GIS Mapping for Peace Corps

Jeremy Huey

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GIS Mapping for Peace Corps

Jeremy Huey: Capstone
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6/04/2012 GIS Implementation Plan Assignment University of Denver
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### Acronyms

<table>
<thead>
<tr>
<th>Acronyms</th>
<th>Translations</th>
</tr>
</thead>
<tbody>
<tr>
<td>APCD</td>
<td>Associate Peace Corps Director</td>
</tr>
<tr>
<td>DEM</td>
<td>Digital Elevation Model</td>
</tr>
<tr>
<td>ESRI</td>
<td>Environmental Sciences Research Institute</td>
</tr>
<tr>
<td>FARC</td>
<td>Fuerzas Armadas Revolucionarias de Colombia (Revolutionary Armed Forces of Colombia)</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information Systems</td>
</tr>
<tr>
<td>IDW</td>
<td>Interpolation Distance Weighted</td>
</tr>
<tr>
<td>USGS</td>
<td>United States Geological Survey</td>
</tr>
</tbody>
</table>
Abstract

International volunteerism programs, such as the Peace Corps, find interested, educated men and women to live abroad in order to help local communities in need of assistance. The goal of this project is to create maps intended to enhance the training of those volunteers. When volunteers leave training programs and head to their prospective service communities, a certain period of time is needed in order to obtain a full grasp of the terrain, boundaries, weather, climate etc. A more effective training program, which incorporates maps of regional climates, environments, landscapes, cultures and resources, will lead to more effective volunteerism. By having these maps during the training period, a volunteer will arrive at their community with a greater set of knowledge. This project provides maps that will supplement an existing training regime in order to create more effective volunteers.
Introduction

Peace Corps has three objectives, “helping the people of interested countries in meeting their need for trained men and women, helping promote a better understanding of Americans on the part of the peoples served and helping promote a better understanding of other peoples on the part of Americans (Peace Corps).”

Created in 1960 by John F. Kennedy, Peace Corps challenges Americans from all age groups to volunteer with other countries and cultures around the world.

Once a Peace Corps volunteer has been selected to serve, he or she is given a training date and flown to their new country. At this point, a two month training process begins where all the volunteers in a group are individually placed with a host family in one central location. Volunteers’ days are typically comprised of a four hour language training session in the morning, followed by four hour job specific training in the afternoon. It is for that four hours of job specific training this project intends to create visual aids via a GIS. Again, while all volunteers can benefit from these maps, environmental health volunteers will benefit the most (further explained in Pilot Project portion).

The Peace Corps trains men and women to perform many different jobs in many different countries including, but not limited to, education, youth & community development, health, business, information & communication technology, agriculture,
environment, HIV/AIDS initiatives, food security projects and more. During training, volunteers, especially environmental health volunteers, will be given education on the country’s cultures, landscape, seasonal weather patterns, boundary zones (administrative, political, or even zones of unrest) and other general information of the country. It is during these points of volunteer’s training where visual aids will help volunteers form a better spatial understanding of this information.

While a basic understanding of service regions can be attained through training and conversations with the locals, adding map data to volunteer training will benefit volunteer organizations and the recipient communities. If an environmental volunteer can start his or her stint in a community with knowledge of the landscape on par with that of a local, then a more positive impact can be made with the volunteers’ time in the host community.

This project involves developing tailored maps that will be integrated into the two month training period with specific geographic focus on Panama. The aim is to incorporate maps into an already well rounded training course in order to further the volunteer’s knowledge of the landscape that awaits him or her. This capstone project will add another level of environmental and spatial awareness to a volunteers training regime in order to produce a more efficient and effective volunteer.
Literature Review

A GIS (Geographic Information System) will ultimately become crucial to the success of this project's future as more sophisticated maps with large data sets may eventually be created (for details see Project Implementation). As defined by the USGS (United States Geological Survey), "a GIS is a computer system capable of capturing, storing, analyzing, and displaying geographically referenced information; that is, data identified according to location. Practitioners also define a GIS as including the procedures, operating personnel, and spatial data that go into the system" (USGS 1). A GIS will allow data to be presented geographically in a visual format.

