

## Examining Litter Distributions in Lethbridge, Alberta, Canada, Using Citizen Science and GIS Methods: OpenLitterMap App and Story Maps

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**Abstract :** Humans' impact on the environment has been incredibly brutal, with enormous plastic- and other pollutants (e.g., cigarette buds, paper cups, tires) worldwide. On land, litter costs taxpayers a fortune. Most of the litter pollution comes from the land, yet it is one of the greatest hazards to marine environments. Due to spatial and temporal limitations, previous litter data covered very small areas. Currently, smartphones can be used to obtain information on various pollutants (through citizen science), and they can greatly assist in acknowledging and mitigating the environmental impact of litter. Litter app data, such as the Litterati, are available for study through a global map only; these data are not available for download, and it is not clear whether irrelevant hashtags have been eliminated. Instagram and Twitter open-source geospatial data are available for download; however, these are considered inaccurate, computationally challenging, and impossible to quantify. Therefore, the resulting data are of poor quality. Other downloadable geospatial data (e.g., Marine Debris Tracker8 and Clean Swell10) are focused on marine- rather than terrestrial litter. Therefore, accurate terrestrial geospatial documentation of litter distribution is needed to improve environmental awareness. The current research employed citizen science to examine litter distribution in Lethbridge, Alberta, Canada, using the OpenLitterMap (OLM) app. The OLM app is an application used to track litter worldwide, and it can mark litter locations through photo georeferencing, which can be presented through GIS-designed maps. The OLM app provides open-source data that can be downloaded. It also offers information on various litter types and "hot-spots" areas where litter accumulates. In this study, Lethbridge College students collected litter data with the OLM app. The students produced GIS Story Maps (interactive web GIS illustrations) and presented these to school children to improve awareness of litter's impact on environmental health. Preliminary results indicate that towards the Lethbridge Coulees' (valleys) East edges, the amount of litter significantly increased due to shrubs' presence, that acted as litter catches. As wind generally travels from west to east in Lethbridge, litter in West-Lethbridge often finds its way down in the east part of the coulees. The students' documented various litter types, while the majority (75%) included plastic and paper food packaging. The students also found metal wires, broken glass, plastic bottles, golf balls, and tires. Presentations of the Story Maps to school children had a significant impact, as the children voluntarily collected litter during school recess, and they were looking into solutions to reduce litter. Further litter distribution documentation through Citizen Science is needed to improve public awareness. Additionally, future research will be focused on Drone imagery of highly concentrated litter areas. Finally, a time series analysis of litter distribution will help us determine whether public education through Citizen Science and Story Maps can assist in reducing litter and reaching a cleaner and healthier environment.

**Keywords :** citizen science, litter pollution, Open Litter Map, GIS Story Map

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