National Protected Area Systems Analysis
Human Footprint

Introduction

The human footprint is an important component of a protected areas planning exercise. The underlying thought is that conservation planning needs to look at the human footprint on the landscape since the human population already occupies a part of that landscape and will ultimately extend this influence.

An human footprint layer is also an integral part of the MARXAN analysis[1] that was carried out for the NPAPSP analysis.

Several initiatives have presented human footprint analysis for the region. Both terrestrial and Marine. Often such analysis are called threat assessments especially when they also include natural factors such as hurricanes and floods.

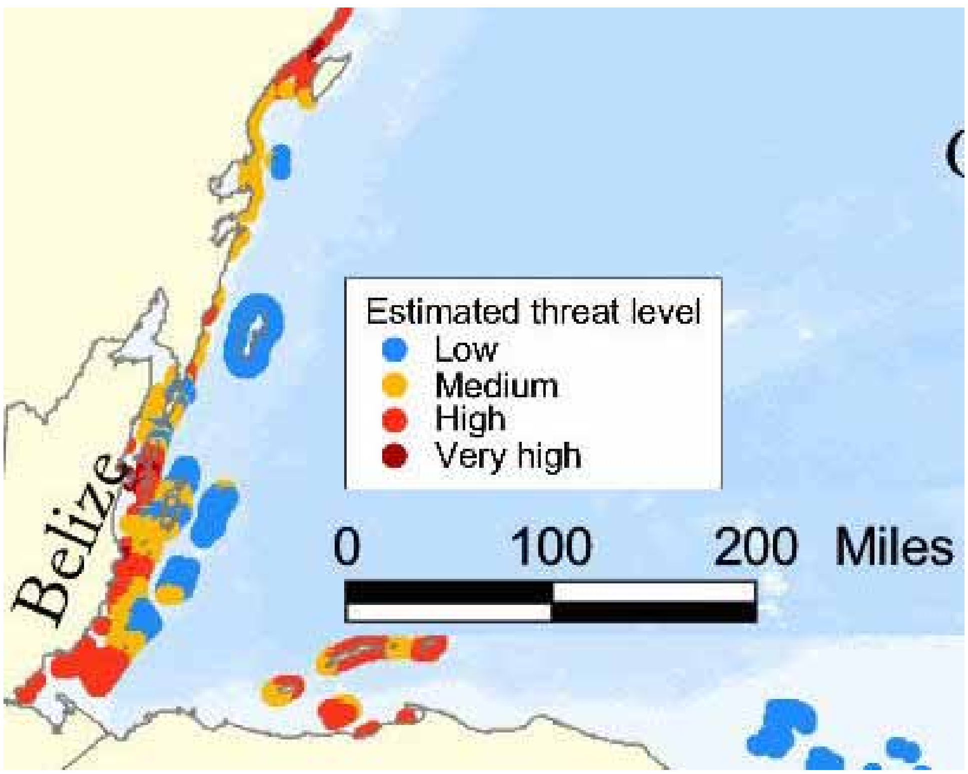


Figure 1. Threat assessment for the Western Caribbean (Kramer, P.A. & P. A. Richards-Kramer. 2002. Ecoregional Conservation Planning for the Mesoamerican Caribbean Reef. Washington DC. World Wildlife Fund. 140 pp).

