DETERMINING THE SPRINGS OF TWO IMPORTANT RIVERS ON THE SERRAS DA JACOBINA MOUNTAINS, CHAPADA DIAMANTINA, BAHIA, BRAZIL

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ABSTRACT

The 'Serra da Fumaça' mountains harbor several water springs, with their most significant water body being the 'Rio Fumaça' river. A study conducted in 2013 proposed to identify the water springs of the Rio Fumaça and evaluate their conservation status. However, the actual location of the northernmost water spring of the Rio Fumaça river did not match the statements of that study based on relief data and satellite imagery. Knowing the actual location of water springs is essential to guarantee their conservation given the ever-growing water scarcity scenario. From this perspective, this study aimed to verify the first (northernmost) water spring of the 'Rio Fumaça' river; summarize the old and current risks to the water springs of the area; and propose measures to protect newly-found water springs. For that purpose, an *in loco* expedition was launched in September 2022 to verify the area. First, contour line maps of the region were obtained using the software QGIS version 3.16.3. GPS devices, Google Earth, and real-time Google Maps were also employed. Various waypoints were visited, filmed, and photographed during the expedition. The present results challenge the data provided by the manuscript published in 2013 about the location of the northernmost spring of the Rio Fumaça. The spring of a tributary of the Rio Aipim river was also found. All springs were threatened by human activities, and efforts should be taken to establish a Conservation Unit in the region.
KEYWORDS: conservation; hydrology; Serra da Fumaça.

DETERMINAÇÃO DAS NASCENTES DE DOIS IMPORTANTES RIOS NAS SERRAS DA JACOBINA, CHAPADA DIAMANTINA, BAHIA, BRASIL

RESUMO

As montanhas da Serra da Fumaça compreendem várias nascentes, com o principal corpo hídrico da região sendo o Rio Fumaça. Um artigo publicado em 2013 se propôs a identificar as nascentes do Rio Fumaça e avaliar seu estado de conservação. Contudo, dados de relevo e imagens de satélite não condizem com a localização atribuída pelos autores daquele manuscrito para a nascente mais ao norte do Rio Fumaça. Saber a localização real de nascentes é essencial para garantir sua conservação em face do cenário crescente de escassez hídrica. Nesse

sentido, este estudo objetivou verificar a primeira (mais ao norte) nascente do Rio Fumaça; enumerar os riscos antigos e novos para as nascentes da região; e propor medidas para proteger as nascentes encontradas. Para esse propósito, uma expedição foi lançada em setembro de 2022 para verificar a área. Primeiramente, mapas de relevo da região foram obtidos utilizando o software QGIS. Também foram utilizados dispositivos GPS e mapas em tempo real no aplicativo Google Maps com imagens de satélite do Google Earth. Vários pontos foram visitados, filmados e fotografados durante a expedição. Como resultados, este trabalho desafia os dados do mencionado artigo publicado em 2013 sobre a localização da primeira nascente do Rio Fumaça. Também foi encontrada uma nascente correspondendo a um afluente do Rio Aipim. Todas as nascentes estavam ameaçadas por atividades antrópicas, e esforços devem ser feitos no sentido de criar uma Unidade de Conservação na região.
PALAVRAS-CHAVE: conservação; hidrologia; Serra da Fumaça.

INTRODUCTION

With an area of approximately 912.000 km^2, the Caatinga Domain (CD), located in northeastern Brazil, presents itself as a mosaic of considerably different smaller units (biomes) (QUEIROZ *et al.,* 2017). However, although most of the CD is represented by environments with rainfall ranging from 600 to 1000 mm per year, about 1.6% of its territory shows rainfall rates above 1200 mm (ANDRADE *et al*., 2017), forming 'humid islands' generally found in elevated regions affected by the orographic effect, e.g., the mountains of the Chapada Diamantina plateau (QUEIROZ *et al*., 2017; SANTOS NETO *et al*., 2022).

Velloso *et al*. (2002) proposed eight ecoregions for the Caatinga Domain (then called biome), one of these being the 'Chapada Diamantina Complex'. According to these authors, this is the highest ecoregion of the Caatinga, with a very irregular relief, rocky tops, steep slopes, and narrow and deep valleys. They also noted that this ecoregion has the predominance of acid and little-fertile latosols in its highest areas, whereas the valleys are mostly composed of deep, well-drained, and clayey podzols and latosols.

Given its peculiarity in being an elevated area within semi-arid surroundings, with a marked elevation gradient, the vegetation of the Chapada Diamantina Complex shows a mosaic of different formations, including the typical dry forest of the Caatinga *stricto sensu*, savannah-like formations associated with the Brazilian Cerrado, and decidual, semidecidual, or non-deciduous formations associated with deep soils and water courses resembling the Atlantic Rainforest, in addition to open fields with rocky outcrops (campos rupestres) (BRASIL, 2007).

Within the Chapada Diamantina Complex, the 'Serras da Jacobina' mountains correspond to the setentrional portion of the Chapada Diamantina plateau formation, which, in turn, constitutes the 'Cadeia do Espinhaço', the second largest mountain range in Brazil, extending for about 1,100 km in a north-south direction across the Brazilian states of Minas Gerais and Bahia (KAMINO *et al.,* 2008). This northern portion of the Chapada Diamantina consists of a geographically isolated unit limited from east to west, forming a plateau with elevations up to 1,300 m high between the municipalities of Miguel Calmon and Jaguarari, Bahia (ALVES; LOEUILLE, 2021).

Within the Serras da Jacobina, an arbitrarily determined stretch between the municipalities of Pindobaçu and Antônio Gonçalves, Bahia, forms the mountain region known as 'Serra da Fumaça'. Following the overall pattern of the Chapada Diamantina, the Serra da Fumaça area shows the typical phytogeographical variations of its larger mountain range, including rocky outcrops, savannah-like fields, and semidecidual and non-deciduous forests along water bodies.

