

Interactive comment on “Differential responses of seabirds to inter-annual environmental change in the continental shelf and oceanic habitats of southeastern Bering Sea” by T. Yamamoto et al.

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We appreciate the critical comment and helpful suggestions on the manuscript by the referee #1. We have addressed all the comments made by the referee, and indicated how we will deal with those. We hope that our explanation and revise plan are acceptable and satisfactory.

The comments by the referee highlighted with “Q” with the number, and our answers to comments highlighted with “A”.

[Q1] It would seem that in the poor, cold year, that RLKs maintained their own condi-

C8694

tion and did not increase foraging effort, passing on the cost of poorer environmental conditions to their offspring. In contrast, TBMUs reduced their own condition and increased foraging effort, so that the adults experienced the cost of the poor conditions and did not pass those costs onto the chicks. Perhaps RLKs are already at the limit and have no more scope to increase foraging effort?

[A] It might be true. In the Pribilof islands, black-legged kittiwakes have switched their reliance upon Pollock during the 1970s and 1980s to myctophids by the 1990s (Sinclair et al., 2008). Myctophid is an important prey to red-legged kittiwake, and there may have been an increase in competition between red-legged and black-legged kittiwakes for what was primarily a red-legged kittiwake prey item. Accordingly, red-legged kittiwakes were the species most threatened by population declines in the 1980s. We will add more explanation about a possible limitation on foraging effort for red-legged kittiwakes, that might be resulted in similarly high stress levels in both years with different environmental conditions, in the Discussion (P17705_L4–12).

[Q2] The main drawback of the study is (1) the short duration and (2) the small sample sizes meaning low statistical power. With only two years' data, it is hard to make robust conclusions, and many of the purported explanations come across as 'just so' stories.

[A] Although longitudinal colony-based monitoring on top-predators, including seabirds, has been conducted in this region (e.g. Byrd et al., 2008a; Sinclair et al., 2008; Renner et al., 2012), the mechanistic response of seabirds to climate variability has been elusive due to the limited information available for the comparative behavior of seabirds at sea in different environmental conditions (P17695_L18–P17696_L15). Our study examined their foraging behavior for a short period of time, but it was conducted in the middle of breeding (i.e. chick-rearing period). Hence, we believe that our study may be limited in sample size, but is still worthwhile and provides an insight into how they respond to oceanographic conditions, which is necessary to predict the effect of future warming in the Bering Sea on them and/or ecosystems.

C8695

[Q3] p17697 There is abundant information that devices can impact seabird behaviour, even if they are less than 5% of body mass. I am surprised the authors do not at least acknowledge this issue.

[A] We are sorry that we did not mention this issue. As the reviewer commented, some studies have reported that attachments of small and light-weight tags do not appear to affect foraging and/or reproductive behavior of individuals (e.g. Phillips et al., 2003; Carey, 2011), while others reported an adverse effect on tagged individuals not only for behavior, but also for their physiological condition (e.g. Barron et al., 2010; Elliott et al., 2012). In this study, we attached GPSs on kittiwakes and murres for a short period of time (2–6 days), but the recovery rate of GPS was about 71–82% (P17697_L20–22). This was because the equipped individuals were resighted, but we could not recapture them (as they nest at the cliff). So, we believe that the attachment of tags did not result in breeding abandonment. We will add this explanation in P19697_L22 after "...recovery rate".

Barron, D. G., Brawn, J. D., and Weatherhead, P. J.: Meta-analysis of transmitter effects on avian behaviour and ecology, *Meth. Ecol. Evol.*, 1, 180–187, 2010.

Carey, M. J.: Leg-mounted data-loggers do not affect the reproductive performance of short-tailed shearwaters (*Puffinus tenuirostris*), *Wildl. Res.*, 38, 740–746, 2011.

Elliott, K. H., McFarlane-Tranquilla, L., Burke, C. M., Hedd, A., Montevecchi, W. A., and Anderson, W. G.: Year-long deployments of small geolocators increase corticosterone levels in murres, *Mar. Ecol. Prog. Ser.*, 466, 1–7, 2012.

Phillips, R. A., Xavier, J. C., and Croxall, J. P.: Effects of satellite transmitters on albatrosses and petrels, *Auk*, 120, 1082–1090, 2003.

