17 Visualizing YouthMappers' Contributions to Environmental Resilience in Latin America

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Abstract

YouthMappers throughout Latin America are working to advance the attainment of the SDGs. Our contributions here centre on open data but also the maps and visualized analysis derived from them, which supports making decisions on how to achieve desired development across all seventeen goals. This chapter highlights the contribution of YouthMappers in ways that reduce inequalities around information access in Latin America (SDG 10), meanwhile advancing environmental resilience across the hemisphere, addressing a number of projects promoting biodiversity, conservation, and tourism that improve life on land (SDG 15).

Keywords

YouthMappers in Latin America · Mapping contributions · Conservation · Biodiversity · Tourism · Panama · Ecuador

1 A Picture of Youth and Open Data in Latin America

Let us visualize a world where youth are seen.

To meet all of our development objectives, from economic to social to environmental, we need more than data and capacity to analyse it. We also need to build information and knowledge that can inform decisions. Mapping open data is an incredible way to visualize what needs to be seen in order to make the right choices, for all of

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the SDGs. Mapping with youth, and led by youth, goes even further. It can not only ensure that the right data and information are visualized, but also that the youth of the country are seen, and that their interests are part of the picture.

Picture the hemisphere of the Americas, where our lands and communities can be viewed by those who make the decisions and policies that affect our lives, livelihoods, and futures. This viewpoint might influence what is decided in ways that better prepare us for the uncertain future of our planet, the one that we as youth will inherit. It could make all of us more resilient, inspiring the whole continent to make progress on any of the Sustainable Development Goals.

While we are not there yet, map contributions by YouthMappers, both residing in Latin America and beyond, are making ourselves seen. Aside from the creation of open spatial data, students are also using this data to visualize important patterns, trends, and potential resilient solutions in spaces where there are the greatest vulnerabilities. This work helps to reduce inequality through access not only to information but also to the processes where smart decisions are made based upon that information. For YouthMappers in Latin America, this vision aligns with SDGs 10 (Reduced Inequality) in the sense that we work with *open* data, and with 15 (Life on Land) in the sense that building this link affects the territories where we live, our biodiversity in protected areas, and how we value and navigate through them.

In this chapter, we first review some of the contributions that YouthMappers within and outside of Latin America have made for the region, in terms of creating open spatial data that can be visualized. We then present a few cases that we have carried out, some with a little success in being seen in the community and in decision-making circles.

Each of the cases highlights ideas about SDG 10, in the sense that unequal access constrains innovation and prevents the smartest choices (Global Partnership for Sustainable Development Data 2015). Each also addresses other dimensions of sustainable development goals where the impact ranges from social and economic aspects (SDG 11: Sustainable cities and communities, inclusive participation, 3: Health and well-being, 5: Gender equality, 4: Quality education, and 17: Alliance to achieve the objectives), as well as environmental (12: On responsible production and consumption, 13: Climate action, 14: Underwater life), and in each case, a connection to what is happening in our environment (SDG 15: Life of Terrestrial Ecosystems).

The participation of YouthMappers and these chapters goes beyond just using OSM and other Geographic Information Systems for data capture, but also counting on the participation of citizens, in which they are motivated and involved to solve those social problems or that promote development activities in their communities (Shannon et al. 2020). This strengthens the possibilities of visibility even further.

The objectives and methods used for each of these projects include work with the community and for the community (Solís et al. 2015; Hawthorne et al. 2015). These were diverse, from university and local communities, with a focus on tourism and conservation, as well as on the ordering and resilience of the population.

Together, these experiences – and many more that are not described here – recount some of the specific regional contribution of YouthMappers in the creation of spatial data by Latin American youth towards the attainment of these goals and a more resilient environment.

2 Generation of Open Spatial Data for Resilience

The activities of YouthMappers in Latin America have offered an important contribution to the open spatial data community itself, including OSM, but also as part of the global network of YouthMappers as well (Anderson 2021). While YouthMappers have been especially active in Africa and Asia, the participation of students across many South American, Central American, and Caribbean nations (LAC) has been impressive for our relative size. While the world population of Asia (4.6 billion) and Africa (1.3 billion) far surpasses the whole Latin American region (527 million, 7% of the world's population), the size of participation in YouthMappers surpasses average expectations. Of

the nearly 300 chapters globally, there are 30 chapters (or 10%) in countries of the LAC region. Of the 64 countries of the world where YouthMappers have been established as of the end of 2021, there are 12 of them in the LAC region (19%). Certainly, the small size of our population does not deter us as youth from the region to join and contribute to the global network.

Figures 17.1 and 17.2 show steady growth over time in the presence of YouthMappers at universities of Central and South America, respectively, particularly in the last two to three years since the establishment of Regional Ambassadors and the presence of YouthMappers organizers as leaders in cartographic diplomacy in Latin America. We also attribute some of this growth to linking YouthMappers activities to externally funded research partnerships in environmental and geographic themes (TTU, ASU, World Bank, OAS-PAIGH, HOT, USAID, etc.). In particular, countries like Peru, Argentina, Colombia, Ecuador, and Brazil are important places for mapping by YouthMappers from LAC and elsewhere. Campaigns around environment and resilience feature prominently, from earthquakes in Ecuador to the pandemic in Peru and to biodiversity in Brazil. Similarly, looking at changes over time, we see in Central America (Fig. 17.3), attention spiked when a series of hurricanes hit Puerto Rico and other nations in the Caribbean. YouthMappers in the Latin America and Caribbean region understand the connection between open spatial data and environmental resilience.

In sum, throughout the entire region of Latin America, YouthMappers have performed nearly 600,000 edits from 2015 to the end of 2021. Of these edits to OpenStreetMap, most of them were to building objects (about 88%), while 3000 were amenities. South America accounts for about half of these contributions (an estimated 49%), followed by Central America (29%) and then the Caribbean region (22%). As of 2022, more than 6750 km of roads and paths across the continent were last edited by YouthMappers. Of course, buildings and highways are more easily traced from satellite imagery by remote mappers. Amenities, however, require having some level of localized knowledge. The chapters in LAC universities and the network collaboration to map on the continent with joint campaigns have produced these contributions so far, with more to come in the future, especially amenities, once the pandemic restrictions may permit more fieldwork.

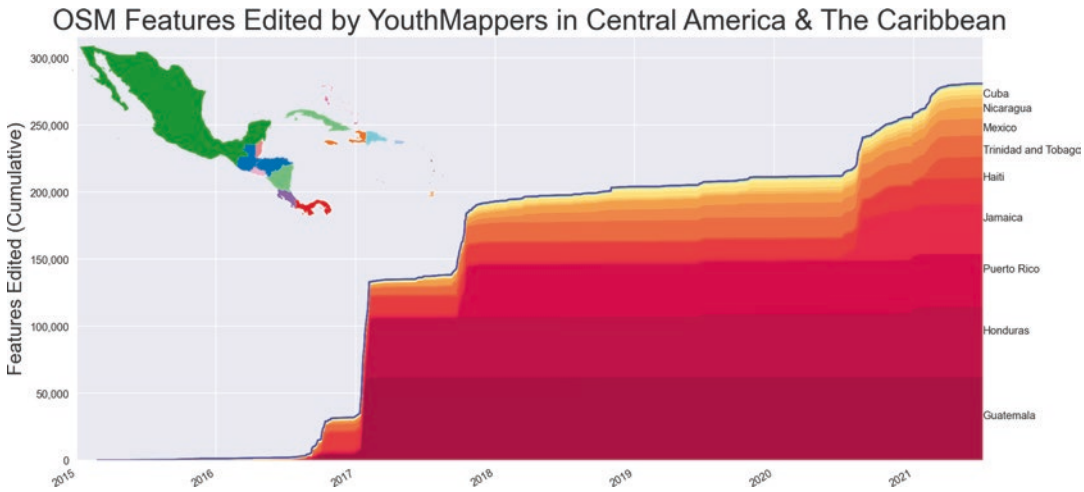

Fig. 17.1 Accumulated numbers of features edited by YouthMappers in Central America and the Caribbean show a surge in growth around 2017 to 2018