Rizzini (1997) stated that elevated open field areas can sometimes be moderately deep and lay over groundwater reservoirs. Accordingly, the Serra da Fumaça, consisting of a larger plateau formation, i.e., allowing the accumulation of water in its high soils, harbors a large number of water springs that emerge from all over its area. In that regard, the most significant water body that originates from the Serra da Fumaça is its homonymous river, the 'Rio Fumaça', whose drainage basin is entirely contained within the Serras da Jacobina (CARVALHO *et al.,* 2013). This drainage basin crosses the municipality of Pindobaçu from northwest to southwest, showing an intermittent behavior and ultimately draining into the Itapicuru-Açu River, a tributary of the larger Itapicuru River (CARVALHO *et al.,* 2013).

Water springs, in turn, are formed when an aquifer is filled to the point of overflowing onto the land surface, ranging in size from intermittent seeps to large perennial pools (USGS, 2022). In that regard, Faria (1997) proposed six different types of water springs according to their location, type of outflow, and durability: fixed, mobile, diffuse, pseudo-springs, primary, and secondary. To date, the available data on the springs of the Serra da Fumaça mountains have only reported the presence of diffuse springs, i.e., ephemeral or perennial springs where water emerges from a large area without a specific seepage point (FARIA, 1997; CARVALHO *et al.,* 2013).

The Brazilian Forest Code defines water springs as perennial or intermittent natural outbursts from the water table that begin a water body, also establishing that the entire area around a minimum 50 m radius from water springs are defined as Permanent Preservation Areas (APPs). The same code establishes that, in case of consolidated rural areas around perennial water springs, it is possible to maintain farming and ecotourism activities as long as there is a recomposition of a minimum 15 m radius of the natural vegetation (BRASIL, 2012).

However, the scenario observed in reality is another, with uncontrolled exploitation and devastation of water spring areas. Also, the single available study that addressed the issue of the water springs of the Serra da Fumaça, published in 2013, already alerted to the fact that the identified springs were threatened by the presence of cattle, fires, deforestation, and camping areas, a situation that has since been further worsened (CARVALHO *et al.,* 2013).

On the other hand, that same study (CARVALHO *et al.,* 2013) proposed to identify the water springs of the Rio Fumaça and evaluate their conservation status. However, the authors of the present study noticed that, although contributing significantly to the theme, some information published by Carvalho *et al.,* (2013) seemed inaccurate and even mistaken considering relief data and satellite imagery. One such conflicting information refers to the actual location of the northernmost water spring of the Rio Fumaça river, whose location, considering the distribution of the vegetation in satellite imagery, was apparently mistaken.

Knowing the actual location of the water springs of any river is essential to guarantee their survival and conservation given the ever-growing water scarcity scenario observed worldwide, with at least three billion people being threatened by dubious quality of water due to a lack of monitoring, almost one billion people living in countries with high and critical levels of water stress, and the loss of over 85% of the planet's wetlands, according to Sustainable Development Goal number 6 of the United Nations (ensure availability and sustainable management of water and sanitation for all) (UN, 2022).

From this perspective, considering the critical conservation status of the water springs located on the Serra da Fumaça mountains given the various activities that impose threats to their existence and the apparent inaccuracy of current available data regarding their location, this study aimed to determine the first (northernmost) water spring of the ‘Rio Fumaça’ river; summarize the old and current (even still unknown) risks to the water springs of the area; and propose measures to protect newly-found water springs.

MATERIAL AND METHODS

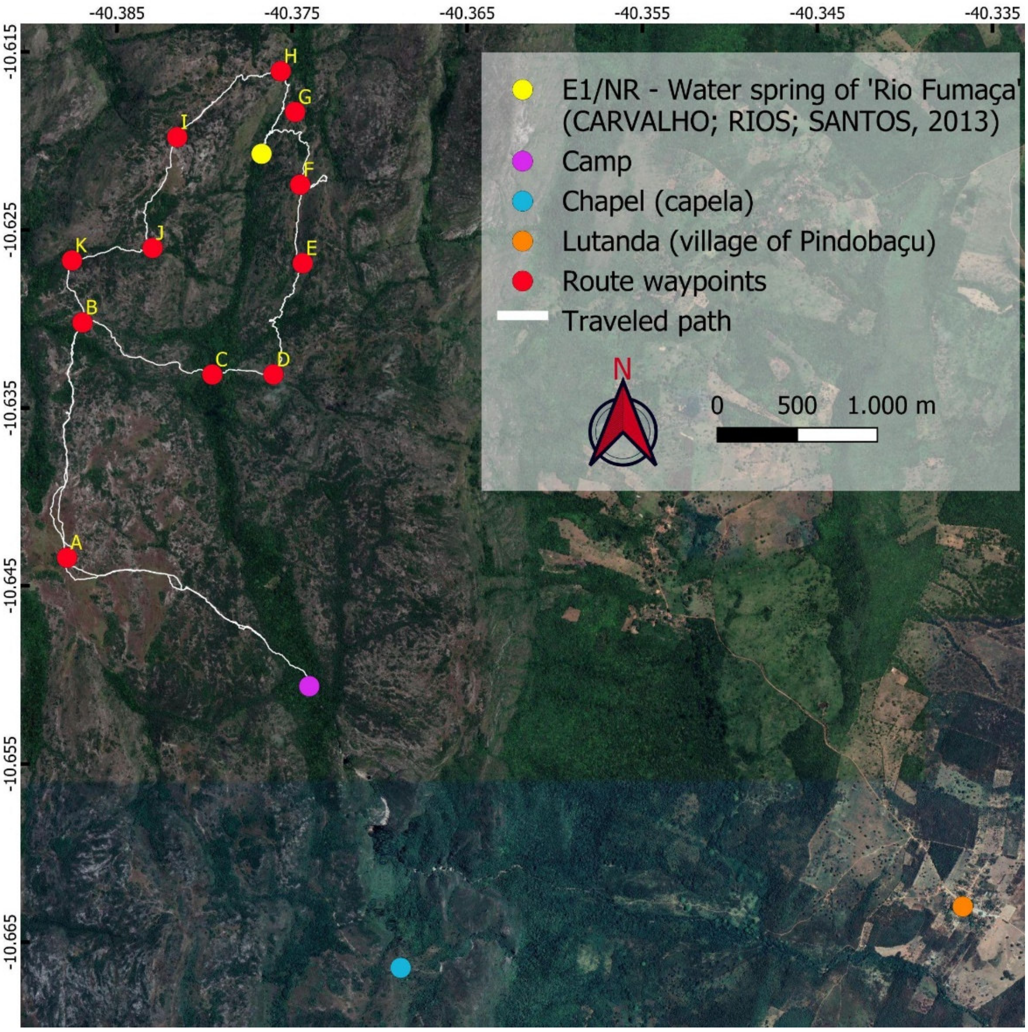
According to data from the National Institute of Meteorology of Brazil (INMET) corresponding to the 10-year period from 2011 to 2020, the studied location has a mean annual temperature of 24ºC, a mean annual rainfall of 624.5 mm, and a mean relative humidity of 67.6% (INMET, 2021). Rainfall in the area is more abundant from January to May and scarcer from September to December (INMET, 2021). According to the Köppen classification, the climate of the area is classified as *Bsh*, corresponding to a dry, semi-arid climate of low latitude and altitude (ALVARES *et al*., 2013).