[1] MARXAN analysis available as separate document on resource CD

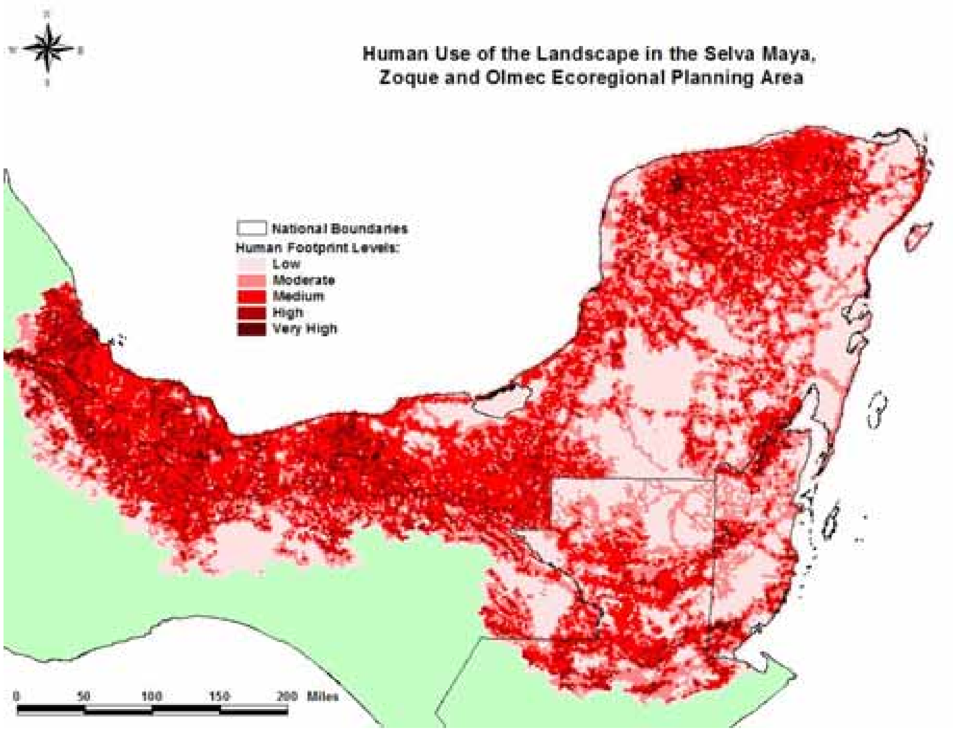


Figure 3. Human use of in the Selva Maya, Zoque and Olmec region (Ecoregional Planning Initiative, draft 2004)

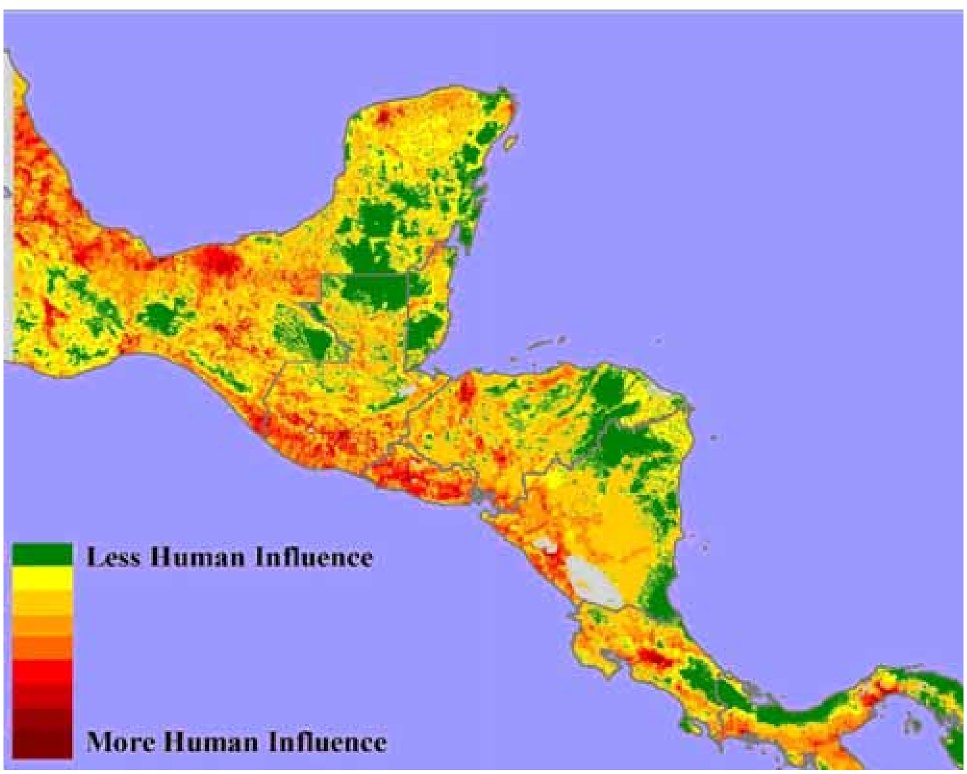
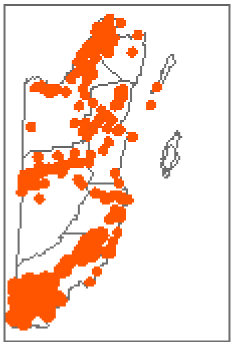
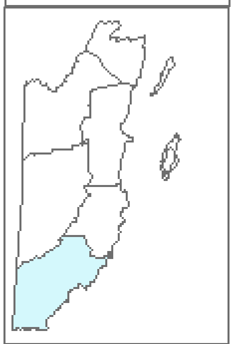
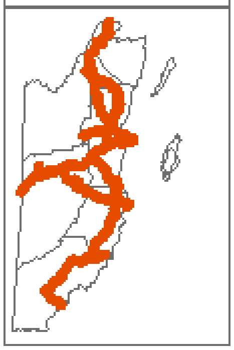


Figure 2. Human footprint through Mesoamerica Ramos, H. 2004. Human Footprint and last of the Wild: Mesoamerica. Powerpoint Presentation to WCS.