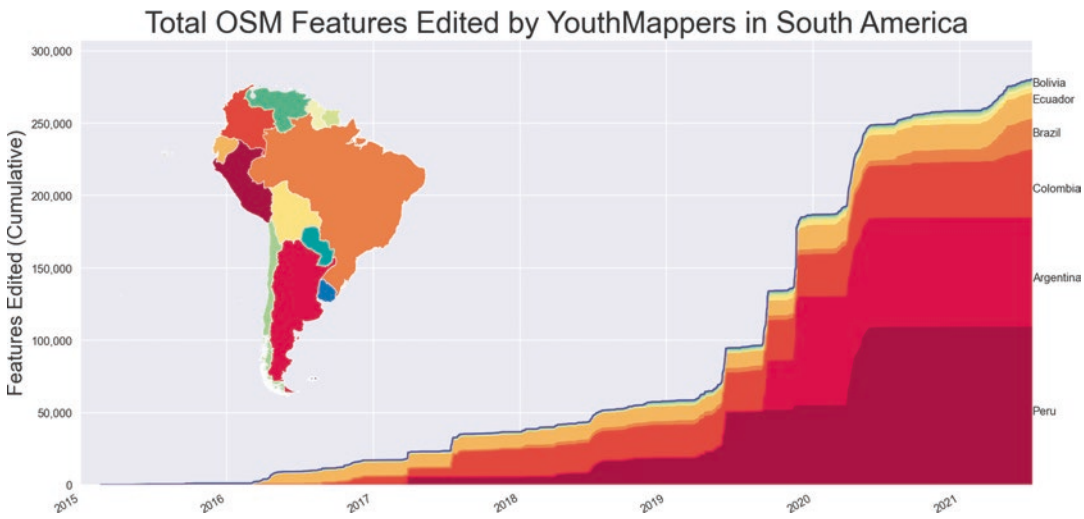

Fig. 17.2 Accumulated numbers of features edited by YouthMappers in South America show steady increases from 2017 to 2022

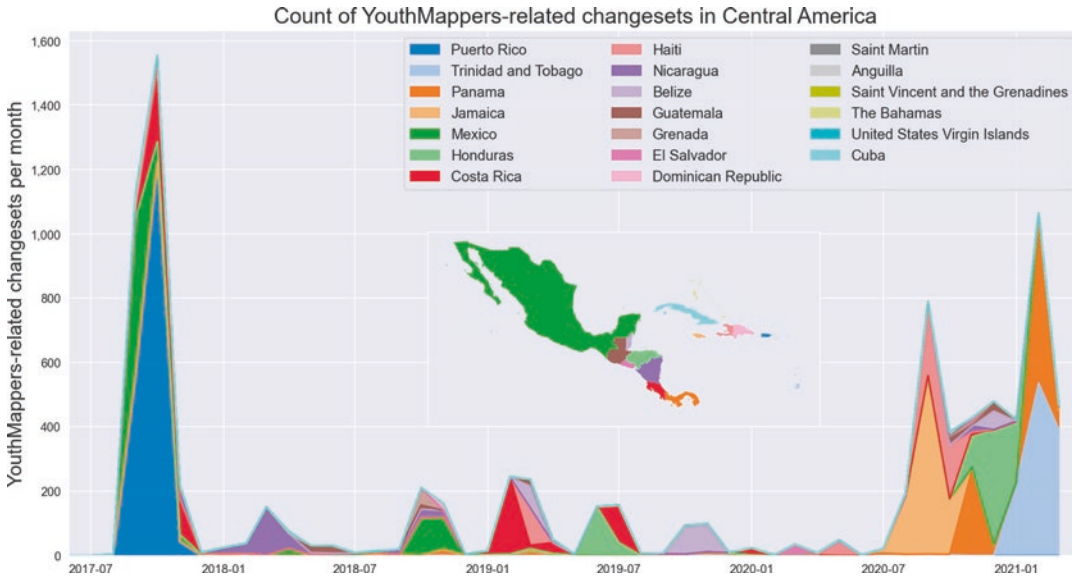

Fig. 17.3 The counts of YouthMappers related changesets by country in Central America and the Caribbean show a pattern of response to campaigns related to UN SDGs

3 Cases for Environmental Resilience in Latin America

The strategies used for the development of these projects include virtual methodologies like Mapathons in OSM, Tasking Manager sets, Webinars, ArcGIS training, Free Software distribution, and more (Coetzee et al. 2018); as well as face-to-face activities like community field visits, data collection with applications and mobile devices or from direct collaboration with some NGOs conducting training and direct support in collecting information through surveys, such as the Pink Shirt Day Panama Foundation in the children's sensations project (Rees et al. 2020). We present visualizations that marked many of

Fig. 17.4 Officers of the chapter of YouthMappers at the University of Panama point to locations on the satellite map during a presentation given at a meeting of a technical advisory group to the Organization of American States

the different stages of this work, to reinforce the idea of open spatial data being viewable and viewed in ways that also make the mapmakers and collaborating communities visible (Fig. 17.4).

3.1 Mapping a Hidden Paradise During a Pandemic

The first project of the Ecuadoran chapter GeoMap-ESPE shows how the community can go from 'hidden' to 'visible' by the geospatial approaches we have advocated for through YouthMappers. This work was a direct approach to the concerns of the community (Fig. 17.5).

The project was developed in Lloa, the most extensive rural parish of the Metropolitan District of Quito-Ecuador, as a field survey to help the economic, tourist, and social reactivation of the sector which had suffered from the necessary shutdowns due to public health concerns in the wake of the global COVID-19 pandemic. In this area you can enjoy beautiful landscapes with natural and ecological attractions which are optimal for attracting national and foreign tourists, an extra bonus of the place being a focus on agricultural and livestock production that allows its potential economic development.

Through a field visit in full observance of the biosecurity measures due to COVID-19, YouthMappers surveyed the residents of Lloa, obtaining vital information that was referenced to OSM base map data. The team was helped with field sheets and tours in tourist areas generating points of control (via the open platform), formally putting into public evidence the resources that the community possesses in terms of tourism and basic services (Fig. 17.6).

More than 50 land-use points characterizing tourist attributes were visualized. More than 180 surveys were carried out with residents of the parish, and georeferenced. YouthMappers tabulated results and produced cartography aimed to inform decision-making in the community about the strengths of tourist areas, and where to recover post-pandemic. This visualization also helped with marking points of interest such as fields, churches, health centres, and places of land use productivity, which will help inform policies to renew the growth and reactivation of the sector after facing the pandemic (Fig. 17.7).