This study proposed to verify the data presented by Carvalho *et al.*, (2013) in their article titled “Spatialization and characterization of the state of conservation of the springs of the river Rio Fumaça - City of Pindobaçu, Bahia”, in which the authors claimed to have identified, mapped, and visited *in loco* ten water springs of the Rio Fumaça river from September 2012 to April 2013. All these springs were classified by them as diffuse, which would imply open field areas where water overflows diffusely onto the surface. However, their statements were particularly troublesome with regard to the northernmost spring of the Rio Fumaça river, which they called ‘E1,’ defined by the UTM coordinates -24L 349399 8825630 (10°37'14.40"S 40°22'36.18"W), since satellite imagery did not agree that a diffuse spring could be located over that type of terrain.

Therefore, in order to confirm that location and the type of spring stated by Carvalho *et al.*, (2013), an *in loco* expedition was launched in September 2022 to verify the area. First, contour line maps of the region were obtained using the software QGIS, version 3.16.3 - Hannover, to determine the easiest route to access and leave the area during a single day. Two GPS devices (Garmin eTrex 10 and Garmin GPSMAP 62s), Google Earth imagery, and a real-time map in Google Maps accessed through a smartphone were also employed.

Then, two goal locations were established in the GPS devices: one corresponding to the ‘E1’ location proposed by Carvalho *et al.*, (2013), which in this study was called ‘NR’ (10°37'14.40"S 40°22'36.18"W), and another which the authors of the present study believed was the most probable neighborhood of the northernmost water spring of the Rio Fumaça river, called ‘G’ (10°37'6.12"S 40°22'29.34"W). The route used to enter the northernmost spring area was marked in the map with uppercase letters from A to G (G being the final point of the entry route). The exit route from the area, used to return to camp, was marked in the map with uppercase letters from H to B (with B being the same ‘B’ point used in the entry route). This trajectory and all route waypoints established can be seen in Figure 1.

FIGURE 1. String lines depicting the trajectory covered in the present study to verify the northernmost water spring of the Rio Fumaça river, Pindobaçu, Bahia, Brazil. The E1/NR location (yellow dot) corresponds to the water spring proposed by Carvalho *et al*., (2013)



Source: composition made by the authors using satellite imagery from Google Earth.

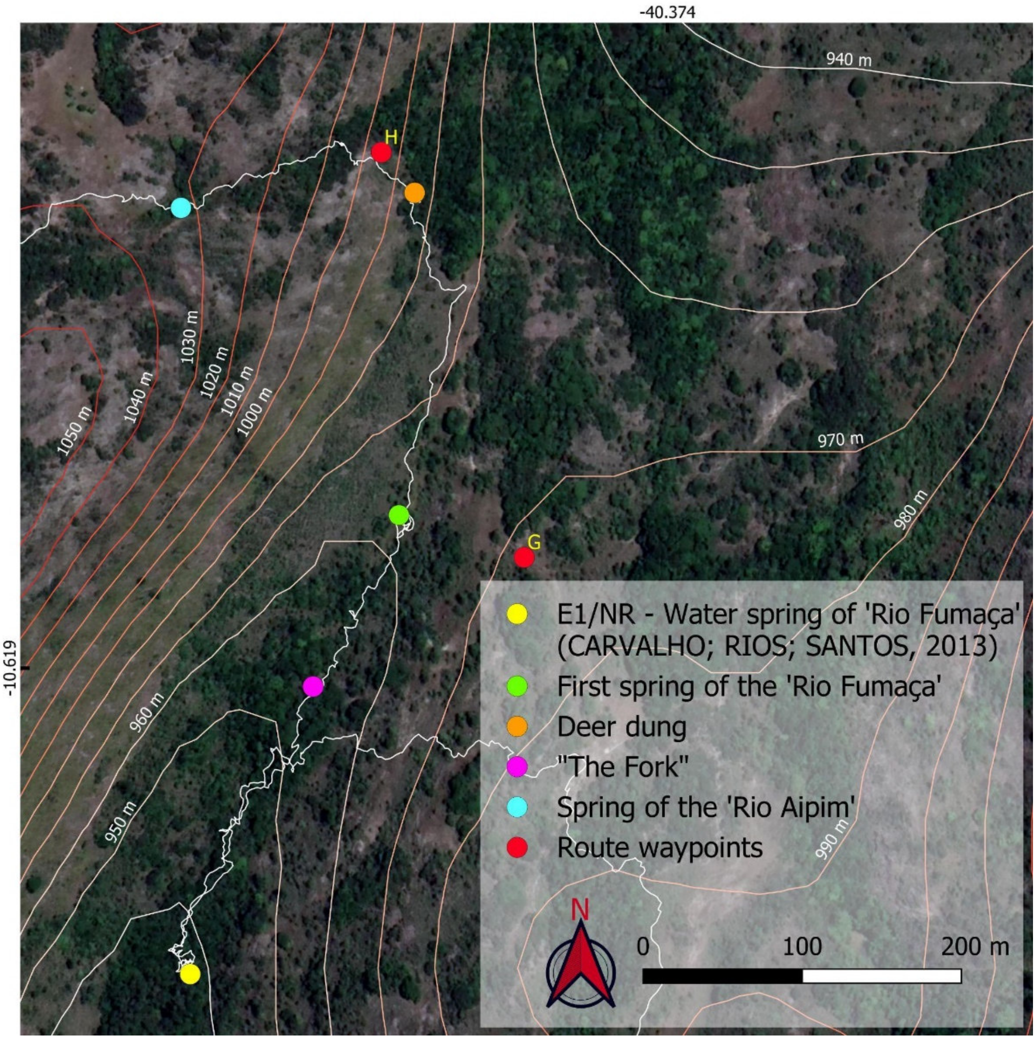
All points established were visited and extensively filmed and photographed during the expedition. New locations and features of interest to the purposes of the present study were georeferenced and photographed. After the expedition, the data obtained were summarized and checked as to whether they corroborated or challenged the data provided by Carvalho *et al.*, (2013). The most significant data are presented in this study.

