Expansion of Urban Land Cover around El Yunque National Forest: 1998 to 2023

Tania López Marrero and L. Annie Hermansen-Báez

Introduction

Urban land cover expansion alters forest processes and functions by fragmenting the landscape, modifying hydrological systems, increasing water temperatures, changing micro-climates, altering nutrient cycles, and more. Urban expansion also alters forest processes by removing forest and other land covers that support forest functions. Ultimately, the changes caused by urban expansion influence the services provided by forests. In the first phase of the El Yunque Ecosystem Service project (López-Marrero and Hermansen-Báez 2011a), urban expansion around El Yunque National Forest was identified as a primary factor affecting the forest and its ecosystem services (López-Marrero and Hermansen-Báez 2011b). Ten years later in the project's second phase, urban expansion was again mentioned as a recurrent negative driver affecting El Yunque and the services it provides.

In this fact sheet, we update the urban land cover data published by López-Marrero and Hermansen-Báez (2011c) in the first phase for the region that comprises the eight municipalities with El Yunque lands within their boundaries. The 2023 urban land cover was created by on-screen digitalizing aerial photographs (**see Box 1**). This information can help forest managers, municipal and land-use planners, policymakers, and other stakeholders learn about urban land cover trends around El Yunque and make informed decisions about landscape planning and management of ecosystem services.

Key Findings

Urban cover in 1998

- Urban areas covered 15,871 acres (9%) within the eight municipalities containing some portion of El Yunque within their boundaries.
- Río Grande had the most urban land (2,923 acres);

Box 1. Development of urban land cover data

Urban land cover refers to land areas overlain by large expanses of impervious surfaces (more than 80% cover) such as concrete, cement, and asphalt. These areas include high-density developed areas, such as towns, but also include low-density developed land, such as scattered buildings and subdivisions.

Urban land-cover data layers were created by on-screen digitizing of digital aerial photographs taken in 1998 and 2010; Google Earth images were used for 2023. Digitization was conducted at a (screen) scale of 1:8,000 to 1:10,000, using a minimum mapping unit of approximately 2,500m^2 (50x50 m). Urban coverage below that mapping unit was not included.

Luquillo had the least (1,236 acres).

- Fajardo and Canóvanas had the largest percentages of total urban land cover (14% and 11%, respectively), while Naguabo had the lowest (4%).

Urban cover in 2010

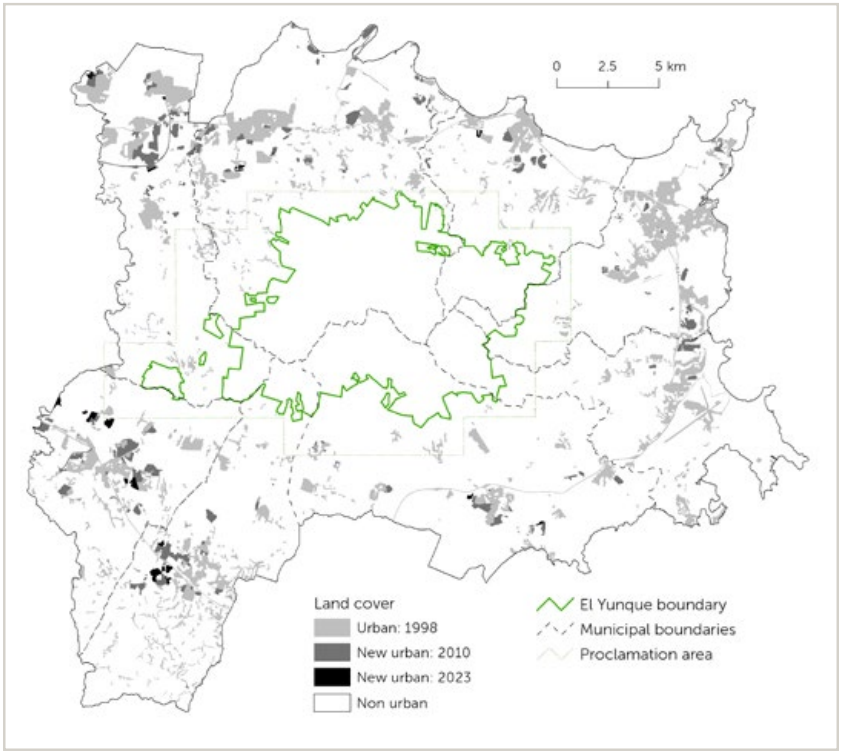
- Urban areas covered 19,145 acres (10%) within the eight municipalities.
- Río Grande remained the municipality with the most urban land cover (3,542 acres), and Luquillo with the least (1,453 acres).
- Fajardo had the highest percentage of land in urban cover (16%), while Naguabo had the lowest (5%).