3.2 Kuna Nega, a Community Living Amidst Pollution

YouthMappers at the University of Panama were the first in Latin America and only the second

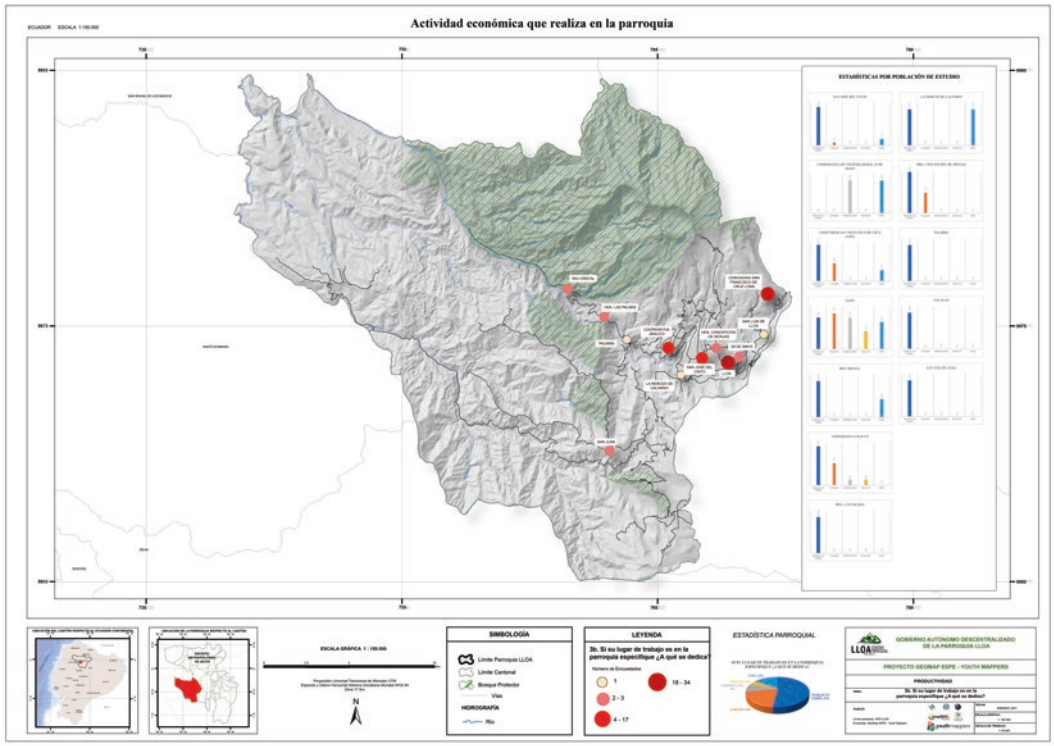

Fig. 17.5 A formal government map summarizes the results of an economic touristic survey conducted with YouthMappers in Lloa, Quito, Ecuador

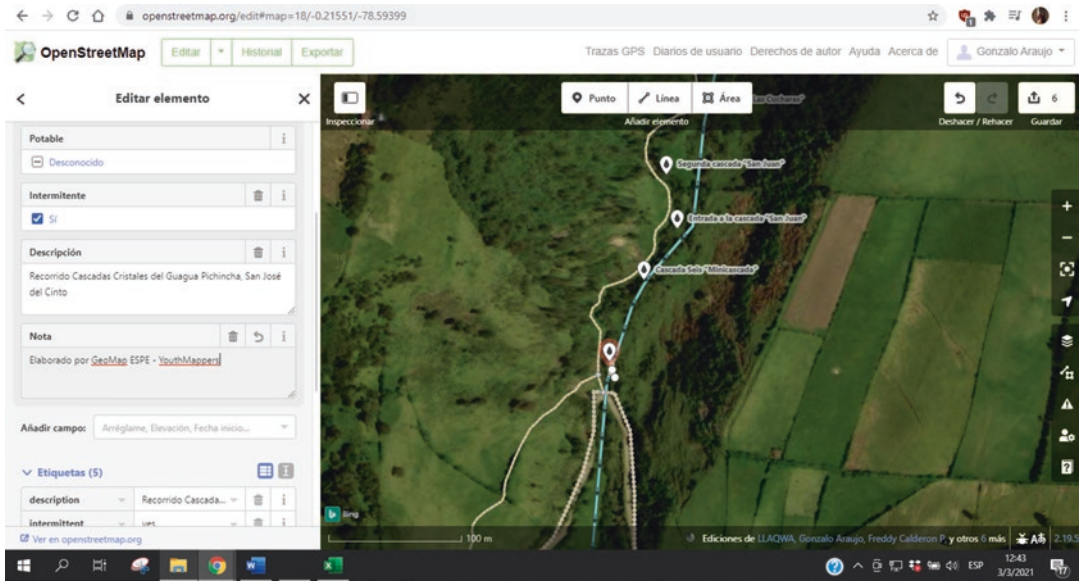

Fig. 17.6 The details of feature edits on OpenStreetMap contain attribute data supporting the project

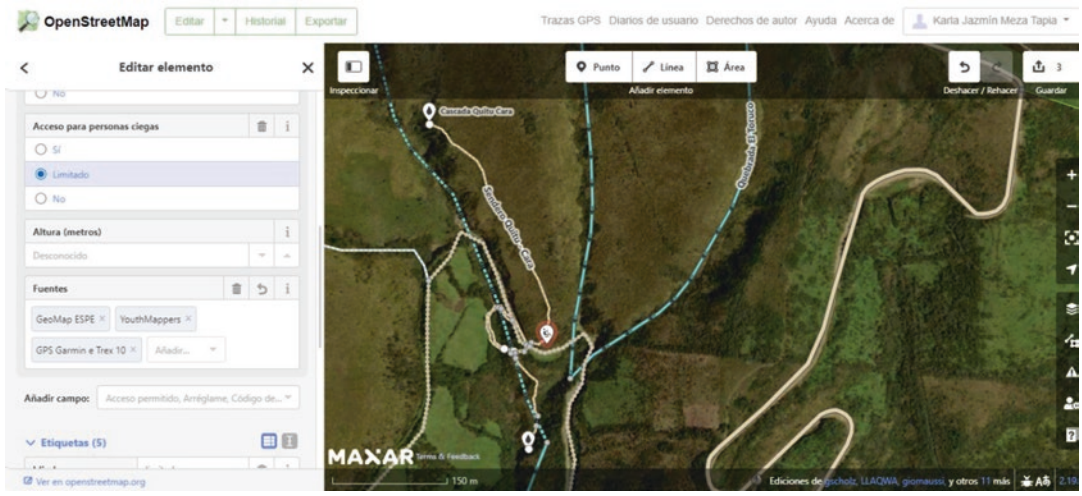

Fig. 17.7 The details of feature edits on OpenStreetMap contain hashtags identifying the project and YouthMappers

inaugural campus in the world to join the network (after UCC in Ghana). This legacy showcases a strong, long history of utilizing mapping by, for, and with communities to make visible problems that are otherwise unseen, hidden, or ignored (Fig. 17.8).

One exemplar of this character is the work with our Kuna Nega community, near the Cerro Patacón landfill that has contact with the Mocambo and Cárdenas rivers. Every day, more than 3000 tons of garbage are deposited here from all parts of Panama City, which has generated large outbreaks of diseases in the surrounding communities – largely marginalized indigenous peoples.

The mapping project was developed by the YouthMappers chapter of the University of Panama with the help of technological tools such as the OSM platform. A launch mapathon was held that intended to support this cause, through the voluntary participation of students who mapped (10 women and 5 men from the chapter and 5 volunteers at-large). This first pass at fundamental data helped to collect geographic information of features in the place, mainly of their buildings, in this case the houses, and also the roads (Fig. 17.9).

For us, it has been quite a challenge to carry out the fieldwork, since due to the pandemic the project has been stopped before reaching its second phase, but even so, we continue to advance in methodology to finish this project that will benefit many people. We will learning from chapters in different places around the world (see also Chap. 20) and begin making the connections and relationships in the meantime with entities responsible for taking decisions about solid waste management through our mentor and networks supporting YouthMappers.

3.3 Mapping 'Where Life Is Born'

A project that is considered one of the most significant and characteristic for the YouthMappers in Ecuador was a mapping effort to visualize tourist-ecological information in the Ecuadoran Amazon (Fig. 17.10).

