

Description of Additional Supplementary Files

Supplementary Data 1. Summary of habitat loss in PAs.

Supplementary Data 2. Pearson's r for four types of habitat loss areas in PAs.

Supplementary Data 3. Results of the average treatment effect on the treated (ATT) for area and proportion of built-up land, cropland, pastureland, forest loss, and total habitat loss in PAs. Significant negative values indicate that the establishment of the protected area can significantly reduce habitat loss, while positive values indicate the opposite. We used a two-sided t-test for data analysis.

Supplementary Data 4. Results of the average treatment effect on the treated (ATT) for area and proportion of built-up land, cropland, pastureland, and forest loss in PAs at the national level. Significant negative values indicate that the establishment of the protected area significantly reduced habitat loss, while positive values indicate the opposite. We used a two-sided t-test for data analysis.

Supplementary Data 5. Results of the time-lag effect for average treatment effect on the treated (ATT) of built-up land, cropland, pastureland, forest loss, and total habitat loss in PAs. Significant negative values indicate that the establishment of the protected area significantly reduced habitat loss, while positive values indicate the opposite. We used a two-sided t-test for data analysis.

Supplementary Data 6. Results of the time-lag effect for average treatment effect on the treated (ATT) of built-up land, cropland, pastureland, forest loss, and total habitat loss in PAs. Significant negative values indicate that the establishment of the protected area significantly reduced habitat loss, while positive values indicate the opposite. We used the habitat loss proportion in PAs as example. We used a two-sided t-test for data analysis.

Supplementary Data 7. Ordinary least squares (OLS) regression and SDID results for the relationship between the effectiveness of PAs and species richness, human footprint, and their distance to cities. We separately applied an OLS model to validate the relationship between the effectiveness of PAs (proportion of combined total habitat loss) and factors such as species richness (a), human footprint (b), and their distance to cities (c). We further conducted a SDID analysis. SDID results are shown in (d). We used a two-sided t-test for data analysis.

Supplementary Data 8. Results of PSM for average treatment effect on the treated (ATT) of habitat loss in PAs. We estimated the average rate difference between protected and unprotected samples based on PSM method. We used a two-sided z-test for data analysis.

Supplementary Data 9. Results of machine learning for habitat loss rate in PAs.

Supplementary Data 10. Results of DID for average treatment effect on the treated (ATT) of built-up land in PAs. We estimated the average effect of PA designation time on built-up land (using the annual proportion and area of built-up land in PAs as example) based on a cstdid model. If the χ^2 (Chi-squared) test is not significant at the 5% level, it indicates that this model has passed the parallel trend test. Conversely, a significant result would imply a failure to pass this test. Based on the results presented in the table below, it is evident that the DID model does not satisfy the parallel trend test. A two-sided z-test was used for data analysis.

Supplementary Data 11. Placebo test results of SDID for average treatment effect on the treated (ATT) of built-up land in PAs. We estimated the average effect of PA designation time on built-up land (using the annual proportion and area of built-up land in PAs as example). A two-sided z-test was used for data analysis.