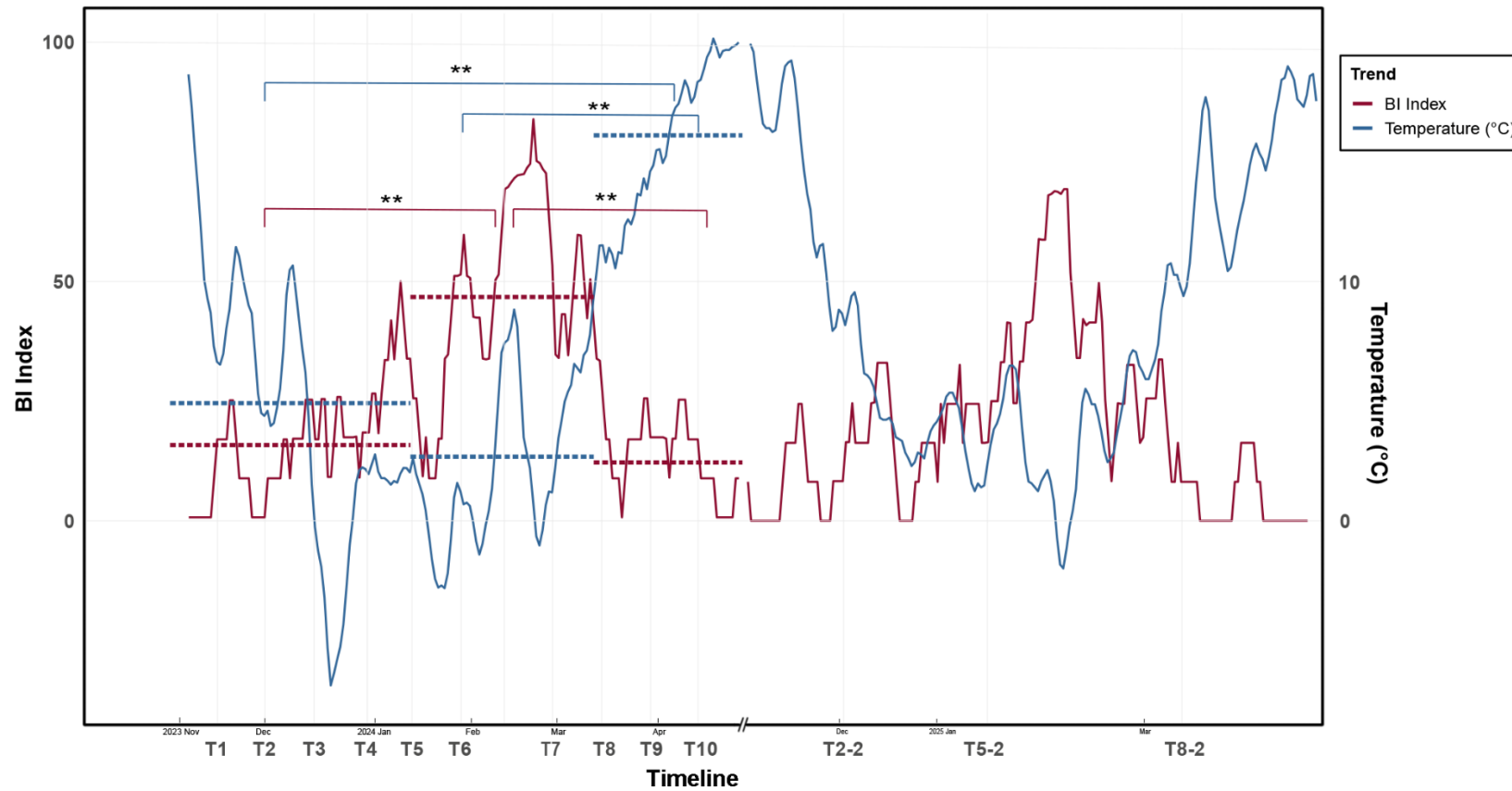
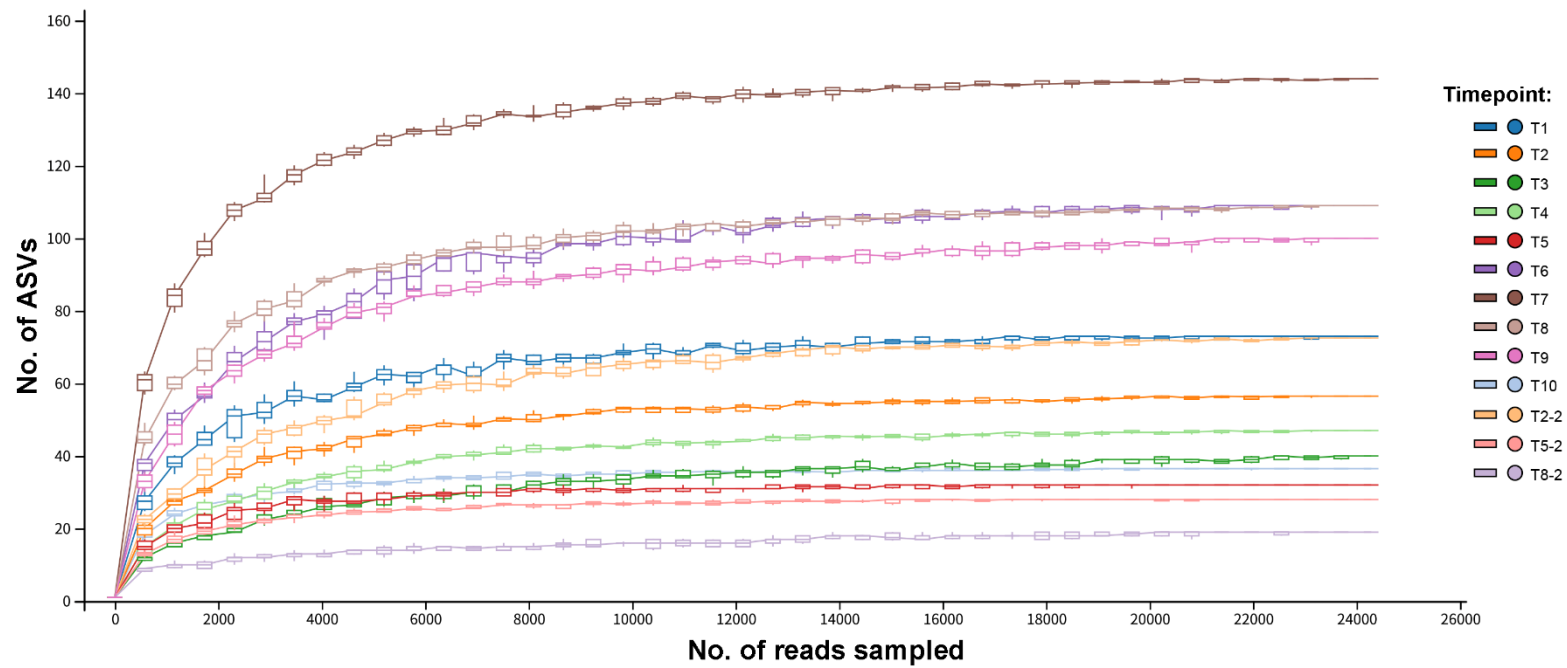




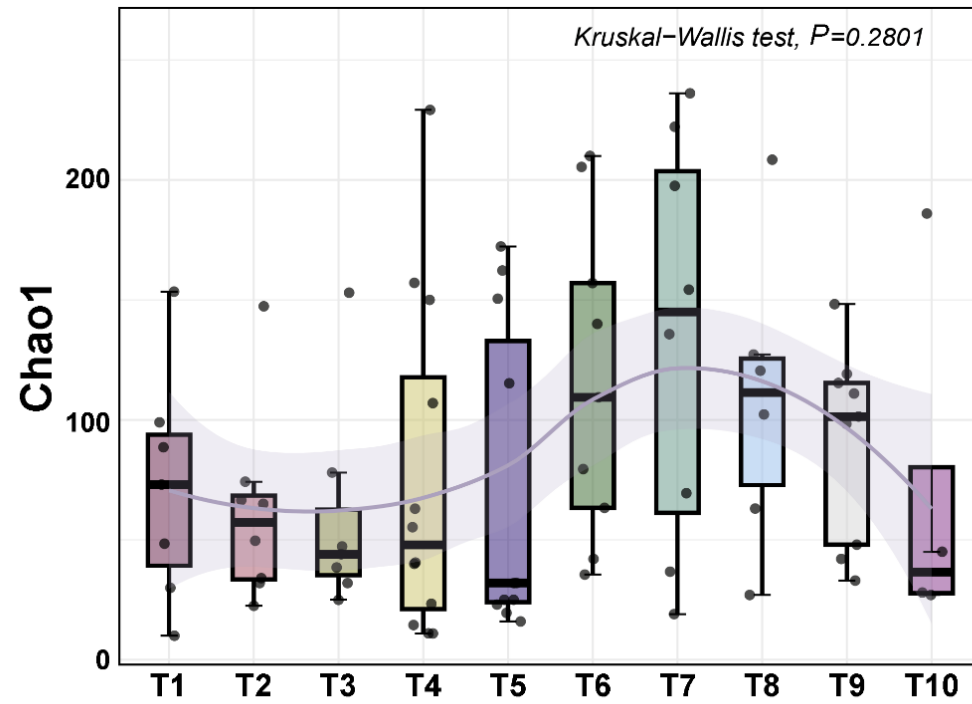
**Figure S1. Dynamics of tourist intensity and ambient temperature during the overwintering period.