The province of Pastaza, Canton Mera, is a beautiful place where there is a whole world to discover which with the correct land use could meet the needs of all residents, who are often marginalized. Through face-to-face collection of information in the field, YouthMappers sought to make visible endemic forests, rivers, caverns, and tourist attractions. This asset inventory helps make the community aware of the potential of its resources, aiming to contribute to the care of bio-

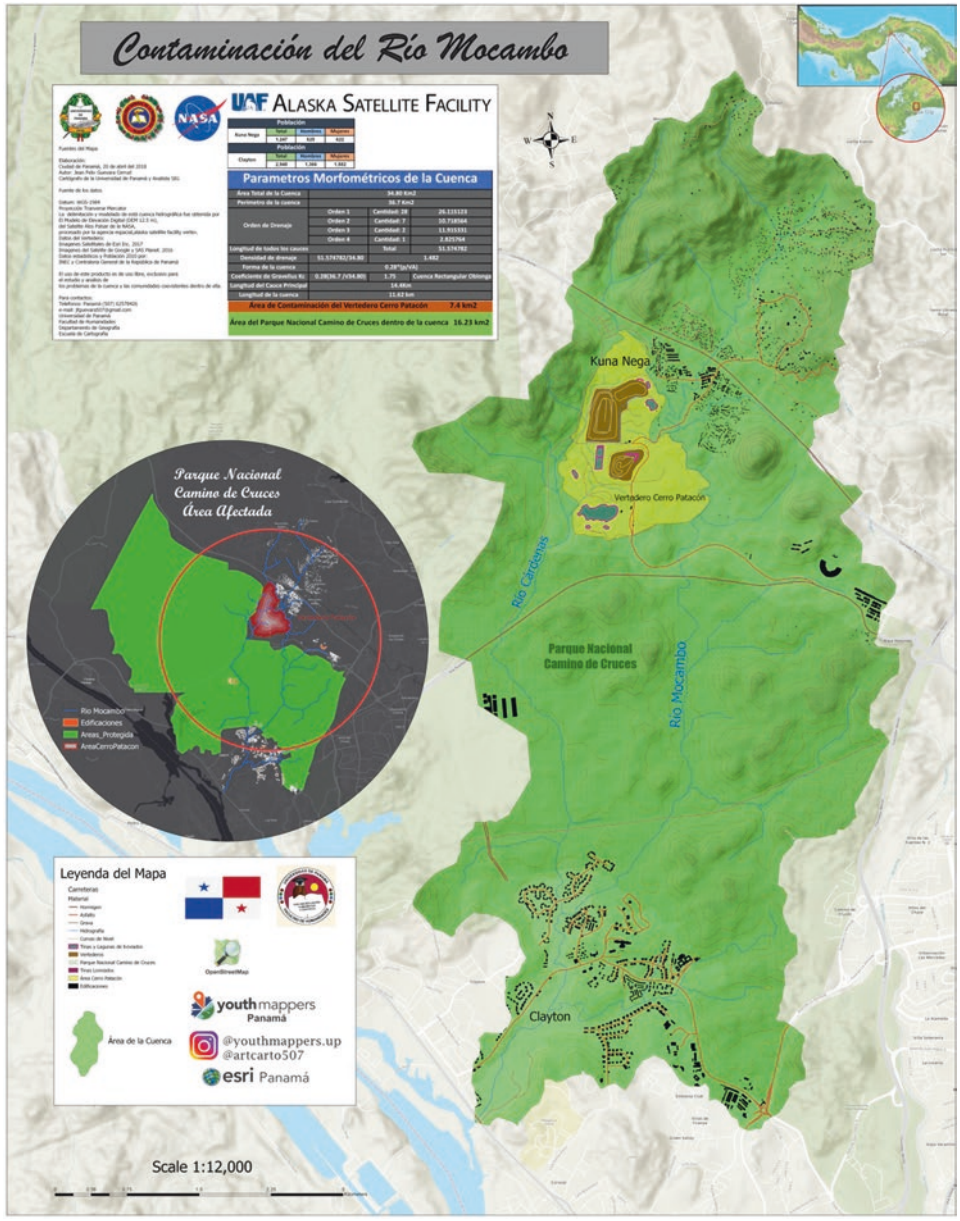

Fig. 17.8 Final products such as this map showing the results of a project monitoring river pollution acknowledge the contributions of YouthMappers at the University of Panama

diversity and showing an extra bonus for benefitting from conservation via eco-tourism (Fig. 17.11).

The community of this sector preserves and takes great care of the environment that surrounds them. However, the production of wood is destructive and damages the ecosystem. To avoid this exploitation of the territory, the residents with the team proposed to take tours to places with eco-tourism potential, representing a source of income, sustaining their communities and the habitat that surrounds them.

Thanks to the visual analysis and the tour, more than 35 eco-tourism information points

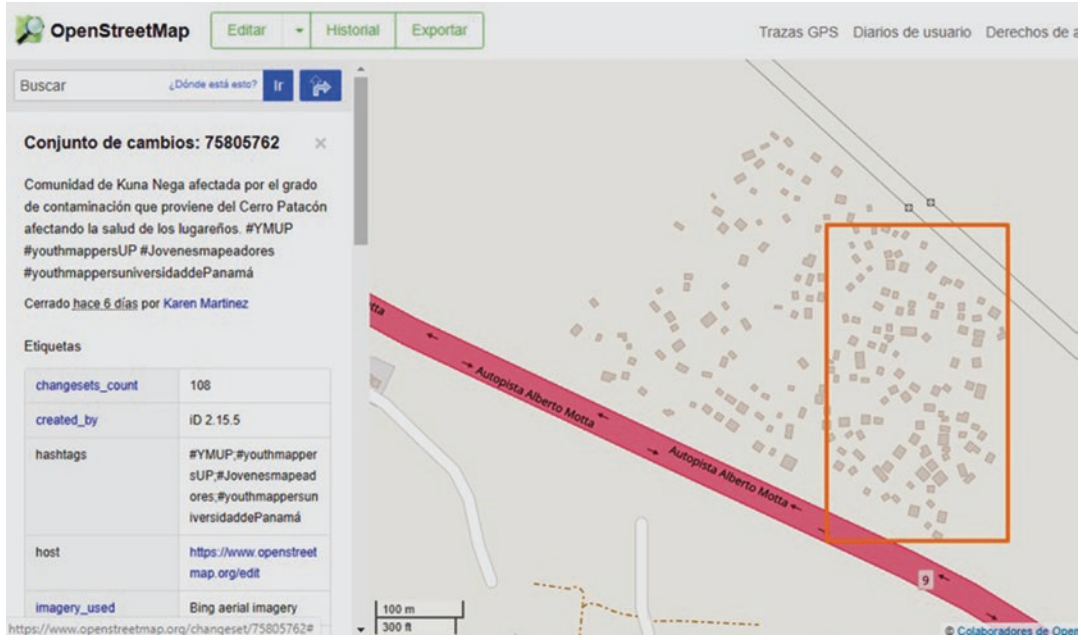

Fig. 17.9 Indigenous communities like Kuna Nega are affected by pollution, so building features are mapped to analyze their location relative to illegal solid waste disposal

