Brazil

Lund Warming

Designation date 5 June 2017
Site number 2306
Coordinates 19°30'07"S 43°59'41"W
Area 23 865.44 ha

https://rsis.ramsar.org/ris/2306
Created by RSIS V.1.6 on - 18 May 2020
Color codes
Fields back-shaded in light blue relate to data and information required only for RIS updates.
Note that some fields concerning aspects of Part 3, the Ecological Character Description of the RIS (tinted in purple), are not expected to be completed as part of a standard RIS, but are included for completeness so as to provide the requested consistency between the RIS and the format of a ‘full’ Ecological Character Description, as adopted in Resolution X.15 (2008). If a Contracting Party does have information available that is relevant to these fields (for example from a national format Ecological Character Description) it may, if it wishes to, include information in these additional fields.

1 - Summary

Summary
The entire Lund Warming Ramsar Site is located within the Lagoa Santa Karst EPA and is composed of several Protected Areas (PA) that can be divided into two different categories: State Park (1-Sumidouro and 2- Cerca Grande) and Natural Monument (1-Lapa Vermelha, 2-Vargem de Pedra; 3-Experiência da Jaguarã; 4-Santo Antônio; and 5-Váreza da Lapa).

The region is located in central-southern Minas Gerais at the intersection between two biodiversity hotspots, the Cerrado (Brazilian savannah) and Atlantic Forest. In terms of carbonatic karstic landscape, it is one of the most important Brazilian regions and is considered to be extremely important for biodiversity conservation (Drummond et al., 2005). The surface relief evolved as a result of the configuration of the groundwater networks and intense dynamics at the rock-soil interface. The combination of these factors favored the appearance of multiple surface water catchment areas, such as the dolines and uvalas, which are large, lowered plains that are seasonally flooded, (forming a system of temporary lakes). This region also contains canyons, blind valleys and collapsed dolines located along fluviokarst segments. Moreover, hundreds of caves, shelters and highly valuable archaeological and palaeontological sites are found in this region. These sites contain a large number of fossils, artifacts and drawings of the first human settlements as well as fossils of extinct Pleistocene megafauna (Berbert-Born 2002, IBAMA 1997, 1998a, 1998b, 1998c, 2007), which were studied by renowned scientists of the 19th century.

The Lund Warming site is composed of Atlantic Forest and Cerrado biomes, which represent two biodiversity hotspots. There are further deciduous and semideciduous forests and rupestrian vegetation associated with limestone and temporary lakes. Together, these different vegetation formations, karst reliefs and temporary lakes confer a high biodiversity and incredible scenic beauty to this region.
2 - Data & location

2.1 - Formal data

2.1.1 - Name and address of the compiler of this RIS

Compiler 1
Name: José Eugênio Côrtes Figueira
Institution/agency: Universidade Federal de Minas Gerais: Instituto de Ciências Biológicas
Postal address: Universidade Federal de Minas Gerais
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E-mail: cortes@icb.ufmg.br
Phone: 55 31 34092593

2.1.2 - Period of collection of data and information used to compile the RIS

From year: 2014
To year: 2014

2.1.3 - Name of the Ramsar Site

Official name (in English, French or Spanish): Lund Warming
Unofficial name (optional): Lagoa Santa Karst Environmental Protection Area

2.2 - Site location

2.2.1 - Defining the Site boundaries

b) Digital map/image
0 files(s) uploaded

Boundaries description
The boundaries of the Lagoa Santa Karst Environmental Protection Area – EPA (Federal Decree 98.881, 25 January 1990) – partially define the border of the Lund Warming Ramsar Site, which is limited to the east by the Velhas River. The details are described in the annex in the section 6.1.2.6

2.2.2 - General location

a) In which large administrative region does the site lie?
Minas Gerais state

b) What is the nearest town or population centre?
Lagoa Santa

2.2.3 - For wetlands on national boundaries only

a) Does the wetland extend onto the territory of one or more other countries?
Yes ☐ No ☑

b) Is the site adjacent to another designated Ramsar Site on the territory of another Contracting Party?
Yes ☐ No ☑

2.2.4 - Area of the Site

Official area, in hectares (ha): 23865.44
Area, in hectares (ha) as calculated from GIS boundaries: 23865.44

2.2.5 - Biogeography

Biogeographic regions
The Cerrado is the second largest Brazilian biome, and it encompasses eight states in Central Brazil. The Cerrado region displays a mosaic of ecosystems, including the ‘cerradão,’ which is similar to a forest; cerrado with low and sparse trees; ‘campo cerrado’ (dominated by shrubs with scattered trees and a grass understory); ‘campo sujo’ (savannah vegetation with sparse shrubs) and ‘campo limpo’ (pure grassland). These ecosystems occur along a gradient with a progressive decrease in tree cover and increase in the grass matrix. In addition, gallery forests are found along the river courses throughout the entire Cerrado region, whereas deciduous forests may be found associated with limestone massifs. The predominant climate in the Cerrado is a seasonal tropical climate with a dry winter. The average annual temperature is 25°C, with a maximum of up to 40°C and a minimum of 10°C. The average annual precipitation is between 1,200 and 1,800 mm, with the months from October to March experiencing the most rain. The relief of the Cerrado domain is usually quite flat. Approximately 50% of its area is located at altitudes between 300 and 600m above sea level, and only 5.5% of the domain is above 900m.
3 - Why is the Site important?

