

DESIGN AND CHARACTERIZATION OF THE CONSERVATION CORRIDOR IN THE COAST OF BAY OF SANTA MARTA, COLOMBIA

SUMMARY

Based on previous studies, an ecological corridor was established in the Coast of Bay of Santa Marta, in the Colombian Caribbean region, a program implemented by the WOMEN FOR BIODIVERSITY ORG. Its objective was to ensure the long-term protection of biodiversity of the Arahua indigenous territory; a conservation corridor was designed, within an altitudinal gradient from 0m to 850, as an interconnection of mosaics of natural and agroforestry ecosystems. This ecological corridor was designed and characterized, with the objective of prioritizing areas, to propose 32 km² as natural protected areas type II, according to IUCN standards. This area was evacuated with specific and unique conservation criteria for Colombia and South America. The corridor will be implemented through the establishment of 10 nurseries with a capacity of 3,000 seedlings, produced from native, timber and fruit species for the diversification of agroforestry systems and for the reforestation of critical areas. It is expected that during 2019, it will be declared as protected natural areas, according to administrative decree, of the Arahua indigenous headquarters.

KEY WORDS: pre-montane and montane forests, certification, conservation, sustainable development.



INTRODUCTION

The Coast of Bay of Santa Marta is a mountainous mass isolated from the Andes Mountains and due to its geographical, climatic and geomorphological characteristics it is a complex mosaic that includes almost all the life zones of the Neotropic, from semi-desert, mangrove thorny thickets, tropical dry and humid forests, montane forests and moors, until the perpetual snows.

The Coast of Bay of Santa Marta occupies 1.48% of the surface of Colombia and is one of the most diverse ecological regions in the world. In it, 642 species of birds have been determined, that is, a third of all those that inhabit Colombia, the richest country in this group on the entire planet. The massif is the most important center of continental endemism in the Neotropics. Of the species that remain in the Coast of Bay of Santa Marta, 18 are endemic, that is, they do not exist anywhere else in the world (Rangel and Garzón, 1995; Stattersfield et al., 1998; Strewé et al., 2006). The 80 species of boreal migratory birds that travel the American continent each year are also part of this wealth. As an "oceanic island," the Coast of Bay of Santa Marta is an oasis in the lowlands of the Colombian Caribbean and the gateway for migratory bird species on their way to the Andes or eastern South America (Strewé et al., 2006).

After more than 80 years of the conformation of the collections of Todd and Carriker (1922), the ornithological investigations carried out recently (Strewé and Navarro 2003, 2004a, 2004b; Strewé, 2005; Strewé et al. 2006) have allowed to prioritize areas of birdlife conservation in the region. The results of the project on altitudinal distribution and habitat preferences show that endemic species and subspecies are mainly distributed at elevations of approximately 900 m. As a consequence of the

immense destruction of natural environments, endemic birds with very restricted distributions are seriously threatened (Renjifo et al., 2002; Strewé et al., 2006).

Based on bird studies, the river basin Magdalena on the San Lorenzo blade, was declared as the first "Important Conservation Area de Aves" (AICA) in the Colombian Caribbean region, a program of the Alexander von Humboldt Institute and BirdLife International, in October 2003 (BirdLife Colonization, logging and inadequate production systems have had negative impacts on the ecosystems of the Coast of Bay of Santa Marta. The native vegetation of this place received the first changes with the colonization of indigenous people, consisting of the destruction of forest ecosystems on a different scale (Carriker, 2000). For example, in the Ranchería river basin, land use by communities of Arhuacos initiated extensive sabanization processes (Cavelier et al., 1998). On the northern slope, concentrations in large towns such as Lost City or Pueblito also produced changes in vegetation cover (Carriker, 2000).

From the 16th century, with the arrival of the Spaniards and the new practices of land use, especially livestock, the natural ecosystems of the Sierra received another strong impact from settlers and indigenous people. One of the strongest was the establishment of marijuana crops and herbicide spraying in the 70s and 80s. Currently, there is high pressure on forests in the lowlands, the foothills of the massif, but also to elevations of the moor as a result of the establishment of illicit crops and the extension of the agricultural frontier.