RESULTS AND DISCUSSION

In their study, Carvalho *et al.*, (2013) stated that E1/NR corresponded to a diffuse water spring with conserved native vegetation and the presence of cattle. However, based on previous expeditions conducted to the region from 2019 to 2021, the authors of the present study knew that that specific location does not favor the presence of large animals such as cattle due to the dense vegetation and to that area being a deep valley, with satellite imagery corroborating that assumption.

Furthermore, the satellite image seen in Figure 1 shows that the green area corresponding to the vegetation around E1/NR extends further north, suggesting the presence of a significant water volume up north from this location. In addition, the elevation profile of the area also corroborates that assumption since the terrain ahead of E1/NR further rises to the north for a few hundred meters. A closer look at the terrain reinforces these assumptions, as seen in Figure 2.

FIGURE 2. Closer look at the region of the northernmost spring of the Rio Fumaça river, with contour lines. The E1/NR location (yellow dot) corresponds to the water spring proposed by Carvalho *et al.*, (2013). The trajectory from the yellow dot to the green dot and from H to the spring of the Rio Aipim were covered by following the course of water.



Source: composition made by the authors using satellite imagery from Google Earth.

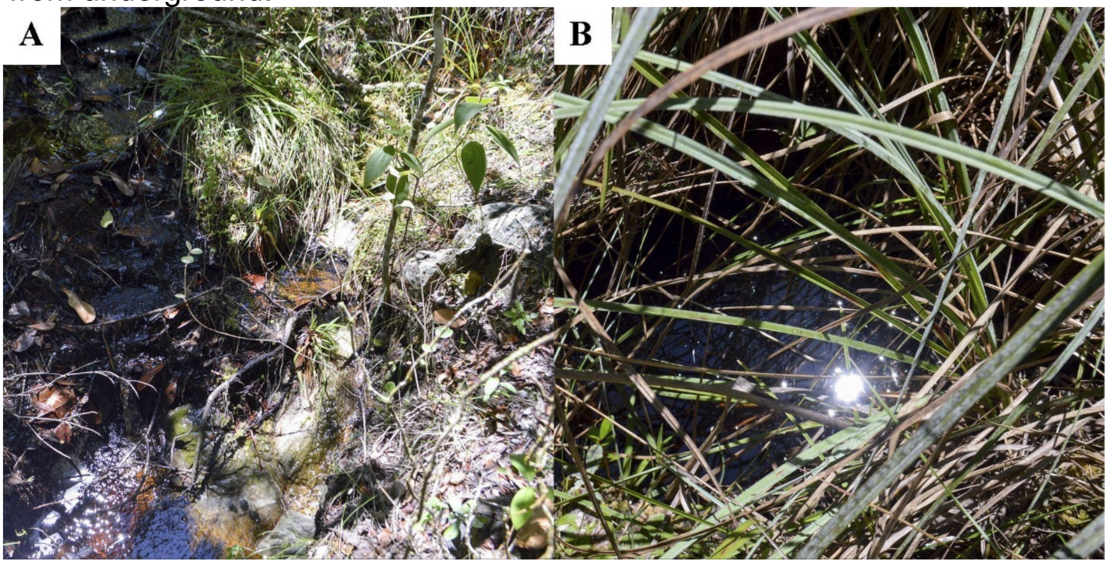
Carvalho *et al.*, (2013) provided no pictures of the E1/NR area in their study, which makes it impossible to perform visual comparisons. However, upon reaching E1/NR (10°37'14.40"S 40°22'36.18"W) during the field expedition, the authors of this study found that the area by no means corresponded to a diffuse water spring. In fact, the Rio Fumaça flows quite strongly toward the south in that location. As suspected, that specific point was a deep valley with no traces of cattle, no open trail, and the only marked feature there was a large whitish rock. The ground view of the E1/NR location can be seen below in Figure 3. Therefore, these results challenge the data attributed to “E1” by Carvalho *et al.*, (2013) and instead reinforce the assumptions of the present study based on the green vegetation spots seen in satellite imagery and the contour line map.

FIGURE 3 (A-D). Pictures of the E1/NR location. 3A: small waterfall of the Rio Fumaça river at the E1/NR location. 3B: vegetation at the E1/NR location. 3C: water and natural foam at the E1/NR location. 3D: the only marked feature at the E1/NR location, a large whitish rock.

Source: provided by the authors.