3.1 - Ramsar Criteria and their justification

**Checkbox** Criterion 1: Representative, rare or unique natural or near-natural wetland types

One of the main peculiarities of the Lund Warming Ramsar Site compared to other karst areas worldwide is the large number of temporary lakes (Auler & Piló 2015). There are approximately 40 temporary lakes, formed in karst depressions (dolines, uvalas and poljés), distributed throughout the entire area and are mostly concentrated on the karst plains. Most of these lakes have temporary characteristics, with annual or multiannual cycles conditioned by the rainfall regime associated with the water table level and flow systems of the karst aquifer (IBAMA 1998d). Warming (1908) described the flood and drought cycles of the Sumidouro Lake, and this phenomenon still occurs throughout this entire region, attracting dozens of aquatic bird species (IBAMA, 1997, Rodrigues & Michelin, 2003, Domas, 2004, Domas & Figueira, 2012, Figueira et al. in press).

The dolines, sinks and caves, allied to diffuse soil infiltration, feed the underground drainage system, charging the karst aquifer that is the main sources of freshwater for the resident population of the region. The high water quality of their contribution to the Velhas River Basin enables them to positively contribute to the dilution of the large volume of sewage and other effluents released into the Velhas River upstream from the area, which mainly originate from the Belo Horizonte Metropolitan Region (IBAMA 1998d). In addition, grasses cultivation in the moist, fertile clay soils of dolines are used for dairy cattle.

The area of the karst of Lagoa Santa represent 4.9% of the Velhas River basin and is considered of extreme importance for its conservation (Plano Diretor do Comitê de Recursos Hídricos da Bacia Hidrográfica do Rio das Velhas 2015). On the other hand, Velhas River is a sub-basin of the longest river that runs entirely in Brazilian territory, the São Francisco (also the fourth longest river in South America), known as "The National Integration River". (Figueira, JEC, Nóbrega, PFA, Domas T, Aguiar, JB and Drumond, MA.The waterbirds and dynamics of karst temporary lakes. Lagoa Santa Karst (Augusto Auler editor). Springer Verlag, in press).

The Cerrado is the second largest Brazilian biome and originally occupied 2,045,064 km², representing the most extensive savannah region in South America. It has a huge biodiversity, in which a large number of endemic species and a high degree of degradation occur (only 20% of the original vegetation cover remained in 2000, with 6.2% of it located in Protected Areas). This biodiversity resulted in this biome’s classification as the sixth most important hotspot among the 34 internationally recognised biodiversity hotspots (Myers et al., 2000, Mittermeier et al., 2005).

The karst areas of South America correspond to 2% of the world’s surface (http://web.ens.auckland.ac.nz/our_research/karst/). Between 5 and 7% of Brazil’s territory is composed of karst terrain, of which 3 to 5% is found in Minas Gerais, between 17,600 and 29,419 km² (Travassos & Kohler 2009).

The Lund Warming site is composed of Atlantic Forest and Cerrado biomes, which represent two biodiversity hotspots. There are further deciduous and semideciduous forests and rupestrian vegetation associated with limestone and temporary lakes. Together, these different vegetation formations, karst reliefs and temporary lakes confer a high biodiversity and incredible scenic beauty to this region.

One characteristic of karst environments is the large amount of speleological sites. A total of 28 animal taxa and approximately 559 caves have been recorded in the Lagoa Santa Karst EPA (IBAMA 1998c).