The coffee industry has its beginning in the foothills of the Coast of Bay of Santa Marta, in the first decades of the last century, with the establishment of large coffee farms such as Cincinati, Vista Nieve or La Victoria, owned by foreign families (Carriker, 2000). The entrance of the coffee farm to the Coast of Bay of Santa Marta

produced impacts on the native ecosystems in the premontane zone. Extensive areas of native forests were destroyed for the establishment of coffee plantations. Due to the special conditions of the Sierra (rainfall, latitude, high slopes, types of soils), a favorable change in the management of coffee farming has been carried out, which implies production under shade (Carriker, 2000; Vega, 2001). In 2001, the Alliance for Critical Ecosystems Foundation (ALPEC) began monitoring birds within the coffee zone, prioritizing areas for habitat management and restoration and for the implementation of a biological corridor in the Magdalena river basin (Strewe and Navarro, 2004a). Studies show the benefits of shade crops for the conservation of migratory birds and endemic or threatened species. In particular, the multi-stratum coffee and cocoa shade plantations represent an option of Substitute. The coffee zone was identified as a key area for future activities with great potential for biodiversity conservation (Strewe and Navarro, 2004a, 2004b; Strewe et al., 2006).

The Sierra Nevada was declared a Biosphere Reserve by UNESCO and is legally protected with the establishment of the Coast of Bay of Santa Marta National Park (3,830 km²). However, the conservation of this protected area is not effective due to the continuous destruction of forests. At this time, less than 15% of the original vegetation of the eco-region subsists (Pro-Sierra Nevada Foundation of Santa Marta, 2000). Especially, the native environments of the premontana zone are transformed and the fragmented remnants, so it is urgent to implement conservation activities in the premontana zone.

What is a conservation corridor in the Coast of Bay of Santa Marta?

It is the interconnection of mosaics of ecosystems, fragments of native forest through an array of coffee plantations in the altitudinal direction and along a basin, based on the biological, economic and social welfare component, which over time tends to turn it into a local and regional planning strategy. (Vega, 2001, 2005).

It seeks to be a development strategy that starts from the productive units managed in a sustainable way, based on a land planning and that transcends through a collaborative management between owners until arranging the articulation of reserve areas and agro-ecological systems throughout and width of a given basin, in this case the Magdalena river basin in the Coast of Bay of Santa Marta.

A broker aims to be an instrument that seeks to continue advancing in the search for mechanisms for the conservation of protected areas starting from the property at the property level and the decision of its owners to keep that store towards the future be subject to incentives (economic and not economic), for conservation contemplated in the environmental regulations of Colombia (which is not implemented in the Sierra Nevada). It raises the need for an analysis of what could be the sources of viable resources applicable to the Sierra Nevada context by concept of water regulation,

CO₂ uptake and other environmental services, which currently provide watersheds such as the Magdalena River (Correa do Carmo et al., 2001; Vega, 2005; Granizo, 2006).

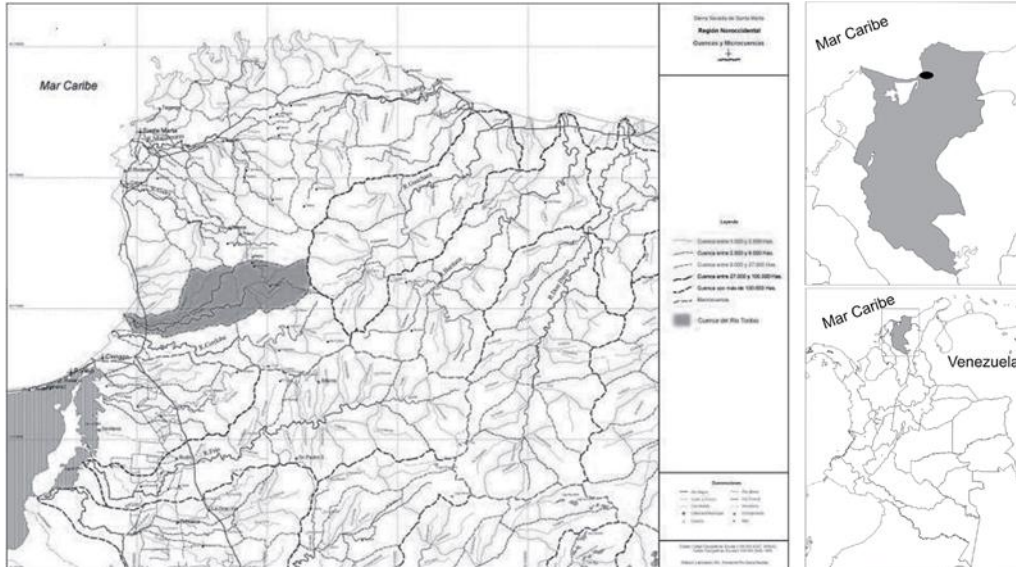
The general objective is to conserve, recover and manage the ecosystems of the Magdalena river biological corridor, with the goal of guaranteeing the environmental supply of biodiversity, water resources and improving the quality of life of local populations. The different action programs are linked to this general objective: protection of biodiversity and environmental monitoring for the

future use of the mechanism of clean development, economic development and sustainable management of the forest in the area of influence.