Already, the idea of incorporating GIS (Geographic Information System) into international volunteerism for relief efforts in developing countries has been done by GIS Corps. The GIS Corps is an organization that started in 2003 and utilizes GIS savvy volunteers in order to aid in humanitarian assistance across the world. Volunteers typically meet in online chat groups, from across the US and discuss current world events in order to determine if a GIS can help support relief efforts. GIS Corps doesn't sponsor projects directly but works with partner agencies and has assisted efforts in places like Haiti, and during Hurricane Katrina (GIS Corps).

Literary journal articles such as Uttal's "Seeing the big picture: map use and the development of spatial cognition" illustrates why the maps that are being created for this
Projects are important, and how they will be viewed from a non-cartographer's perspective. Using maps to educate newly forming thoughts of a foreign environment allows us to "transcend our direct experience of the world and think systematically about relations among multiple locations" (Uttal 247). Most importantly, a volunteer should be able to transcend his/her own location or temporal space and think about the community's surroundings, topography, future and past weather patterns, and even make spatial correlations.

For example, when presented with certain types of maps, will the volunteer understand what they are looking at? That is to say, while maps can create a spatial representation of regions outside our field of vision or spatial knowledge, will all maps be clearly understood? While a GIS can create overly complicated maps full of data, it is important that "every map has a specific communication objective" (Sila 109). This simple but important concept has guided the development of each map produced for volunteer training.

Bocco (2001) points out how land-use planning in developing countries is central in maximizing natural resources and how different groups in Mexico typically belong to different types or parts of the land. For example, the majority of the people are found among rural communities, while indigenous populations may be found in and around
the remaining jungle environments. This is very important to consider as nearby resources may not always be available to other groups.

Panama, much like the example from Mexico, has eight different groups of people including Latinos, Kuna, Embera, Waounan, Ngabe, Bugle, Nassau, and the Teribe people spread and mixed across nine provinces. Resources that may seem nearby for one group or community may not belong to that particular group. Thus, having a basic understanding of the land cover, regional boundaries and cultural epicenters is also very important.

Purpose

The purpose of this pilot project is to introduce Peace Corps Panama to maps created through a GIS and start a dialog with the current APCD’s (Associate Peace Corps Director) about future mapping requirements. The current project maps, created for this project, have been designed by manipulating existing data (see database design portion) into basic maps; these maps will be used as visual aids during training. While much of the maps created thus far are basic and do not require a powerful GIS, future maps created by the researcher for Peace Corps Panama may require ESRI’s (Environmental Sciences Research Institute) ArcMap applications.
Plan Participants

Initially, this project implementation plan will be sent to the current country director, Brian Riley, and the various APCD’s of Peace Corps Panama. The APCD’s are the instructors who teach and assist volunteers in one of the five programs: agriculture, environmental conservation, environmental health, community economic development, and the tourist and English advising program. The implementation of this plan will greatly depend on the APCD’s desire for tailor made GIS maps.

Project Area Map

The Peace Corps currently deploys volunteers to 70 countries across the world and on every continent except Antarctica. Because of the researcher’s knowledge of Panama, as a past Panama group #64 volunteer, a pilot project will be performed here.

Panama shares an eastern border with Colombia (W -77.1 Longitude), and a western border with Costa Rica (W -83.05 Longitude). The southernmost point in Panama sits about 500 miles north of the equator in the Pacific Ocean (N 7.2 Latitude), and the northernmost point rests in the Caribbean Sea (N 9.7 Latitude). Panama’s climate is tropical with an average rainfall of one inch per day. Panama has nine provinces and is rich in cultural diversity. The highest point in Panama is Cerro Volcan Baru, whose elevation is 3,475 m (11,468 ft.) above sea level (Diplomacy in Action 1).
Project Organization

The implementation of this project can start immediately after the proposal is submitted to the Peace Corps Panama office. Peace Corps Panama has many different types of volunteers including: agriculture, environmental conservation, environmental health, community economic development, and a tourist and English advising program. Each program is typically taught two at a time, at different times of the year, and with different instructors. Ideally, the instructor of each program will communicate their individual mapping needs to the researcher. For example, if the
tourist and English advising program needs a map created that highlights all the tourist information centers and travel agency offices around Panama, the researcher would be able to create one once the instructor of the program collects the appropriate data.

