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Conservation of endemic species in the national system of protected areas from Nicaragua

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ABSTRACT

Nicaragua, in the framework of the Convention on Biological Diversity (CBD), agreed to establish a "Representative system of protected areas that adequately conserve biodiversity and terrestrial, marine and inland water ecosystems". Pursuant to the above, we conducted a Gap Analysis of Biodiversity Conservation for the National System of Protected Areas (SINAP) of Nicaragua, focused on terrestrial and inland water ecosystems as well as on terrestrial species. This paper presents the results of the analysis of the conservation status of the endemic species in the national system of protected areas of Nicaragua. The groups considered for analysis were plants, mollusks, amphibians, reptiles, and mammals. Data presented came from reviewing books, scientific papers, management plans of protected areas and unpublished reports by the authors, and nearly 140 websites. Of the 75 plant species and 31 animal species considered in the analysis, 25 species have some distribution points within the SINAP (ten of them have only one point). There are 81 species apparently absent from the SINAP. Nicaraguan endemic species are severely unprotected.

KEY WORDS

Endemism, conservation, protected areas, Nicaragua, mollusks, amphibians, reptiles, birds, mammals, plants

RESUMEN

Nicaragua, en el marco de la Convención de Diversidad Biológica (CDB), se comprometió a establecer un "Sistema representativo de áreas protegidas que conserve de forma adecuada la biodiversidad y los ecosistemas terrestres, marinos y de aguas intercontinentales". En cumplimiento de lo anterior, se realizó un Análisis de Vacíos de Conservación de la Biodiversidad para el Sistema Nacional de Áreas Protegidas (SINAP), de Nicaragua, enfocado en ecosistemas terrestres y de aguas continentales, así como especies terrestres. En el presente trabajo se presentan los resultados sobre el análisis del estado de conservación de los endemismos en el sistema nacional de áreas protegidas de Nicaragua. Los grupos considerados para el análisis fueron plantas, moluscos, anfibios, reptiles y mamíferos. Los datos presentados procedieron de la revisión de libros, artículos científicos, planes de manejo de áreas protegidas e informes inéditos de los autores, así como unas 140 páginas webs revisadas. De las 75 especies de flora y las 31 especies de fauna consideradas en el análisis, 25 especies tienen alguno de sus puntos de distribución dentro del SINAP (diez de ellas tienen un solo punto). Hay 81 especies aparentemente ausentes dentro del SINAP. Especies endémicas de Nicaragua se encuentran gravemente desprotegidas.

PALABRAS CLAVE

Endemismos, conservación, áreas protegidas, Nicaragua, moluscos, anfibios, reptiles, aves, mamíferos, plantas

Nicaragua, in the framework of the Convention on Biological Diversity (CBD) (CBD, 2004), agreed to establish a "Representative system of protected areas that adequately conserve biodiversity and terrestrial, marine and inland water ecosystems", therefore must be implemented steps for the conservation of highly threatened ecosystems (MARENA, 2011; Pérez, Siria & Sotelo, 2005). Pursuant to the above, we conducted a Gap Analysis of Biodiversity

Conservation for the National System of Protected Areas (SINAP) of Nicaragua, focused on terrestrial, inland water ecosystems as well as terrestrial species, to help preserve them properly (MARENA, 2011).

Nicaragua is one of the countries with the highest biodiversity in the region, despite the lack of studies on this topic, as well as of programs of long-term biodiversity monitoring (Perez, 2004; Pérez, 2008). According to recent

data it has about 12 493 species of animals (10 625 species of invertebrates and 1 868 of vertebrates) and 5 796 species of higher plants (Pérez, 2011). Of this total there are 200 endemic species of which 104 are plants and the other animals (MARENA, 2011). Endemism is understood in the sense of Brown and Lomolino (1998), who argue that endemic species are those strictly located in an area that can be highly variable of extension, usually specific locations or geographical areas (Mayr & Ashlock, 1993).