MATERIALS AND METHODS

Study area

The Magdalena river basin is located on the north-western slope of the Coast of Bay of Santa Marta,



municipality of Santa Marta and Ciénaga, department Magdalena, Colombia (11 ° 05 'N, 74 ° 04' W; Figure 1), within an altitudinal gradient from sea level to 2,600 m (approximately 9,500 ha). The project was carried out in January 2002 to July 2007.

Life zones, bioclimatic provinces or plant formations were defined according to the Holdridge system (Rangel and Garzón, 1995), author who takes into account climatic factors (annual average temperature, annual average rainfall and potential evapotranspiration), pedological content and vegetation distribution; Sizes and isolation of wooded relics were identified (Figure 3).

Phase IV: Connections between forested and agroforestry relics were identified in an altitudinal gradient (Figure 3). Be prepared the map of the conservation corridor (Figure 4).

The categories present are: Tropical Dry Forests (bs-T), Premontane Humid Forest (bh-PM) and Low Montane Humid Forest (bh-MB).

CONSERVATION CORRIDOR DESIGN

The design of the conservation corridor was carried

out in four phases (Figure 2):

Phase I:

Conservation priorities in the basin were identified through birdlife monitoring over a four-year period with sampling stations at different elevations: Río Magdalena Nature Reserve (500-1,300 m), Vista Nieve (1,200-2,000 m) and La Cumbre (2,000-2,600 m).

Phase II: Vegetation types and forest cover were analyzed using field information and LANDSAT satellite images taken in 2002 (Figure 2). The coverage map was prepared (Figure 3). Phase III:

Figure 1. Magdalena river basin study area, Coast of Bay of Santa Marta, department of Magdalena.

Source: WOMEN FOR BIODIVERSITY ORG

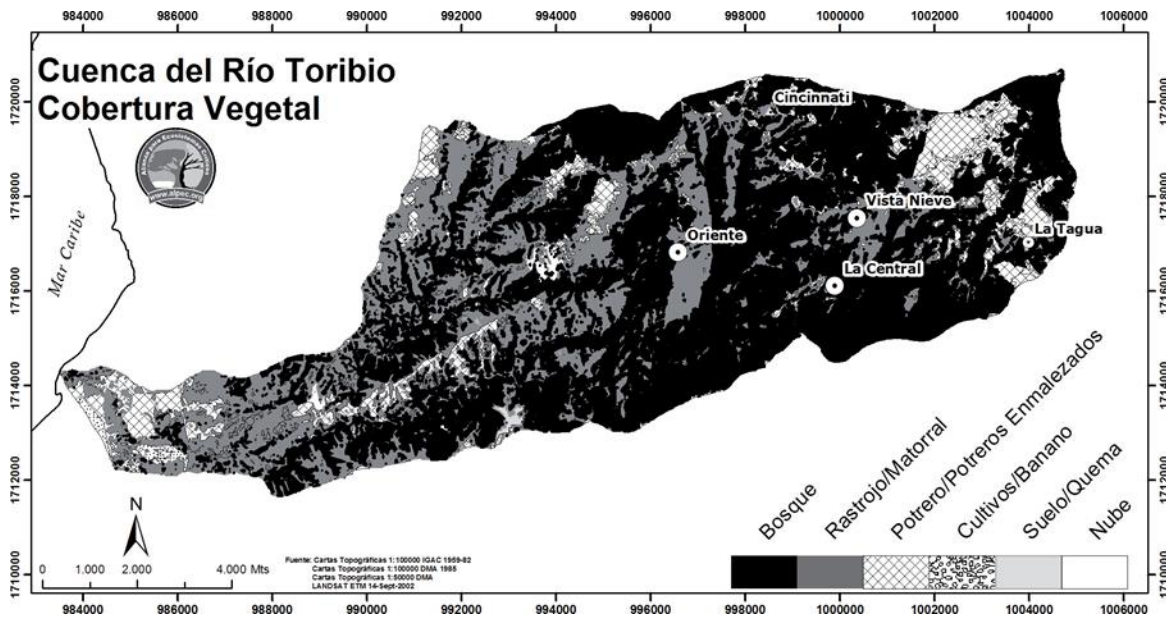


Figure 2. Vegetation coverage of the Magdalena river corridor. Source: WOMEN FOR BIODIVERSITY ORG