While a GIS and tools such as Google and Google Earth may be able to collect some of the data necessary, having a person in country to aid in confirming the data will be crucial in creating accurate maps. Data resources central to creating training aids are not available in products such as Google, GIS databases and libraries will play a key role in the creation of the educational products for this project. Other information that is readily available to Peace Corps Panama such as FARC (Fuerzas Armadas Revolucionarias de Colombia/Revolutionary Armed Forces of Colombia) safety lines and restriction borders, criminal activity in the city where volunteers should not go, areas where volunteers are encouraged to go, etc., should be given to the researcher in order to immediately create more useful maps for volunteer training.

**Project Goals**

- Introduce Peace Corps Panama to maps created with a GIS
- Demonstrate how the current maps could be useful in a training setting
- Start a dialog with Peace Corps Panama about future map needs
- Start a dialog with Peace Corps Panama about their current data, and how it could be used in future projects and educational planning
Current Environment Analysis

Currently, Peace Corps Panama uses few or no maps during training. While many handouts are printed and given out daily, maps or spatial data are not provided to volunteers. Training in rural areas of Panama under a palm-thatched roof or jungle canopy, RPCD’s have few options. Although, once a week volunteers are taken to a conference room outside of the training town, where Peace Corps volunteers reside with host families, and are given PowerPoint® lectures. These weekly training periods would be an ideal setting for introducing volunteers to this type of data.

Needs Assessment

A training program which incorporates maps of regional climates, environments, landscapes, cultures and resources, will lead to more effective volunteerism. Also, once RPCD’s have had a chance to communicate with the researcher what type of GIS maps would be most beneficial their individual program, even more specialized visual aids can be provided to each educational platform. These maps, presented during the training period, will further a volunteer’s training experience and expand upon his or her knowledge. This project provides maps that will supplement an existing training regime in order to create more effective volunteers.

Application Description

The shapefiles and data used for this project were predominantly collected from NASA’s Echo Reverb website and ESRI ArcGIS online. ESRI uses many sources for
their data library, and each original source has been listed below in the Conceptual Database design portion of this implementation plan. The majority of the data was manipulated (see Pilot Project section) to form a final product for this mapping project.

**Conceptual Database Design**

<table>
<thead>
<tr>
<th>Layer Name</th>
<th>Type</th>
<th>Source</th>
<th>Maps Created</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration</td>
<td>Polygon</td>
<td>Peace Corps Locations, Panama Hydrology, Panama Precipitation, Panama Temperature, Panama Cultures</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>Point</td>
<td>G:\GlobalGIS\database\mapbase\c_atmos\tmp.shp</td>
<td>Panama Temperature</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Point</td>
<td>G:\GlobalGIS\database\mapbase\c_atmos\tmp.shp</td>
<td>Panama Precipitation</td>
</tr>
<tr>
<td>Cobboscosa2000 / Land use</td>
<td>PNG</td>
<td><a href="http://mapserver.stri.si.edu:8399/arcgis/services">http://mapserver.stri.si.edu:8399/arcgis/services</a></td>
<td>Panama Land Use</td>
</tr>
<tr>
<td>Oceanic Base map</td>
<td>Grid</td>
<td><a href="http://services.arcgis.com/ArcGIS/services">http://services.arcgis.com/ArcGIS/services</a></td>
<td>Panama Hydrology, Panama Precipitation, Panama Temperature, Panama Land Use</td>
</tr>
<tr>
<td>Light Grey Canvas Base map</td>
<td>Jpeg</td>
<td><a href="http://services.arcgis.com/ArcGIS/services">http://services.arcgis.com/ArcGIS/services</a></td>
<td>Panama Cultures</td>
</tr>
<tr>
<td>Panama Aster DEM</td>
<td>DEM</td>
<td>NASA EOSDIS; <a href="http://reverb.echo.nasa.gov">http://reverb.echo.nasa.gov</a></td>
<td>Panama Hydrology, Panama Land Use</td>
</tr>
</tbody>
</table>


**Functional Requirements**

While the hardware and software are currently fulfilled by the researcher, Peace Corps Panama should be aware of the GIS requirements should it ever have a desire to create data in house. A single use ArcMap 10 with a Spatial Analyst extension license on a newer computer (see hardware and software requirements) was used to create all maps shown in this research. A single use ArcMap 10 software package costs $1,500.00 USD, and the Spatial Analyst extension costs $2,500.00 (ESRI Store).

