

# Robust assessment of population trends in marine mammals applied to New Caledonian humpback whales

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**ABSTRACT:** Estimating population trends for long-lived, migratory animals is challenging but essential for managing populations. Here we propose using a simple but potentially robust method, the direct estimation of population growth rate (PGR) from capture–recapture data. We considered an Endangered population of humpback whales *Megaptera novaeangliae* breeding and calving annually in the southern lagoon of New Caledonia. Studied since 1996, this population is known to exhibit a strong signal of transience, i.e. the presence of individuals that pass through the sampling area once, inducing detection heterogeneity. Another difficulty is that a more recently discovered second breeding and calving habitat (offshore seamounts to the south) has been surveyed with less intensity. Current direct PGR estimation models cannot deal with spatial sampling heterogeneity. In order to assess the reliability of the proposed method—in general and for our population in particular—we evaluated its robustness using simulations: first, when there are transient individuals; then, when the study area is split into 2 unequally sampled parts. We found no bias in PGR in the presence of transients. The bias with 2 unequally sampled parts depends on the amount and direction of exchanges, but appears negligible in our case study. The constant yearly PGR of the New Caledonian humpback whale population at the level of the 2 habitats was estimated at 1.15 (95% CI 1.11–1.20), suggesting outside recruitment. Whenever capture–recapture is feasible, we recommend the Pradel approach to estimate the PGR, validated with appropriate simulations, in order to assess population welfare.

**KEY WORDS:** *Megaptera novaeangliae* · Capture–recapture · Transients · Multi-site · Population growth rate · Pradel Model · Population trend

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## INTRODUCTION

Estimating abundance and demographic parameters of marine mammals is essential for management and conservation decisions. In particular, estimating the population growth rate (PGR) allows us to assess whether a population is declining, thriving, or stable. Capture–recapture (CR), where individually recognizable animals are sampled repeatedly in a population, is a popular and useful method for studying the

population dynamics of several species of birds, reptiles, and mammals (Williams et al. 2002, Amstrup et al. 2006). With regard to cetaceans, the ability to recognize individuals from natural markings makes it possible to apply the CR technique based on photo-identifications (e.g. Hammond et al. 1990). CR is becoming widely used for estimating cetacean abundance (e.g. Cerchio et al. 2009, Carroll et al. 2011, Constantine et al. 2012), but it has seldom been used for estimating PGR.

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