



Patterns of association among fin whales (*Balaenoptera physalus*) observed in the Gulf of St. Lawrence, Canada

Julien Delarue¹, Christian Ramp¹, Martine Bérubé² and Richard Sears¹

¹ Mingan Island Cetacean Study, 285 Green, St. Lambert, J4P1T3, QC, Canada

² Department of Genetics, Stockholm University, 106 91, Stockholm, Sweden



Condensed abstract:

Little is known about the social organization of balaenopterids. Fin whales are typically seen alone or in pairs but larger groups occur in some areas. We analyzed fin whale photo-identification and biopsy data collected in the northern Gulf of St. Lawrence (GSL), Canada. 2068 sightings (out of 3608) contained at least one identified fin whale; 286 fin whales were identified (61 males; 64 females). Observed group sizes ranged between one and 18 individuals and were among the largest reported for fin whales. Females were significantly more likely to be seen alone than males. 57% of pairs were mixed, but male biased sex ratio was evident in all larger group sizes sampled. Mean associations indices (MAI) were twice as high for males as for females. Similarly, male-male MAI were twice as high as male-female and three times as high as female-female MAI. Permutation tests provided evidence of short-term association among males, females and between males and females but there was no evidence of long-term associations. Standard lagged association rates indicated some long-term associations between males and females.

Methods:

- Analysis focusing on fin whale photo-identification and biopsy data collected in the Jacques Cartier Passage (Fig.1) in the summers of 2004-2008 and 1990-2007, respectively.
- Group defined as individuals swimming within 1 body length and exhibiting coordinated surfacing patterns. Group size (GS) was characterized by mean±SD and typical GS (GS experienced by an average individual)
- Groups gender assemblages analyzed for all groups completely identified and sexed
- Half-weight association indices, tests for preferred/avoided associations using permutation tests and standard lagged association rates (SLAR) were derived using Socprog 2.4
- Data were restricted to single animals and groups for which at least 2 whales were identified. Only individuals seen a minimum of 2 days/yr for at least 2 yrs were included. Cows and calves were excluded.

Results:

- Restrictions yielded a data set of 1797 sightings of 99 identified fin whale (51 females and 48 males)

