Maintaining active peatbogs on the Graminhais Plateau

Nordeste, November 2025

PROJECT SUPPORTED BY

GIVING BACK TO NATURE

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The Giving Back to Nature foundation supported, in 2025, the work carried out to maintain the restoration of active peatbogs on the Graminhais Plateau, São Miguel Island, Azores. This support enabled us to control the regrowth of invasive and exotic plant species and to promote waterlogging by closing drainage ditches. These actions involved the SPEA team and volunteers and helped retain water within the peatbogs, thereby promoting the development of active peat-forming habitats.

Our Mission

Working for the study and conservation of birds and their habitats, promoting development that guarantees the viability of the natural heritage for the enjoyment of future generations.

SPEA - the Portuguese Society for the Study of Birds is a Non-Governmental Environmental Organisation that works for the conservation of birds and their habitats in Portugal. As a non-profit association, it depends on the support of its members and various organisations to carry out its activities. It is part of a worldwide network of environmental organisations, BirdLife International, which operates in 120 countries and aims to preserve biological diversity by conserving birds and their habitats and promoting the sustainable use of natural resources.

The SPEA was recognised as an entity of public utility in 2012.

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Maintaining active peatbogs on the Graminhais Plateau – Giving Back to Nature

Sociedade Portuguesa para o Estudo das Aves, 2025

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SUMMARY

In 2025, the *Giving Back to Nature Foundation* supported the continuation of restoration efforts aimed at maintaining active peatbogs on the Graminhais Plateau, São Miguel Island, Azores. This support primarily enabled the control of regrowth from invasive alien plant species (IAS), namely *Gunnera tinctoria*, and the removal of *Cryptomeria japonica* resprouts, which, although not invasive, are exotic and used in forestry for timber production. It also facilitated the ecological restoration of drainage ditches through the implementation of Nature-Based Solutions (NBS) to retain water within the peatbogs. Additionally, nocturnal insect sampling was conducted to compile an inventory of the local insect fauna, with a particular focus on the order *Lepidoptera*.

Importantly, these actions were carried out with the active involvement of volunteers, highlighting the crucial role of community engagement in peatbog restoration. Collectively, these efforts contributed to raising awareness of peatbog conservation and promoting the development of active peat-forming habitats.

RESUMO

Em 2025, a *Fundação Giving Back to Nature* apoiou ações de conservação destinadas a melhorar o estado ecológico das turfeiras ativas no Planalto dos Graminhais, ilha de São Miguel, Açores. Estas ações permitiram, sobretudo, o controlo de espécies vegetais exóticas invasoras, nomeadamente *Gunnera tinctoria*, bem como a remoção de rebentos de *Cryptomeria japonica*, que, embora não invasiva, é exótica e utilizada em projetos florestais para produção de madeira. Foi também possível o restauro ecológico de valas de drenagem através da implementação de Soluções Baseadas na Natureza (NBS) para promover a retenção de água nas turfeiras. Adicionalmente, foi realizada uma amostragem noturna de insetos para compilar um inventário da fauna entomológica local, com especial enfoque na ordem *Lepidoptera*.

Importa sublinhar que estas ações contaram com a participação ativa de voluntários, evidenciando o papel crucial do envolvimento comunitário na conservação das turfeiras. No seu conjunto, estes esforços contribuíram para aumentar a sensibilização sobre a importância das turfeiras e promover o desenvolvimento de habitats ativos formadores de turfa.

1. INTRODUCTION

Peatlands in the Azores:

Peatlands are terrestrial wetland ecosystems where the production of organic matter exceeds decomposition, leading to the accumulation of partially decayed plant material, known as peat (International Peatland Society, 2025). These nutrient-poor habitats remain waterlogged for most of the year, which slows decomposition and supports hydrophilous vegetation adapted to flooding. The persistent wet conditions also promote peat soil formation under low-oxygen (anoxic) conditions (Holden, 2006; Forest Carbon, 2024; Mendes & Dias, 2019).

Globally, peatlands cover approximately 3–4% of the land surface, of which around 12% are degraded, mostly due to agricultural activities (UNEP, 2022).