- **Checkbox** Criterion 2: Rare species and threatened ecological communities

- **Checkbox** Criterion 3: Biological diversity
The different phases of the lake cycle (filling, full, drying and dry) create specific environmental conditions that have different plant formations and food resources associated with them. Because the size of a lake determines its duration, these same variables vary with size as well. Consequently, different phases of the cycle, or different sizes of lakes, attract different species of aquatic and terrestrial birds that find refuge, food and/or nesting sites, or are simply using as stopover place during migration. When the lakes are full, they attract gallinules, wood storks, cormorants, snail kites, ducks, sandpipers, stilts, jacanas, ibis, spoonbills, and kingfishers, among others. Several of these birds are migratory and probably migrate to other wetland areas of Minas Gerais, or even other Brazilian states, where there are seasonal concentrations of waterbirds, such as Rio Paraná valley (Paraná) and the Pantanal (Mato Grosso do Sul and Mato Grosso). The largest karst lakes have large littoral and limnetic zones, and can reach several meters in depth. Their beds and banks can possess a mixture of terrestrial and aquatic vegetation, resulting from the retraction and advancement of the water. Larger lakes also possess a great range of food resources, including fruits, fish, frogs, molluscs, other benthic invertebrates and the macrophytes themselves, with their leaves, seeds and stalks, as well as the terrestrial and aquatic invertebrates that feed and shelter on them. When different lakes are compared at the same time, the larger will have the greater richness of species and larger populations of waterbirds. The lakes also receive migratory birds fleeing the winter of the Northern Hemisphere, such as the Osprey and the Greater-yellow Legs, which winter in South America, and errant migrants which are sporadically observed, such as the Gulf-billed Tern, and the Semipalmated Plover. As drought progresses, smaller lakes dry faster and are soon abandoned by birds who concentrate in those that still have water, and are usually more perennial. Drying lakes can be great for foraging by birds such as the Wood Stork and the Roseate Spoonbill. Among the margins, birds that feed on insects, snakes, tadpoles, frogs etc., such as the Buff-necked Ibis, Whistling Herons and Cattle Egrets, can be found (but they are also present during the flood). Terrestrial birds, such as Picazuro Pigeons probably seek seeds in the newly exposed lakebed, while Caracaras and Turkey and Black Vultures seek carcasses of frog, waterbirds and fish (Figueira et al. in press).

**Criterion 4 : Support during critical life cycle stage or in adverse conditions**

3.2 - Plant species whose presence relates to the international importance of the site

Kart depressions (dolines, uvalas and poljès) and their aquatic, higrophilous and terrestrial plants. The lakes of APA Carste differ significantly in aquatic macrophyte species composition and coverage. They can possess floating macrophytes, such as Salvinia, Pistia and Eichhornia, as well as macrophytes rooted in the bottom with emergent leaves, such as Nymphaea and Nymphaeoides, and rooted emergents, some with dense coverage, such as Typha and Juncus. They can also have plants associated with wet, soggy soils, such as Ludwigia and Cyperus (BAMA/CPRM 1998a).

As the water level drops, newly exposed soils are gradually covered by terrestrial herbaceous vegetation that advances like a "green wave." Legumes and other shrubby plants intolerant of soggy soils may form very distinct bands in the higher, and drier, areas. Some of these species probably originate from seeds deposited in the soil during the previous dry season when their progenitors reproduced, suggesting that they are plants with a therophyte life cycle. Therophytes are common, for example, in the floodplains of the Pantanal in Mato Grosso. Thus, karstic depressions become large fields, gradually dominated by species with different degrees of affinity for moisture, but are intolerant to soggy soils, and which grow rapidly and enter the reproductive phase quickly. Some months later, in years of intense and regular rainfall, these fields flood and the terrestrial herbaceous vegetation gradually disappears and the process of ecological succession is interrupted, while the aquatic vegetation returns to dominate. During the phase transitions (from dry to flooding and back to dry), space is partitioned between aquatic and semiaquatic and terrestrial plants. Shrub plants that do not tolerate excessive moisture languish, but their dry branches can serve as perches and nesting sites for birds. The persistence of the lakes, in continuous ecological succession from aquatic to terrestrial and back to aquatic ecological communities, is threatened by the growing use of underground water associated to urban and industrial expansion, limestone mining and deforestation, that lower the upper level of the karst aquifers (Figueira et al. in press).

