to a policy as well as plastic bag litter trends from places that do not have a policy.

We first present the overall effect of plastic bag policies on plastic litter in the environment on the basis of evidence from shoreline cleanups. Our analysis shows that plastic bag policies result in a 25 to 47% reduction in the proportion of plastic bags among the total items collected during cleanups compared with places without policies. We then explore heterogeneities by the policy type (full ban, partial ban, or fee), geographic scope of the policy (state, county, or town), type of shoreline (coast, river, or lake), and baseline concentration of plastic bags. Finally, we examine whether bag policies reduce wildlife entanglement.

Patchwork of US plastic bag policies

Plastic bag laws in the United States vary widely, making it a useful laboratory for comparing the effects of different policies. Policies have been implemented at the state, county, and town levels. We define town policies as anything at a geographic scale smaller than a county, including cities and townships. Common types of policies include bag bans, bag fees, and preemption laws. Bag bans are command-and-control policies prohibiting certain retailers from distributing plastic bags. Bans may be complete or partial, the latter prohibiting only thin, disposable bags. An example of a complete ban is New York's March 2020 statewide ban, and an example of a partial ban is Washington's October 2021 statewide ban. The latter allows the distribution of plastic bags at least 2.25 mm thick made from at least 40% recycled materials. These thicker plastic bags are often considered "reusable" under partial ban policies, although there is evidence that some consumers still treat them as single-use (*35*). Bag fee policies (or taxes) require stores to collect a small fee (usually ranging from 5 to 25 cents) on each disposable plastic bag the consumer takes. An example is the 5-cent tax on disposable plastic shopping bags in Arlington County, Virginia. Finally, 17 states have passed full preemption laws that prohibit jurisdictions within that state from passing bag policies, often as a way of ensuring that plastic bags will remain unregulated. Another two states have partial preemption (prohibiting either only bans or fees), and one state (Pennsylvania) had a temporary preemption.

We document 611 total policies from 2008 through 2023 addressing plastic bag pollution across the country (summarized according to the geographic scope and type of policy in Fig. 1A and in table S1 and by geographic coverage in fig. S2). Ten states have implemented state laws, and 43 counties have passed county-level bag legislation, but most policies (558, or 91%) are at the town level. Plastic bag fees are the least common type of policy, although most policies passed after 2021 are either fees or full bans, as partial bans have fallen out of favor.

Matching policies with affected zip codes enables us to provide estimates of the number of Americans who live in areas with plastic bag laws, broken down by geographic scope and type of policy (Fig. 1B). As of December 2023, about one in three Americans, or 116 million in all, lived in a jurisdiction with a bag law. Since the recent increase in statewide policies, state-level policies cover the largest number of Americans (90.7 million, or 78.2% of those living in areas with bag policies), followed by town- and county-level policies (10.0 million, or 8.6%, and 15.3 million, or 13.2%, respectively) (Fig. 1B).

Plastic bags are prevalent in shoreline litter

The Ocean Conservancy provides citizen science data from shoreline cleanups, where volunteers pick up and categorize litter from a stretch of coast, river, or lake (*36*). Our analysis includes 45,067 shoreline cleanups from January 2016 to December 2023 (fig. S3). Plastic bags are the fifth-most-common item found in US shoreline cleanups (after cigarette butts, food wrappers, plastic bottle caps, and plastic beverage bottles), out of a total of 60 distinct item categories (fig. S4). On average, plastic bags make up 4.5% of the items collected in a cleanup, however, this number rose to 6.7% in 2023 (fig. S5). Although plastic bags in shoreline cleanups represent an unknown fraction of all plastic bag litter, the cleanup data offer a plausible proxy for the overall reduction in marine and freshwater plastic litter that the policies achieve. It is for this reason that we focus on the percentage reduction in plastic bags as a share of cleaned-up litter rather than on the absolute number of plastic bags reduced by the policies. We aggregate the cleanup data to the 0.1° grid cell (or ~11.1 km), as 98.6% of our cleanups cover this much distance or less. We also aggregate the data by zip code to match the geographic scale of our policy data. Temporally, the data are aggregated by year to match the annual peak in the histogram of time between cleanups (fig. S6 shows that the histogram is right-skewed with a long right tail), while giving us enough observations to create a balanced panel from January 2016 to December 2023. We estimate that 65.6% of the cleanups are within 10 km of the coast and that 86.6% of the cleanups are in watersheds that drain into the oceans.

There were 182 plastic bag policies in zip codes that had shoreline cleanups, affecting a cumulative 15 million Americans (Fig. 1, C and D, and table S2). These 182 policies were used to generate the main results.

Bag laws reduce plastic bag prevalence on shorelines

We find a 25 to 47% decrease in plastic bag share in treated areas compared with places without policies (Fig. 2A and table S3). This range reflects the range in point estimates from five different estimators [two-way fixed effects (TWFE) and estimators described in (*31*–*34*)] using eq. S1 (see materials and methods in the supplementary materials). This decrease is normalized to the control mean (4.5% of items collected). While plastic bag share increased overall in both treated and untreated areas, it increased by considerably less in the treated areas. We present our main results using our preferred aggregation level (0.1° or ~11.1 km grid cell by year) as well as a zip-code-by-year aggregation (Fig. 2, A and C). The results using the 0.1° grid-cell-by-year aggregation are statistically significant at the 5% level for all estimators. The results at the zip-code-by-year aggregation are statistically significant for four of the five estimators and somewhat less precise for one (*32*), likely owing to additional noise created by aggregating to a larger geographical unit.

Next, we investigate the dynamic effects of plastic bag policies, using an event-study-style plot of treatment effects by year (eq. S2), where the first year is the first full year for which a policy is in effect (Fig. 2B and fig. S7A). This approach also allows us to check for pretrends. We do not see evidence of pretrends (1 to 3 years before laws were implemented), but we do observe decreases in plastic bags' share of total items relative to untreated areas in the years after the implementation of a policy (years 1 to 5). The magnitude of the relative decrease grows over time, and we do not find evidence of rebound effects, at least within the first five years of a policy. We repeat these analyses for a subset of grid cells for which we are able to construct a balanced panel. Because cleanups take place sporadically, constructing a balanced panel drastically reduces the number of observations available for our analysis. For this reason, we use an unbalanced sample in our primary analysis. However, both the overall and dynamic effects are similar using a balanced panel subset of the data (Fig. 2, C and D, and fig. S7B).

We then conduct falsification (placebo) tests on plastic litter items whose prevalence we do not expect to change in response to plastic bag laws. We look at the share of plastic bottles and caps, plastic straws, and plastic containers and do not find decreases in the share of these plastic items after bag policies are passed (fig. S8). This reassures us that the decline in the share of plastic bags relative to untreated areas is driven by the policies rather than by general decreases in plastic usage or litter that happened to coincide with the policies. A slight increase in the share of these nonbag plastic items may be mechanical: As the share of plastic bags decreases, the share of other commonly collected items may increase. We also run our analysis on