In the Azores, three main types of peatlands exist (Mendes & Dias, 2019):

1. **Bogs**: nutrient-poor areas receiving only rainwater (low mineralization). They are dominated by large mosses (*Sphagnum* spp.), which form the structural basis of the habitat. The floristic diversity is relatively low, dominated by *Sphagnum* species (*S. palustre, S. auriculatum, S. subnitens, S. papillosum, S. squarrosum, S. cuspidatum, S. lescurii, S. centrale, S. capillifolium* e *S. compactum*, etc.) and can also include *Polytrichum commune* mosses and some vascular plants like *Eleocharis multicaulis*.

2. **Fens** – Wet grasslands influenced by groundwater, receiving more mineral-rich water than bogs. This nutrient input allows slightly higher floristic diversity. Fens are often dominated by *P. commune* and vascular species such as *Eleocharis palustre*, *E. multicaulis*, and *Juncus effusus*.

3. **Bog Woodlands** - areas where endemic and native forest species grow atop moss layers, including Azorean Heather (*Erica azorica*), Azorean Juniper (*Juniperus brevifolia*), and Azorean Blueberry (*Vaccinium cylindraceum*). These habitats are usually small due to wind exposure and are associated with a continuous *Sphagnum* layer beneath.

In the scientific literature, the terms *peatlands* and *peatbogs* are related but not identical. Peatlands is a general term for all ecosystems where *peat*, partially decomposed organic matter, accumulates, including bogs, fens, and transitional mires, which may differ in water sources, nutrient availability, and vegetation. While peatbogs (or bogs), are a specific type of peatland that receive water exclusively from precipitation. They are typically ombrotrophic, nutrient-poor, acidic, and dominated by mosses such as *Sphagnum spp.* (International Peatland Society, 2025).

From this point onwards, the term *peatbog* will be used specifically to refer to the Graminhais area, which exhibits typical bog characteristics.

Ecological importance

Peatlands provide key ecosystem services, including the regulation of local and global climate, basin hydrology and soil conditions. They play a critical role in both hydrological and carbon cycles, regulating surface runoff, water quantity and quality, microclimate, and contributing to climate change mitigation (Joosten and Clarke, 2002).

Water retention in a peatbog is directly proportional to its degree of preservation. These habitats are essential for recharging local aquifers and regulating the flow of surrounding watercourses. Restoration of peatland ecosystems not only restores ecological integrity but also enhances vital ecosystem services, such as carbon sequestration, water regulation, and biodiversity support (Forest Carbon, 2024).

Degraded peatlands, on the other hand, can cause significant environmental and ecological problems, including the emission of roughly 5% of global anthropogenic greenhouse gases and contributing to biodiversity loss (UICN, 2021).

Example of key ecosystem functions (Mendes & Dias, 2019):

- *Sphagnum* spp. can **retain up to 20 times their dry weight in water**, gradually releasing it to control soil erosion, stream flow, and groundwater replenishment. They also **purify water** by retaining metals and toxins, and their acidic pH has bactericidal properties.
- Peat layers **accumulate large amounts of carbon** due to low oxygen and acidic conditions, making peatlands important carbon sinks. Well preserved peatlands can storage 0,7 tons of carbon per hectare and provide good quality water.

1.1 Intervention area: Graminhais Plateau

One of the largest peatland areas on São Miguel Island (Azores), is located on the Graminhais Plateau, within the Site of Community Importance Pico da Vara/Planalto dos Graminhais, classified under the Natura 2000 protected areas network. The plateau, located in the Nordeste municipality on the north coast of São Miguel, hosts one of the largest continuous peatlands in the archipelago, covering approximately 99 hectares (Figure 1). High-altitude peatlands, such as this one, are particularly important as they serve as significant water reservoirs (Pereira *et al*., 2022).