**Hardware and Software Requirements**

Currently, all hardware and software requirements are fulfilled by the researcher in order to implement this project; the researcher will provide all necessary hardware and ArcMap 10 software until 5/15/2013 when this temporary license will expire. Once this license expires, a new license may be obtained for free through ESRI’s Nonprofit Organization Program (ESRI). Months before the license expires, the researcher will contact ESRI for further details on license arrangements. Also, see minimum system requirements below for ESRI’s suggested hardware requirements (ESRI System Requirements).
### System Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CPU Speed</strong></td>
<td>2.2 GHz minimum or higher; Hyper-threading (HHT) or Multi-core recommended</td>
</tr>
<tr>
<td><strong>Processor</strong></td>
<td>Intel Pentium 4, Intel Core Duo, or Xeon Processors; SSE2 (or greater)</td>
</tr>
<tr>
<td></td>
<td>Run this Microsoft utility from your Windows command prompt to check your processor.</td>
</tr>
<tr>
<td></td>
<td>See Dual or dual-core support policy.</td>
</tr>
<tr>
<td><strong>Memory/RAM</strong></td>
<td>2 GB or higher</td>
</tr>
<tr>
<td><strong>Display Properties</strong></td>
<td>24 bit color depth</td>
</tr>
<tr>
<td><strong>Screen Resolution</strong></td>
<td>1024 x 768 recommended or higher at Normal size (96dpi)</td>
</tr>
<tr>
<td><strong>Swap Space</strong></td>
<td>Determined by the operating system, 300 MB minimum.</td>
</tr>
<tr>
<td><strong>Disk Space</strong></td>
<td>2.4 GB In addition, up to 50 MB of disk space maybe needed in the Windows System directory (typically C:Windows\System32). You can view the disk space requirement for each of the 10.0 components in the Setup program. If using ArcGlobe (as part of 3D Analyst), additional disk space may be required. ArcGlobe will create cache files when used.</td>
</tr>
<tr>
<td><strong>Video/Graphics Adapter</strong></td>
<td>Check your computer's ability to run ArcGIS</td>
</tr>
<tr>
<td></td>
<td>64 MB RAM minimum, 256 MB RAM or higher recommended. NVIDIA, ATI and INTEL chipsets supported</td>
</tr>
<tr>
<td></td>
<td>24 bit capable graphics accelerator</td>
</tr>
<tr>
<td></td>
<td>OpenGL version 2.0 runtime or higher is required, and Shader Model 3.0 or higher is recommended. Be sure to use the latest available driver.</td>
</tr>
<tr>
<td><strong>Networking Hardware</strong></td>
<td>Simple TCP/IP, Network Card or Microsoft Loopback Adapter is required for the License Manager.</td>
</tr>
</tbody>
</table>

#### Figure 2: System Requirements

**Pilot Project**

The initial maps created for this project are shown in Appendices 1 - 21. The maps are divided into four sections: land use, precipitation and temperature, provincial hydrology, and cultural mapping. Descriptions of how the maps have been created,
followed by a brief description of how these maps can be used in training have been provided.

The ASTER DEM (Digital Elevation Model) provided from NASA came in 18 one degree tiles, extents 7 to 10 degrees north and 77 to 83 degrees west, and were mosaicked together into a single DEM. The Extract by Mask, a spatial analyst tool, was then used with the Panama polygon in order to create a DEM without ocean values. The DEM, now clipped within the country's borders was inserted between the basemap and the main layer of the map. Because layers can be given a transparency value in ArcMap, placing a DEM's hillshade between a basemap and a layer with a transparency value gives the map the illusion of depth.

Land Use Mapping

The land coverage mapping for this project was created by using three different layers (Appendix 1). The primary shape file for this project came from Panama's own database, and shared with ESRI. The other shape files used for this map were an ocean background map obtained from ESRI online, as well as a DEM of Panama which was obtained from NASA (National Aeronautics and Space Administration). The map was composed using the ocean layer as a basemap, clipping the DEM of Panama to create a hillshade effect for the entire country, and then placing the land use layer on top of the
DEM at a transparency level of 35 percent. This effect gave Panama’s land cover map more depth.