According to the map of ecosystems prepared by the CCAD according to UNESCO (1973), in Central America there are 114 types of ecosystems, including 65 forests, 19 types of grasslands, 9 shrub-lands, 7 types of savannas, and 14 aquatic ecosystems, including freshwater and marine. Of this total there are 68 types represented in Nicaragua (MARENA, 2001) for a 60% of the total present in the region.

This paper presents the results on the analysis about the conservation status of endemic species in the National System of Protected Areas of Nicaragua. The groups considered for analysis were plants, mollusks, amphibians, reptiles, birds and mammals. All protected areas belonging to the SINAP were considered.

The data presented came from reviewing books, scientific papers, management plans of protected areas, unpublished reports by the authors, and some 140 websites checked. Of the total of 104 plant species endemic to the

country cited only 77 could be taken into account in the analysis because the rest lacked any coordinates. The endemic taxa of Nicaragua in contrast to the total number of species per group are presented in Table 1. In the case of birds there are no endemic species cited for Nicaragua (Martínez-Sánchez, 2007).

The distribution of all endemic species is presented in Figure 1. As can be seen, although there is data presence throughout the country, the area with most points is the North-Central region. Unexpectedly, in the Department of Chontales and specifically in Amerrisque protected area, with a low level of ecological integrity (MARENA, 2011) a large number of endemic species are present. The existence of gaps in the Atlantic area is probably due more to lack of information than to lack of endemism. In the case of fauna groups, spatial coverage in the country is much wider than in flora.

The distribution of endemic species of flora is associated mainly with the North-Central region but there are some endemic species in the Pacific and the Atlantic, unlike the endemic fauna which is more evenly distributed throughout the country. The orchids are 24 endemic species, Fabaceae (12), Asteraceae (seven), Myrtaceae (six), Rubiaceae (five), Myrsinaceae and Lauraceae have four endemic species each; the Asclepiadaceae and Viscaceae three species each; Acanthaceae, Araceae, Bignoniaceae, Convolvulaceae, Cyperaceae, Ericaceae, Rutaceae and

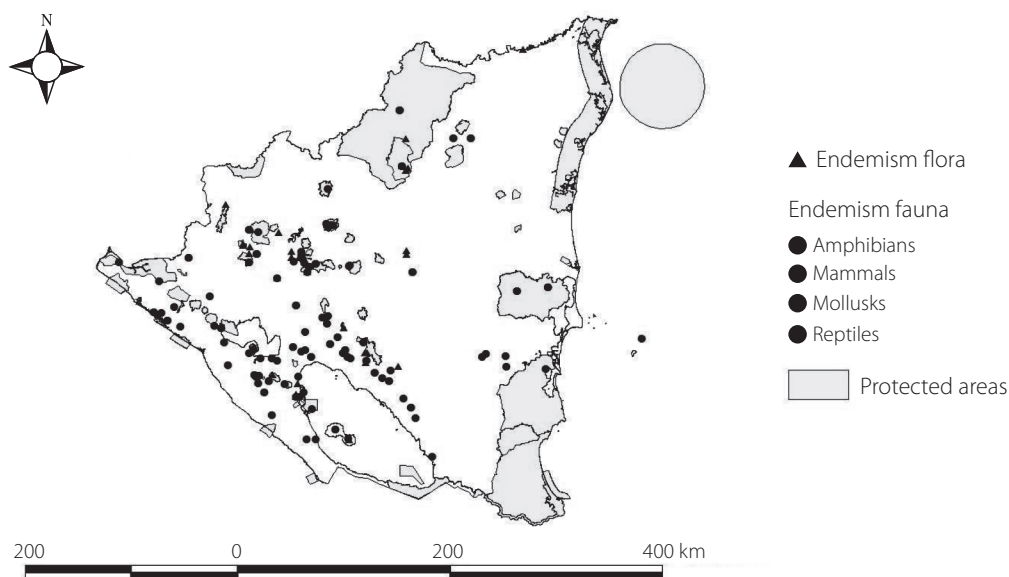


FIG. 1. Distribution of the endemic species per faunal groups.

TABLE 1
Species endemic to Nicaragua in the groups studied.