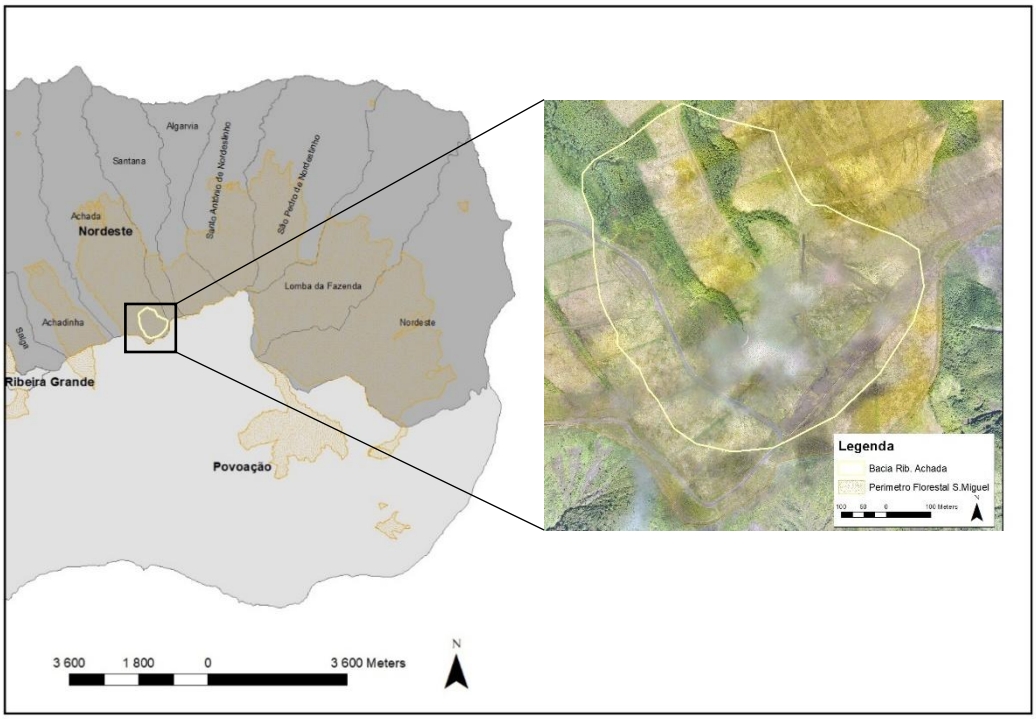

Figure 1. Location of the headwaters of the Achada stream catchment, Graminhais Plateau, Nordeste municipality, São Miguel Island, Azores. Autorship SPEA Azores.

This area lies within the forest perimeter of São Miguel Island and is managed by the Regional Directorate for Forest Resources (DRRF). The intervention area (Figure 2) is located at the headwaters of the Achada stream, covering approximately 39 hectares within the São Miguel Island Natural Park. It forms part of the Tronqueira–Graminhais protected area (PTMIG0024) and overlaps with the Pico da Vara/Ribeira do Guilherme Special Protection Area (PTZPE0033).

The Achada catchment is one of several permanent watercourses in this hydrographic complex, flowing into the sea near the parish of Achada. The headwater area, dominated by peatbogs, exhibits minimal altitudinal variation due to its plateau-like morphology. Steep slopes (>15%) occur near water lines due to hydric erosion (Botelho & Peñil, 2013).

Figure 2. Intervention area within the Achada catchment on the Graminhais Plateau, showing the protected area boundaries. Autorship SPEA Azores.

This area hosts active high-altitude *Sphagnum* peatbogs (habitat 7110*), degraded peatbogs still capable of natural regeneration (7120), and forested peatbogs (91D0). Historical anthropogenic interventions, including drainage and pasture conversion, have contributed to habitat degradation and the spread of invasive exotic species.

1.2 Past projects within the intervention area

Peatbogs on the Graminhais Plateau face several threats, including habitat degradation and reduction due to conversion to grassland and forestry projects (Mendes & Dias, 2019), invasion by exotic species such as Chilean rhubarb (*Gunnera tinctoria*), tree fern (*Dicksonia antarctica*), and *Clethra arborea*, as well as trampling by visitors. Past drainage works for water supply and pasture conversion, combined with overgrazing and drought events, have further facilitated the spread of invasive species, displaced native vegetation and altered streamside habitats.

The restoration strategy in this area builds on SPEA's experience gained from previous and ongoing habitat recovery projects implemented in the Pico da Vara/Ribeira do Guilherme Special Protection Area.

- **LIFE+ Sustainable Laurel Forest** (LIFE07 NAT/P/000630, 2009-2013): Ecological restoration of 75 hectares of degraded peatbogs, including cattle removal, eradication of invasive exotic plants, planting of native species, construction of small dykes to promote waterlogging and block drainage, inoculation of *Sphagnum* moss, installation of fences, and a raised boardwalk to guide visitors while reducing trampling impacts.

