*Reply to "Comment on population trends of southern rockhopper penguins (*Eudyptes chrysocome chrysocome*) on Isla Pingüino, Santa Cruz, Argentina" by Nina Dehnhard*

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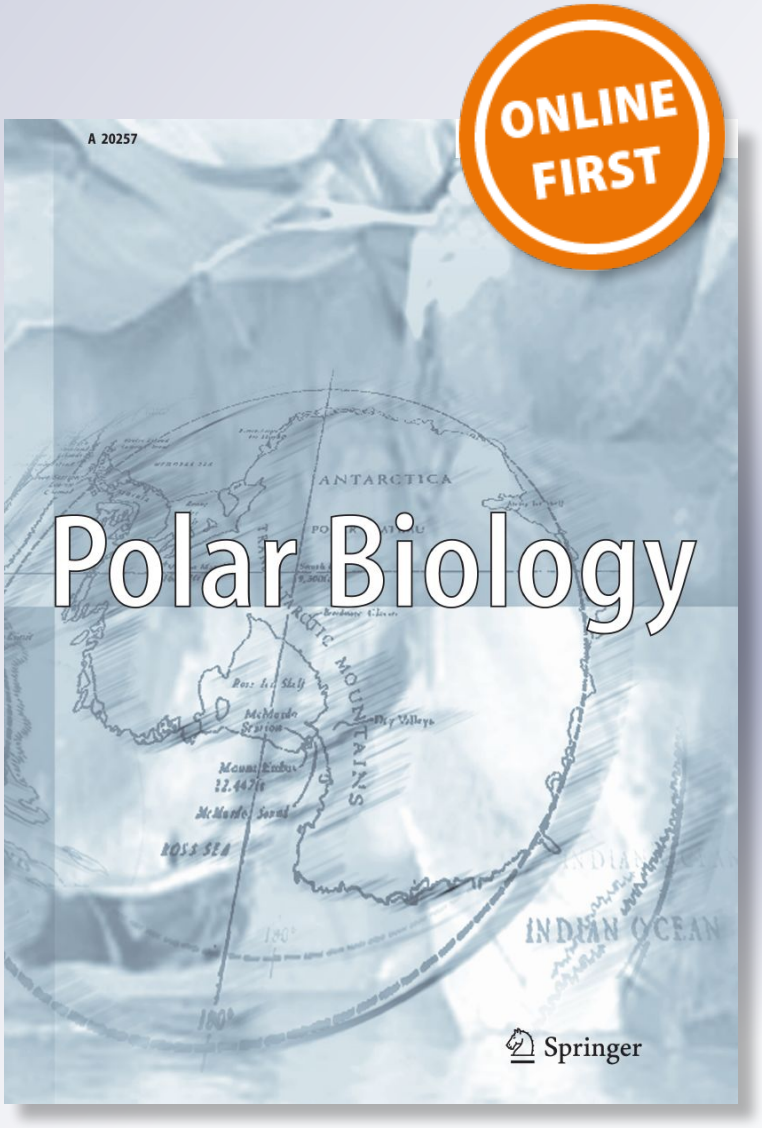

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REPLY

Reply to "Comment on population trends of southern rockhopper penguins (*Eudyptes chrysocome chrysocome*) on Isla Pingüino, Santa Cruz, Argentina" by Nina Dehnhard

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Recently N. Dehnhard has commented on our paper published in Polar Biology (Gandini et al. 2016). She noted out several points of criticism on the interpretation and conclusion of our results, particularly our hypothesis presented in the discussion stating that the population increase observed at Isla Pingüino colony (IP) could not be obtained by intrinsic growth but was likely driven by immigration—probably from the Falkland Islands/Islas Malvinas (hereafter FI-M). The objective of this reply is to respond to the most important criticisms, but not first thanking for her willingness to improve our work. The main objective of our study (Gandini et al. 2016) was to determine whether the population at IP has continued to grow since its discovery assessing its population trend over a 30-year period. We also estimated the breeding success of this species at this site. The notion of a potential immigration from FI-M to IP was a hypothesis, and as we clearly affirmed, "further studies, including genetic comparisons, are needed to confirm the immigration hypothesis". To respond to the main points discussed by Dehnhard, we will follow the same order as her comments.