Taxa	Number of endemic species	Total number of species	% endemism	Source
Flora	104	5 796	1,79	Grijalva, 1999; Meyrat, In litt.
Mollusks	15	1 908	0,79	Pérez et al., 2003
Amphibians	4	76	5,26	Köhler, 2002; 2003; Köhler & Sunyer, 2006; Sunyer et al., 2008
Reptiles	6	163	3,68	Köhler, 2003
Mammals	2	225	0,89	Saldaña O. & Medina A., In litt.
Total	200	17 380	15,72	

Sabiaceae, have two endemic species each. Furthermore, the Agavaceae, Bombacaceae, Cacti, Cesalpinaceae, Campanulaceae, Chlorantaceae, Clethraceae, Crassulaceae, Cucurbitaceae, Ebenaceae, Euphorbiaceae, Lorantaceae, Piperaceae, Polygonaceae, Rosaceae, Sapindaceae, Sapotaceae, Simaroubaceae, Styracaceae, Theophrastaceae and Lamiaceae, have an endemic species per each family (Stevens, 2001).

Analysis of endemism

Flora

One thing to note is that the distribution has a zoned influence: northern species have greater influence in the North-central zone of Nicaragua with vegetation of cloud forests and pine-oak; the Pacific Zone has almost exclusive elements of the vegetation from Tehuantepec, and the Atlantic region, where species have spread from the jungles of Yucatan, added to the dry zone species just entering. Mesoamerican endemics occur most abundantly in the Atlantic and North-central regions, and its presence is lower in the Pacific region, many species endemic to the Atlantic area are in the Southeast Reserve and are shared with Costa Rica and Panama.

Mollusk fauna

According to Perez (2002) and Perez and Lopez (2002) on continental mollusks of Nicaragua endemism is associated with:

1. In the Pacific: the volcanic lakes of the region.
2. In the North Central region: the tops of many hills.
3. A particular case in the Pacific: an endemic to the islets of Granada.

The case of point 3 is *Pseudopeas* sp., a species new to science, which is distributed in a single point, one of the islets of Granada. This type of endemism, so closely located, indicates that if this species is removed product to disappearance or alteration of its habitat will be lost from the face of the earth without having had the opportunity to be known and studied its possible importance. This example illustrates in a clear way, the importance of conservation to the maintenance of biodiversity.

Herpetofauna

The endemism on reptiles and amphibians is mostly associated with elevations of the northern zone (*Nototriton Saslaya*, *Rhadinaea rogerromani*, *Geophis dunni*, *Norops wermuthi*) (Köhler, 2002; 2003) and the Mombacho Volcano in the Pacific slope (*Bolitoglossa mombachonesis*). Endemism also has elements associated with islands, as *Bolitoglossa insularis*, of Ometepe Island, *Anolis villai*, cited only from Corn Island, and *Lithobates miadis*, from Little Corn Island. There are also two endemic species on this group described from the Atlantic region: *Craugastor chin-gopetaca* and *Bolitoglossa indio*, and, taking into account the biology of this group, predictions suggest that future studies in this area of the country will lead to the discovery of new species of reptiles and amphibians to science (Köhler, 2003).

Birds

Although there are no endemic species in this group, Nicaragua has 14 species of restricted distribution according to the criteria of Birdlife International (2000): *Amazilia cyanura*, *Aphanotriccus capitales*, *Carpodectes nitidus*, *Cyanocorax melanocyaneus*, *Cyrtonyx ocellatus*, *Dysithamnus striaticeps*, *Lampornis sybillae*, *Ortalis leucogastra*, *Oryzoborus nuttingi*, *Piprites griseiceps*, *Quiscalus*

nicaraguensis, *Thryothorus atrogularis*, *Troglodytes rufociliatus*, and *Trogon clathratus*, all with a range of distribution of less than 50 000 km².

Mastozoofauna

Mammals are the group of wildlife that has less endemism after birds, where no endemic species are present in Nicaragua. It probably happens because after birds, mammals are the second most vagile group of animals and with larger species. Endemic species are usually small in size and are mostly associated with the highlands of the North Central region of the country. The distribution of all endemism of fauna groups can be seen in Figure 2.