Next, the course of water from E1/NR was followed toward the north to reach the ‘G’ location seen in Figure 2 (10°37'6.12"S 40°22'29.34"W), which was believed to be most likely neighborhood of the first water spring of the Rio Fumaça river. However, while moving north from E1/NR, the group found an area that was called ‘the Fork’ (pink dot in Figure 2) (10°37'8.74"S 40°22'33.82"W), in which the river flowed down from two courses: one to the left, which came down from up north, and one to the right, which was a fixed spring where water seeped from underground. The ground view of the area corresponding to ‘the Fork’ can be seen in Figure 4. Therefore, not only were the data provided by Carvalho *et al.*, (2013) about ‘E1’ challenged by the present results, but also there was more than one spring in that area, one of them being a fixed seepage point, which was not reported at all in their study and is a completely new finding.

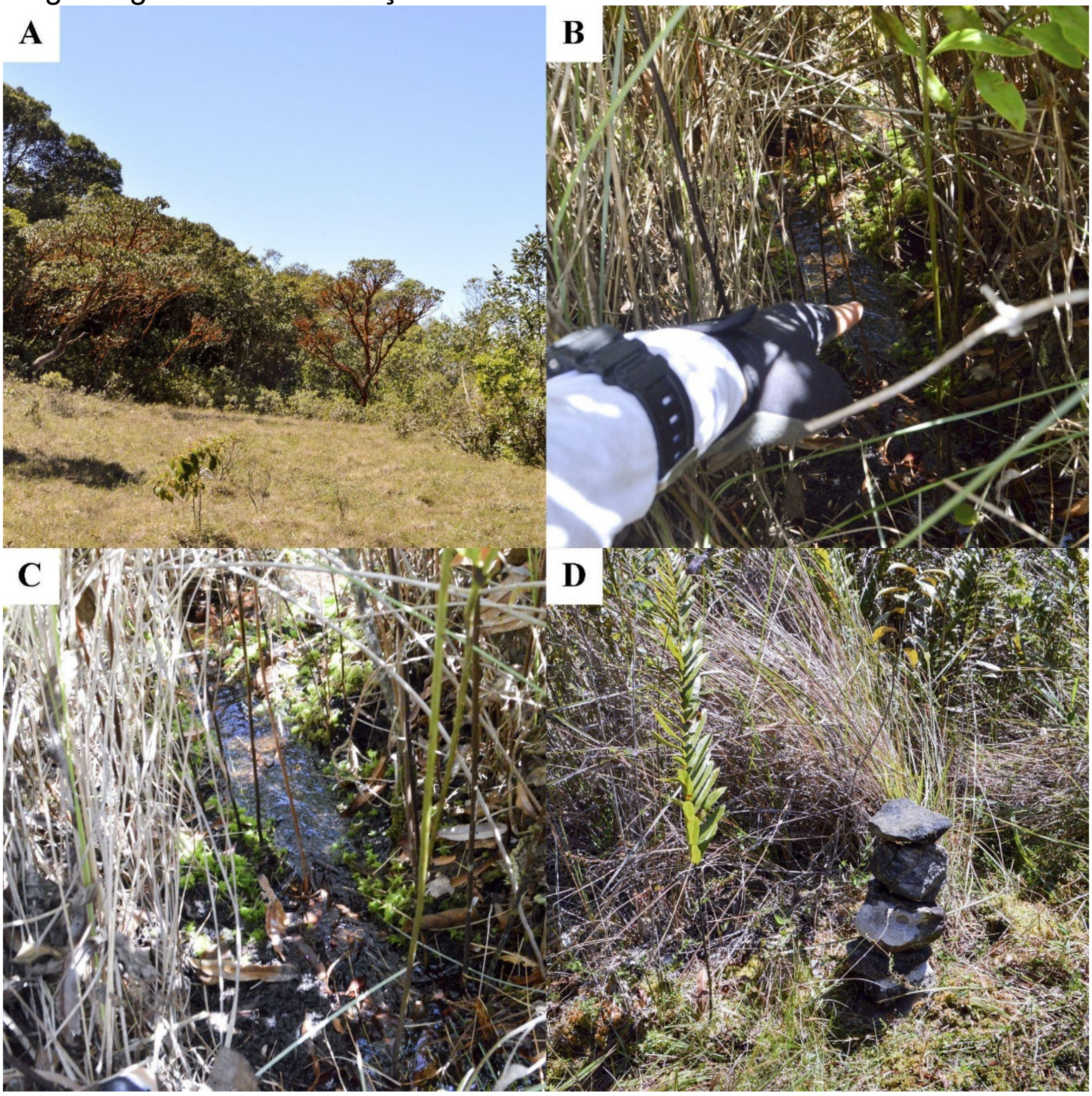
FIGURE 4 (A-B). 'The Fork'. 4A: area corresponding to a split in the northernmost Rio Fumaça stretch. 4B: fixed water spring where water seeps from underground.



Source: provided by the authors.

Then, after filming and photographing the previous area, the left (and only) stream was followed in a northward direction until finding an open area where the stream no longer existed and was lost in an open field where water came from the underground diffusely. Since it was impossible to determine the exact spot of seepage, the first spot in that area where water started to run with a visible, consistent volume was considered as the actual location of the northernmost spring of the Rio Fumaça river (green dot in Figure 2) (10°37'5.51"S 40°22'32.03"W). In summary, the northernmost spring is indeed a diffuse one, but at a different location from what Carvalho *et al.*, (2013) reported, and with a fixed spring occurring between the mistaken and the actual location of the first water spring, which was not reported at all before. This location can be seen in Figure 5.