** Tourist intensity was quantified using 7-day moving averages of daily Baidu Index search volumes for the Chinese phrase "feeding seagulls" in Qingdao. Dashed horizontal lines indicate stage-specific mean values for each overwintering stage. Statistical significance was tested by Wilcoxon rank-sum test. \*,  $P < 0.05$ .



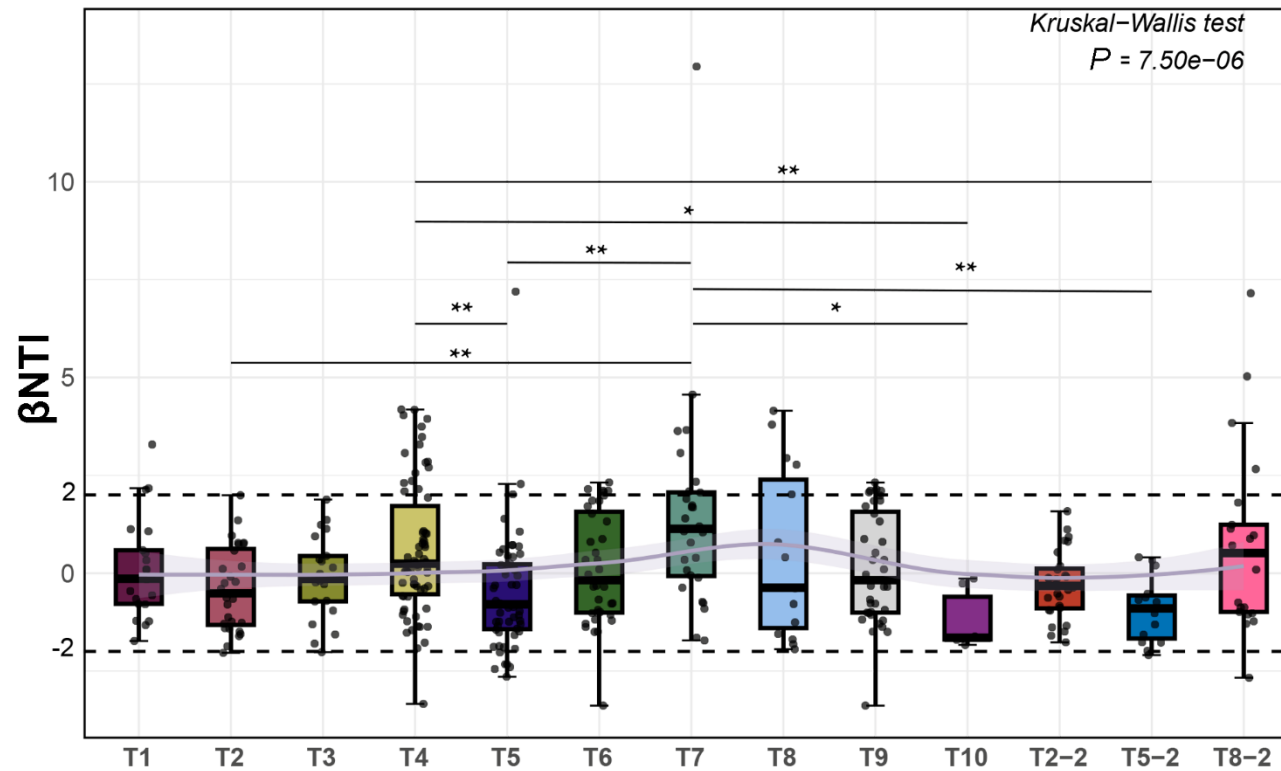
**Figure S2. Rarefaction curves.** The horizontal axis is the number of randomly selected sequences, and the vertical