Protected areas and endemic species

An important aspect to mention is the geographical asymmetry existing in the location of sites with records of endemic species in the country. There is a higher number of distribution points in the Pacific and the North-Central region than in the Atlantic region.

Of the 75 plant species and 31 animal species considered in the analysis for a total of 106 species analyzed, 25 species have some distribution points within the SINAP, for a 23,58%, of those 25 species, 10 species (40%) have only one point within the SINAP. Moreover, we have 81 species (76,41%), which has no distribution points within the SINAP (Table 2, Fig. 1). Thus, we can conclude that our endemic species are severely unprotected.

As pointed out by Dudley and Parrish (2005) and Grooves et al. (2000), in the case of wildlife, conservation targets of "fine filter", it is difficult to try to preserve 10% of its current extent, since in many cases only scarce and / or fragmented data on the distribution of species is available for most countries of the region.

Given the difficulties of proposing some figure of territorial conservation for endemic species, urges more complete studies within and outside protected areas that allow us to know their distribution as completely as possible in order to develop their plans for long-term preservation, the latter could consider the promulgation of Private Reserves (RSP), Municipal Ecological Parks (PEM) or other figures at the municipal level.

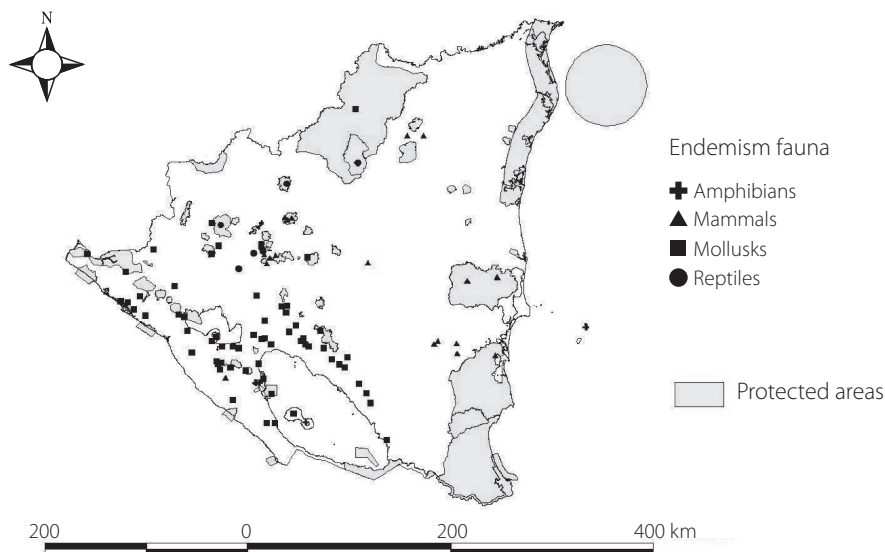


FIG. 2. Endemic species of Nicaragua.