The land coverage map shows 16 different categories of land coverage types. These coverage regions range from new to old forests, agriculture, mangroves and protected forests. The most important aspect of this map, especially for environmental health volunteers, is to understand how the forest is shaped around the country, and what areas are more arid and void of dense forest. This is important information as many of the projects done by environmental health volunteers within their communities are aqueduct and/or sanitation projects such as latrine building. If a volunteer is placed in a dense forest scenario, aqueduct planning and placement becomes very complicated. On the other hand, if a volunteer, especially environmental health volunteer, is placed in a more arid region of the country, building materials such as lumber for latrine housing or riverbed sand for clay ovens are incredibly scarce.

This information presented to a volunteer during his or her training could open a dialog about how to accomplish certain tasks with minimal resources. A volunteer heading to a grassland region with minimal tree coverage could advance his or her knowledge during training by learning adobe or mud brick latrine housing. Likewise, a volunteer heading to a dense forest environment could focus on aqueduct planning for dense forest scenarios. For example, creating rope bridges for PVC tubing to rest on
when passing over obstacles such as gorges, cliffs, or even rivers would be a great use of a volunteer's time in this scenario.

**Temperature and Precipitation Mapping**

The temperature and precipitation mapping for this project were created with two different layers (Appendices 2-9). The first layer is the oceanic base map, a default base map provided by ESRI. The second layer is a gridded point map, provided by the USGS. This point map was interpreted into a raster by using the IDW (Interpolation Distance weighted) interpolation tool in order to construct the isohyets and thermoclines. Each set of temperature and precipitation maps have four maps per set as a quarterly report of average temperature and precipitation has been provided with the original dataset.

These maps present quarterly precipitation and temperature data in order to prepare volunteers for the climate and conditions they can expect from their new region. For example, trying to work on projects that require concrete to set and dry will be a difficult task during the wet season. Appendix 5 illustrates a high level of precipitation in Bocas Del Toro during the months of September through November, rendering concrete and brick work infeasible. Although a volunteer will gain this information while *in situ*, learning of it beforehand will allow the volunteer to acquire compensatory skills during initial training.
Likewise, regions of the country can expect arid and hot months that can be equally challenging to work. Los Santos is a perfect example of how extreme heat and low precipitation can debilitate project progress. As seen in Appendix 2, the months of December – February offer Los Santos little precipitation and little drinking water, while Appendix 7 illustrates the high average temperatures in the months of March – May. This creates problems with large scale projects during these periods. Volunteers will be able to make better project planning decisions and schedules, with their community, using these maps.

Hydrology Mapping

The 11 hydrology maps provided have been created with four layers (Appendix 10-20). The background layer for all the hydrology maps is the oceanic base map from ESRI. The borders of each individual province were created from a borders layer by selecting all borders contiguous with that region and exporting the selected borders as a new shape file. The DEM for Panama has been layered on top of the oceanic layer, between the hydrology layer which has been given a 35 percent transparency in order to give the hydrology maps more depth by allowing the DEM to add shading. Finally, a second data frame has been added to all hydrology maps, in which a small frame of Panama is shown with a highlighted province in order to allow the reader a visual reference for the region's location.
As an environmental health volunteer, one of the most critical mission goals is to help the community find a reliable source of potable water. The hydrology maps will give a volunteer a general idea of how the watershed, main water networks and secondary water networks traverse his or her region. While each region appears to have several options for water, the dry seasons, dams, overuse of individual water systems and even pollution lead to low potable water levels.

Because community leaders may not know all water sources within their region, this type of mapping may also uncover resources unknown in the target communities. Unfortunately, many residences of small communities never leave their immediate region and information about other water systems would be a valuable asset. If a volunteer is to help a community find its best option for potable water, these undiscovered water sources should be included. While these maps are not at such a large scale that a volunteer will be able to see every stream or river in the region, the larger systems are illustrated well enough that a volunteer can get a sense of where other water sources may exist.