axis is the number of ASVs obtained based on the number of sequencing entries.



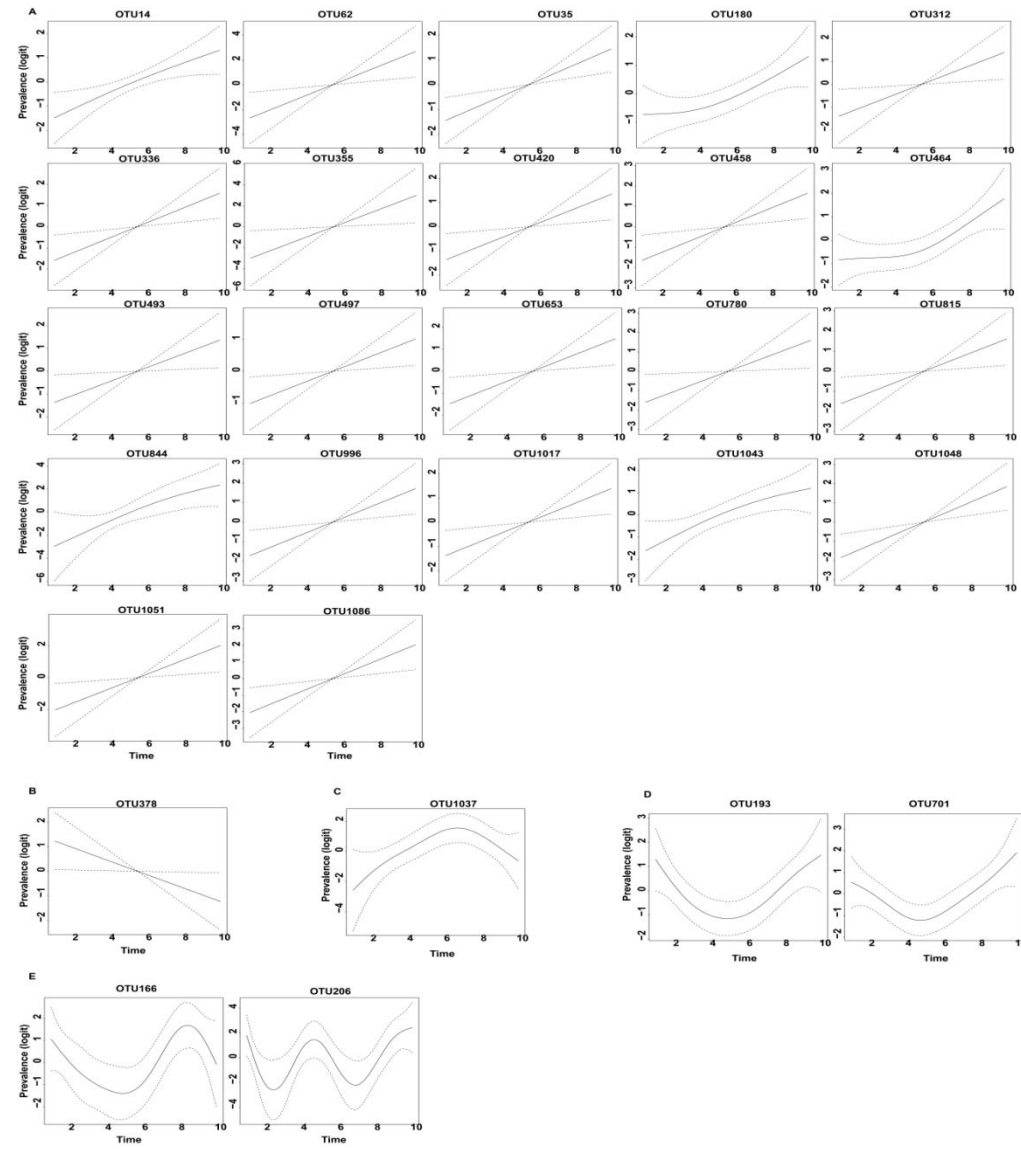
**Figure S3. Relative abundance of the ten most abundant phylum.**



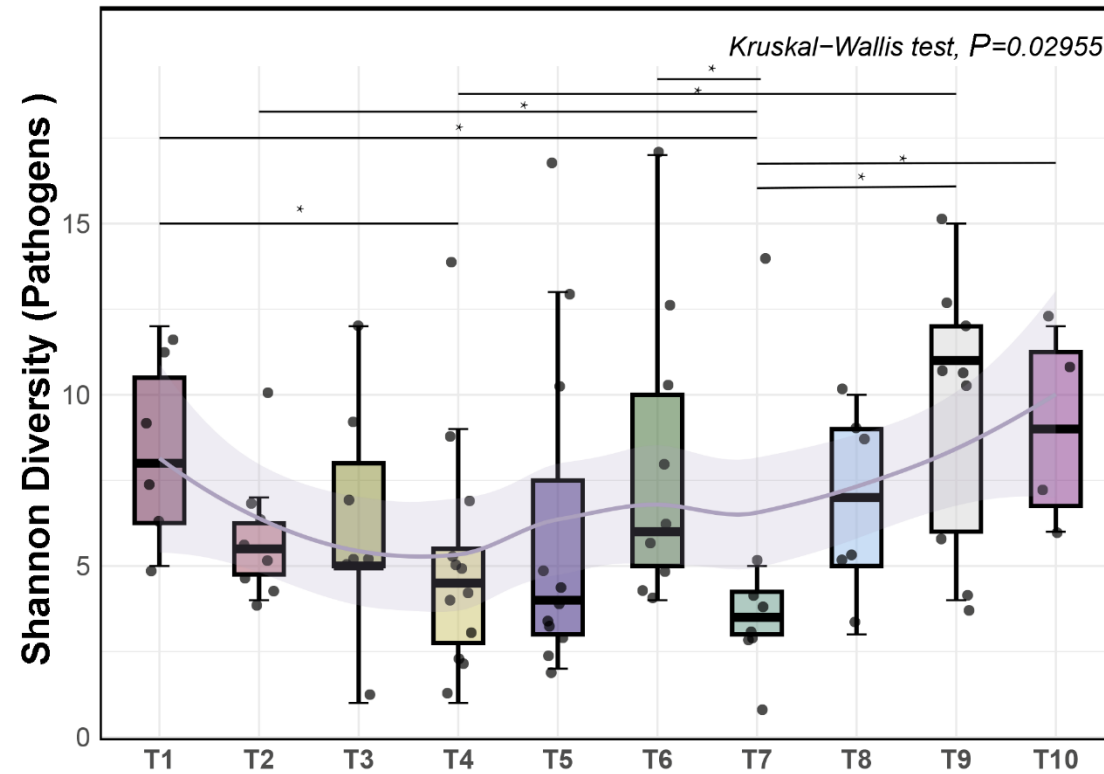
**Figure S4. Alpha-diversity (Chao1) over time.** Statistical significance was tested by Kruskal-Wallis test. The light purple trend line represents loess smooth regression estimates, with shaded cloud representing 95% confidence interval.