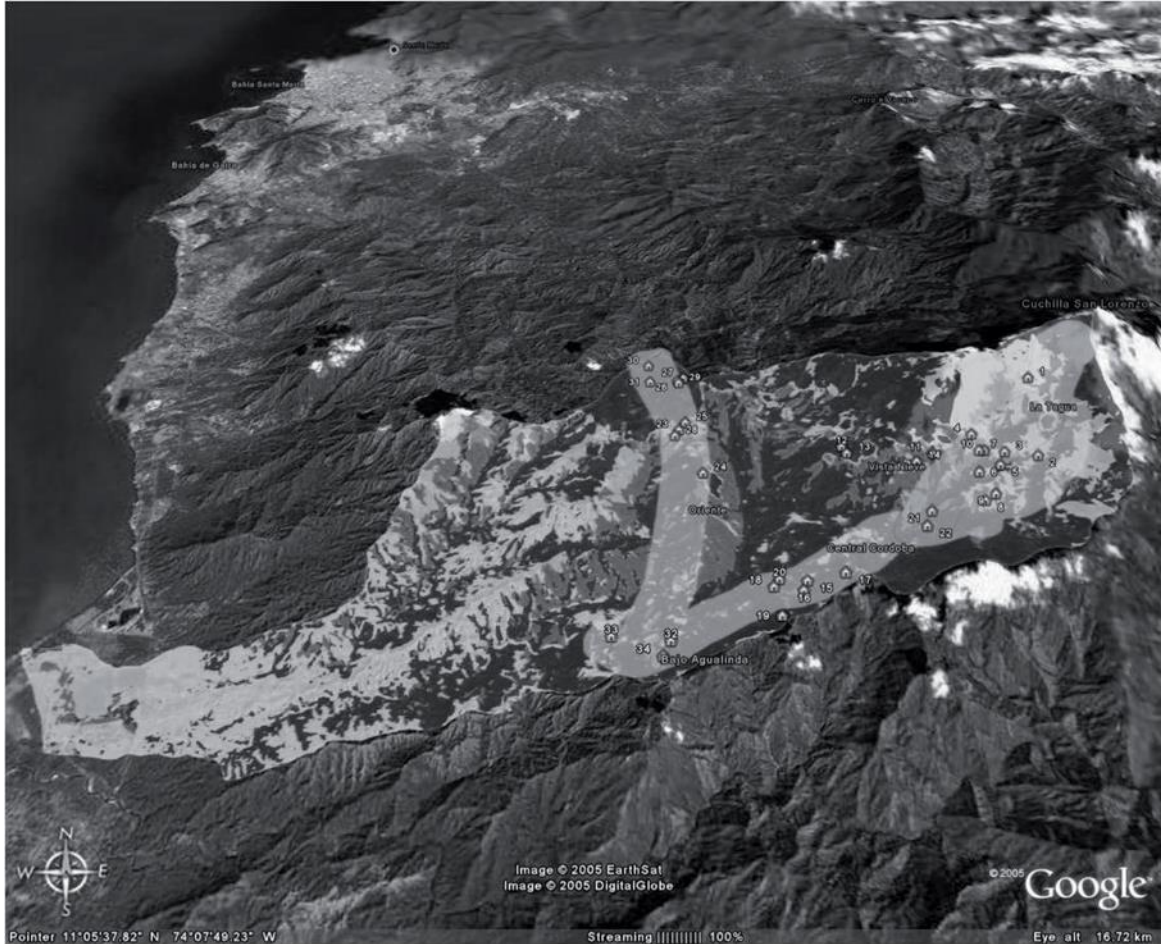


Figure 4. Distribution of the 34 farms characterized within the Magdalena river conservation corridor.

CONSERVATION CORRIDOR CHARACTERIZATION

Based on the map of the conservation corridor (Figure 4), the distribution of land in the basin was analyzed, to select 34 properties for the corridor implementation phase. The number of properties was defined through the resources available for the first phase of implementation. The criteria for selecting the properties were: the presence of forestry relics of relevance to the corridor, the presence of agroforestry systems and finally the acceptance of the owner for the proposed conservation corridor.

In each selected property, a property characterization was carried out. The detailed field evaluation determined the spatial location of the properties using "Global Positioning System" receivers. For each property, its limits and the limits and area (absolute and proportion) of agroforestry systems, forest remnants and buffer zones of water sources were determined (Table 1). A property map was drawn up for each property (Figure 5). Based on the property map, areas for the implementation of the conservation corridor were identified.