Urban cover in 2023

- Urban areas covered 19,498 acres (10%) within the eight municipalities.
- Río Grande had the most urban land cover (3,569 acres), while Luquillo had the least (1,468 acres).
- Fajardo and Juncos had the highest percentage of land in urban cover (16% and 15%, respectively), while Naguabo had the lowest (5%).

Urban expansion between 1998 and 2010

- Urban land cover increased by 3,274 acres within the eight municipalities.

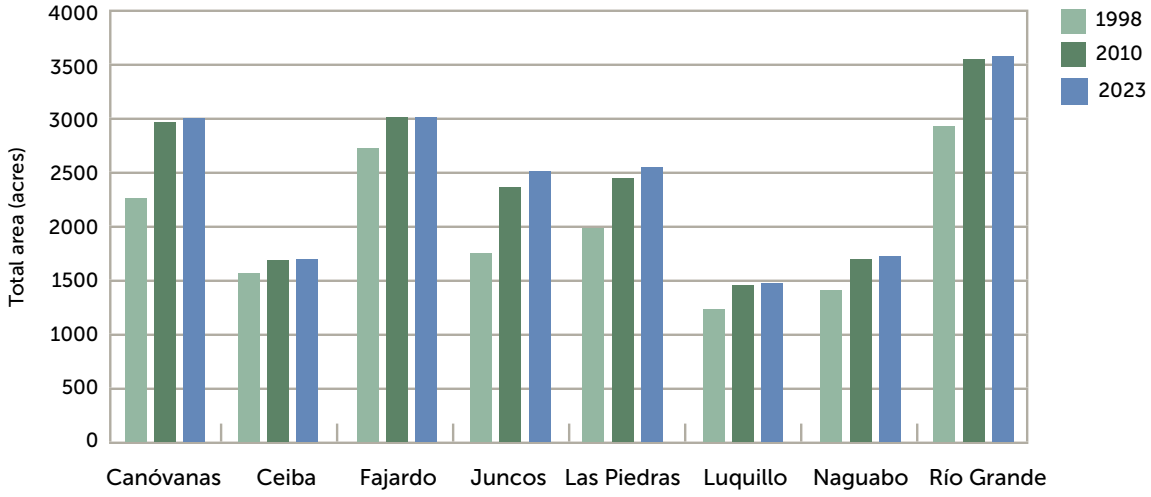


Urban land cover in 1998, 2010, and 2023.

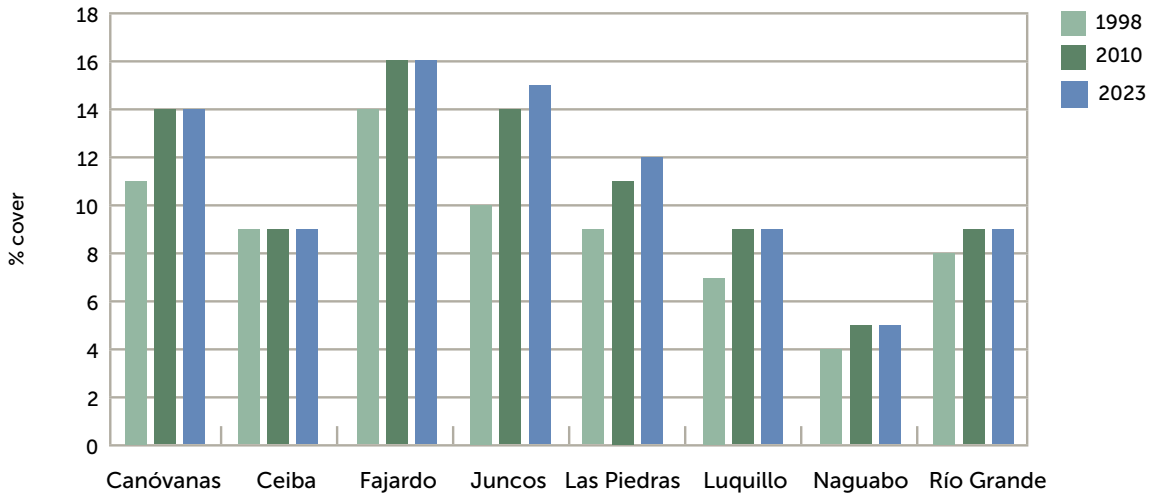
- Canóvanas had the greatest increase in urban land cover (692 acres), whereas Ceiba had the smallest increase (127 acres).
- Juncos had the highest percentage of change in urban land area (35%), whereas Ceiba had the lowest (8%).