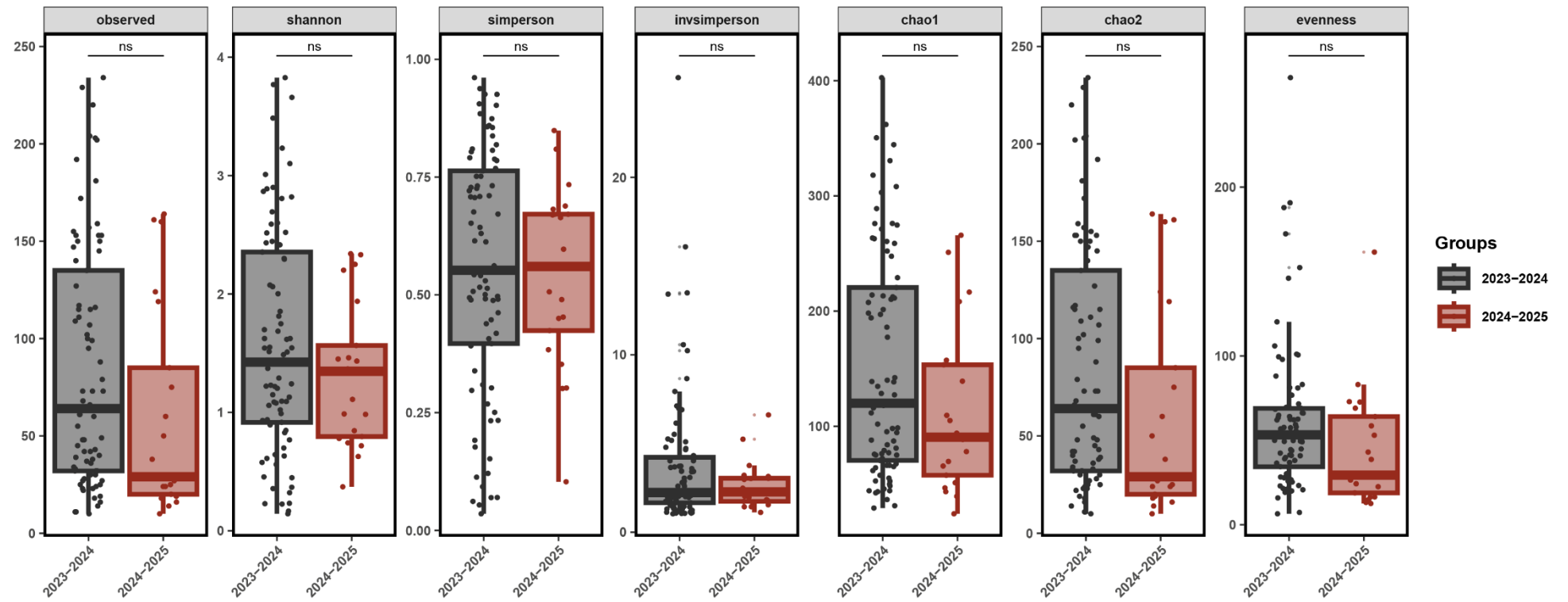
**Figure S5. Box-plot of the total  $\beta$ NTI of sampling groups.** Statistical significance was tested by Kruskal-Wallis test, followed by multiple comparisons using Wilcoxon rank-sum test (\*,  $P < 0.05$ ; \*\*,  $P < 0.01$ ).