3.3 - Animal species whose presence relates to the international importance of the site
| Phylum         | Scientific name | Common name         | Species qualifies under criterion | Species contributes under criterion | Pop. Size | Period of pop. Est. | % occurrence 1) | IUCN Red List | CITES Appendix I | CMS Appendix I | Other Status                | Justification                                                                 |
|---------------|-----------------|---------------------|-----------------------------------|-----------------------------------|-----------|---------------------|-----------------|---------------|------------------|----------------|----------------|-----------------|--------------------------------------------------------------------------------|
| Birds         |                 |                     |                                   |                                   |           |                     |                 |               |                  |                |                  |                               |                                                                                |
| CHORDATA/AVES | Calidris        | Pectoral Sandpiper   | ☑️                              | ☑️                                | LC        |                     |                 |               |                  |                |                  | Migratory bird that uses the area for resting and feeding                      |                                                                                |
| CHORDATA/AVES | Charadrius      | Semipalmated Plover  | ☑️                              | ☑️                                | LC        |                     |                 |               |                  |                |                  |                               |                                                                                |
| CHORDATA/AVES | Gelochelidon    | Nilotica             | ☑️                              | ☑️                                | LC        |                     |                 |               |                  |                |                  |                               |                                                                                |
| CHORDATA/AVES | Jabiru          | mycteria             | ☑️                              | ☑️                                | LC        |                     |                 |               |                  |                |                  |                               |                                                                                |
| CHORDATA/AVES | Tringa          | melanoleuca          | ☑️                              | ☑️                                | LC        |                     |                 |               |                  |                |                  |                               |                                                                                |
| CHORDATA/AVES | Tringa          | solitaria            | ☑️                              | ☑️                                | LC        |                     |                 |               |                  |                |                  |                               |                                                                                |
| Fish, Mollusc and Crustacea |     |                     |                                   |                                   |           |                     |                 |               |                  |                |                  |                               |                                                                                |
| CHORDATA/ACTINOPTERYGI | Astyanax mutans |                        | ☑️                              | ☑️                                | LC        |                     |                 |               |                  |                |                  |                               |                                                                                |
| CHORDATA/ACTINOPTERYGI | Rhamdia querian |                        | ☑️                              | ☑️                                | LC        |                     |                 |               |                  |                |                  |                               |                                                                                |
| Others        |                 |                     |                                   |                                   |           |                     |                 |               |                  |                |                  |                               |                                                                                |
| CHORDATA/MAMMALIA | Alouatta guiana | guiana               | ☑️                              | ☑️                                | LC        |                     |                 |               |                  |                |                  | VU in Brazil                                                                 |                                                                                |
| CHORDATA/MAMMALIA | Callicebus     | coronatus            | ☑️                              | ☑️                                | LC        |                     |                 |               |                  |                |                  | VU in Brazil                                                                 |                                                                                |
| CHORDATA/MAMMALIA | Puma concolor |                        | ☑️                              | ☑️                                | LC        |                     |                 |               |                  |                |                  | VU in Brazil                                                                 |                                                                                |

1) Percentage of the total biogeographic population at the site

3.4 - Ecological communities whose presence relates to the international importance of the site

<table>
<thead>
<tr>
<th>Name of ecological community</th>
<th>Community qualifies under Criterion 2?</th>
<th>Description</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karst depressions (dolines, uvalas and poljes) and their aquatic, higrophilous and terrestrial plants.</td>
<td>☑️</td>
<td>The vegetation of the Karst depressions furnish food, feeding places, shelter, perches (for nesting or feeding) for aquatic and terrestrial birds.</td>
<td>Different bird species benefit from different phases of the karst lakes with their mosaic of aquatic and terrestrial vegetation.</td>
</tr>
</tbody>
</table>
4 - What is the Site like? (Ecological character description)

4.1 - Ecological character

The 523 caves found in the Lund Warming Ramsar Site and its surroundings serve as refuges for cave fauna. Species of troglodytes, troglobhythtes and troglobites are found in these caves (ICMBIO 2012). Iniesta et al. (2012) surveyed seven caves located in the Sumidouro State Park and found 203 invertebrate and vertebrate species belonging to at least 98 families. Two invertebrate species identified in this survey have troglobite characteristics: Trichorhina sp. (Isopoda: Plathyarthridae) and the mite Labidostomatidae (Acariforme). This latter species demands special attention because of its restricted distribution and extremely small population inside the cave. In addition, a troglobite spider (Nesticus sp.) and a troglobite isopod (Pectenoniscus sp.) were found in other caves in this region (Trajano & Bichuette 2009).

Although no troglobite fish species have been found in this region (L.R. Ferreira, com. pess.), the archaeologist Anibal Mattos (1961) has described what appear to be troglobite fish in the site called ‘vargem do Mucambo’ (probably Mocambeiro). Conversely, the fish Astyanax rivularis (Order Characiformes, Family Characidae) and Rhamdia quelen (Order Siluriformes, Family Heptapteridae) were found in surface running water and groundwater close to the Lapinha Cave (Mariana Araújo Moreira, personal communication), which suggests that these species are troglobites.

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4.2 - What wetland type(s) are in the site?