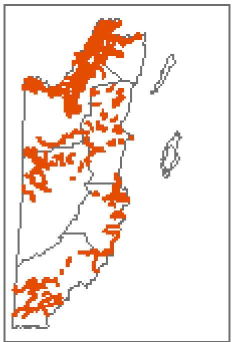
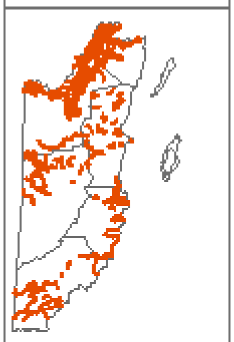
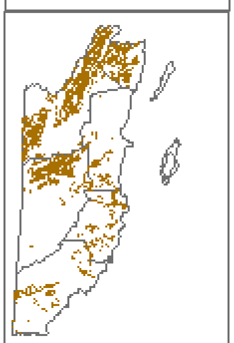
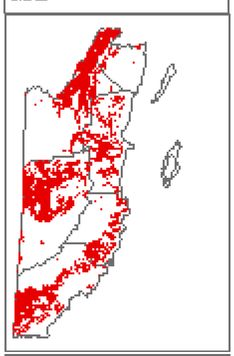
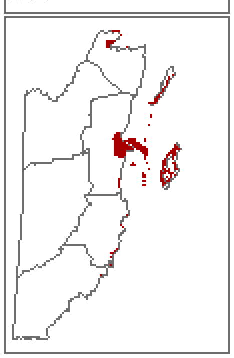
Methodology

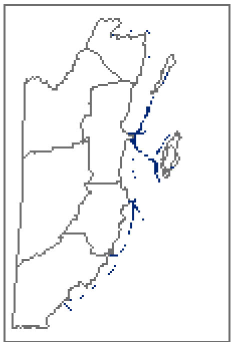
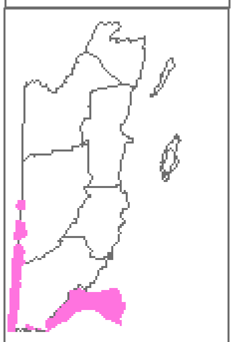
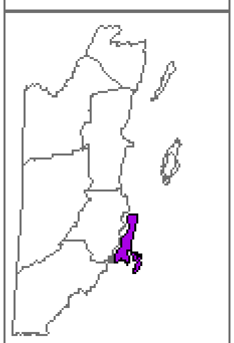
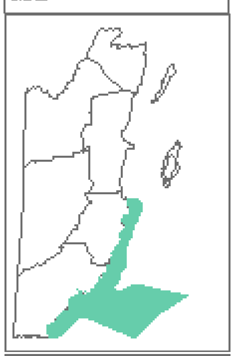
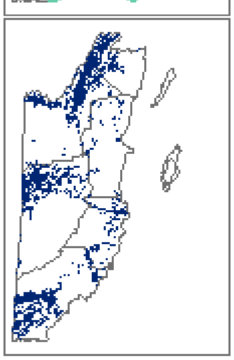
For the current human footprint assessment a number of data layers[2] were collected and/or compiled, each of which have relevance to the human footprint (table 1). In the terrestrial realm, these layers tend to be straight forward, but the marine realm which does not have settlements or roads has a more diffuse footprint. Like in any analysis, only those data could be used that have a more or less uniform accuracy on a nationwide scale.