TABLE 2
Representation of endemism in SINAP

No. Total	Species	Taxa	Points outside PA	Points within PA	% of presence in PA	Total Points
1	<i>Aldama mesoamericana</i>	Flora	1		0,0	1
2	<i>Amyris oblanceolata</i>	Flora	1		0,0	1
3	<i>Anisacanthus nicaraguensis</i>	Flora	2		0,0	2
4	<i>Anolis villai</i>	Reptiles	1		0,0	1
5	<i>Anolis wermuthi</i>	Reptiles	2	5	71,4	7
6	<i>Anthurium beltianum</i>	Flora	1		0,0	1
7	<i>Aplexa nicaraguana</i>	Mollusks	17	1	5,6	18
8	<i>Archibaccharis nicaraguensis</i>	Flora		1	100,0	1
9	<i>Ardisia ometepensis</i>	Flora	1		0,0	1
10	<i>Beckianum sinistrum</i>	Mollusks	56	3	5,1	59
11	<i>Beckianum</i> sp.	Mollusks	1		0,0	1
12	<i>Bidens oerstediana</i>	Flora	1		0,0	1
13	<i>Biomphalaria</i> sp.	Mollusks	3		0,0	3
14	<i>Bolitoglossa indio</i>	Amphibians		1	100,0	1
15	<i>Bolitoglossa insularis</i>	Amphibians		1	100,0	1
16	<i>Bolitoglossa mombachensis</i>	Amphibians		2	100,0	2
17	<i>Bonamia douglasii</i>	Flora	1		0,0	1
18	<i>Caesalpinia nicaraguensis</i>	Flora	1		0,0	1
19	<i>Calypttranthes amarulenta</i>	Flora	1		0,0	1
20	<i>Carpodectes nitidus</i>	Flora	1	3	75,0	4
21	<i>Centrosema seymourianum</i>	Flora	1		0,0	1
22	<i>Chondrorhyncha helleri</i>	Flora	1		0,0	1
23	<i>Clethra nicaraguensis</i>	Flora	1		0,0	1
24	<i>Coccoloba nicaraguensis</i>	Flora	1		0,0	1
25	<i>Coursetia apantensis</i>	Flora	1		0,0	1
26	<i>Coursetia paucifoliolata</i>	Flora	1		0,0	1
27	<i>Coursetia polyphylla</i> var. <i>acutifolia</i>	Flora	1		0,0	1
28	<i>Cranichis revoluta</i>	Flora	1		0,0	1
29	<i>Craugastor chingopetaca</i>	Reptiles		1	100,0	1
30	<i>Dalbergia glabra</i> var. <i>chontalensis</i>	Flora	1		0,0	1
31	<i>Diospyros morenoi</i>	Flora	1		0,0	1
32	<i>Disocactus aurantiacus</i>	Flora	1		0,0	1
33	<i>Dressleria helleri</i>	Flora	1		0,0	1
34	<i>Dysithamnus striaticeps</i>	Flora		2	100,0	2
35	<i>Epidendrum glumarum</i>	Flora	1		0,0	1
36	<i>Epidendrum hameri</i>	Flora	1		0,0	1
37	<i>Epidendrum hawkesii</i>	Flora	1		0,0	1

TABLE 2 (Continued...)
Representation of endemism in SINAP

No. Total	Species	Taxa	Points outside PA	Points within PA	% of presence in PA	Total Points
38	<i>Epidendrum nicaraguense</i>	Flora	1		0,0	1
39	<i>Epidendrum vulcanicola</i>	Flora	1		0,0	1
40	<i>Eugenia esteliensis</i>	Flora	1		0,0	1
41	<i>Eugenia matagalpensis</i>	Flora	1		0,0	1
42	<i>Eugenia zelayensis</i>	Flora	1		0,0	1
43	<i>Euglandina obtusa</i>	Mollusks	15		0,0	15
44	<i>Eupatorium nicaraguense</i>	Flora	1		0,0	1
45	<i>Furcraea stratiotes</i>	Flora	1		0,0	1
46	<i>Gastrocopta gularis</i>	Mollusks	25	5	16,7	30
47	<i>Geophis dunni</i>	Amphibians	1		0,0	1
48	<i>Glyphyalinia</i> sp.	Mollusks	36	2	5,3	38
49	<i>Habenaria oerstedii</i>	Flora	1		0,0	1
50	<i>Hedyosmum goudotianum</i> var. <i>mombachanum</i>	Flora	1		0,0	1
51	<i>Helisoma nicaraguanus</i>	Mollusks	14		0,0	14
52	<i>Jacquinia montana</i>	Flora	1		0,0	1
53	<i>Jatropha stevensii</i>	Flora	1		0,0	1
54	<i>Justicia nicaraguensis</i>	Flora	1		0,0	1
55	<i>Kegeliella atropilosa</i>	Flora	1		0,0	1
56	<i>Leptinaria</i> sp.	Mollusks	4	1	20,0	5
57	<i>Lithobates (Rana) miadis</i>	Amphibians	1		0,0	1
58	<i>Lobelia zelayensis</i>	Flora	1		0,0	1
59	<i>Lonchocarpus bicolor</i>	Flora	1		0,0	1
60	<i>Lonchocarpus pilosus</i>	Flora	1		0,0	1
61	<i>Marsdenia nicaraguensis</i>	Flora	1		0,0	1
62	<i>Marsdenia olgamarthae</i>	Flora		1	100,0	1
63	<i>Masdevallia nicaraguae</i>	Flora	1		0,0	1
64	<i>Meliosma corymbosa</i>	Flora	1		0,0	1
65	<i>Meliosma nanarum</i>	Flora	1		0,0	1
66	<i>Miradiscops opal</i>	Mollusks	12	3	20,0	15
67	<i>Nectandra mirafloris</i>	Flora	1		0,0	1
68	<i>Neocyclotus dysoni</i> <i>nicaraguense</i>	Mollusks	7	5	41,7	12
69	<i>Nototriton saslaya</i>	Amphibians		2	100,0	2
70	<i>Ocotea nicaraguensis</i>	Flora	1		0,0	1
71	<i>Ocotea strigosa</i>	Flora	1		0,0	1
72	<i>Orthogeomys matagalpae</i>	Mammals	1	5	83,3	6
73	<i>Oryzomys dimidiatus</i>	Mammals	4		0,0	4