<table>
<thead>
<tr>
<th>Inland wetlands</th>
<th>Local name</th>
<th>Ranking of extent (1: greatest - 4: least)</th>
<th>Area (ha) of wetland type</th>
<th>Justification of Criterion 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh water &gt; Flowing water &gt;&gt; M: Permanent rivers/streams/creeks</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh water &gt; Lakes and pools &gt;&gt; O: Permanent freshwater lakes</td>
<td>4</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh water &gt; Lakes and pools &gt;&gt; P: Seasonal/intermittent freshwater lakes</td>
<td>1</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh water &gt; Lakes and pools &gt;&gt; Tp: Permanent freshwater marshes/pools</td>
<td>3</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh of brackish or alkaline water &gt;&gt; Subterranean &gt;&gt; Zk(b): Karst and other subterranean hydrological systems</td>
<td>4</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.3 - Biological components

4.3.1 - Plant species

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
<th>Position in range / endemism / other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caryocar brasiliense</td>
<td>Tabebuia aurea</td>
<td></td>
</tr>
</tbody>
</table>

4.3.2 - Animal species

<table>
<thead>
<tr>
<th>Phylum</th>
<th>Scientific name</th>
<th>Common name</th>
<th>Pop. size</th>
<th>Period of pop. est.</th>
<th>% occurrence</th>
<th>Position in range/endemism/other</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHORDATA/AVES</td>
<td>Ciconia maguari</td>
<td>Maguari Stork</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHORDATA/MAMMALIA</td>
<td>Kunsia fronto</td>
<td>Rato-do mato</td>
<td></td>
<td></td>
<td></td>
<td>New species, found in caves</td>
</tr>
<tr>
<td>CHORDATA/MAMMALIA</td>
<td>Leopardus pardalis mitis</td>
<td>Gato-maracajá</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHORDATA</td>
<td>Myotis americana</td>
<td>Wood Stork</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHORDATA/MAMMALIA</td>
<td>Phyllostomus brasiliensis</td>
<td>Orange-brown Atlantic Tree-rat</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHORDATA/AVES</td>
<td>Platelia aaja</td>
<td>Roseate Spoonbill</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.4 - Physical components

4.4.1 - Climate

<table>
<thead>
<tr>
<th>Climatic region</th>
<th>Subregion</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Tropical humid climate</td>
<td>Aw: Tropical savanna (Winter dry season)</td>
</tr>
</tbody>
</table>
4.4.2 - Geomorphic setting

- Minimum elevation above sea level (in metres): 652
- Maximum elevation above sea level (in metres): 859

- Entire river basin
- Upper part of river basin
- Middle part of river basin
- Lower part of river basin
- More than one river basin
- Not in river basin
- Coastal

Please name the river basin or basins. If the site lies in a sub-basin, please also name the larger river basin. For a coastal/marine site, please name the sea or ocean.

**São Francisco River Basin and Velhas River sub-basin**

4.4.3 - Soil

- Mineral
- Organic
- No available information

Are soil types subject to change as a result of changing hydrological conditions (e.g., increased salinity or acidification)?

- Yes
- No

Please provide further information on the soil (optional).

The following soil class units are found in the area: Red Oxisols, Inceptisols, Red Ultisols and Haplic Gleysols. Moreover, rocky outcrops are also found in the area and are composed mostly of limestone rocks distributed throughout the Pedro Leopoldo and Fidalgo districts and in the central portion of Matozinhos (Oliveira et al., 1992).

4.4.4 - Water regime

**Water permanence**

- Presence?
- Usually permanent water present
- Usually seasonal, ephemeral or intermittent water present

**Source of water that maintains character of the site**

<table>
<thead>
<tr>
<th>Presence?</th>
<th>Predominant water source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water inputs from surface water</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Water destination**

- Presence?
- Feeds groundwater

**Stability of water regime**

- Presence?
- Water levels fluctuating (including tidal)

Please add any comments on the water regime and its determinants (if relevant). Use this box to explain sites with complex hydrology.

The high water quality of these streams enables them to positively contribute to the dilution of the large volume of sewage and other effluents released into the Velhas River upstream from the area, which mainly originate from the Belo Horizonte Metropolitan Region (IBAMA 1998d). There are approximately 40 temporary lakes in the Lagoa Santa Karst EPA that are distributed throughout the entire area and are mostly concentrated on the karst plains. Most of these lakes have temporary characteristics, with annual or multiannual cycles conditioned by the rainfall regime associated with the water table level and flow systems of the karst aquifer (IBAMA 1998d).

4.4.5 - Sediment regime

- Significant erosion of sediments occurs on the site
- Significant accretion or deposition of sediments occurs on the site
- Significant transportation of sediments occurs on or through the site
- Sediment regime is highly variable, either seasonally or inter-annually
- Sediment regime unknown

4.4.6 - Water pH

- Acid (pH<5.5)
- Circumneutral (pH: 5.5-7.4)
- Alkaline (pH>7.4)
- Unknown

4.4.7 - Water salinity

What is the Site like?, S4 - Page 2
4.4.8 - Dissolved or suspended nutrients in water

- Mixohaline (brackish)/Mixosaline (0.5-30 g/l)
- Euhaline/Eusaline (30-40 g/l)
- Hyperhaline/Hypersaline (>40 g/l)
- Mixohaline (brackish)/Mixosaline (0.5-30 g/l)
- Unknown

4.4.9 - Features of the surrounding area which may affect the Site

Please describe whether, and if so how, the landscape and ecological characteristics in the area surrounding the Ramsar Site differ from the site itself:

- i) broadly similar
- ii) significantly different

The surroundings of the Peter Lund Karst Ramsar Site are occupied by large private rural properties, cement industries and cities. Large rural properties, especially of the agricultural sector, limestone mining, an industrial airport that serves high-technology corporations (e.g., biotechnology, electronics) and intense and disorderly urbanization are the main causes of environmental impacts. Although they do not occur directly in the lakes, the presence of mining activities leads to the loss of native vegetation and changes in the quality of the surface water and groundwater (Neri, 2007).

