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The reproductive histories and inter-birth calving intervals of female bottlenose dolphins in northeast Scotland

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Introduction Where coastal bottlenose dolphins (*Tursiops truncatus*) range over large distances (Robinson *et al.*, 2012), establishing robust estimates for individual birth rates can be inherently difficult. Nevertheless, ascertaining reproductive histories is particularly significant for management. Between-female variation in reproductive output provides a strong measure of reproductive fitness, for example (Pomeroy *et al.*, 1999). Accordingly, the intervals between births may be one of the most important determinants for reproductive success in these animals.

In the Moray Firth in northeast Scotland, studies carried-out since the late 1980s have greatly increased our understanding of these coastal delphinids and assisted in their conservation management (Thompson *et al.*, 2011). Integrated datasets provide a current estimate of ~200 animals for this population (Cheney *et al.*, 2013), a large percentage of which evidently use the outer Moray Firth area (Culloch & Robinson, 2008; Cheney *et al.*, 2013). Indeed, the southern coastline of the outer Moray Firth (Figure 1) is thought to provide favourable calving/nursery areas for the population (Culloch & Robinson, 2008) and dedicated mark-recapture studies by the CRRU research team since 1997 have documented no less than 171 calves by 77 identifiable mothers in this region to date.

In the present study, the reproductive rate and inter-birth period (IBIs) for all adult females known to have produced at least 2 or more calves between 1997 and 2013 were examined from the long-term CRRU dataset.

Results

- Calves were produced between May and October, with a peak number of births during August.
- Calving rates were highly variable between years and between females, with annual calf births ranging from 4 to 16 births per year with an average of 8 calves per year for the study area.
- IBIs for females with surviving calves ranged from 2 to 8 years with an average of 3.72 ±1.29 for all calves (33 females with 107 assigned calves = 74 inter-birth intervals).
- Primiparous females produced their first young at a minimum age of 6 years and the IBI between first and second-born calves was significantly higher than between all subsequent IBIs.
- The rate of calf production decreased with increasing age of known females (Figure 2).
- An average calf mortality of 10.4% was determined, with first year calves accounting for 89% of all documented mortalities of animals between 0 and 3 years old.

Discussion As with other temperate bottlenose populations, calf births peaked during the mid-summer months, in association with increasing water temperatures and food supplies. Females attained sexual maturity early in life. Indeed, two primiparous females gave birth at 6 and 7, suggesting sexual maturity was reached as early as 5 and 6 years of age. IBIs for females with surviving calves were similar to other studies (see Fruet *et al.*, 2014). Females were found to invest more in reproduction early in life, changing their role from “breeding” to “nursing” individuals at older ages with ensuing reproductive senescence.

The high proportion of first-year mortalities observed in this population was attributed to maternal inexperience, late weaning and a high-incidence of congenital or inflicted deformities in calves (e.g. Haskins & Robinson, 2006; Robinson, 2014). However, the health, age and subsequent body condition of reproductive females (as also related to resource access, e.g. Mann *et al.*, 2000) were thought to be the primary cause of calf mortality and between-female variation in reproductive output and success. Reproductive success and calf survivorship therefore provide a tangible measure of the overall health of the population, demonstrating the importance of long-term monitoring studies for demographic and viability analyses.

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Fig. 1. Map showing the position of the Moray Firth in NE Scotland and the CRRU study area along the southern coastline of outer Moray Firth embayment, where the present mark-recapture dataset was collated.

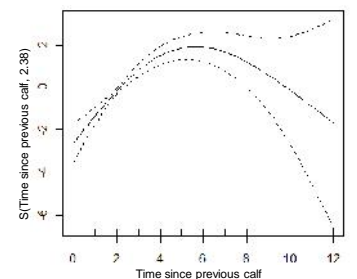


Fig. 2. General additive model showing the effect of increasing IBI on the probability of a calving event for female coastal bottlenose dolphins in the Moray Firth population.



Plate 1. Primiparous (first-time) female bottlenose with newborn calf in tow. Note the distinctive foetal folds on the young calf.