Validity of Parameter Estimates

One hypothesis to explain variation in the proportion of individuals observed breeding as a function of winter location is that individuals from different breeding colonies used different wintering locations. If some females from TR dispersed to other colonies, where we could not observe them, and if particular breeding colonies were disproportionately associated with specific winter locations, we would have expected patterns similar to those we actually observed. That is, females wintering in some locations would have been observed as breeders with lower probability because some of them were breeding at locations other than TR. This hypothesis cannot explain the patterns we observed, however, because we restricted the analysis to females that had bred at least once at TR. Females are nearly perfectly faithful to a breeding colony once they have bred there (Sedinger et al. 2008). Consequently, individuals that we did not observe breeding in a given year (after accounting for encounter probability) were nonbreeders that year.

As expected, transitions to particular wintering areas differed between the analysis containing both winter and breeding encounters (WBW models) and the analysis containing only winter encounters (WW models; cf. figs. 3 and 4). For example, the probability of transition to BSQ averaged 0.12 in figure 3, from the analysis including transition from wintering areas to breeding or nonbreeding and transition from breeding back to wintering areas. These estimates reflect the probability that an individual alive and in the breeding (or nonbreeding) population during summer migrated to one of the wintering areas we studied, statistically independent of where these individuals had wintered the year before. Consequently, estimates in figure 3 were influenced by the distribution during the previous winter through the contribution of these areas to the breeding population (fig. 4; Lindberg et al. 2007), combined with individual decisions about where to winter. For example, the largest number of brant wintered in LOL; thus, this area contributed the largest number of individuals to the breeding plus nonbreeding populations. As a result, we would expect the largest proportion of the breeding and nonbreeding populations to migrate to LOL in fall unless a substantial number of individuals changed wintering locations. Transitions to specific wintering locations in WBW models were also influenced by the effect of wintering locations or breeding probability (fig. 2) and the effect of breeding on migration to wintering location (fig. 4). In contrast, estimates presented in figure 4, based on the analysis including only winter encounters, were conditioned only on winter location. Thus, these estimates represented the probabilities that individuals wintering in a particular wintering area, for example, BSQ in year $i$, wintered in BSQ or one of the other areas we studied in year $i + 1$. 