4.5 - Ecosystem services

4.5.1 - Ecosystem services/benefits

<table>
<thead>
<tr>
<th>Provisioning Services</th>
<th>Importance/Extent/Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh water Water for irrigated agriculture</td>
<td>Medium</td>
</tr>
<tr>
<td>Fresh water Water for industry</td>
<td>Medium</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Regulating Services</th>
<th>Importance/Extent/Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollution control and detoxification Water purification/waste treatment or dilution</td>
<td>High</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cultural Services</th>
<th>Importance/Extent/Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreation and tourism Nature observation and nature-based tourism</td>
<td>High</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supporting Services</th>
<th>Importance/Extent/Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiversity Supports a variety of all life forms including plants, animals and microorganisms, the genes they contain, and the ecosystems of which they form a part</td>
<td>High</td>
</tr>
</tbody>
</table>

Outside the site: 1000000

Have studies or assessments been made of the economic valuation of ecosystem services provided by this Ramsar Site? [ ] Yes [ ] No [ ] Unknown

4.5.2 - Social and cultural values

- i) the site provides a model of wetland wise use, demonstrating the application of traditional knowledge and methods of management and use that maintain the ecological character of the wetland
- ii) the site has exceptional cultural traditions or records of former civilizations that have influenced the ecological character of the wetland

Description if applicable
iii) the ecological character of the wetland depends on its interaction with local communities or indigenous peoples.

iv) relevant non-material values such as sacred sites are present and their existence is strongly linked with the maintenance of the ecological character of the wetland.

4.6 - Ecological processes

The Lagoa Santa karst site is considered the birthplace of Brazilian palaeontology, archaeology and spelaeology. The high number of caves and shelters in this region harbor numerous Pleistocene fossils and traces of prehistoric human settlements, including rock drawings, tools and human bones.

Peter Lund explored over 800 caves during the period in which he lived in this region, where he found traces of human presence alongside traces of Pleistocene megaflora. In the early 1970s, a French-Brazilian archaeological expedition led by Annette Laming-Emperaire found a fossilised female human skull dated circa 11,000-11,500 years old in the Lapa Vermelha, Pedro Leopolodo municipality. This skull, which was named 'Luzia', is considered the oldest human trace in the Americas (Prous et al., 1998, Figure 6).

The rock art in the Lagoa Santa karst region (known as the Planalto Tradition) was likely made 8,000 ago. Datings in the Lapa Vermelha archaeological site have established a minimum age of 3,800 years.

The first scientific study on the Brazilian Cerrado was published in 1892. This study is the Lagoa Santa Et Bidrag til den biologiske Plantergeografie (translated as Lagoa Santa, A Contribution to Phytobiological Geography) and was authored by Eugenius Warming, a professor of botany at the University of Copenhagen (Figure 3).

Old colonial farms are also a cultural attraction in this region. An example of such farms is the Jaguarã Velha Farm, which contains the ruins of the Church of Nossa Senhora da Conceição, built in 1786 (Instituto Terrazul, 2007).

Because of its historical, cultural and biological importance, the region was transformed into a Protected Area in 1990 named Lagoa Santa Karst EPA (IBAMA 1998b). This region was also categorized as a region of importance ranging from 'special' to 'extreme' for biodiversity conservation in Minas Gerais (Drummond et al., 2005).
5 - How is the Site managed? (Conservation and management)

5.1 - Land tenure and responsibilities (Managers)

5.1.1 - Land tenure/ownership

<table>
<thead>
<tr>
<th>Category</th>
<th>Within the Ramsar Site</th>
<th>In the surrounding area</th>
</tr>
</thead>
<tbody>
<tr>
<td>National/Federal government</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Private ownership

<table>
<thead>
<tr>
<th>Category</th>
<th>Within the Ramsar Site</th>
<th>In the surrounding area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other types of private/individual owner(s)</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Provide further information on the land tenure / ownership regime (optional):

a) within the Ramsar site:
The land is private in the largest part of the Peter Lund Karst site. The state owns 50% of the area of Sumidouro State Park, which has an area of 2,000 ha. Other Protected Areas located on private land in the region are currently in the process of expropriation by the state.

c) in the surrounding area:
The surroundings of the Peter Lund Karst Ramsar Site are occupied by large private rural properties, cement industries and cities.