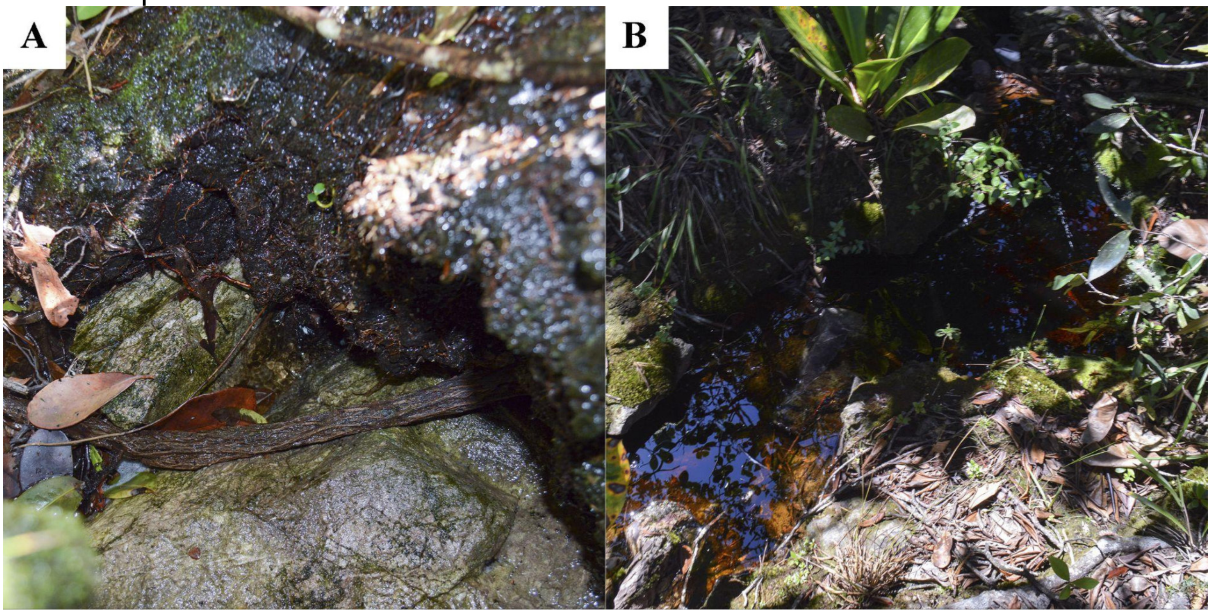
FIGURE 5 (A-D). Actual location of the first spring of the Rio Fumaça river. 5A: wide open area where water seeps diffusely from the ground and forms the first spring of the Rio Fumaça. 5B: exact location where water begins to flow consistently. 5C: another picture of the exact location where water begins to flow consistently. 5D: small stone pile left by the group to mark the beginning of the Rio Fumaça river.



Source: provided by the authors.

Finally, while heading back to camp by moving toward the 'H' waypoint, another water stream was found, but this time flowing to the north, unlike all other water bodies found until that time, which flowed to the south. That stream was followed and it ended in a fixed and well-established water spring (blue dot in Figure 2) (10°36'58.92"S 40°22'36.60"W) where water dropped from a small underground cave, evidencing the exact point where water seeped from underground onto the surface (Figure 6). When the data were analyzed after the expedition by following the vegetation spots toward the north in satellite imagery and the contour line maps, that stream revealed to be a tributary of the Aipim River, which, in turn, is later dammed by the "Aipim Dam" (10°35'49.13"S 40°20'47.34"W) in the municipality of Antônio Gonçalves, Bahia, serving as water supply for thousands of people.

FIGURE 6 (A-B). Spring of a tributary of the Rio Aipim river. 6A: fixed seepage spring of a tributary of the Rio Aipim. 6B: north-flowing stream corresponding to a tributary of the Rio Aipim.



Source: provided by the authors.

The results of this study expand the current knowledge about the springs of the Rio Fumaça river and provide new data that will serve to subsidize protective measures for these resources. As stated before, the entire Serra da Fumaça region is threatened by various activities that endanger the fauna, flora, soil, and water, e.g., camping, deforestation, and cattle raising (CARVALHO *et al.,* 2013).

The plateau tops of the Serra da Fumaça mountains are used for cattle raising by inhabitants of at least four neighboring municipalities: Campo Formoso, Antônio Gonçalves, Pindobaçu, Ponto Novo, and Mirangaba (MARQUES *et al*., 2021). Whereas the cattle and deforestation represent dangers through the removal of natural vegetation and illegal fires set up to open new grazing sites, the cattle itself has the additional impact of compacting the soil, which is even more worrisome in open water spring areas (DIAS *et al*. 2022). Examples of the area's occupation by cattle raising can be seen below in Figure 7:

FIGURE 7 (A-D). Cattle raising on the Serra da Fumaça mountains. 7A: fenced areas used to store cattle like the one depicted here (10°37'25.89"S 40°22'58.77"W) are common all over the area. 7B: cattle herd roaming free near the northernmost water spring of the Rio Fumaça river. 7C: iron used to mark the cattle found outside the shack seen in Figure 7D. 7D: shack used by cattle keepers on the Serra da Fumaça.

Source: provided by the authors.

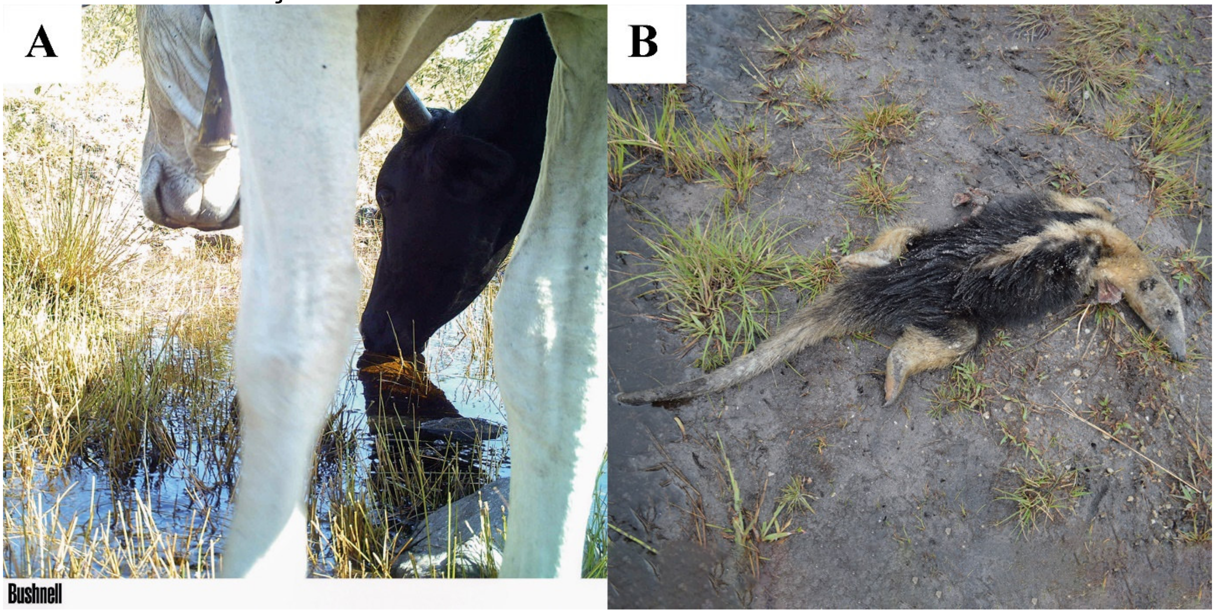
Moreover, the intensive and uncontrolled presence of tourists in the area has worsened the pollution of both soil and water, further compromising the conservation of the region (CARVALHO *et al.,* 2013). The trail of garbage left behind by tourists and their role in the devastation of the natural vegetation through the unnecessary removal of trees to widen clearings in the forest can be seen below in Figure 8.