Urban expansion between 2010 and 2023

- Urban land cover increased by 353 acres within the eight municipalities.



Area of urban land cover for each municipality in 1998, 2010, and 2023.



Percentage of urban land cover for each municipality in 1998, 2010, and 2023.

- Juncos had the greatest increase in urban land cover (145 acres), whereas Luquillo had the smallest increase (15 acres). Based on our land cover classification procedure, neither Ceiba or Fajardo increased in urban coverage.
- Juncos and Las Piedras had the highest percentage of change in urban land cover (6% and 4%, respectively); the remaining municipalities increased by 1% or less.

Conclusion

Urban expansion around El Yunque National Forest has slowed down during the past decade. The increase in urban land coverage was greater between 1998 and 2010 than from 2010 to 2023. Urban land cover increased by 21% from 1998 to 2010 and by 2% from 2010 to 2023. Differences were also found in the amount of urban expansion between municipalities during the two study periods. Different factors that could explain the deceleration in urban expansion during the second study period are the implementation of land use plans around El Yunque, Puerto Rico's economic slowdown, and population decline (all of which could have resulted in a decrease in demand for construction projects). Drivers of land cover change vary at different temporal and spatial scales and should be explored in more detail.

The information provided in this fact sheet can help stakeholders visualize urban land cover increase and distribution around El Yunque National Forest in the last 25 years and promote further research to understand the drivers of such changes. This information can also be used to assist urban land-use planning and management decisions to support the functions and ecosystem services of El Yunque.

To convert acres to hectares, divide the number of acres by 2.47. To convert acres to cuerdas (a unit of land measurement commonly used in Puerto Rico), multiply the number of acres by 1.03.

Change in the total area and percentage of urban land cover increase from 1998 to 2010 and from 2010 to 2023.

Municipality	1998 to 2010		2010 to 2023	
	Area (Acres)	Percentage change	Area (Acres)	Percentage change
Canóvanas	692	31%	35	1%
Ceiba	127	8%	0	0%
Fajardo	281	10%	0	0%
Juncos	611	35%	145	6%
Las Piedras	451	23%	108	4%
Luquillo	217	18%	15	1%
Naguabo	276	19%	23	1%
Río Grande	619	21%	27	1%
Region	**3,274**	**21%**	**353**	**2%**

References

López-Marrero, T.; Hermansen-Báez, L.A. 2011a. El Yunque Ecosystem Services: A Participatory Research Approach. [Fact sheet]. USDA Forest Service, Region 8. 4 p.

López-Marrero, T.; Hermansen-Báez, L.A. 2011b. Participatory Listing, Ranking, and Scoring Ecosystem Services and Drivers of Change. [Guide]. USDA Forest Service, Region 8. 8 p.

López-Marrero, T.; Hermánsen-Báez, L.A. 2011c. Expansion of Urban Land Cover around El Yunque National Forest. [Fact sheet]. USDA Forest Service, Region 8. 4 p.

Acknowledgements

We would like to acknowledge Antonio González for reviewing this fact sheet. Tamara Enz is acknowledged for editing this fact sheet and Raghu Consbruck is acknowledged for the design and layout of this publication. This publication is part of a research and science delivery project funded through the USDA Forest Service.

How to cite this publication

López-Marrero, T.; Hermansen-Báez, L.A. 2024. Expansion of Urban Land Cover around El Yunque National Forest: 1998 to 2023. [Fact sheet]. USDA Forest Service, Region 8. 4 p.

For more information

For more information or if you have questions, contact Tania López Marrero at tania.lopez1@upr.edu.

USDA United States Department of Agriculture