5.1.2 - Management authority

Please list the local office / offices of any agency or organization responsible for managing the site:

Coordenação Regional 11 - Lagoa Santa: Instituto Chico Mendes de Conservação da Biodiversidade - ICMBio:
Alameda Dra. Vilma Edelweiss dos Santos, 115 – Bairro Lundcélia – Lagoa Santa/Minas Gerais
Instituto Chico Mendes de Conservação da Biodiversidade - ICMBio (head office):
EQSW 103/104, Bloco “C”, Complexo Administrativo - Setor Sudoeste CEP: 70.670-350 - Brasilia - DF

Provide the name and title of the person or people with responsibility for the wetland:
Mr. Ricardo de Magalhães Barbalho, Head of Lagoa Santa Karst EPA
Postal address:
Alameda Dra. Vilma Edelweiss dos Santos, 115 – Bairro Lundcélia. Lagoa Santa/MG, Brazil, postcode: 33.400-000
E-mail address: ricardo.barbalho@icmbio.gov.br

5.2 - Ecological character threats and responses (Management)

5.2.1 - Factors (actual or likely) adversely affecting the Site’s ecological character

Human settlements (non agricultural)

<table>
<thead>
<tr>
<th>Factors adversely affecting site</th>
<th>Actual threat</th>
<th>Potential threat</th>
<th>Within the site</th>
<th>In the surrounding area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing and urban areas</td>
<td>unknown impact</td>
<td>unknown impact</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial and industrial areas</td>
<td>unknown impact</td>
<td>unknown impact</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Water regulation

<table>
<thead>
<tr>
<th>Factors adversely affecting site</th>
<th>Actual threat</th>
<th>Potential threat</th>
<th>Within the site</th>
<th>In the surrounding area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drainage</td>
<td>unknown impact</td>
<td>unknown impact</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water abstraction</td>
<td>unknown impact</td>
<td>unknown impact</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Agriculture and aquaculture

<table>
<thead>
<tr>
<th>Factors adversely affecting site</th>
<th>Actual threat</th>
<th>Potential threat</th>
<th>Within the site</th>
<th>In the surrounding area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual and perennial non-timber crops</td>
<td>unknown impact</td>
<td>unknown impact</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Energy production and mining

<table>
<thead>
<tr>
<th>Factors adversely affecting site</th>
<th>Actual threat</th>
<th>Potential threat</th>
<th>Within the site</th>
<th>In the surrounding area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining and quarrying</td>
<td>unknown impact</td>
<td>unknown impact</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Transportation and service corridors

<table>
<thead>
<tr>
<th>Factors adversely affecting site</th>
<th>Actual threat</th>
<th>Potential threat</th>
<th>Within the site</th>
<th>In the surrounding area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads and railroads</td>
<td>unknown impact</td>
<td>unknown impact</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Natural system modifications

How is the Site managed?, S5 - Page 1
<table>
<thead>
<tr>
<th>Factors adversely affecting site</th>
<th>Actual threat</th>
<th>Potential threat</th>
<th>Within the site</th>
<th>In the surrounding area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetation clearance/land conversion</td>
<td>High impact</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Please describe any other threats (optional):

a) within the Ramsar site:

Many threats to the temporary lake system and other landscape units of the Peter Lund Karst region have been identified. The native vegetation has been largely modified through conversion into pastures and agricultural fields, construction of roads and the urbanisation process. The conversion of the region’s forests and cerrados into farms and pastures dates back to the 19th century (IBAMA, 1998b). The impoverishment of the native fauna and overload of the karst aquifer are expected problems. In addition, certain doline sinkholes have been intentionally blocked, precluding water drainage and making these lakes more permanent. The construction of roads in this region has seriously impacted many of the temporary lakes because some of the roads were built on the margins or beds of these lakes. The ill-planned placement of cemeteries and landfills, in addition to the construction of dwellings and hotels, also directly threatens the lake system (Hardt, 2008; Milanovic, 2002; Urich, 2002), because the sinkholes of some of the temporary lakes are water absorption sites that supply a whole groundwater drainage system (Hardt, 2008; Sampaio, 2010). However, there are also Protected Areas within the borders of the Peter Lund Karst Ramsar Site, such as the Sumidouro and Cerca Grande State Parks and Lapa Vermelha, Vargem de Pedra, Experiência de Jaguara, Santo Antônio and Várzea de Pedra Natural Monuments, which may influence decisions aimed at reducing the impacts to this region.

b) in the surrounding area:

Large rural properties, especially of the agricultural sector, limestone mining, an industrial airport that serves high-technology corporations (e.g., biotechnology, electronics) and intense and disorderly urbanisation are the main causes of environmental impacts. Although they do not occur directly in the lakes, the presence of mining activities leads to the loss of native vegetation and changes in the quality of the surface water and groundwater (Neri, 2007).