The "Critical Ecosystem Alliance" (CEA) certification was developed as an instrument for the

implementation of the long-term conservation corridor. Certification is defined through internal criteria of crop management and conservation for corridor producers. The Critical Ecosystem Alliance Certification criteria are:

1. Protected areas - forest protection and reforestation. Protect the remnants of existing native forests; deforestation is prohibited. Farms with a percentage of less than 10% of native forest should define recovery areas with native species equivalent to 10% of their area, including existing native forests.
2. Agroforestry systems. Manage at least 30% of the area of the farm in agroforestry systems. Diversify the shadow of agroforestry systems with five species (minimum) of timber trees and additional fruit trees to the dominant species (maximum 70% of trees per ha) inside the lot.
3. Conservation of water resources (buffer zones). Protect or establish buffer zone for water sources with a minimum radius of 20 m. Protect or establish zones of damping along water streams at a minimum distance of 10 m on both banks. Buffer zones include natural vegetation without intervention and natural vegetation in different recovery phases.
4. Environmental education. Compulsory participation of owners and labor personnel in the farm in training on conservation and sustainable use of biodiversity. Hunting, fishing and the extraction of fauna and flora, of endangered species and endemic species of the eco-region are prohibited; wild animals are banned in captivity.

The certification criteria help the implementation of the conservation corridor and ensure its operation in the medium and long term. To implement the certification criteria, an area for the recovery and conservation of natural habitats was

defined in each property to establish a network of protected areas in the Magdalena river basin.

On each site nurseries were built with native, timber and fruit tree species for the diversification of the shade of the crops and for the arborization of critical areas.

RESULTS

The conservation corridor in the Magdalena river basin was designed as an interconnection of mosaics of natural and agroforestry ecosystems in the altitudinal gradient of 450-2,600 m of approximately 6,500 ha of extension (Figure 3). The total area of direct influence land of the project within the corridor is of 1,535 ha.

Within the conservation corridor, 34 farms were characterized through a detailed field evaluation; 34 farm maps were prepared (Figures 4 and 5). The CEA program certifies all farm products that meet the requirements and allows the use of their seals on these products. The criteria of the program were applied in 34 farms in the Magdalena river basin, managing agroforestry and liberating areas for the recovery and conservation of habitats (14 farms in the upper basin, 17 farms in the middle basin and three farms in the lower basin) (Figure 4).

In each of the properties, a nursery was installed for the diversification of agroforestry systems and for the reforestation of critical areas and corridor implementation. In total, 61,000 bags were delivered



No.	Predio	Vereda	Area total (ha)	Agroforestales (ha)	conservación recuperación (ha)	arborización (ha)
1	La Cumbre	La Tagua	70	0	12	5,3
2	San Martín	La Tagua	68	4	7	4,3
3	Casa de Tabla	Vista Nieve	5	1	1	3,4
4	La Zorroca	Vista Nieve	47	2	5	2,8
5	El Urupán	Vista Nieve	4	3	1	3,4
6	Miramar	Vista Nieve	90	5	9	4,4
7	El Acuario	Vista Nieve	48	15	5	5,1
8	La Esperanza I	Vista Nieve	33	10	1,5	2,8
9	La Esperanza II	Vista Nieve	34	5	3,2	1,4
10	El Brillante	Vista Nieve	31	2	3	3,1
11	La Colina	Vista Nieve	50	18	5	3,4
12	Escondida	Vista Nieve	12	6	1,5	2,3
13	Santa Mónica	Vista Nieve	9	10	0,5	1,4
14	Sindamano	Vista Nieve	8	4	0,8	2,3
15	El Roble	Central Córdoba	25	12	2,5	2,1
16	San Matco	Central Córdoba	12	5	1	1,4
17	San José	Central Córdoba	60	6	6	2,9
18	Reserva Toribio	Central Córdoba	69	25	20	5,9
19	El Quindío	Central Córdoba	105	15	7	1,4
20	La Sobrana	Central Córdoba	80	12	8	3,4
21	Las Ajuntas	Central Córdoba	30	8	2	2,9
22	Toquedana	Central Córdoba	160	20	18	3,4
23	El Limón	Oriente	20	5	2	2,6
24	Dindal	Oriente	36	8	4	1,4
25	La Argentina	Oriente	25	12	3	2,3
26	Laural Gomorra	Oriente	24	10	3	3,7
27	Leticia	Oriente	38	15	4	2,9
28	El Reco	Oriente	34	12	5	1,7
29	El Laurel	Oriente	10	7	1	0,6
30	Delicias de Santa Fe	Oriente	42	15	4	2,9
31	Si Dios Quiere	Oriente	27	5	3	2,9
32	Por Venir	Bajo Agua Linda	140	7	20	5,1
33	Miraflores	Bajo Agua Linda	65	17	10	5,7
34	Los Hermanos	Bajo Agua Linda	24	7	3	1,4
	Total		1535	308	182	102

Table 1. Results of the characterization of the properties.

