To be clear, we are not advocating the view that glaucous gull numbers or nests have increased or remained stable during the period studied, nor are we suggesting that oilfield development has affected important population parameters of glaucous gulls. Rather, our primary goal of this letter was to suggest that the data used by Noel et al. to assess potential effects of oilfield development on glaucous gull distribution and abundance appear to lack sufficient replication (within and among years and across areas) and resolution (both spatial and temporal), and at best, the statistical procedures employed led to largely spurious results with limited inference to the target population.

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Sincerely,

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Dear Editor:

Lanctot and Gleason offer critical comments on our paper about glaucous gull (*Larus hyperboreus*) distribution and abundance along the central Beaufort Sea coast of Alaska. We thank Lanctot and Gleason for considering our paper, and we respond to their various points by clarifying the data and rationale for analyses presented in our paper.

Point 1. The stated objective of our paper was to “review existing data for trends in glaucous gull numbers on Alaska’s Arctic Coastal Plain (ACP)” and to “analyze two historical datasets from the Prudhoe Bay region to evaluate the influence of this industrial development on glaucous gulls” (p. 66). Contrary to the assertion by Lanctot and Gleason, we did not evaluate relationships between gull numbers and the availability of anthropogenic food. Nor did we conclude, either directly or indirectly, “that the Prudhoe Bay oilfields have not led to changes in glaucous gull numbers on the ACP.”

Characterization of our analyses as “data dredging” is incorrect. The categorical structure of the analytical design was dictated by the design of the surveys used to collect the data. The exploratory analysis was restricted to covariates that could be used to explain the extent of sighting and identification of birds in coastal aerial monitoring surveys (Johnson, 1990; Johnson and Gazey, 1992; Johnson et al., 2005). For example, wave height and the associated “whitecaps” directly influence glaucous gull detectability and observer efficiency. Such exploratory analysis of covariates does not violate statistical protocol; many texts (e.g., Milliken and Johnson, 2002) recommend this procedure.

Data concerning glaucous gull numbers in coastal and inland habitats of the ACP were used to establish a context for the presentation of data collected in the Prudhoe Bay region. Similarly, glaucous gull nest data from the Yukon-Kuskokwim Delta were used to make comparisons with Beaufort Sea data.

We objectively evaluated all historical data sets before incorporating them in our analyses.

Point 2. We acknowledged in our paper that the glaucous gull nest data collected over several decades were imperfect for drawing firm conclusions about trends in the numbers of glaucous gull nests in the Beaufort Sea region. Most of the nest survey data were collected during single annual trips in June or July by one or more people walking and searching islands for bird nests. We provided references for all survey data in Table 6 (p. 75). These nest data, and the aerial survey data, were the only long-term data that were available for analysis. To help compensate for variations in intensity and timing of nest sampling in different years, we used averages over three time periods during annual nesting seasons, not numbers of nests per year.

Point 3. Lanctot and Gleason misinterpreted our human activity and disturbance data and indices. Disturbance data included not only observations of people and equipment (vessels, aircraft, ATVs, nets, duck-traps, etc.) along aerial survey transects, but also, as described in our Table 1 (p. 69), semi-permanent and permanent structures and associated varying levels of human activity. Any other measures of "disturbance" would have required "data dredging" and inevitably would have failed to document all important disturbance events.

Cumulative impacts of disturbance in the two study areas were tested through the Area*Year interaction term in our ANCOVA (notwithstanding the high level of disturbance from research activities in our Reference area—see Final Point, below). Levels of human activity were summed to be consistent with the resolution of the density of gulls. The summation over transects was a means to minimize the frequency of zero observations. Lanctot and Gleason inappropriately interpret the empirical results of our statistical tests as our conclusion(s).