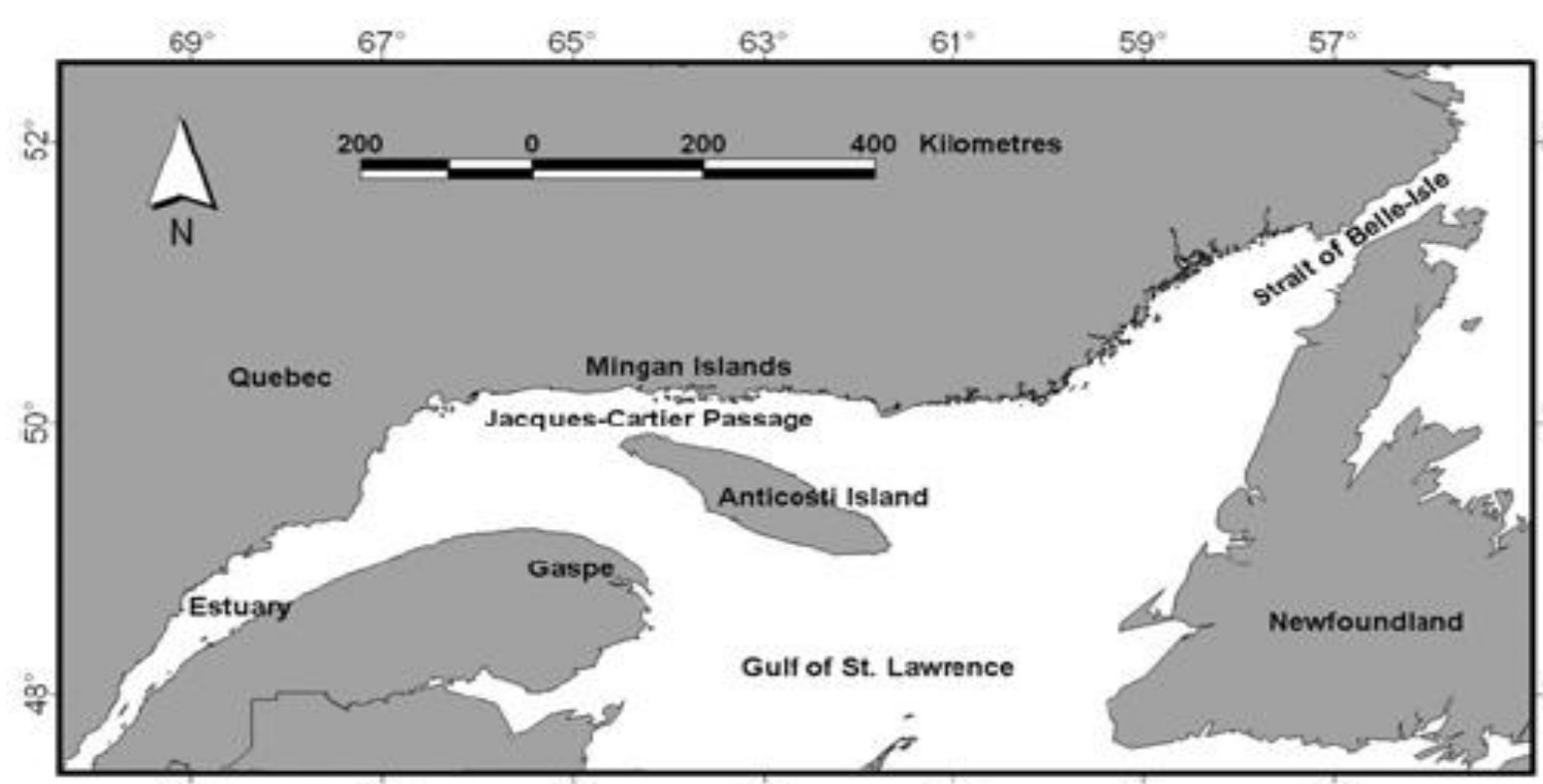


Fig.1 Study area.