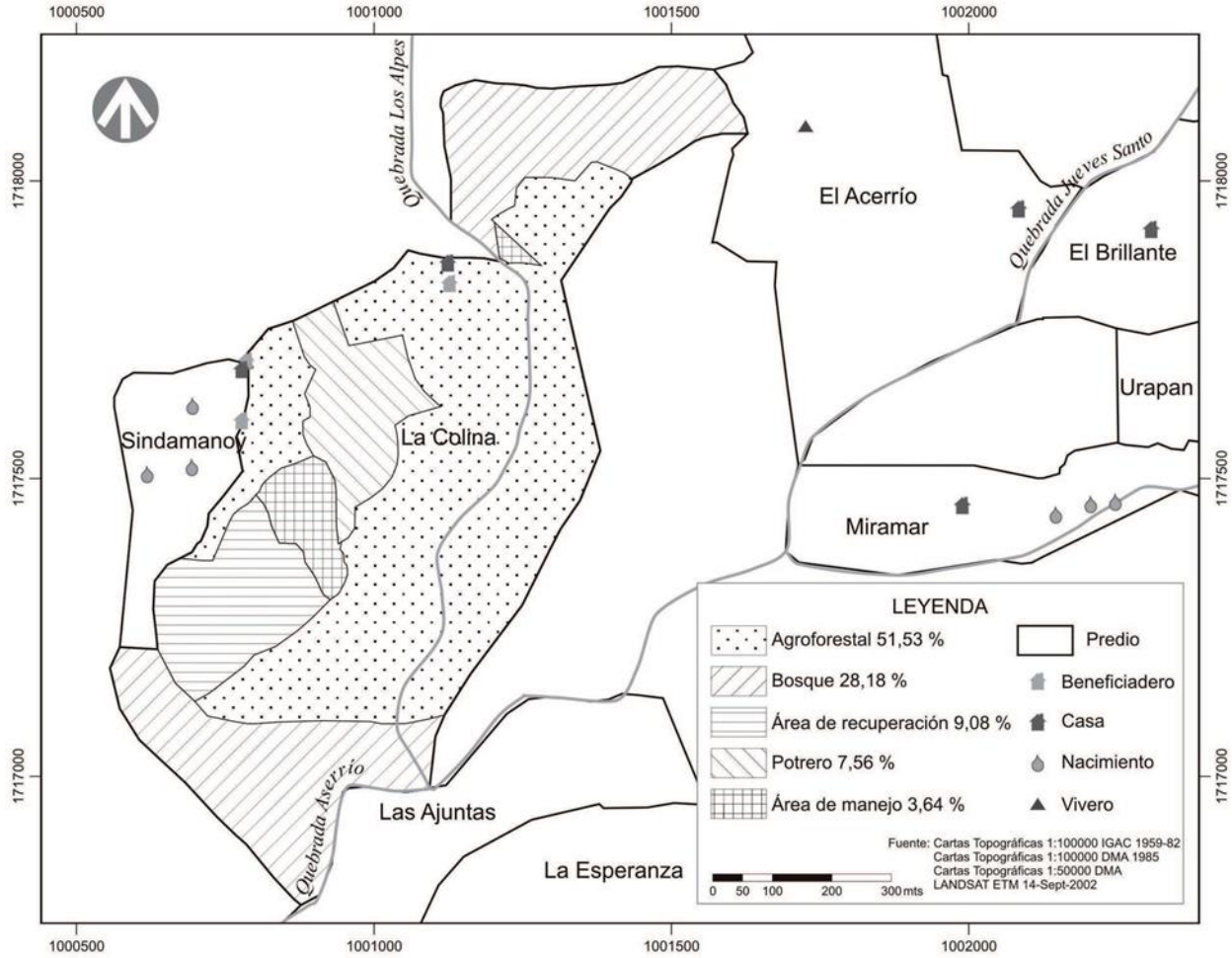


Figure 5. Distribution of properties within the Magdalena river conservation corridor.

of planting to the beneficiaries. Finally, 35,810 seedlings were produced from tree species native to the region and from non-native timber and fruit tree species in the basin. Additionally, a material of 5,200 native seedlings delivered by the company Drummond LTDA, produced in the nursery of the company in the Mine, in the department of Cesar was handled.

The planting of seedlings produced in nurseries and those delivered by the company Drummond LTDA was supported by the project with the payment of tree planting incentive, delivered by tree planted in the field. With the plant material handled they were arborized 102 ha.