- Under the ongoing **LIFE IP AZORES NATURA** project (LIFE17 IPE/PT/000010, 2019–2027): Interventions focus on a 5-hectare section of the upper Achada stream, connecting previously restored areas to create an 80-hectare core of restored habitat, thereby contributing to ecological stability and supporting the Natura 2000 network.

- The **SpongeBoost project** European Union Horizon (Europe research and innovation programme, grant agreement No. 101112906, 2024-2027): Evaluates "sponge effect" restoration measures and assesses the long-term outcomes of LIFE+ Sustainable Laurel Forest actions through hydrological monitoring.

These restoration efforts (Figure 3) have led to a healthier and more resilient peatbog ecosystem. Ongoing maintenance is essential, and SPEA's technicians and volunteers have played a key role in restoration activities, raising awareness of peatland ecological importance and fostering community engagement.

Figure 3. Photographs taken during LIFE Laurisilva project, showing applied restoration measures, including invasive species control, fence construction, dyke maintenance and plantation of native and endemic species and inoculation of Sphagnum spp. Photos: SPEA Azores.

Some key outcomes that can be extrapolated from these restoration projects (Wetlands International, 2008):

- Carbon storage of up to 0.7 tonnes per hectare of well-restored peatbog.
- Improved hydrological connectivity and availability of high-quality water for human use.
- Increased biodiversity and support for endemic Azorean species.
- Promotion of sustainable tourism while reducing visitor impacts.

1.3 Proposed interventions for 2025 supported by GBTN Foundation

Since 2010 the peatbogs of Graminhais Plateau have been undergoing recovery. However, regular removal of invasive alien species (IAS), as well as the repair of drainage ditches, remains essential to ensure that the habitat continues along a stable recovery path.

In 2025, the project will support the ongoing maintenance and restoration of the peatbogs, with active involvement from volunteers in fieldwork. The initiative aims to contribute to the protection of endangered habitats and ecosystems, while supporting the broader goal of preserving and enhancing global biodiversity.

Based on the field data, local knowledge, and SPEA's previous conservation experience (see section 1.2), the following objectives and tasks have been planned for 2025 under the support of the Giving Back to Nature Foundation. These maintenance and restoration efforts on the Graminhais Plateau will be strengthened through the actions outlined in Figure 4.

	January	February	March	April	May	June	July	August	September	October	November	December
Removal of isolated exotic tree *Criptomeria japonica* reprouts by chainsaw operators				X	X							
Removal of IAS Gunnera tinctoria by trainees and volunteers				X	X	X			X	X		
Aplications of NBS solutions to promote peatbogs waterlogging					X	X						
Preparation and installation of a monitoring system for local insect communities		X			X	X			X	X		
Preparation of a Operational Plan and a final report on activities carried out		X								X	X	

Figure 4. SPEA's work plan for the Giving Back to Nature project during 2025.

2. TECHNICAL EXECUTION

The technical execution of the planned interventions on the Graminhais Plateau was carried out by SPEA's technical and operational team, with the collaboration of volunteers. All actions were implemented according to the 2025 work plan (Figure 4) and focused on maintaining the peatbogs' ecological integrity through targeted restoration measures (Figure 5).

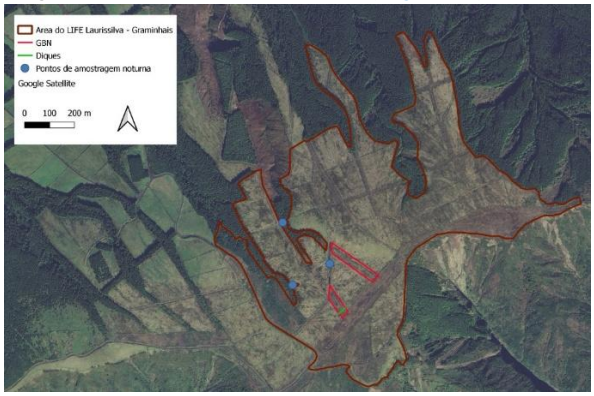

Figure 5. Aerial image showing the planned interventions to be carried out by SPEA on Graminhais Plateau. Map by Marcos Evangelho.