Cultural Mapping

The cultural mapping as seen in Appendix 21 has nine layers, an oceanic basemap and a provincial boundary layer make up the map's background. In order to create a map that illustrates nine different cultures, many sharing the same provinces,
Each culture listed has individual data frames with highlighted provinces. For example, the Latinos of Panama reside in all regions but San Blas so all provinces except San Blas were highlighted, given a color and exported into their own data frame. The same process was repeated with all groups. The Naso and the Teribe cultures share a data frame, as they both reside in the same two provinces of Panama.

During training, a volunteer will learn about each of these cultures. The volunteer will be given the map as a reference during training. This map, in conjunction with other maps, will provide further insight into a certain culture’s annual precipitation, temperature and hydrology patterns. Used together, the set of maps can help a volunteer form a fuller picture of the environment that awaits them after training.

Personnel Requirements

In order to create more maps for future training, APCD’s will need to communicate their needs to the researcher and help with the collection of pertinent data. Some country specific data may not always be readily available to the researcher such as newly updated FARC safety line information, new volunteer restricted zones, etc.
Training Requirements

Should Peace Corps Panama ever desire to own a copy of ArcMap 10 and a Spatial Analyst extension, there are several training options for software participants. Firstly, the researcher can help provide any data already obtained to date and help guide new users to an end goal or product. Secondly, ESRI has several training books which even come with free four month trial subscriptions. The latter would help Peace Corps Panama cheaply decide if this product is a good fit for the organization.

Summary

In summary, this project strives to inform volunteers of their new landscape, via maps during training, in order to ensure their knowledge of the region is at such a level that the volunteer can help lead their community to the best project planning decisions. This information is not meant to replace or contradict local knowledge but to enhance it by empowering volunteers to guide local peoples in creating a sustainable solution to resource management. Although much more mapping could be provided for Peace Corps Panama, not all data is currently available to the researcher. Further action is now required on behalf of the Peace Corps Panama Country Director and APCDs in order to continue creating more maps for volunteers.
Next-Step Action Plan

With the help of the researcher, Peace Corps Panama can immediately start implementing even more visual data into the existing training program. These maps will have a positive impact on project planning and lead to more effective volunteerism.

Many cultures and regions across the world in need of aid do not have internet communication. Therefore, it is not sustainable to give these maps to anyone but volunteers.

Sustainability is of the utmost importance for worldwide relief and volunteerism. Because this project lends itself to worldwide relief and volunteerism, sustainability is also a concern for GIS mapping. Because a community would not normally have access to this type of data, a volunteer should not dictate community projects based on these maps. A volunteer should only use these maps as reference and make a strong attempt to use this information to ask leading questions of the community leadership that will help the community to arrive at the best decisions.
Bibliography


March - May: Average Panama Precipitation

Three Month Average Rainfall (MM)

High: 751
Low: 298

0 25 50 100 150 200 Kilometers

Atlantic Ocean

Bocas del Toro
Chiriqui
Veraguas
Herrera
Los Santos

Colón
Panama
San Blas

Golfo de Panamá

Pacific Ocean

Colo Rico
September - November: Average Panama Precipitation

Three Month Average Rainfall (MM)

- High: 1576
- Low: 792

Other regions mentioned in the map include:
- Bocas del Toro
- Chiriquí
- Veraguas
- Colón
- Panamá
- San Blas
- Herrera
- Los Santos
- Darién

The map shows the average rainfall in millimeters across different regions of Panama during September to November.
December - February: Three Month Average Temperature

Degrees °C
- 17.1 - 18.0
- 18.1 - 19.0
- 19.1 - 20.0
- 20.1 - 22.0
- 22.1 - 23.0
- 23.1 - 24.0
- 24.1 - 25.0
- 25.1 - 27.0

Kilometers

Costa Rica
Bocas del Toro
Chiriqui
Veraguas
Coclé
Colon
San Blas
Panama
Darién
Columbia
June - August: Three Month Average Temperature
Appendix 14

Cocle Hydrology

Legend

- Cuencas
- Red Primaria
- Red Secundaria
- Cocle Boundary
The Cultures of Panama By Province

Naso/Teribe

Latino

Bugle

Embera

Ngabe

Kuna

Wounan

Afro-Antillean