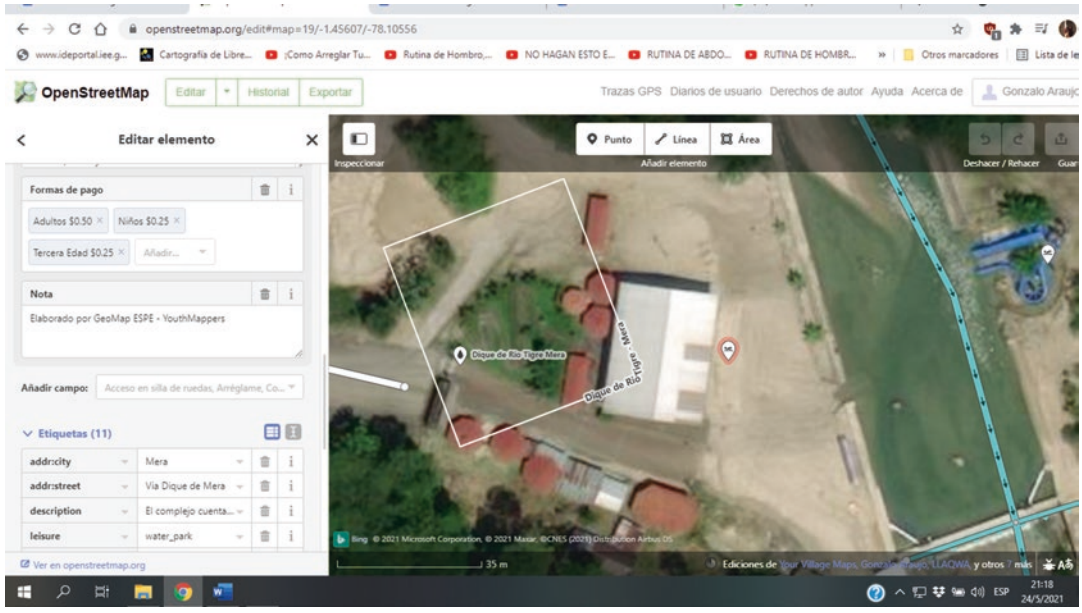

Fig. 17.10 Detailed points of interest attribute mapping on OSM enables YouthMappers in Ecuador to tag important tourist features with information such as ticket costs

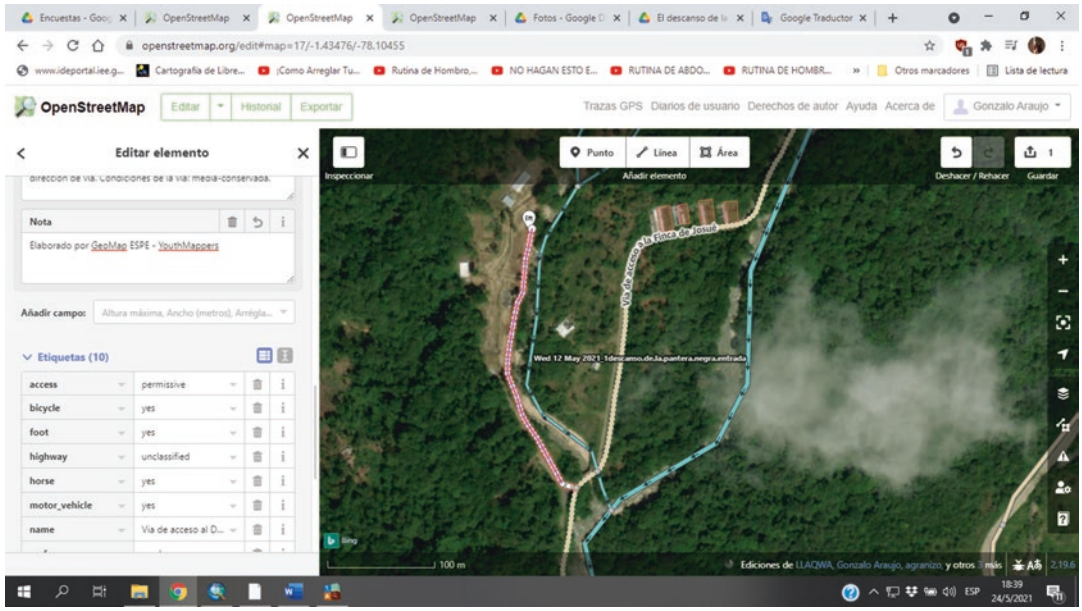

Fig. 17.11 Detailed path feature attribute mapping on OSM enables YouthMappers in Ecuador to tag important tourist routes with information such as bicycle access

were obtained that were published in OSM and are evidenced in a thematic map. The team generated an information matrix with characteristics, activities, and costs of the places that help local residents to be more organized. Finally, training was provided so that the community can learn about its resources, conserve its species and help care for them, preventing them from disappearing (Figs. 17.12, 17.13 and 17.14).

3.4 Ecological Zoning for Conservation and Sustainability

In the eastern area of the province of Panama, in the district of Chepo, a need arises to safeguard biological and hydrological wealth in the face of the negative impact caused by different phenomena such as deforestation, loss of biodiversity, pollution, among others, which from a future perspective could be accompanied by considerable environmental and socioeconomic consequences. YouthMappers propose ecological zoning as a planning and development instrument for the sustainable management of natural resources, specifically considering the relationship between water resources, protected areas, and communities located in the study area. Watersheds are considered the natural units of analysis and planning that in some cases coincide with the political-administrative divisions of the country (Fig. 17.15).

The basin of interest for this research was Number 148 of the Bayano River, represented by the Chichebre and Tranca rivers in the study area. Here there are 21 communities with mainly agricultural and service economic activities.

Panama has approximately 105 protected areas, of which two share an ecosystem relationship in the area of our study: the Tapagra Hydrological Reserve and the Panama Bay Wetlands. The forests of the Tapagra Hydrological Reserve are located on slopes, where the natural forest cover provides an effective barrier against soil erosion and reduces water sedimentation. Therefore, they are vital in maintaining high water quality. Wetlands are highly dependent on freshwater inputs and the healthy nutrients and sediments provided by rivers. In this case, a significant area of the Panama Bay Wetland requires the waters that drain from the Tapagra Hydrological Reserve.

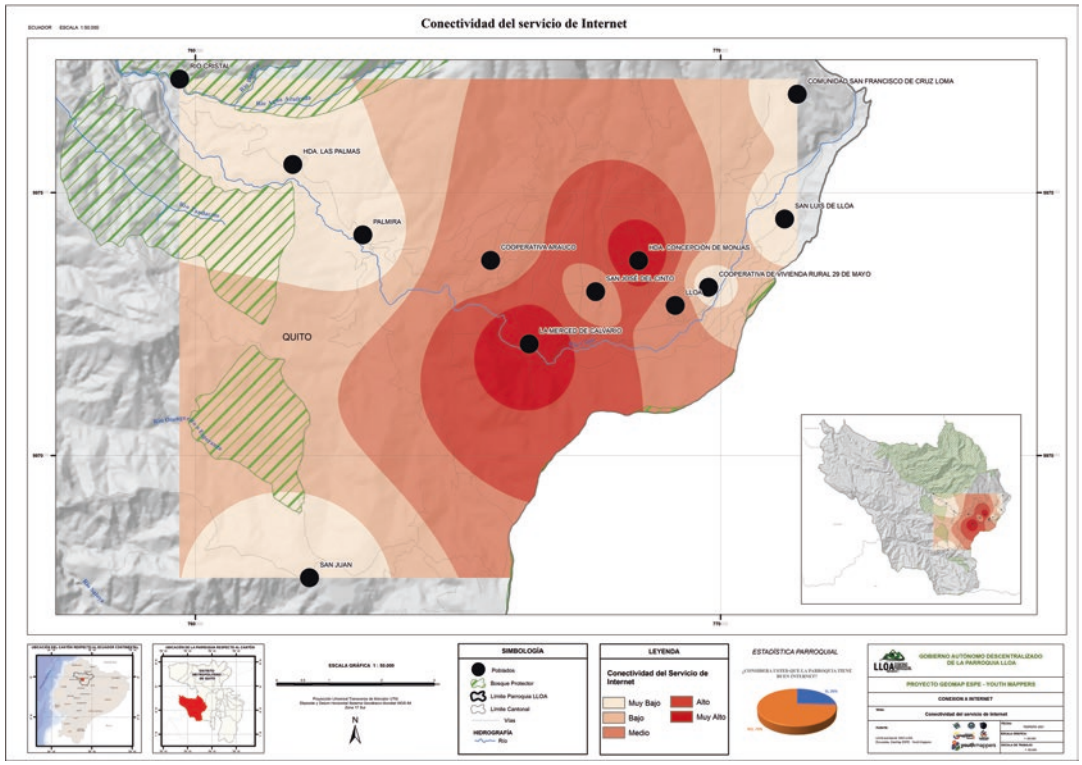

Fig. 17.12 Information from the project contributes to a map of internet service connectivity in the project area