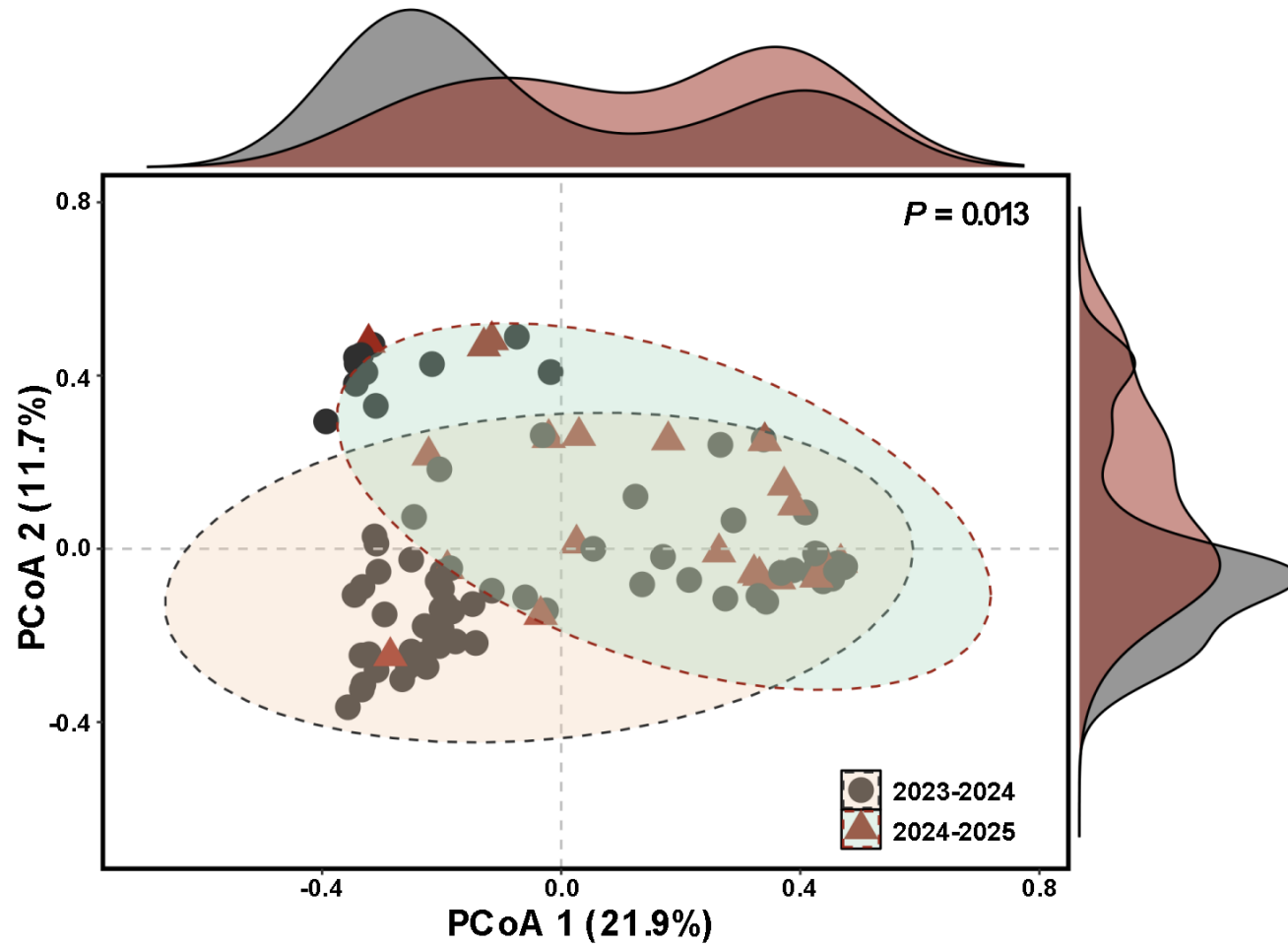
**Figure S6. Temporal prevalence dynamics of representative species-level OTUs.** Panels display five distinct patterns: (A) increasing, (B) decreasing, (C) hump-shaped, (D) U-shaped, and (E) oscillating.