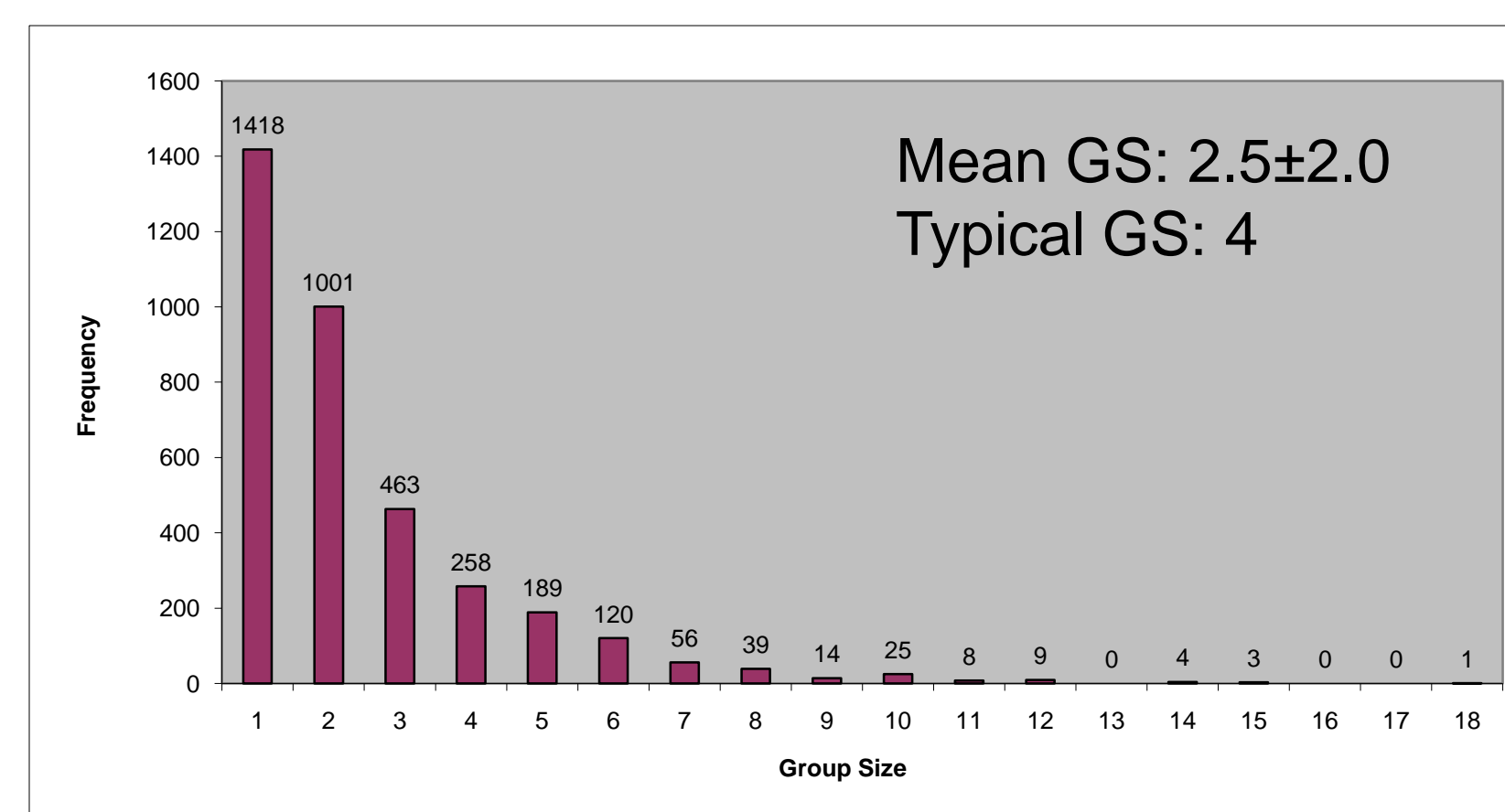


Fig.2 Group size (GS) frequency distribution. GS ranged from 1-18 individuals. All sighting data (2004-08) were used for that graph.

	Mean Assoc. Index	Maximum Association
F	0.0078 (0.0054)	0.1751 (0.0915)
M	0.0148 (0.0081)	0.2018 (0.0777)
F-F	0.0058 (0.0054)	0.1195 (0.1048)
F-M	0.0098 (0.0075)	0.1465 (0.0778)
M-M	0.0197 (0.0115)	0.1758 (0.0783)
Overall	0.0113 (0.0077)	0.1886 (0.0854)

Table 1: Mean and maximum association indices for male and female fin whales. MAI were twice as high for males as for females. Male-male MAI were twice as high as male-female and three times as high as female-female MAI.

- Permutation tests provided evidence of short-term association among males, females and between males and females but no evidence of long-term associations.
- SLAR provided some evidence of long-term associations between males and females (Fig. 3).
- Females were leading groups in 60% of cases while males were flanking in 78% of cases.