[Q4] p17698 Ground speed during flight will be strongly impacted by wind speed. Given that you have GPS data and the availability of wind speed (e.g. from MoveBank or elsewhere), why not calculate airspeed, which would reduce the error associated with

C8696

separating flight from non flight? i.e. some movement >3 m/s will be surface movement and some movement <3 m/s will be flight.

[A] As the reviewer pointed out, ground speed of birds is supposed to be influenced by wind direction and speed (e.g. Garthe et al., 2007, *Deep-Sea Res II*). However, this issue is not so simple. For example, ocean current is also influences moving speed when a tagged individual is sitting on the water (strong current may push a bird fast) (e.g. Yoda et al., 2014, *Prog Oceanogr*), possibly resulting in its movements being classified as flight. In addition, we recorded fixes per min, so between fixes, within those minute intervals, we had no information on which direction or how they moved (i.e. straight flight or winding flight between fixes which should relate to the wind they experienced in flight). So, although what the reviewer mentioned is definitely important and interesting issue to consider, we can only classify flight or on-water locations by the ground speed. In a future study, we would like to try this issue using high-resolution GPS data (probably 1 second recording interval) and fine-scale wind data.

Garthe, S., Montevecchi, W. A., and Davoren, G. K.: Flight destinations and foraging behavior of northern gannets (*Sula bassana*) preying on a small forage fish in a low-Arctic ecosystem, *Deep-Sea Res. II*, 54, 311–320, 2007.

Yoda, K., Shiomi, K., and Sato, K.: Foraging spots of streaked shearwaters in relation to ocean surface currents as identified using their drift movements, *Prog. Oceanogr.*, 122, 54–64, 2014.

[Q5] p17703L27. Why are there no confidence intervals on fledging success? Are the values significantly different from one another? This difference in reproductive success should be mentioned in the Introduction to set up robust predictions.

[A] We are sorry, but there is no information available on a confidence interval for the fledging success of both species. Instead, we will add information on the standard deviation in the fledging success in P17703_L26–27, as 8 plots were combined for red-legged kittiwakes (SD = 0.07 in 2013 and 0.02 in 2014) and 10 plots in 2013 and

C8697

12 plots in 2014 are combined for thick-billed murre (see Table 22, 23, 63 and 65 in Mudge et al. 2015). In addition, we are planning to include the mean growth rate (g/day) of red-legged kittiwakes, which was better in warmer 2014 (mean \pm SD: 14.9 \pm 3.7g) compared to cooler 2013 (11.7 \pm 3.6g) (Table 66 in Mudge et al. 2015) in P17705_L11. It may support our prediction that in a cold year the inter-specific competition with sympatric black-legged kittiwakes is supposed to be high, and resulted in relatively lower fledgling success in 2013 (0.57) compared to 2014 (0.92) (P17705_L8–12). We mentioned the fluctuation in reproductive success in the Introduction to explain and make clear what has been known and is needed to understand the mechanism for it (P17695_L22–P17696_L15).

[Q6] It would be worthwhile noting that the opposite trends (cold vs warm) are observed in seabirds farther north (Divoky, G. J., Lukacs, P. M., & Druckenmiller, M. L. 2015. Effects of recent decreases in arctic sea ice on an ice-associated marine bird. *Progress in Oceanography*).

[A] We appreciate for the information. I have read it, and will mention that in the text (P17707_L1), as saying, for example, “species’ response to ocean warming appears to differ depending on habitats as well as the prey they rely on, as the decrease in sea ice extent negatively affects foraging behavior in some species (e.g. Divoky et al. 2015), while in other part of region it possibly positively affects behavior of provisioning individuals (this study)”.

Divoky, G. J., Lukacs, P. M., and Druckenmiller, M. L.: Effects of recent decreases in arctic sea ice on an ice-associated marine bird, *Prog. Oceanogr.*, 136, 151–161, 2015.

[Q7 Fig. 5. Suggest deleting this figure as I don't see what it adds. OK, the $\delta^{13}C$ is different, but so what? Nothing is made of these data.

[A] I will delete Fig. 5 as the reviewer suggested, but I would like to include the result of $\delta^{15}N$ in the text at least to examine the difference in prey between the years in addition to the result from diet observations. So, I will delete the result and discussion parts for

C8698

$\delta^{13}C$ (P17702_L10–13, P17703_L17–24).

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C8699