FIGURE 8 (A-D). 8A: garbage left by tourists being collected by volunteers on the Serra da Fumaça. 8B-C: waste left behind by tourists on the Serra da Fumaça. 8D: tree nearly cut down near a camping clearing on the Serra da Fumaça.

Source: provided by the authors.

Tourists come on foot from the eastern side of the mountain and on motorbikes from its western side while no protective measures are put into effect to restrict or control this movement. As a result, in addition to the garbage left in the forest, as seen in the last figure, the presence of motorbikes crossing the area contributes to polluting the water, compacting the soil, and disturbing the local fauna, as seen below in Figure 9.

FIGURE 9 (A-B). Some of the impacts caused by human activities and presence on the Serra da Fumaça. 9A: cattle photographed drinking water by a trap camera meant to photograph the natural fauna. 9B: roadkill (anteater) on a motorbike trail on the Serra da Fumaça.



Source: provided by the authors.

Further aggravating this scenario, while conducting this study, the group discovered the existence of previously unknown mining activities on the Serra da Fumaça mountains, even with the presence of semi-permanent dwellings built to host miners along remote valleys of the mountain, as seen in Figure 7. It should be noted that such dwellings are built through deforestation, both to clear the area and to obtain raw material used to build the shelters. Then, after the area dug to search for minerals is exhausted, holes such as the one seen below in Figure 10 are simply left behind.

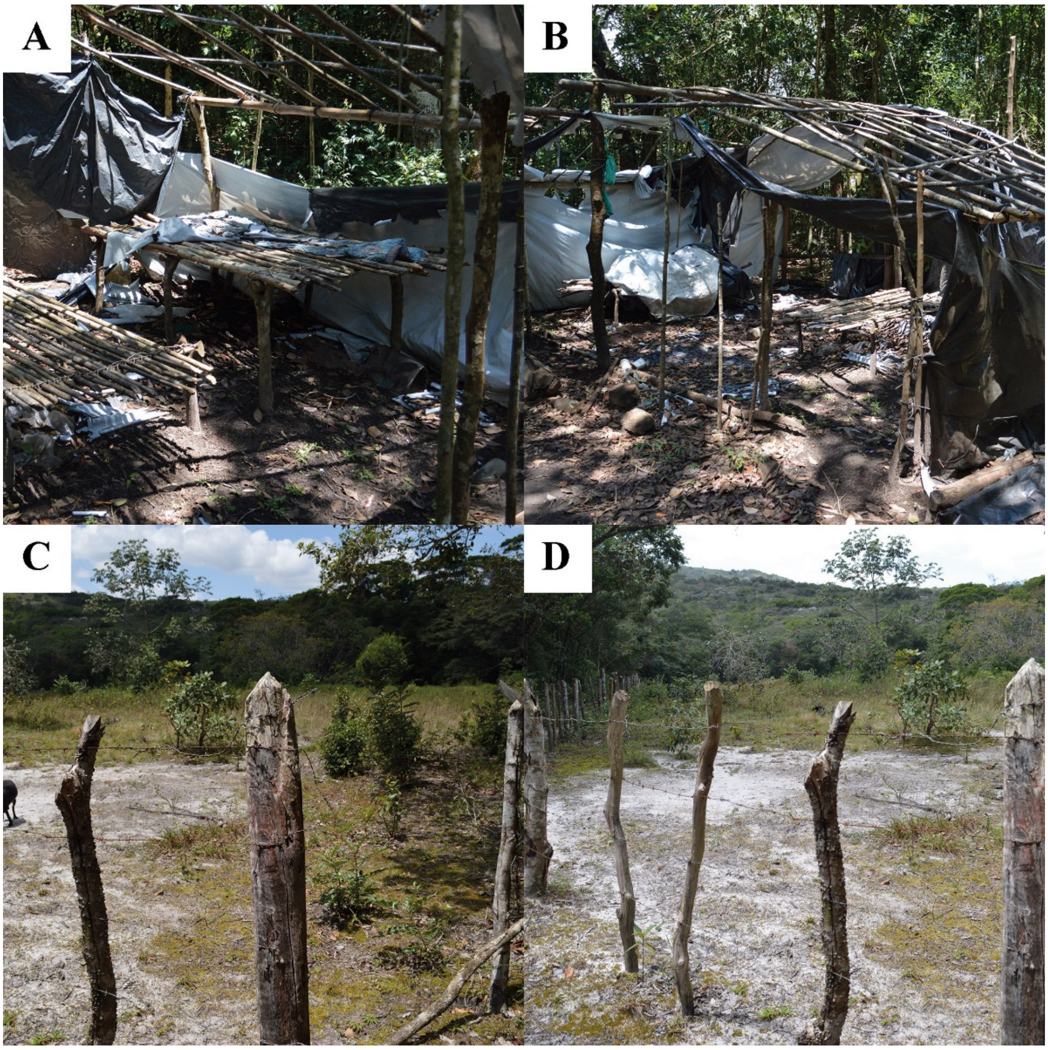
FIGURE 10 (A-B). 10A: Semi-permanent shelter used to host miners on the Serra da Fumaça. 10B: mining hole left behind by miners.