2.1 Removal of isolated *Criptomeria japonica* resprouts

Apart from invasive species, one of the most notable features of exotic vegetation on the Graminhais Plateau is the presence of *Cryptomeria japonica* plantations along the margins of the two Achada headwater streams, covering approximately 5.7 hectares. The *Cryptomeria* shelterbelts on the Planalto dos Graminhais were originally established to support agricultural and livestock activities, serving both as windbreaks and to facilitate soil drainage. These stands were planted more than 60 years ago as part of agro-pastoral exploitation schemes and are now reaching harvest age.

In areas that had been cleared under the LIFE Laurisilva project, natural regeneration of *Cryptomeria japonica* has been observed over approximately 0.2 hectares, with scattered resprouts emerging. This intervention specifically targeted the removal of those isolated *Cryptomeria japonica* resprouts in the previously cleared zones, including the clearing of exotic understorey vegetation, felling of resprouting trees, and management and repurposing of forestry residues (see section 2.3) (Figure 6).

Figure 6. Work area showing *Cryptomeria japonica* resprouts. Photographs taken in February 2025, prior to intervention. General area photographs by Yasmin Redolosis (top); close-up images of plant size by Filipe Figueiredo (bottom).

2.2 Removal of *Gunnera tinctoria* (IAS) by trainees and volunteers

Surveys conducted in the area (Action C3, LIFE Laurissilva Sustentável, 2013) indicated a high degree of invasion by exotic species, the most concerning being *Gunnera tinctoria* (Chilean rhubarb), *Clethra arborea* (lily-of-the-valley tree), and *Dicksonia antarctica* (Tasmanian tree fern). These species have increasingly dominated peatbogs and natural grasslands, colonising new niches such as stream banks and landslides, and consequently altering the natural dynamics of these habitats. By competing with *Sphagnum* spp. and native peatland shrubs, they pose significant challenges for peatland conservation. Removal of these invasive species is therefore essential to enable the recovery of native peat-forming vegetation (Mendes *et al*., 2023).

Although a significant amount of invasive vegetation was removed during previous projects, continued effort and maintenance are required to eliminate new resprouting individuals of *Gunnera tinctoria.* To control this invasive species, which poses a major threat to the peatbog ecosystem, a volunteer activity was organised in May 2025 to manage this species. The activity was strategically scheduled before the plant's fruiting period to prevent seed dispersal and further spread (Figure 7).

Figure 7. SPEA's volunteers carrying out the removal of invasive species, *Gunnera tinctoria*. Photos: Yasmin Redolosis.

2.3 NBS to promote peatbog waterlogging

To restore the hydrology of degraded peatbogs, one of the most effective strategies is the installation of small-scale Nature-Based Solutions (NBS) designed to retain water and slow surface runoff. On the Graminhais Plateau, this approach builds on the previous restoration actions (see section 1.3), by reusing previously cut *Cryptomeria japonica* wood and branches (see section 2.1) to construct woody debris dams and associated microstructures to stabilize the peatbog hydrology.
This method replaces earlier practices based on plastic barriers, although effective, were visually intrusive and environmentally problematic (Figure 8). By using only natural, locally available materials, these new measures ensure ecological compatibility, landscape integration, and long-term sustainability (see section 3.3).

Figure 8. Area prior to modification, before tree cutting and dam construction. Photo taken in June 2025, showing the plastic dyke. *Cryptomeria* resprouting trees can also be observed. Photo: Aitor Puente-Valle.

2.4 Nocturnal insect inventory

As previously mentioned, peatbog areas represent key habitats for many endemic species. The Graminhais Plateau is particularly important for a wide range of plants and animals, including endemic Lepidoptera.

An **inventory of nocturnal insects** was conducted during the new moon period in June 2025 to assess the presence of diverse nocturnal insects, with a special focus on the order Lepidoptera, due to their high ecological importance as pollinators and their role as bioindicators, among other functions. (van Koppenhagen *et al.,* 2025). A standardised nocturnal insect sampling protocol was implemented, adapted from methodologies used in the LIFE Natura@Night project, which have also been applied across Azores, and the Canary Islands.

The necessary authorisation to collect insects for scientific purposes was obtained in March 2025. Three sampling points with different habitat conditions were established across the Graminhais Plateau (Figure 9).