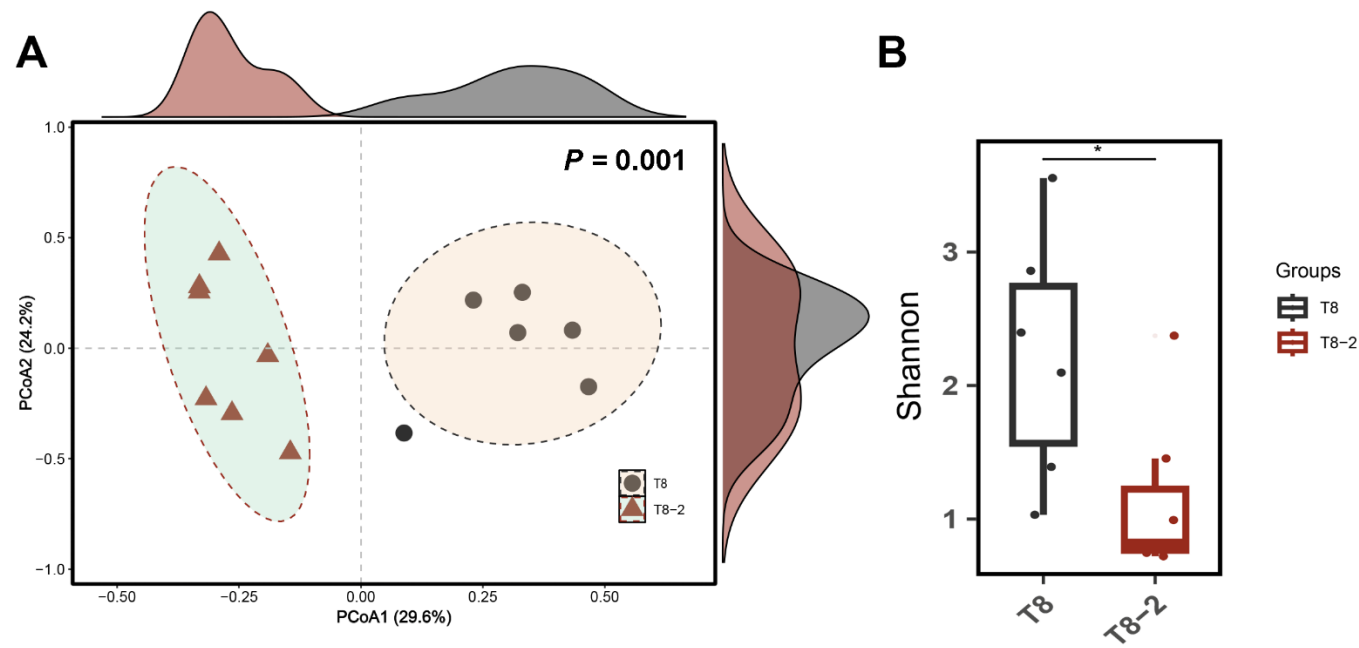
**Figure S7. Alpha-diversity (Shannon) of putative pathogens over time.** Statistical significance was tested by Kruskal-Wallis test, followed by multiple comparisons using Wilcoxon rank-sum test (\*,  $P < 0.05$ ). The light purple trend line represents loess smooth regression estimates, with shaded cloud representing 95% confidence interval.



**Figure S8. Alpha diversity analysis.** Statistical significance was tested by Wilcoxon rank-sum test. NS, no significance.



**Figure S9. Interannual variation of the seagull fecal microbiome.** The PCoA plot showing the Bray-Curtis distances of bacterial communities between initial (2023-2024) and subsequent (2024-2025) overwintering periods. *P*-value was obtained from PERMANOVA. The kernel density curves represent the distribution and peaks of sample densities along each axis.



**Figure S10. Significant divergences in both  $\alpha$ - and  $\beta$ -diversity emerged between T8 and T8-2.** (A) The PCoA plot based on Bray-Curtis dissimilarity distance showing the compositional differences.  $P$ -value was obtained from PERMANOVA. (B) Alpha-diversity (Shannon). Statistical significance was tested by Wilcoxon rank-sum test (\*,  $P < 0.05$ )