Fig. 17.13 The project informs a master database of tourist attractions in Mera

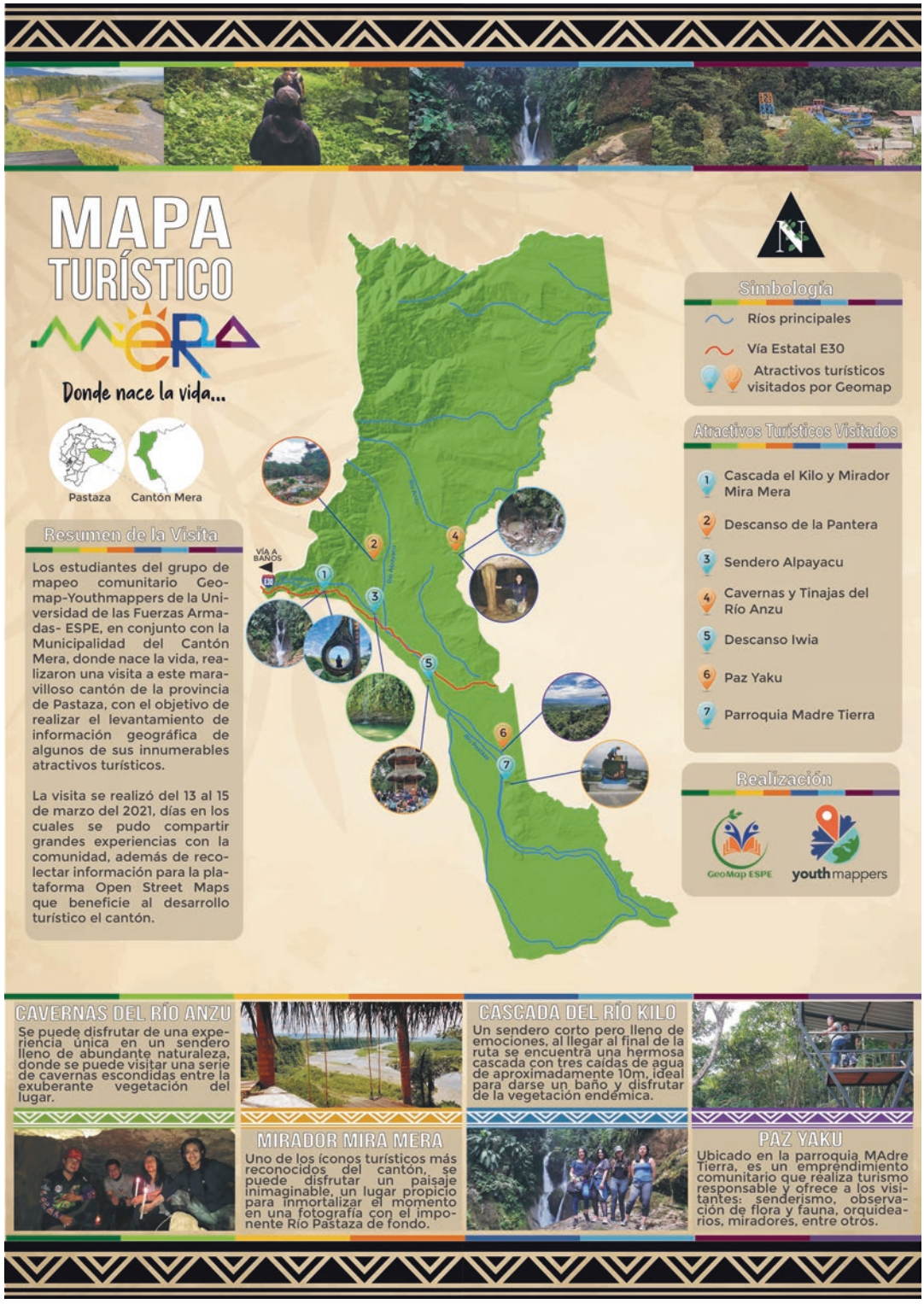

Fig. 17.14 YouthMappers in Ecuador create data on OSM to develop a touristic map of Mera

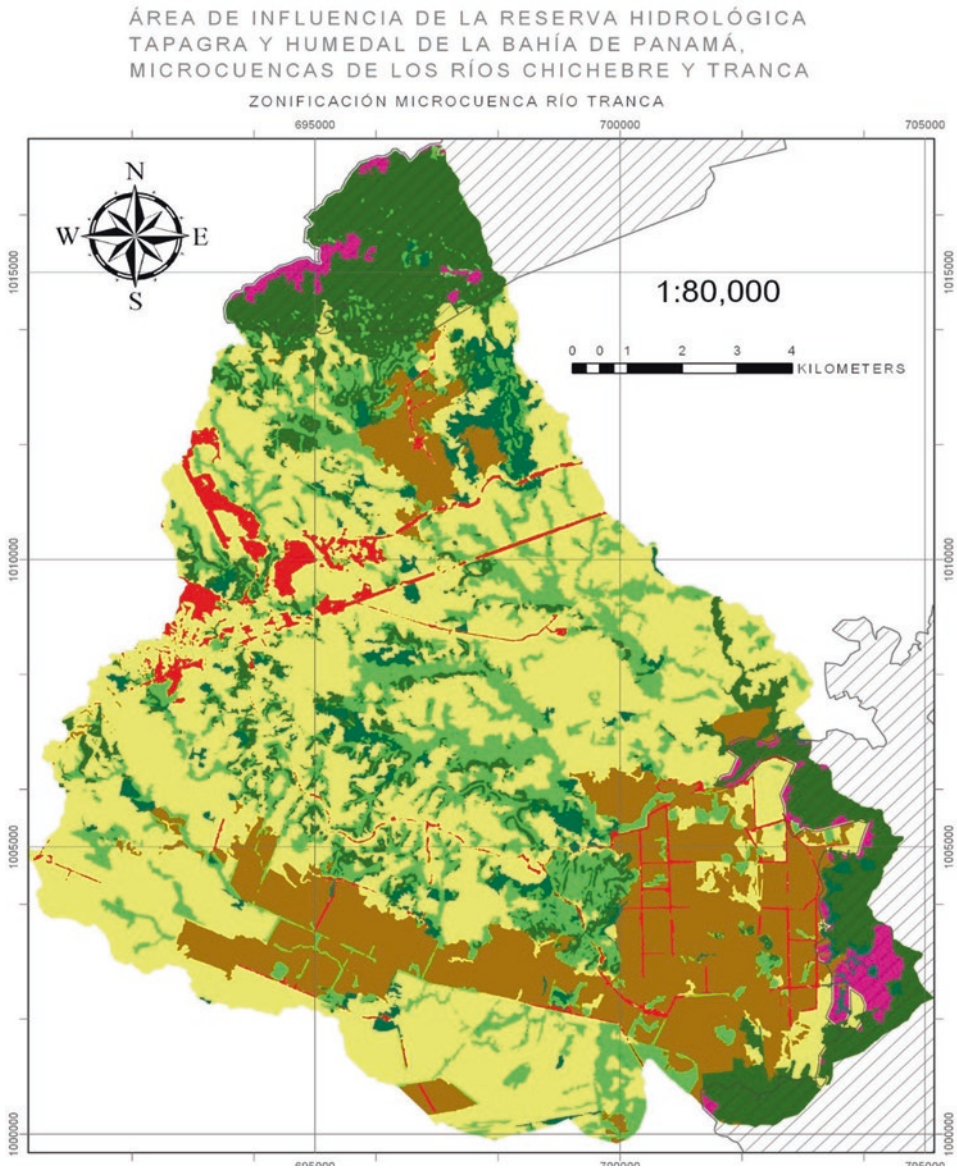

Fig. 17.15 YouthMappers in Panama create data on OSM to inform research in protected areas in the Trancha River watershed

