	22 March	0	0	2	272	274
Northern	10 March	3	80	3	1	87
	12 March	1	613	68	31	713
	17 March	5	182	147	339	673
	19 March	0	25	98	100	223
	22 March	0	30	85	241	356

Table 2. Numbers of hooded seal pups in individual age dependent stages at the Front during March 2005.

		Newborn	Thin	Fat	Solitary	TOTAL
Cartwright	March 14	0	383	75	44	502
	March 17	0	13	10	17	40
	March 22	0	8	46	599	653
Notre Dame Bay	March 11	0	26	4	2	32
	March 18	0	106	38	62	206
	March 22	0	6	28	754	788
White Bay	March 22	0	0	0	136	136
Lower Strait & Black Tickle		0	39	37	63	139
	March 18					
	March 20	0	0	0	129	129
Upper Strait	March 22	0	91	179	146	416
	March 23	0	30	170	83	283

Table 3. Stage data used to estimate the temporal distribution of hooded seal births in from the Gulf during 2004.

Date	Newborn	Thin	Fat	Total
March 15	0	10	7	17
March 19	3	6	20	29
March 20	0	1	2	3

Table 4. Numbers of hooded seal pups in individual age dependent stages in the Gulf of St. Lawrence during March 2005. Patch 1 was surveyed on 8 March, Patch 2 on 12 March and the whole area (Combined) on 21 March.

Date	Newborn	Thin	Fat	Total
<u>Patch 1</u>				
7 March	6	20	37	63
9 March		23	82	105
12 March	7	52	33	92
15 March		6	50	56
16 March	6	45	57	108
22 March	1	7	63	71
<u>Patch 2</u>				
7 March	0	4	2	6
9 March	1	22	31	54
12 March	1	46	53	100
15 March		25	75	100
16 March	1	2	16	19
<u>Combined</u>				
7 March	6	24	39	69
9 March	1	45	113	159
12 March	8	98	86	192
15 March	0	31	125	156
16 March	7	47	73	127
22 March	2	14	126	142

Table 5. The patch and date that at least 99% of births had occurred and the mean proportion of pups born with standard error in brackets.

Location	Date 99% born	Mean proportion of births (SE)
<u>Front</u>		
Concentration 1	2 April 1990	1 (-)
Concentration 2	4 April 1990	1 (0.0002)
Southern	18 Mar 2004	1 (0.0005)
Northern	29 March 2004	1 (0.0002)
Cartwright	26 March 2005	1 (0.00002)
Notre-Dame	24 March 2005	1 (0.00009)
Straits	20 March 2005	1 (-)
Upper Straits	31 March 2005	1 (0.00001)
<u>Gulf</u>		
Gulf Patch 1	2 April 2005	1 (0.0007)
Gulf Patch 2	25 March 2005	1 (0.0003)
Gulf, combined	31 March 2005	1 (0.0008)
Gulf	29 March 2004	1 (0.0003)
	25 March 1991	1 (0.0002)
	25 March 1991	1 (0.0005)
	1 May, 1994	0.996 (0.064)