Point 4. Barrier island transect segments 190 to 214 located in the Prudhoe Bay region (Dau and Anderson, 2001, 2002) represented an additional level of aerial survey effort. The addition of these survey results to those from transect segments 19 and 20 for the Prudhoe Bay region would in effect double the sampling effort for this region compared to survey coverage along the remainder of the coastline. Because our intent was to describe the relative distribution and abundance of glaucous gulls based on similar sampling effort across the entire region, we felt it was inappropriate to include multiple transects and increased levels of sampling for one region (i.e., the Prudhoe Bay region) when only a single transect was surveyed in other regions. We clearly noted (p. 66), on the basis of data from Dau and Anderson (2001, 2002), that there were apparent aggregations of glaucous gulls at coastal villages and at Prudhoe Bay.

Point 5. No long-term, comprehensive surveys have been conducted that were designed specifically to address the issue of potential impacts of oilfield development on glaucous gull distribution and abundance, either on the Arctic Coastal Plain or within the Prudhoe Bay development area. Lanctot and Gleason argue that the coastal lagoon aerial survey data that we used are "insufficient and inappropriate" to examine this issue because of the small numbers of gulls within this survey area in proportion to the numbers across the entire ACP and the ACP coastline. We did not attempt to define the boundaries or sample the "true" or entire population of glaucous gulls, as claimed by Lanctot and Gleason. We felt that our long-term data from coastal surveys formed a reasonable sample of the local population that was appropriate for our analyses.

Our objective in summarizing and presenting the ACP data collected by the U.S. Fish and Wildlife Service was to set the context for our discussion of the distribution and abundance of glaucous gulls along the Beaufort Sea coast.

Point 6. Our discussion statement that glaucous gulls breeding along the central Beaufort Sea coast were not typical of a growing gull population (p. 74) was based on observations by numerous researchers that a high proportion of active nests relative to total nest structures and a mean clutch size approaching three eggs indicate good nutrition for Larid gulls and are typical of growing gull populations. We did not state that nest activity and clutch size data given in our paper show that glaucous gulls along the Beaufort Sea coast were doing poorly. We simply stated that our data were not typical of a growing gull population.

Point 7. We found it noteworthy that numbers of active nests of three species of island-nesting water birds showed similar trends during our study period. Some environmental factors, e.g., mammalian and avian predation, are known to be linked to the numbers of active water-bird nests along the central Beaufort Sea coast (Johnson and Noel, 2005). We felt that this issue had sufficient scientific relevance to warrant presentation and some discussion in our paper.

Final Point. We did not refer to our reference area as a "control" because we were well aware that it was not a control. Our Figure 5 (p. 74) showed that surveys with some disturbance were more common after about 1990. While it might have been helpful for us to describe again in this paper the confounding levels of industry/research activities in our reference area, we felt that this issue had been well described elsewhere (Fischer et al., 2002; Fischer and Larned, 2004; Johnson et al., 2005).

The statement by Lanctot and Gleason that "survey data … often did not include complete surveys in both the Reference and Industrial areas at the same time (lacks temporal overlap)" is not true. Particular attention and care were given to the selection of transects to provide a balanced design for the structured ANCOVA. An aerial survey was included in this analysis only if sampling had occurred at all spatial locations, i.e., along all transects. Similarly, in the designs of the longer-term regression and ANCOVA analyses, only aerial surveys with data for all 10 transects in the Industrial area were included.

Alternative Design Issue. We are unsure how one would construct a global model that would include both aerial survey and nest data. If one were to use only aerial survey data, an unbalanced global model would be feasible and could be analyzed using statistical software (e.g., Singer, 1998) of the type suggested by Lanctot and Gleason. If the sampling design of such an analysis is balanced to include only complete surveys of all transects (as in our study), then the unbalanced global model structure suggested by Lanctot and Gleason simplifies to the model presented in our paper.

A remaining issue is whether statistical inferences should be conducted using a frequentist, alpha-based approach (Type III sum of squares), as in our paper, or a likelihood information approach (AIC), as suggested by Lanctot and Gleason. This issue is beyond the scope of our paper. Again, we thank Lanctot and Gleason for their comments and for this opportunity to clarify the rationale behind the presentation and analyses of these long-term data for glaucous gulls.

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