1. Reproductive success: we agree with what Dehnhard mentions here: a high breeding failure during incubation would be a large bias in the breeding success estimation. However, our observations show that the complete loss of the clutch during early–medium incubation is not frequent at IP (personal observations), and it is more important during the end of incubation (hatching) and the early brooding period. So, we are confident in our breeding success estimates and in the validity in comparing our results with those of others (Clausen and Pütz 2003; Raya Rey et al. 2007; Poisbleau et al. 2008). Furthermore, assuming that our results of breeding success are overestimated and those of breeding population underestimated, as Dehnhard asserts, our hypothesis of partly extrinsic growth would gain even greater strength.
2. Existing literature on population dynamics: we considered all of the most important literature on population trends, and our paper clearly pointed out that some colonies (like FI-M) had periods of both decreasing and increasing population during the last decades (Bingham 1998; Pütz et al. 2003; BirdLife International 2010; Baylis et al. 2013). Furthermore, even if we consider that the IP colony has not reached its carrying capacity, we do not agree with Dehnhard's assertion regarding the lack of possible density dependence effects on IP. Density dependence factors can act during both breeding and non-breeding seasons, so how can Dehnhard maintain that IP population is not under density-dependence factors during winter? Does Dehnhard suggest with this statement that the IP colony could have had extraordinary survival of juveniles (>80%) for 30 years (see below)? On the other hand inter-specific competition with the numerous Magellanic penguins (*Spheniscus magellanicus*) could also drive density-dependent effects, as both species feed on same main prey (*Loligo gahi* and *Sprattus fuegensis*)

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around IP (Frere et al. 1996; Frere et al. unpubl. data). Exponential population growth can reflect the absence of density dependence in a closed population, however a population with immigration could grow exponentially with immigration even under the effects of density dependence.

The point that Dehnhard is trying to illustrate with the different trends in FI-M colonies, remains unclear. Moreover, considering that some colonies grow while others decrease, would it not be possible to justify some of these differences by movement between colonies within FI-M? Intercolonial movement is certainly a hypothesis, both between colonies from FI-M, and between FI-M and IP. Without a doubt additional studies are necessary but we think that our hypothesis remains valid.

3. Intrinsic versus extrinsic drivers of the population increase on IP: Gandini et al. (2016) do not conclude, but suggest/hypothesize, the possibility that the exponential population increase on IP is not driven by intrinsic factors alone, and more likely by immigration (most likely originating from the FI-M). Dehnhard et al. (2014) estimated a post-fledging annual survival probability in immature southern rockhopper penguin could be as high as 81% in their first year of life, and 98% thereafter. This study was conducted in one specific colony (New Island, FI-M) over a 3-year period, where 114 marked fledglings were recovered. The authors clarify, that the entire study period was characterized by generally low SSTs around the breeding and wintering grounds, and recognize the extremely high survival rates obtained in comparison with other penguin species and also with the other rockhopper penguins (northern rockhopper penguin), which have shown 39% immature survival during the first year (Guinard et al. 1998). Thus, these rates can be considered as maximum and they were obtained during an exceptionally favorable period. Dehnhard assumes these notably high rates were valid for IP over 30 years; she concludes (using a simple mathematical model) that the intrinsic growth of IP could explain the observed population increase in this colony. We consider these assumptions to be incorrect (high values without considering variability in survival rates over three decades), and we still think that the intrinsic growth could hardly explain the observed population increase at IP. We do not question the high philopatry of the species, but a small proportion of recruits that do not return to FI-M (see Dehnhard et al. 2014), could represent a high proportion of new breeders for IP. Magellanic penguins, with high philopatry, under special circumstances and sites have shown high rates of movement between colonies (Pozzi et al. 2015).
4. Clarification about the potential negative effects in the FI-M compared to IP: Gandini et al. (2016) analyzed the main threats for IP discussed by BirdLife International (2010), and also discussed and compared these threats with those from the nearby population of FI-M (the trend of which is different). Concerning tourism, we merely pointed out the differences in the number of tourists between places and supported our numbers with our own data for IP and the available literature for the FI-M (Pütz et al. 2013). We did not conclude that tourism could be the determinant of the differences in population trends between localities; we only presented evidences that tourism at IP seems to have no negative effect on the colony.