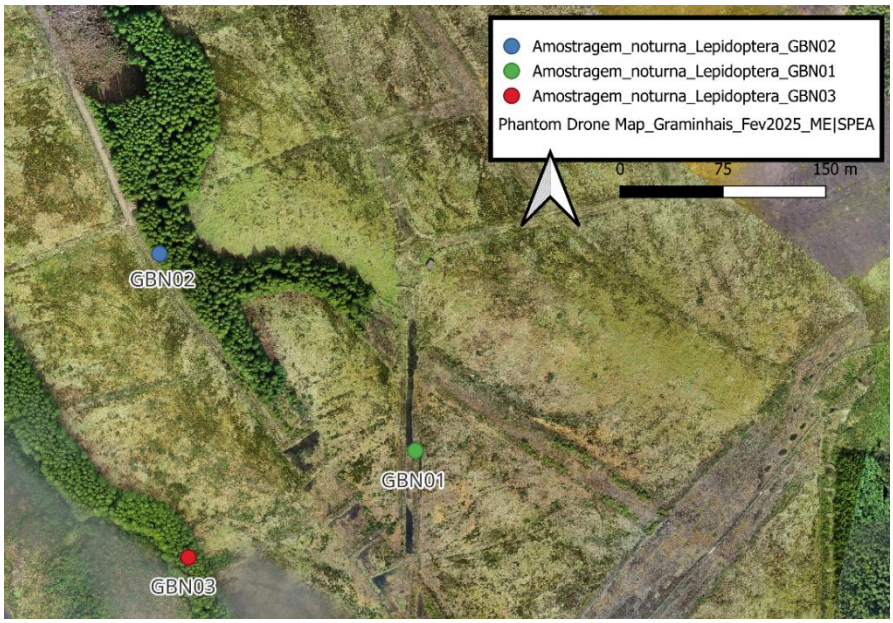

Figure 9. Aerial image of the sampling area and sampling points (GBN01, GBN02, GBN03). GBN01; is located within a well-preserved peatbog habitat, located close to the area where isolated resprouting *Cryptomeria* trees had just been cut (see 2.1;3.1). GBN02&03, are two water line areas within a *Cryptomeria* forest zone planned for future removal. The habitat at GBN02 and GBN03 is similar, serving as a suitable control reference. Map authorship: Marcos Evangelho.

At each sampling site (Figure 10), relatively flat areas were selected to ensure stability and accessibility. Fieldwork was conducted over a four-hour period starting at sunset, using a portable Heath-type light trap equipped with a UV fluorescent tube powered by a portable battery to attract nocturnal insects, primarily targeting Lepidoptera. Sampling conditions were recorded in an Excel database, including specimen identification once processed. Captured specimens were preserved in 70% ethanol or dried in entomological boxes, depending on their abundance and taxonomic group. Identification was performed using insect guides and the iNaturalist app to resolve uncertainties due to the absence of entomology specialists. Specimens were identified to species level whenever possible, otherwise to order or family.

Figure 10. Conducting insect sampling at Graminhais Plateau. Bottom right: Sorting and identification of insect specimens at the lab (Santo Antonio de Nordestinho). Photos: Yasmin Redolosis.

3. RESULTS

3.1 Results the removal of *Criptomeria japonica* resprouts

The operational team, composed of six members, carried out this activity between July and August 2025. Approximately 600 linear metres of *Cryptomeria japonica* were removed, covering an area of 0,2 ha (Figure 12). The cut material was subsequently reused for natural engineering works, contributing to the construction of woody debris dams and fascines (see section 2.3).

Figure 11. Drone images showing the intervention area. The cut *Cryptomeria* trees that had resprouted can be observed in a brown-reddish colour. Drone photos: Marcos Evangelho.

The ecological restoration of this area is essential to mitigate hydrological alterations caused by *Cryptomeria* shelterbelts, promote even dispersion of mist across peatlands, allowing mosses and low native vegetation to retain water. These efforts will ultimately support the restoration of native woodland typical of raised bogs (habitat 91D0) and endemic juniper forests (*Juniperus brevifolia*; habitat 9560).

