



Data analysis model selection for estimating local population size of the Risso's dolphin (*Grampus griseus*) in the Azores



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Introduction

Different models estimating cetacean population size require making assumptions about the marking and recapturing of individuals, and on the structure of the population^{1, 2, 3}. Crucial in selecting the most appropriate model is a critical assessment of these assumptions. In this study we applied the robust parameterization of the open Jolly-Seber (JS) model (POPAN)², using the software program MARK⁴. This model was applied to data collected on the Risso's dolphin (*Grampus griseus*). Between 2004 – 2007, photo-identification was used as a Capture-Mark-Recapture technique to identify 670 unique individuals off Pico Island, Azores⁵. For this model, it was assessed what assumptions are supported or violated. **The aim of this study was improving our understanding of how to select the most appropriate population size model.**

Methods

The robust parameterization of the open JS model was used to estimate the size of the super-population ("No class"). To account for demographic heterogeneity with regard to *survival & recapture probability*, individuals were classified by **age class** (see fig. 1) or by **residency class**⁸ (resident: sighted every year, partially resident: sighted in at least 2 or 3 years, or transient: sighted in only 1 year) prior to re-running the model.

Age class: classification in the overall dataset where the individuals are categorized based on their age.

Residency class: classification in the overall dataset whereby individuals are divided based on how often they were seen over the 4 years of study.

We tested six assumptions⁶ found under this model (see Results). MARK computes the estimates of model parameters via numerical maximum likelihood techniques.



Figure 1. The six Risso's age classes differentiated in this study

Results

Table 1. Support (✓) or violation (X) of model assumptions

	No class	+Age	+Res
Marks are not lost or overlooked	✓	✓	✓
Sampling is done instantaneously	✓	✓	✓
Survival probabilities are equal for all individuals	X*	(✓)**	(✓)**
Capture probabilities are equal for all individuals	X*	(✓)**	(✓)**
The fate of each individual is independent of the fate of any other animal	X	X	X
All individuals are assumed to be available for detection at any time	X	X	X

* Assumption tested using U-CARE⁷ ** Tested assumption is less often rejected using U-CARE⁷

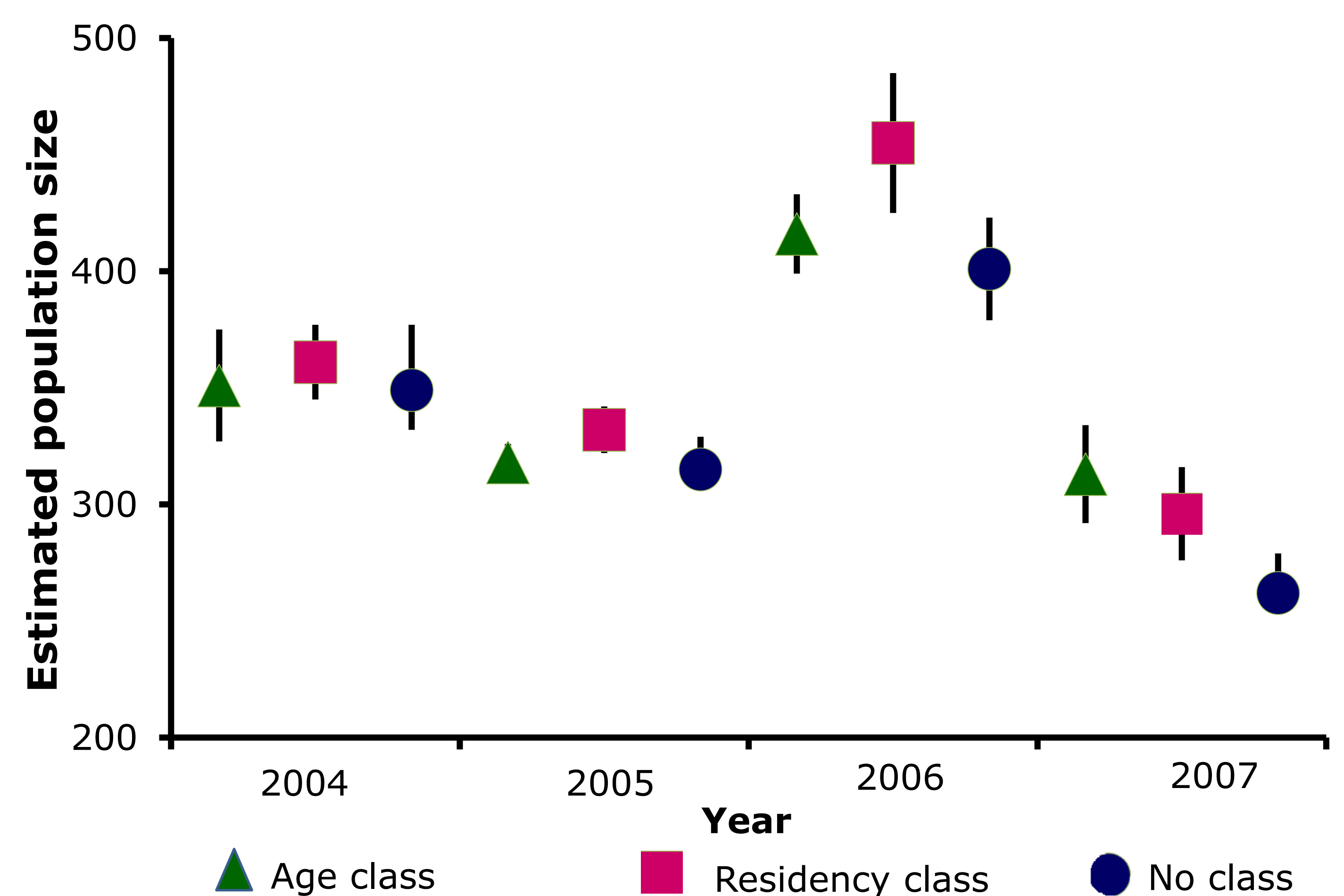


Figure 2. Population size estimates without (no class) or with (age class, residency class) demographic heterogeneity. Bars represent 95% CI.

Conclusions

- * Most model assumptions are violated
- * Incorporation of age or residency classes reduces the violations of the assumptions to some extent
- * Future studies should quantify the effect of violating model assumptions on population estimates.

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References

- (1) Otis, D.L., Burnham, K.P., White, G.C. & Anderson, D.R. (1978). Statistical inference from capture data on closed animal populations. *Wildlife monographs*, 3–135. (2) Schwarz, C.J. & Arnason, A.N. (1996). A general methodology for the analysis of capture-recapture experiments in open populations. *Biometrics*, 860–873. (3) Pollock, K.H. (1982). A capture-recapture design robust to unequal probability of capture. *The Journal of Wildlife management*, 752–757. (4) Cooch, E. & White, G. (2006). Program MARK: a gentle introduction. www.phidot.org/software/mark/docs/book/ (5) Hartman, K.L., Visser, F. & Hendriks, A.J.E. (2008). Social structure of Risso's dolphins (*Grampus griseus*) at the Azores: a stratified community based on highly associated social units. *Canadian Journal of Zoology*, 86, 222–233. (6) Kendall, W. (2004) Coping with unobservable and mis-classified states in capture-recapture studies. *Animal biodiversity and conservation*, 27, 97–107. (7) Choquet, R., Reboulet, A.M., Lebreton, J., Gimenez, O. & Pradel, R. (2005). U-CARE 2.2 user's manual. *CEFE, Montpellier, France*. (8) Hartman, K., et al., in review