   Concerning introduced predators, Quillfeldt et al. (2008) mentioned rats and cats in FI-M; we presented them only as a potential threat for seabirds. At IP, neither cats nor rats have been present during the last 30 years.

   Although we agree with Dehnhard that oil pollution was a problem for penguins on the Patagonian coast, this threat has almost disappeared over the last 15 years due to changes in oil tanker routes in the waters of Argentine Patagonia (see Boersma 2008).

   Therefore, differences in potential threats (fisheries, oil pollution, local oceanographic conditions, massive mortality events, and other factors) might be affecting each population in different ways. However, we cannot conclude which are the main factors driving the observed differences in population trends (a combination of several factors were likely responsible); and as it was mentioned in Gandini et al. (2016), more study is needed to test our hypothesis on the importance of immigration on the increase in IP's population.

References

Baylis AMM, Wolfaardt AC, Crofts S, Pistorius PA, Ratcliffe N (2013) Increasing trend in the number of Southern Rockhopper Penguins (*Eudyptes c. chrysocome*) breeding at the Falkland Islands. Polar Biol 36:1007–1018

Bingham M (1998) The distribution, abundance and population trends of Gentoo, Rockhopper and King Penguins at the Falkland Islands. Oryx 32:223–232

BirdLife International (2010) Rockhopper Penguins: a plan for research and conservation action to investigate and address population changes. In: Proceedings of an international workshop Edinburgh 3–5 June 2008. Birdlife International, Cambridge

Boersma PD (2008) Penguins as marine sentinels. Bioscience 58:597–607

Clausen AP, Pütz K (2003) Status and numerical trends of king, gentoo and rockhopper penguins breeding in the Falkland Islands. Waterbirds 26:389–402

Dehnhard N, Poisbleau M, Demongin L, Ludynia K, Quillfeldt P (2014) High juvenile annual survival probabilities in Southern

Rockhopper Penguins Eudyptes crysocome are independent of individual fledging traits. Ibis 156:548–560

Frere E, Gandini P, Lichtschain V (1996) Variación latitudinal en la dieta del Pingüino de Magallanes (Spheniscus magellanicus) en la costa Patagonica, Argentina. Ornitol Neotrop 7:35–41

Gandini P, Millones A, Morgenthaler A, Frere E (2016) Population trends of the southern rockhopper penguins *Eudyptes chrysocome* at the northern limit of its breeding range: Isla Pingüino, Santa Cruz, Argentina. Polar Biol. doi:10.1007/s00300-016-2026-7

Guinard E, Weimerskirch H and Jouventin P (1998) Population changes and demography of the Northern Rockhopper Penguin on Amsterdam and Saint Paul Islands. Waterbirds 21:222–228

Poisbleau M, Demongin L, Strange IJ, Otley H, Quillfeldt P (2008) Aspects of the breeding biology of the southern Rockhopper Penguin *Eudyptes c. chrysocome* and new consideration on the intrinsic capacity of the A-egg. Polar Biol 31:925–932

Pozzi LM, Borboroglu PG, Boersma PD, Pascual MA (2015) Population regulation in Magellanic penguins: what determines changes in colony size? PLoS One 10(3):e0119002. doi:10.1371/journal.pone.0119002

Pütz K, Clausen AP, Huin N, Croxall JP (2003) Re-evaluation of historical Rockhopper Penguin population data in the Falkland Islands. Waterbirds 26:169–175

Pütz K, Raya Rey A, Otley H (2013) Southern Rockhopper Penguin (*Eudyptes chrysocome*). In: Garcia Borboraglu P, Boersma D (eds) Penguins: natural history and conservation. University of Washington Press, Seattle, pp 113–129

Quillfeldt P, Schenk I, McGill RAR, Strange IJ, Masello JF, Gladbach A, Roesch V, Furness RW (2008) Introduced mammals coexist with seabirds at New Island, Falkland Islands: abundance, habitat preferences and stable isotope analysis of diet. Polar Biol 31:333–349

Raya Rey A, Trathan P, Schiavini A (2007) Inter-annual variation in provisioning behaviour of Rockhopper Penguins *Eudyptes chrysocome chrysocome* at Staten Island. Ibis 149:826–835