### 5.2.2 - Legal conservation status

<table>
<thead>
<tr>
<th>Designation type</th>
<th>Name of area</th>
<th>Online information url</th>
<th>Overlap with Ramsar Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>national protected area</td>
<td>Lagoa Santa Karst Environmental Protection Area</td>
<td></td>
<td>partly</td>
</tr>
<tr>
<td>natural monuments</td>
<td>Lapa Vermelha, Vargem de Pedra, Experiência de Jaguara, Santo Antônio and Várzea de Pedra</td>
<td></td>
<td>partly</td>
</tr>
<tr>
<td>state protected area</td>
<td>Cerca Grande state park</td>
<td></td>
<td>partly</td>
</tr>
<tr>
<td>state protected area</td>
<td>Sumidouro state park</td>
<td></td>
<td>whole</td>
</tr>
</tbody>
</table>

### 5.2.3 - IUCN protected areas categories (2008)

- Ia Strict Nature Reserve
- Ib Wilderness Area: protected area managed mainly for wilderness protection
- II National Park: protected area managed mainly for ecosystem protection and recreation
- III Natural Monument: protected area managed mainly for conservation of specific natural features
- IV Habitat/Species Management Area: protected area managed mainly for conservation through management intervention
- V Protected Landscape/Seascape: protected area managed mainly for landscape/seascape conservation and recreation
- VI Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems

### 5.2.4 - Key conservation measures

#### Legal protection

<table>
<thead>
<tr>
<th>Measures</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legal protection</td>
<td>Implemented</td>
</tr>
</tbody>
</table>

#### Habitat

<table>
<thead>
<tr>
<th>Measures</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improvement of water quality</td>
<td>Proposed</td>
</tr>
</tbody>
</table>

Human Activities
5.2.5 - Management planning

Is there a site-specific management plan for the site? No

Has a management effectiveness assessment been undertaken for the site? Yes ☐ No ☐

If the site is a formal transboundary site as indicated in section 3 Data and location > Site location, are there shared management planning processes with another Contracting Party? Yes ☐ No ☐

Please indicate if a Ramsar centre, other educational or visitor facility, or an educational or visitor programme is associated with the site:

Magazine of the Manuelzão Project, which aims to promote awareness, social mobilization, environmental education and recovery of local cultures as well as to identify the environmental impacts on the Velhas River Basin. This publication is available online (http://www.manuelzao.ufmg.br/publicacoes/revista?revista_start=60).

The Peter Lund Museum will contain approximately 80 human and animal fossils discovered in the region by Lund (http://www.manuelzao.ufmg.br/publicacoes/revista?revista_start=60).

5.2.6 - Planning for restoration

Is there a site-specific restoration plan? Yes, there is a plan

5.2.7 - Monitoring implemented or proposed

<table>
<thead>
<tr>
<th>Monitoring</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water quality</td>
<td>Proposed</td>
</tr>
</tbody>
</table>

There is a proposal to create a surface water and groundwater monitoring program to identify fragile areas and to limit the anthropogenic activities that may compromise water quality, in the Peter Lund Ramsar Site. The Manuelzão Project is also underway in the Lagoa Santa Karst EPA. This project was created in 1997 by professors from the School of Medicine of the Federal University of Minas Gerais (Universidade Federal de Minas Gerais - UFMG), and its aim is to advocate for improved environmental conditions to promote the health and quality of life, which is opposed to the predominantly welfare-based system. The Velhas River drainage basin was selected as the group’s focus of operation. The partnership with the local community has grown considerably during the project’s existence and includes the participation of civil society, government representatives and water users. The project has also been conducting important research activities, including water quality biomonitoring, geoprocessing and riparian forest restoration.

The Sumidouro State Park, which is included in the Peter Lund Karst area, performs on-going surveillance, monitoring and restoration activities in accordance with the management plan.
6 - Additional material

6.1 - Additional reports and documents

6.1.1 - Bibliographical references

The whole list of references is in the section 6.1.2.6

6.1.2 - Additional reports and documents

i. taxonomic lists of plant and animal species occurring in the site (see section 4.3)

ii. a detailed Ecological Character Description (ECD) (in a national format)

iii. a description of the site in a national or regional wetland inventory

iv. relevant Article 3.2 reports

v. site management plan

vi. other published literature

6.1.3 - Photograph(s) of the Site

Please provide at least one photograph of the site:


6.1.4 - Designation letter and related data

Designation letter

Date of Designation | 2017-06-05