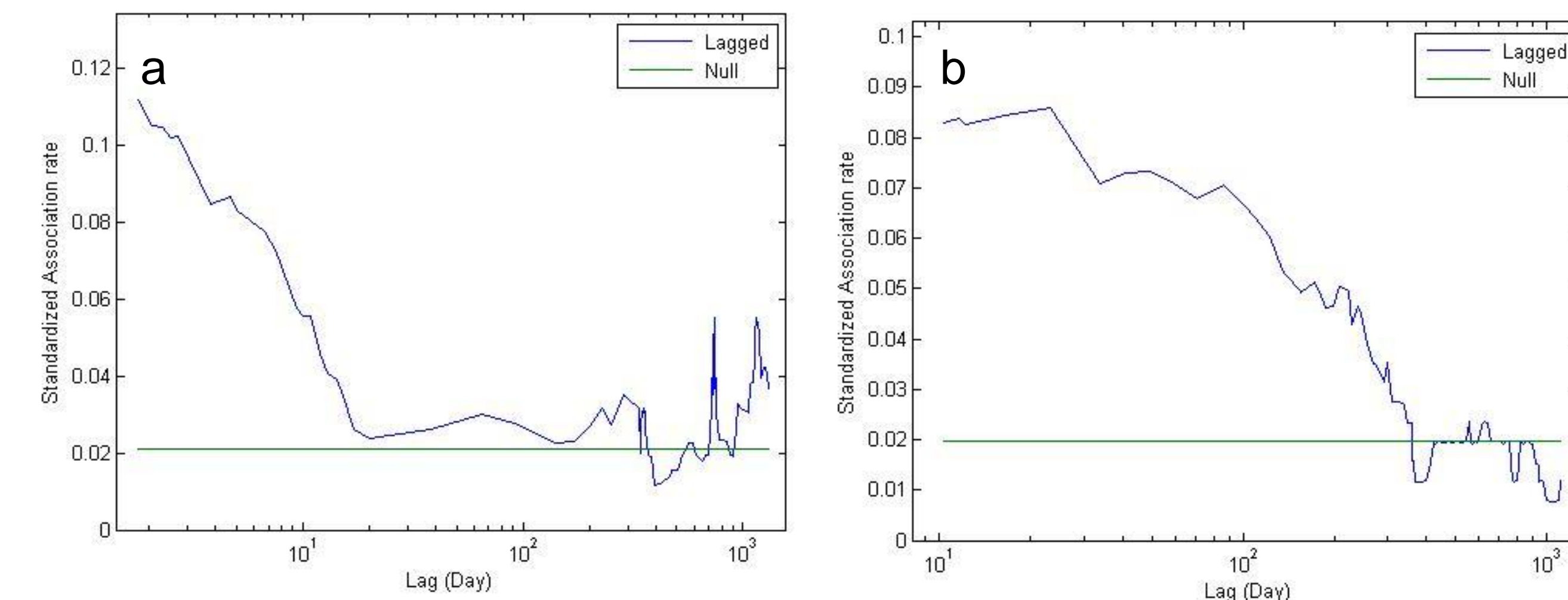


Fig.3: SLAR for MM (a) and MF (b) fin whale associations. MM associations disassociate quickly over 20 days whereas MF associations disassociate more slowly over the length of a field season.

Table 1: Group gender composition for entirely sampled/sexed group. Females are more likely to be seen alone than males ($X^2=5.83$, $p=0.016$), pairs tend to be mixed (57%) and larger groups are male biased.

group size	# males	# females	frequency
1	1	0	166
1	0	1	213
2	2	0	30
2	1	1	62
2	0	2	16
3	3	0	7
3	2	1	9
3	1	2	2
3	0	3	1
4	4	0	1
4	3	1	4
4	2	2	3
5	3	2	1
5	6	0	1
6	5	1	1
6	2	4	1
7	4	3	1

Discussion:

- Male fin whale higher MAI is a consequence of their presence in larger groups. Higher MM MAI can be explained by the larger number of potential males associates in groups.
- Although singles, pairs and trios were most common, groups containing 4-18 whales represented 20% of sightings. The causes of group formation are unclear but prey type and school size have been correlated to group size in some areas.
- The sex ratio for the study population being close to parity, male-biased sex ratio in groups and the higher tendency of females to be alone indicates non-random group formation.
- Rapid changes in group composition are often linked to physical interactions seen at the surface which suggests that social and not only foraging-related factors are at play in shaping fin whale groups in the GSL.
- These physical /aggressive interactions (e.g. chasing, ramming, see picture) are typically observed among flanking animals (i.e. likely males). The short duration of MM associations is consistent with agonistic interactions.
- Typical positions of males (flanking) and females (leading) in groups are similar to observations of blue whale trios on the feeding grounds (see talk by Sears et al) and humpback whale groups on the breeding grounds which often display male competitive behavior.
- Small testis/body size ratio in fin whales suggests mate competition as mating strategy (See poster by Ramp et al.).
- The above evidences indicate that fin whales' patterns of associations could be influenced by males competing for proximity/access to females in the GSL. This is supported by the longer MF SLAR in comparison to MM SLAR.
- However, we cannot rule out the impact of competition for food or a favored group position on group structure. Focal sampling is needed to address this hypothesis.



Acknowledgements:

Thanks to all the volunteers that contributed to data collection and analysis. A special thank you to Catherine Berchok and Alain Carpentier for their dedicated work on finbacks. Data collected under DFO permits.