The natural subsystem diagnosis phase of our work required an elevation model to generate morphometric data through geographic information systems tools. In addition to fundamental data from OSM, data on wild flora and fauna, ecosystem services, and socioeconomic and environmental problems were obtained from previous studies, field trips, and statistics. With the diagnostic information obtained, the information was integrated for a holistic analysis, which determined the aspects of the proposed solutions (Fig. 17.16).

Zoning recommendations took into account three factors: slope, land use, and protected areas. The result of the spatial analysis showed seven areas suitable for activities and land use in a compatible way, namely: protection zone, forest restoration, ecological connectivity, live-

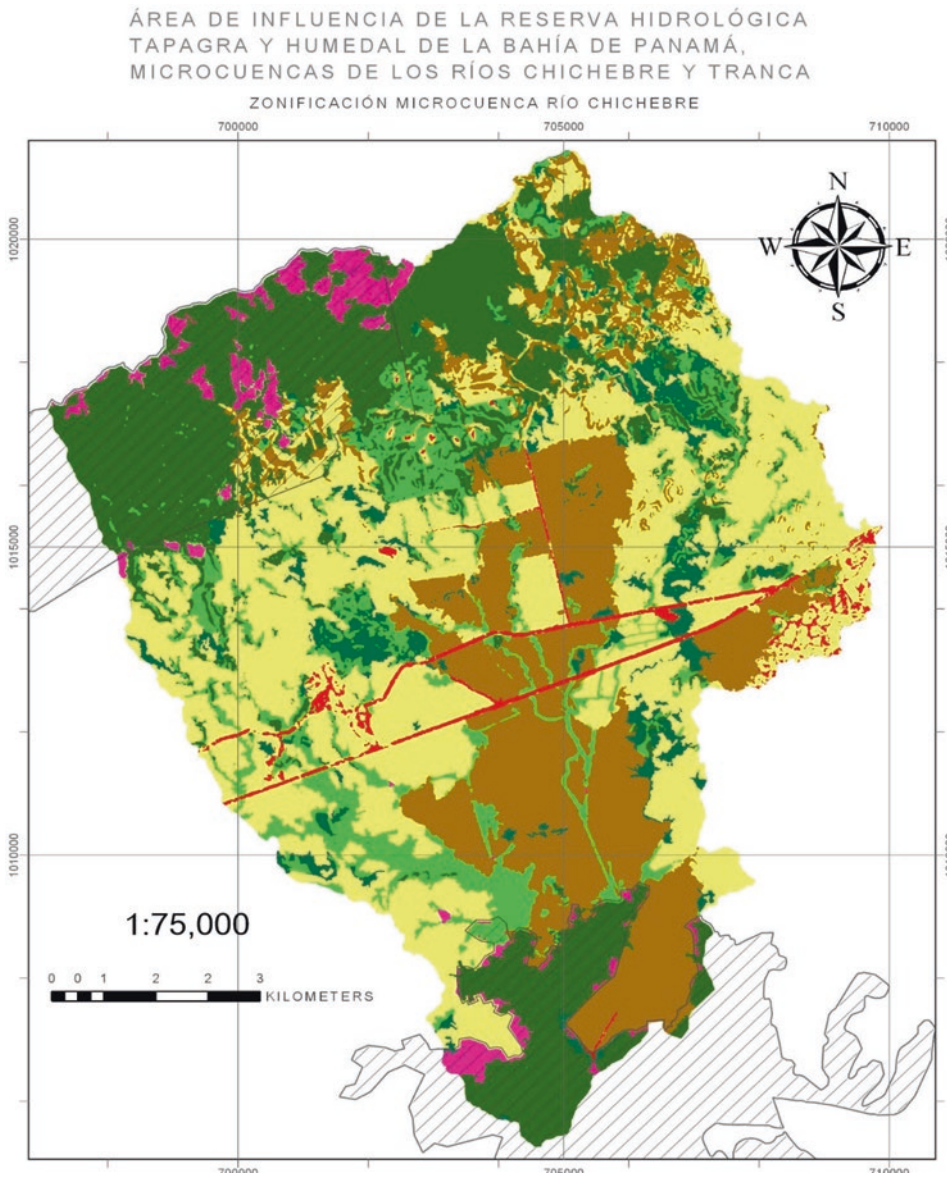

Fig. 17.16 YouthMappers in Panama create data on OSM to inform research in protected areas in the Chichebre River watershed

stock production, agricultural production, forestry production, and urban development and infrastructures.

Our project also frames strategies for food production areas, with the adaptation of agricultural, livestock, and forestry practices, promoting the adequate use of water, soil conservation, and use of trees and crops with the ability to adapt, in order to mitigate the environmental effects. This would benefit rural development and food security alike.

Guidelines and strategies for the conservation of biodiversity are also proposed, and the importance of the environmental services offered by wetlands. In this case, a vital area of the Bay of Panama is highlighted. From visualized patterns, a framework was generated to manage and protect in a sustainable way the coastal ecosystems

that are affected, for the most part, from terrestrial sources, as a result of anthropogenic activities, such as agriculture, livestock, deforestation, and poor disposal of solid waste.

Finally, we offered recommendations for policy makers to sustainably manage the forests, both in the protected areas and in the gallery forests that extend along the rivers, and reduce desertification, soil degradation, and stop the loss of wild flora and fauna, through the guidelines and strategies proposed in the Protection and Restoration Zones.

3.5 Mapping Trees and Palms Around Old Panama Historic Monument

The intersection of environmental and cultural assets is a ripe place for the kind of work we promote. In the historic old sector of Panama City, in an area administered by the Board of Trustees, is an important monument to the national heritage, a park surrounded by the modern city of Panama, off the coast of the Pacific Ocean. This site aims not only to tell the history of Panama, showing the ruins of the first European settlement on the American Pacific coast, as well as a series of vestiges of the first inhabitants of the Isthmus, but also, through the aesthetics of the trees, it shows us the natural history in a well-known, visible site, interacting the human legacy with animals and plants.

We took an inventory of the entire extent of arboreal vegetation which allowed us to know the health status of each of the trees and palms within the study area and to serve as the basis to provide necessary recommendations for their maintenance. Each one of the uses of these trees, their state of conservation, was shown to the public and alliances were achieved with the aim of conservation, among the Board, the University of Panama through YouthMappers, and Esri Panama for the continuation of related activities that highlight the importance of our national monuments. historical sites and the surrounding environment. We produced web resources such as location maps, web applications, and Story Maps of the project process itself (Fig. 17.17).