Source: provided by the authors.

According to the Brazilian Federal Law no. 11,685, of June 2, 2008, which institutes the Miner's Statute, mining activities can only occur after the granting of mining rights by the competent authorities, without which any extraction is considered illegal and miners are not allowed to commercialize any extracted minerals. The same law also establishes that miners are required to recover the areas degraded by their activities, in addition to observing other local regulations (BRASIL, 2008). Therefore, one cannot say that the mining activities occurring on the Serra da Fumaça are either legal or illegal. Nevertheless, this report should serve as an alert to the local authorities regarding the need to regulate and monitor this activity in the area.

The mining shelter shown before in Figure 10 is not an isolated situation. During previous expeditions conducted by this group, another shelter, this time abandoned, was found near the margins of the Rio Fumaça river (10°38'40.67"S 40°22'34.89"W). Following the same pattern, the shelter was built by removing the natural vegetation. Furthermore, after the activities for which the shelter was built cease, the structure is simply abandoned and left behind without care. The shelter depicted below in Figure11 was built beside a large area of about 5,400 m^2 in which the trees were cut down to store cattle:

FIGURE 11 (A-D). 11A-B: abandoned shelter near the margins of the Rio Fumaça River. 11C-D: large deforested area of about 5,400 m^2 beside the shelter.



Source: provided by the authors.

Another grave concern is related to the expansion of wind parks, which harness wind power to convert mechanical energy into electrical energy. Although with a proposal of sustainability through the production of clean energy, the construction of such wind parks drastically reduces green areas, threatens the local fauna and flora, negatively impacts the mountain environments where they are installed, and contributes to the expansion of mining, deforestation, and illegal fires (MARQUES *et al*., 2021). The Serra da Fumaça mountains fare no better in this regard. In fact, from the western side of the mountain it is possible to witness in first hand numberless wind towers increasingly closer to the study area of the present manuscript, in addition to various and vast areas already deforested for farming and grazing purposes. The view from the western side of the mountain can be seen below in Figure 12.

FIGURE 12. View from the western side of the Serra da Fumaça mountains depicting many wind towers on the horizon and deforested areas used for farming and grazing.

Source: provided by the authors.

As stated in the Introduction, the Brazilian Forest Code establishes that the area around a minimum 50 m radius from any water springs is defined as a Permanent Preservation Area (APP), demanding the re-composition of a minimum 15 m radius of natural vegetation in case of consolidated rural areas established around perennial water springs while maintaining the current human activities (BRASIL, 2012).

However, all water spring areas visited and found in this study, or their surroundings, are affected by cattle grazing and other activities, with all of them showing tracks, feces, or remains of cattle. None of the areas is either protected or has signs warning visitors and users, and these sites are currently under the possibility of indiscriminate degradation. This is especially worrisome considering the north-flowing tributary of the Aipim River, whose spring was found in this study, since this river is dammed only a few kilometers away. Therefore, if this spring is severely compromised, it could threaten the very supply of water to the populations below the mountain who depend on this water for multiple uses.

Although regulatory practices by the governments of the municipalities of Pindobaçu and Antônio Gonçalves, both with domains included in the area explored by the present study, are virtually non-existent, these authorities should know that applying such regulations does not imply expelling people from the area or halting any activities developed but rather controlling them and ensuring the maintenance and conservation of natural resources, which is the very principle of conservation, i.e., seeking balance between the requirements of human and economic development and those of conserving biological diversity and resources (CAO *et al.*, 2021).

From this perspective, these authors stress the importance of protecting the water and other natural resources on the Serra da Fumaça mountains and call on authorities to direct special efforts to put into effect the measures determined by the Brazilian Forest Code and other regulations, aiming to guarantee the existence and conservation of the water springs and bodies of the entire Serras da Jacobina mountains.

The respective authorities could begin by formalizing the establishment of Permanent Protection Areas (APPs) around all water springs of this region and installing signs warning about their presence. Furthermore, it is essential to establish a permanent or semi-permanent presence on the Serra da Fumaça mountains in order to monitor the current activities and inhibit illegal practices. Attention should also be paid to finding legal ways to legalize the mining activities if they are to be allowed at all in the area, thus preventing illegal practices and even anticipating the occurrence of potential contamination events due to mercury contamination, for example.

Finally, efforts should be taken by all parties involved in using the Serra da Fumaça mountains to establish, as soon as possible and with the uttermost urgency, a Conservation Unit in the region.

CONCLUSIONS

The *in loco* visit revealed that no water springs existed in the location stated by previous research, with the Rio Fumaça flowing quite strongly in that area. Also, the actual location of the northernmost water spring was some hundred meters to the north of the location claimed by other research.

The fixed spring of a stream corresponding to a tributary of the Rio Aipim river, which is dammed in the municipality of Antônio Gonçalves, Bahia, was also found during the *in loco* visit.

The entire area is threatened by the nearby presence of cattle, horses, and even human activities such as deforestation and mining, raising alarming concerns regarding the degradation of natural resources in the region should these uncontrolled activities continue without any regulation

The presence of multiple water springs in the area implies the mandatory establishment of Permanent Protection Areas (APPs) in order to guarantee the existence of such springs and the rivers they form, which are used by thousands of people for multiple purposes. However, the establishment of APPs is not occurring since none of these protected areas exist in the Serra da Fumaça and devastation is happening fast.

Finally, efforts should be taken by all parties involved in using the Serra da Fumaça mountains to establish, as soon as possible and with the uttermost urgency, a Conservation Unit in the region.

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