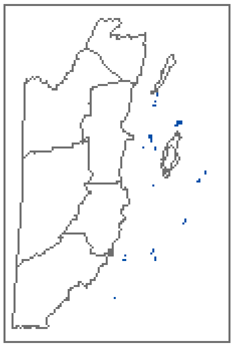
Table 1. Human footprint assessment layers

Layer	Name	#shape	Source and other details
	Communities	701	Lists all the communities in Belize and assigns 5 km buffers around them. In the case of villages nearly entirely dependant on agriculture, a 7km buffer was assigned. (Sources: CSO & Meerman & Clabaugh, 2004: Biodiversity and Environmental Research Data System (BERDS)). Buffer size based on some empirical evidence on the readiness of people to establish economic activities near their place of settlement. Maximum hexagon value 1000.
	Poverty assessment	703	Provides a ranking per district based on the assumption that poor communities are more dependant on natural resources than more affluent communities. (source: CSO). In the case of Belize, the Toledo district has a markedly higher poverty index than any of the other districts. Maximum hexagon value 1000.
	Roads-main	705	All the main roads (paved or otherwise) were assigned 5km buffers (source: Meerman & Clabaugh, 2004: Biodiversity and Environmental Research Data System (BERDS)). This again based on the readiness of people to establish economic activities near main roads. This 5 km buffer probably too wide in narrow valleys, such as locally along the Hummingbird highway. Maximum hexagon value 1000.

[2] All layers available as ArcView shape-files on resource CD

	Roads-other	706	All other roads were assigned 2 km buffers (source: Meerman & Clabaugh, 2004: Biodiversity and Environmental Research Data System (BERDS)). Buffer size arbitrary but in relation to the buffer size of the main roads. Maximum hexagon value 1000.
	Road/tracks	707	Smaller tracks and trails were assigned 500m buffers (forest trails left out especially in areas where these trails serve management purposes) (source: Meerman & Clabaugh, 2004: Biodiversity and Environmental Research Data System (BERDS)). Buffer size arbitrary but in relation to the buffer size of the main roads. Maximum hexagon value 1000.
	Good soil	710	Identified as polygons larger than 1000 acres with agricultural land value class 1 and 2 based on King et al 1992. Not all this "good soil" is currently occupied but this layer is important since it indicates the potential for upcoming pressure. Maximum hexagon value 1000.
	Fire Risk	720	Based on the assumption that wildfires present a risk for biodiversity conservation. Takes into account only high risk classes 10 -18 = highest risk. (source: Meerman & Clabaugh, 2004: Biodiversity and Environmental Research Data System (BERDS)). Fire risk is a threat but some ecosystems in Belize are the result of centuries of human induced fires and as such fire is a difficult factor in calculating the human footprint. The value of fire risk is therefore smaller than for the other footprints (Maximum hexagon value 100)
	Coastal development	730	Various Coastal Developments (based on 19 Oct 2004 Marine Risk Assessment Workshop). Maximum hexagon value 1000.

	Boating Lanes	731	Skiff and boating lanes. Adapted from State of the Coastal Zone Report 1995. Map 4. Maximum hexagon value 1000.
	Incursions	740	For the terrestrial realm based on the 2004 ecosystems map (Meerman, 2005) for agricultural incursions from the Guatemalan sided and assigned a 4 km buffer. Other incursions such as hunting and xate harvesting were not mapped since they also occur away from the border at the hands of Belizeans and are difficult to quantify. Also includes actual penetration of Guatemalan and Honduran fishermen on the marine side based on 19 Oct 2004 Marine Risk Assessment Workshop. Maximum hexagon value 1000.
	Trawling	750	Shrimp trawling (based on 19 Oct 2004 Marine Risk Assessment Workshop). Maximum hexagon value 1000.
	Runoff	760	Agricultural runoff in south (based on 19 Oct 2004 Marine Risk Assessment Workshop). Maximum hexagon value 1000.
	Agriculture	761	Existing Agriculture and aquaculture in all its forms based on the 2005 ecosystems map (Meerman, 2005). Maximum hexagon value 1000.

	Resilience	405	Resilience of Coral Reef to coral bleaching. Based on data provided by the consortium (level 2 & 3 resilience). This data is not really a cost but for practical purposes it has been introduced as a “negative” cost. In this way more resilient reefs have more chance of being selected in the analysis. Hexagon value always negative with a maximum of -1000.

All these above elements are more or less directly human related influences. Fire risk is somewhat of an exception. While most fires in Belize are human induced, it is more a risk than an actual footprint. Weighing this “risk” too heavy might result in including these fire risk areas inside the human needs area while this may not be directly the case (think of savanna’s), meanwhile weighing them too heavy might make fire risk areas seem less important for conservation management, while the reality is that fire-management is what is really needed for such areas. For this reason, fire was given a weight of only 0.1, while all other human footprint layers were given a uniform value of 1.

