

Appendix 3

SUMMARY OF AVAILABLE INFORMATION ON NORTH ATLANTIC RIGHT WHALE REPRODUCTION

Reproductive parameter	Result/Conclusion	Caveats	Source	Cf Southern Hemisphere
Calving interval	Regression of observed calving intervals against year shows significant increase from 1985 to 1998. Mean 3.67 yrs (1980-1992), over 5 yrs (1996-98).	Observed intervals only. Some of longer intervals undoubtedly represent unobserved calvings (12/20 or 60% of 6-7 yr intervals). But intervals between sightings of adult females similar in 1980s and 1990s.	Kraus et al (in press)	
	Mean calving interval (likelihood model) 3.28 ± 0.24 yrs in 1980s, 4.44 ± 0.43 yrs in 1990s. Distribution of calving intervals shifted from 3-year intervals in 1980s to 5+ intervals in 1990s, 4-year intervals unchanged.	Annual sighting probabilities estimated to have been close to 100% in recent years. Shift in calving interval distribution consistent with increased pre- or neonatal mortality in 1990s (2-yr intervals). Analysis does not include mature females that have calved only once or not at all, so actual intervals are likely to be even longer.	Cooke & Glinka (SC/O99/RW1) SC/O99/Report	3.26 ± 0.14 yrs in 1970s, 3.43 ± 0.14 yrs in 1980s (Cooke & Glinka)
%age of mature females that are reproductively active	70%	Potentially biased low due to missed calvings and some females reaching sexual maturity after 9 years of age.	SC/O99/Report	
Average annual calf production rate per mature female	12.94%	Refers to 1990s B may well have been higher in 1980s but not possible to estimate. Fluctuates substantially from year to year. Derivation unclear.	SC/O99/Report White et al (SC/O99/RW6)	More than double that in N Atlantic (SC/O99/Report)
Mean age at first calving	Mean age of first observed calvings = 9.53 ± 2.32 (SD) yrs	Assumes all first calvings observed.	Kraus et al (in press)	
	Likelihood model indicates 10.1 ± 0.5 years in 1990s	Too few known-age animals to test for temporal trend	Cooke & Glinka (SC/O99/RW1)	9.8 ± 0.6 yrs in 1980s (Cooke & Glinka)

Survival rate of calving females	0.94 in 1980, declining to 0.63 in 1995	Stage-structured model indicates that this is the primary component of the decline in population growth rate and survival	Fujiwara et al (SC/O99/RW7)	
	0.982 ± 0.017 in 1980s, declining to 0.955 ± 0.067 in 1990s		Cooke & Glinka (SC/O99/RW1)	0.984 ± 0.005 in 1970s and 1980s (Cooke & Glinka)
Survival rate of females from birth to first calf	Overall rate 0.85 ± 0.29 in 1990s	Implied rate required to account for estimated rate of population increase B may be too high because increase rate over-estimated?	Cooke & Glinka (SC/O99/RW1)	1.01 ± 0.17 in 1980s (Cooke & Glinka)
	No significant trend in annual survival rate of female calves or immature females from 1980 to 1995		Fujiwara et al (SC/O99/RW7)	
Annual population growth rate	+3% in 1980 shifting to B2% in 1995; overall rate 1.3% (95% CI 0.1, 2.5%) 4.4% ± 2.8% for 1980-97	Decline mainly due to vital rates of females with calves Likelihood model B estimate very imprecise and may not be significantly different from zero	Fujiwara et al (SC/O99/RW7) Cooke & Glinka (SC/O99/RW1)	7.1 ± 1.4 % for 1971-90 (Cooke & Glinka)

SUMMARY

- Annual calf production per female highly variable and, since 1990, about half that expected from comparison with Southern Hemisphere (*Eubalaena australis*) females: from 1998 to 2000, lower in absolute terms than in all but one of the preceding 17 years
- Calf production now largely from cows not taking their calves to the Bay of Fundy nursery ground
- Calving interval has increased significantly from 1980s to 1990s, now averaging 5 years
- This increased calving interval apparent in cows of all ages
- Shift in distribution of calving intervals consistent with increased pre- or neonatal mortality
- Survival rate of calving females shows significant decline over time
- Survival rate of immature females shows no significant decline
- Age at first parturition similar to that in Southern Hemisphere animals
- Population increase rate significantly lower than in Southern Hemisphere, and since 1990 may be negative