3.6 Smart Campus as a Model of Resilient Inclusive Innovation

The Smart Campus University of Panama project centres on the creation of an app that contains

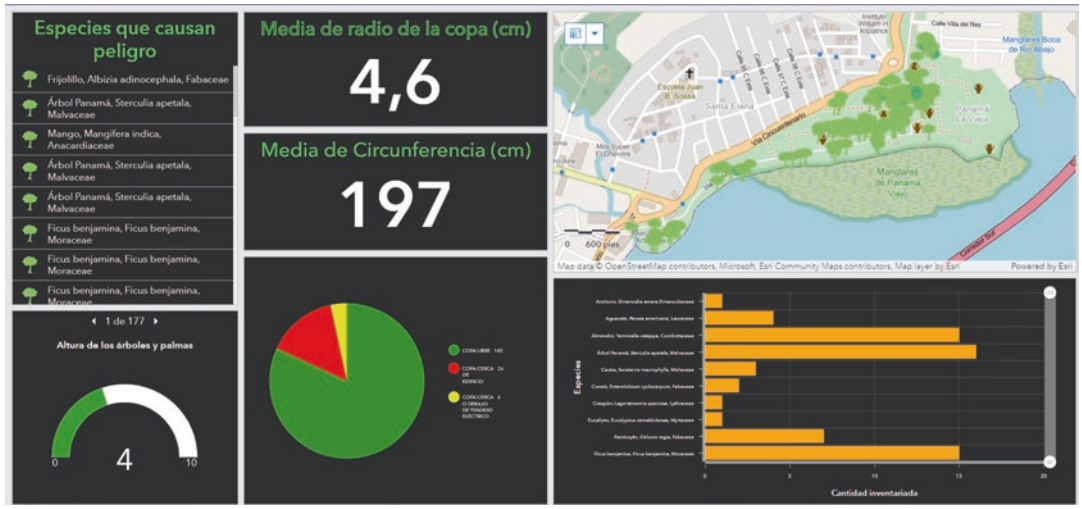

Fig. 17.17 Tree data mapped onto OpenStreetMap near a historic monument in Old Panama City combines with a dashboard to monitor species health

interactive maps in 2D and 3D. The app shows the facilities and infrastructure found within the campus – from multi-story details of the built environment to the environmental features of tree-lined paths. The project aims to create a more friendly and inclusive university from the point of view of giving the public open access to everyone on the location of its infrastructures, maintenance, and making the administrative processes more efficient (Fernández 2017; Nedwich 2018). For instance, a good understanding of where the broken sidewalks can help students and faculty with mobility challenges, location of poor lighting to improve the safety of women, and general knowledge about how to find collaborators on campus can all make it that much easier for the community to collaborate on research. The incorporation of this technology promises to improve the quality of life not only of those who work or study there but also of the members of society who visit the University of Panama (Fig. 17.18).

The project has been developed and implemented in phases starting with training of techno-

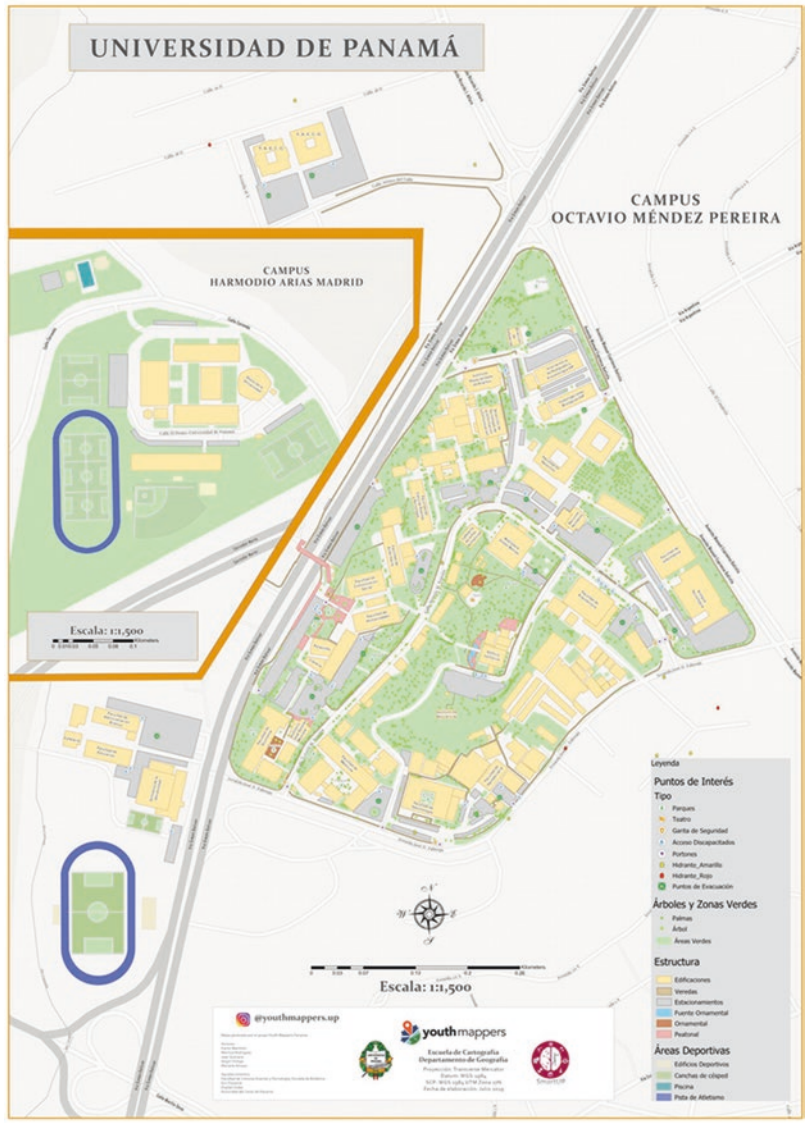

Fig. 17.18 YouthMappers at the University of Panama launch a smart campus mapping program

Fig. 17.19 Smart campus mapping at the University of Panama is visualized in 3D

logical tools for the collection of geographic information of the infrastructures, the elements around the campus, and inventories. We thus proceed to the creation of digital maps, achieving the survey of the campus editions in 3D. We next worked on developing web applications for use by the general public. Then a drone flight was carried out on the campus for a new methodology that supported the analysis and updating of information. Finally, a database portal was created for the University of Panama that is open and used broadly (Fig. 17.19).

The development of this project includes projects by students and professors from various campus faculties and with the support of public and private companies.

This project also makes visible the main challenge of the University of Panama, particularly the need to continue to move towards an intelligent and sustainable campus model, achieving the integration of data and the university community for decision-making and actions without losing sight of the integral way the university is part of the context of the city.

4 Towards an Equitable Resilient Future

At present, collaborative work and the use of geographic information are vitally important skills for obtaining information that benefits the Latin American community. Truly, community geography is an important framework for this action towards a more equitable future (Shannon et al. 2020), but also the spatial component that we obtain from geography within other aspects can be considered as a whole if we also seek resilience. For this, it needs components that cross boundaries that are social, economic, cultural, ecological, biodiverse, and inclusive, among others, and that comply with the sustainable development objectives, in order for these efforts to generate open data, embedded solutions, and helpful decision-making.

In this way, YouthMappers in and from Latin America made a path to different approaches that today allow us to tell our experiences lived within each project, gain great learning, and, above all, grow as human beings by serving. Each challenge and each success make us *modelers within the communities*, working with them to be resilient, entrepreneurial, and successful, having the sole impulse to help the community that surrounds us and precisely wanting to make the change; daring to do things differently and loving our world. The final proof will be in the adaptation we have made by handling digital tools for the creation of each project and its dissemination.

This work teaches us that small changes can lead to great achievements. Working hand in hand across communities as university students, neighbours, and friends, it has been possible to

create a series of projects in our part of this little handkerchief called the world.

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