For the analysis the country was divided in 10 km² hexagons. And since the human footprint layer is also an integral part of the MARXAN analysis, these hexagons were the same as used for that analysis. The maximum value of each component per10 km² hexagon is 1000 (except in the case of fire risk where the value was set at 0.1 and thus the maximum value is 100). In other words; where a particular layer entirely fills a hexagon, its value will be 1000. Where this layer fills only 35% of another hexagon, the value of that hexagon will be 350.

The result of the analysis is visualized in Figure 4. Notice that the darker reds indicate highest level of human activities. Notice also that the footprint in the marine sector is not as easy to quantify as in the terrestrial sector and that the Guatemala incursions in the south – and south west also show up in this analysis.

Considering the fact that to a large degree the same or similar data were used by the various other producers of human footprint layers, it is not surprising that these all these products share a certain degree of similarity. If anything the Belize human footprint map is based on a larger number of data (table 1) than any of the other efforts.

As an extra measure to prevent conflict between human needs and conservation, all areas with mapped subdivisions (Figure 15) were excluded from further analysis. In other words; in the MARXAN analysis, no conservation targets could be placed within such densely subdivided areas.

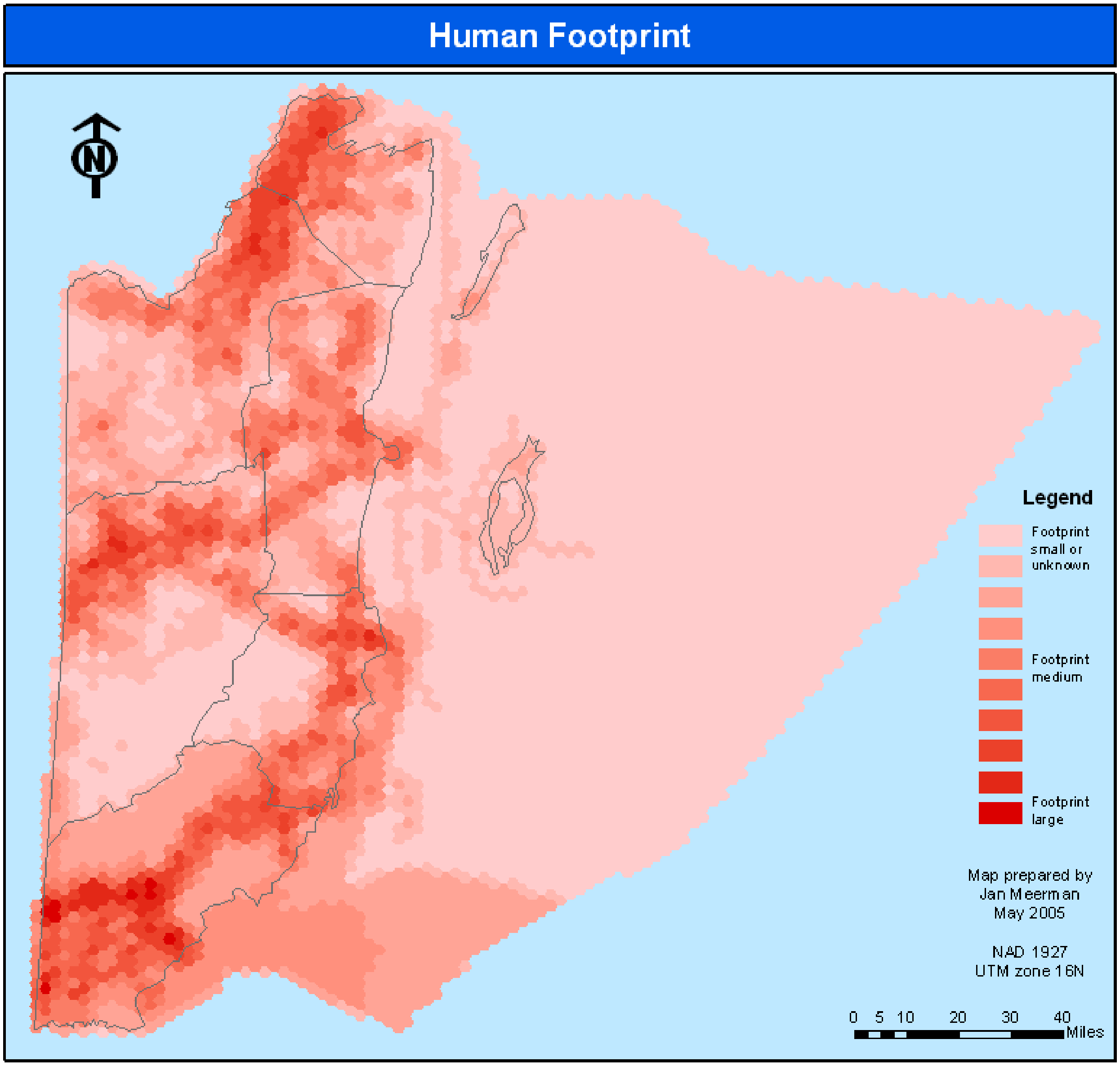


Figure 4. Human footprint

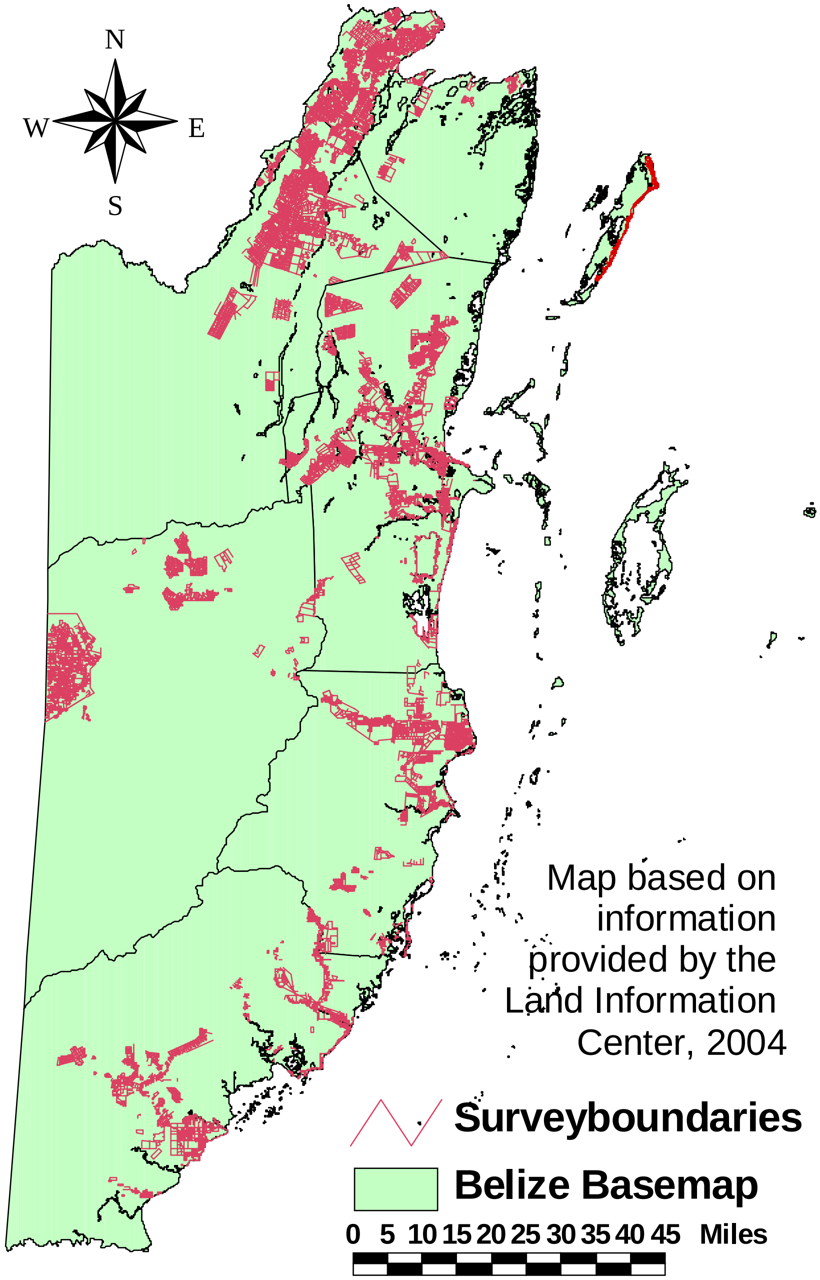


Figure 5. Mapped Subdivisions in Belize (source LIC)