In the 34 farms, a total area of 308 ha of agroforestry systems with a diversified shade was managed, mainly coffee crops and a low percentage of cocoa crops (2%); 182 ha were allocated to conservation and recovery of native forests (Table 1). Of the 1,535 ha of the project, an area of 592 ha (agroforestry, conservation and recovery areas, reforested areas) is managed through the conservation criteria of the CEA.

Sixty-nine water births and their buffer zones are protected within the conservation and recovery areas and coffee plantation areas, through CEA criteria.

The project allowed the diagnosis of a high percentage of coverage of unproductive pastures. In order to look for a sustainable alternative, to plant the pasture area on the land, planting cut grass near the houses was planned. The advantage of this handling is the production of high quality feed for cattle, horses and mules in a limited and easily accessible area. In 17 properties were established areas of cut grass (Mombasa type seeds at elevations below 1,800 m, Azul Ochoro type elevations greater than 1,800 m) for better handling of domestic animals. At the same time, the incorporation of pasture areas was proposed for the purpose of recovery and reforestation.

In the process of raising awareness and training on the national and international importance of the environmental services of the Magdalena river basin in different workshops and conferences, 82 families from the basin participated in the Vista Nieve, La Tagua, Central Córdoba, Bajo Agua Linda and El East.

Events such as conferences, talks and workshops were held with the urban community of Santa Marta where the Magdalena River Conservation Corridor process was informed and sensitized. At the same time, the urban community sector of Santa Marta was identified as future potential customers for the products of the Conservation Corridor.

Within the project, the following dissemination materials were prepared: brochure "AICA Conservation Corridor Magdalena River"; labels for packaging with a conservation message (honey and blackberry jam, Café "La Reserva", Café Amigo de las Aves); poster "Parakeet of Santa Marta"; Poster "Species of Endemic Birds of the Coast of Bay of Santa Marta" and the CD "Sound guide of the birds of Vista Nieve and San Lorenzo, Coast of Bay of Santa Marta Colombia" (Strewe et al., 2005).

Part of the project commitment was the initiative to present products from the Conservation Corridor.

The commercialization of farm products was promoted, participating in the implementation of the corridor to diversify the economic income of the producers. The project achieved the presentation of four product chains, from production, handling, transportation, packaging, labeling and search for first customers. Coffee is the most important product, given the aspect of volume and size of marketing within the corridor. For this reason, the project worked with greater emphasis on strengthening this product under ecological and sustainable aspects. The corridor's own brand was created with the names "Café La Reserva" and "Café Amigo de las Aves".

In the upper-middle basin, Mora crops are an important income of the communities. To value the harvest, the project began with production and development of packaging and label of Mora jam. The purpose was to strengthen small crops in the upper basin, without allowing the expansion of crops under the cost of deforestation.

Another product with potential for sustainable development and favorable to the conservation of natural resources is honey (*Apis mellifera*). The beneficiaries easily understand the relationship between the management and production of honey and the conservation of the natural vegetation where they feed. The implementation of hives on the premises facilitated the destination of areas for management under CEA criteria. Among the 34 beneficiaries there are seven with hives installed. The project strengthened this product through the development of the corridor's labeled packaging and the search for customers in the region.

In the "La Cumbre" farm in the upper basin, the project began with an analysis of production, quality and marketing of peasant cheese, the main income of this farm. The objective was to improve the quality of the product, justify a better price in

the market and at the same time decrease the area of pasture on the property.

DISCUSSION

At this time, the Conservation Corridor is still undergoing a deforestation process. The ecosystems that make up the biological corridor are of vital importance, not only for the conservation of biodiversity and landscape beauty, but also allow the conservation of the water resource.

Through the creation of the conservation corridor, the project foresees two objectives: to conserve the biological diversity that runs a very high risk of suffering mass extinctions produced mainly by the destruction of habitats due to deforestation and to generate sustainable development opportunities for all the inhabitants and producers of the corridor through the design and implementation of alternative models of agroforestry, forestry and sustainable crops.

The transformation of the current unsustainable agricultural production systems into silvopastoral, agroforestry, forestry and native forest management systems contemplated in the project will allow the conservation and development of soils, the conservation and incorporation of regional biodiversity into productive systems, the protection and better use of water and the fixation and storage of significant amounts of atmospheric carbon. Additionally, its impacts will lead to a valuation of native and planted forests as an important economic capital, a diversification of regional production and raising the income of peasant families.