TABLE 2 (Continued...)
Representation of endemism in SINAP

No. Total	Species	Taxa	Points outside PA	Points within PA	% of presence in PA	Total Points
74	<i>Parathesis rothschuhiana</i>	Flora	1		0,0	1
75	<i>Parmentiera trunciflora</i>	Flora	1		0,0	1
76	<i>Pentacalia matagalpensis</i>	Flora	1		0,0	1
77	<i>Peperomia matagalpensis</i>	Flora	1		0,0	1
78	<i>Phoradendron boacoi</i>	Flora		1	100,0	1
79	<i>Phoradendron molinae</i>	Flora	1		0,0	1
80	<i>Phoradendron zelayanum</i>	Flora	1		0,0	1
81	<i>Picramnia antidesma</i> <i>ssp. nicaraguensis</i>	Flora	1		0,0	1
82	<i>Pseudopeas</i> sp.	Mollusks	1		0,0	1
83	<i>Psittacanthus minor</i>	Flora	1		0,0	1
84	<i>Quararibea funebris</i> <i>ssp. nicaraguensis</i>	Flora	1		0,0	1
85	<i>Radiodiscus</i> sp.	Mammals	3	2	40,0	5
86	<i>Randia nicaraguensis</i>	Flora	1		0,0	1
87	<i>Reithrodontomys paradoxus</i>	Mammals	3		0,0	3
88	<i>Rhadinaea rogerromani</i>	Reptiles		1	100,0	1
89	<i>Rhynchospora waspamensis</i>	Flora	1		0,0	1
90	<i>Rondeletia nicaraguensis</i>	Flora	1		0,0	1
91	<i>Rubus ostumensis</i>	Flora	1		0,0	1
92	<i>Sciurus richmondi</i>	Mammals	12	6	33,3	18
93	<i>Scutellaria saslayensis</i>	Flora	1		0,0	1
94	<i>Serjania setulosa</i>	Flora	1		0,0	1
95	<i>Sobralia chatoensis</i>	Flora	1		0,0	1
96	<i>Sobralia triandra</i>	Flora	1		0,0	1
97	<i>Spiraxis</i> sp.	Mollusks	8	3	27,3	11
98	<i>Stellilabium helleri</i>	Flora	1		0,0	1
99	<i>Strobilops</i> sp.	Mollusks	9	2	18,2	11
100	<i>Styphnolobium caudatum</i>	Flora	1		0,0	1
101	<i>Styrax nicaraguensis</i> P. Fritsch <i>ssp. nicaraguensis</i>	Flora	1		0,0	1
102	<i>Swartzia sumorum</i>	Flora	1		0,0	1
103	<i>Vanilla helleri</i>	Flora	1		0,0	1
104	<i>X. Myrmecolaelia fuchsii</i>	Flora	1		0,0	1
105	<i>Zanthoxylum nicaraguense</i>	Flora	1		0,0	1
106	<i>Zea nicaraguensis</i>	Flora		1	100,0	1
Total			309	60	16,26	369

*PA: Protected Areas.

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