In parallel to the project monitoring and evaluation program, a certification mechanism for sustainable management and quality of the products and services generated will be developed, considered as

one of the main ways for the implementation of the corridor in the field and its long-term maintenance term.

The extension of the agricultural frontier and the intensification of agriculture are the main threats suffered by natural ecosystems in the Sierra Nevada eco-region of Santa Marta. In response to this situation, ALPEC created the CEA Certification program with specific conservation criteria. In this way the CEA certification is unique in Colombia and South America. Based on the special conditions in the Coast of Bay of Santa Marta, these certification criteria can be applied without making a broad change in the management of the properties.

Certification is a broad process, which improves agricultural practices for the benefit of farmers, offers better products for consumers and preserves native ecosystems. The certification is not taken as part of the "organic" certification program, since one of the objectives of the CEA certification is the conservation of wild flora and fauna. The standards have clear guidelines for their protection. Because the certification criteria cover aspects of sustainable production and environmental protection, the program is only a commitment to conservation.

Farmers participating in the process receive benefits, such as better access to buyers of green products that support natural resource conservation processes; product differentiation from others, based on management criteria, geographic areas of origin and importance strategic for conservation; a better image of products before the public, advertising and technical assistance. The certificate opens special market niches and produces arguments to manage resources and projects for

conservation and sustainable management in the region and on each site.

The CEA certification is a program of the region administered by local groups, producer associations and companies aware of the culture, ecology and traditions of agriculture. It has local verifiers, which means lowering costs and achieving greater cultural sensitivity.

To strengthen the system, CEA must be registered in the Ministries of Agriculture and Commerce, Industry and Tourism, as well as international certification programs, among others, and continue with awareness, promotion and commercialization processes of products associated with the implementation of the Conservation Corridor in the Magdalena river basin.

Finally, the success of the conservation corridor depends on the impulse and management for the commercialization of products (Coffee, Cocoa, honey, fruits, cheese, vegetable oils) of farms that participate in the implementation of the corridor to diversify the economic income of the producers.

The implementation of a conservation corridor is a process from decades to generations (Bennet, 1998; Correa do Carmo et al., 2001). The work done in the last three years is only the beginning of the implementation. The impact of the project on the area of 592 hectares of 1,535 hectares of the 34 properties is not sufficient to ensure the operation of the corridor. It is necessary to expand the impact on the ground in each of the 34 properties, as well as the coverage of the certification process and the implementation of the corridor to additional properties.

It is necessary to form natural reserves within the premises in the corridor, linked to the Network of Natural Reserves of Civil Society. A legal protection figure would be of great importance in this region, since there are few conservation areas

on this slope, mainly in the middle and lower basins. It is necessary in the future to establish connections with other protected areas.

For the success of the project, the search for product marketing impulses to finance the maintenance of the Conservation Corridor is of great importance. The information of the society of Santa Marta on the importance of the basin for the conservation and source of water resources, is stimulating a policy of protection of the environmental services in the basin within the plans of development of territorial entities, supporting the communities coffee makers in maintaining forest cover and stimulating sustainable management of natural resources. The basin works as a model for other basins of the massif.

The increased number of inter-institutional cooperation established and strengthened by the project will facilitate the identification of future financing opportunities. The need and the arguments produced by the plant cover improvement project in the basin will initialize the participation of government entities and the private sector in reforestation and recovery activities in the basin.

An impulse of great importance for the maintenance of the corridor is eco-tourism in the basin as an economic income for the communities of the region (Jiménez 2001; Granizo, 2006); The activities that strengthen the process are: publications (articles, website), conferences, training of ecological guides and infrastructure improvement. A specific group of tourists are birdwatchers. International studies document the potential of this tourism with millions of fans in North America, Europe and Japan (Noss 1987; Bennet, 1998; Sanderson |, 2002). The project strengthens this type of tourism. The implementation of the corridor protects a large part of the Area of Importance of Birds Conservation in Colombia AICA Magdalena river, including

habitats of 24 species of birds with restricted distribution (eg, Paujil de Picoazul *Crax alberti*, Periquito de Santa Marta *Pyrrhura viridicata*) and 15 endangered species globally (eg, Green Macaw *Ara militaris*, endemic species and different species of raptors), as well as migratory bird habitats (BirdLife International, 2000; Strewe, 2005).

The documentation of the operation of the Magdalena River Conservation Corridor under biodiversity conservation criteria requires the accompaniment of an environmental monitoring program at the population, species and landscape level for at least a decade (Noss, 1987; Simberloff and Cox, 1987 ; Jiménez, 2001).

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**Reception date: 09/29/2018 Acceptance date:
12/14/2019**