3.2 Results on *Gunnera tinctoria* removal

A total of seven participants joined the activity, although 19 users had previously registered their interest through the Facebook event page created in May. During the activity, 170 kg of *Gunnera tinctoria* fruiting structures were removed, preventing their spread into the ongoing restoration areas (Figure 12).

Figure 12. Volunteers during the removal of *Gunnera tinctoria* activity. Photos: Yasmin Redolosis.

The results highlight the ecological success of long-term restoration efforts. While several tonnes of *G. tinctoria* were removed annually in the past, this year's result of 170 kg demonstrates the effectiveness of continued management. The peatbogs of the Graminhais Plateau are now more resilient, balanced, and closer to their recovery.

3.3 Results on NBS implementation

A woody debris dam measuring 18.5 m in length, was constructed in a former drainage channel previously identified as a source of accelerated water flow and soil erosion (Figure 13). This natural structure is intended to replace the plastic barrier installed in earlier interventions (Figure 8). The work was completed over two days by a team of eight people (four conservation technicians and four interns).

In addition, three natural ponds were created upstream of the dam to further increase water retention capacity and enhance microhabitats for the peatbog flora and fauna. Each pond was also inoculated with *Sphagnum* moss to accelerate natural colonisation and recover peat-forming habitat (Figure 14).

This intervention demonstrates that NBS can be low-cost, sustainable, and highly effective for peatbog restoration (Figure 15). The performance of the dam will be monitored regularly, particularly after periods of heavy rainfall, to assess its stability and water retention capacity. Any minor damage will be repaired using the same natural materials. Once the dam proves effective, the remaining plastic barrier from earlier interventions will be dismantled and removed, eliminating a source of visual and environmental impact.

The woody debris dam and the associated ponds are expected to:

- Slow down water flow and increase local water retention capacity,
- Reduce downstream erosion and stabilise the soil,
- Recreate conditions for peat regeneration and *Sphagnum* colonisation,
- Enhance biodiversity by providing habitats for aquatic and semi-aquatic species

Contribute to carbon storage and climate resilience by promoting the development of active peat.

Figure 13. Construction process using NBS. The first step involved taking the necessary measurements, followed by the excavation of a trench across the drainage channel to anchor the structure. A horizontal log base layer was placed using previously cut *Cryptomeria* wood (see 2.1). These branches and trunks, sourced from the surrounding area, were reused and positioned to form the dam. The logs were secured and reinforced, and additional stability was provided by fascines made of *Cryptomeria* branches tightly bound with sisal rope. Once the fascines were placed, compacted soil to consolidate the structure. The dam was then sealed with compacted soil, slightly raised to create a shallow upstream pool. Photos: Yasmin Redolosis.

Figure 14. Development process of the three natural ponds. Top left: initial stage of removing the top vegetation layer. Top right: water naturally filtering into the excavated area. Bottom left: after each pond was excavated to the desired dept, the removed vegetation layer was placed back on top, followed by inoculation of *Sphagnum* moss. Bottom right: condition of one pond after two months (October 2025). Photos: Yasmin Redolosis.

Figure 15. Comparative photographs of the woody debris dam over a two-month period in 2025. Top left: immediately after construction in August 2025 (Yasmin Redolosis). *Top right:* two weeks later, at the end of August 2025 (Rui Botelho). *Bottom left:* October 2025 (Yasmin Redolosis). *Bottom right:* aerial view taken in October 2025 (Marcos Evangelho).

3.4 Results on nocturnal insect inventory

During a single night, the methodology was successfully implemented at three sampling points using three light traps, with the participation of four people (three interns and one conservation technician) (Figure 10). A total of 453 invertebrates were collected across the three sampling points (see Annex A), distributed as follows: GBN01:174 individuals; GBN02:84 individuals; GBN03:195 individuals. Abundance was highest at GBN03, closely followed by GBN01 while GBN02 recorded the lowest number of individuals.

Across all invertebrates collected, the most represented orders were Lepidoptera, Diptera, and Trichoptera, with occasional representatives of Hymenoptera, Hemiptera, and Araneae (Figures 16 and 17). According to the naturality of each identified species, the great majority of Lepidoptera were endemic to the Azores, while a high proportion of individuals from other orders remained unidentified at species level (120 individuals), as this inventory focused primarily on Lepidoptera identification. Consequently, all individuals were identified at least to the order level (Figure 16).

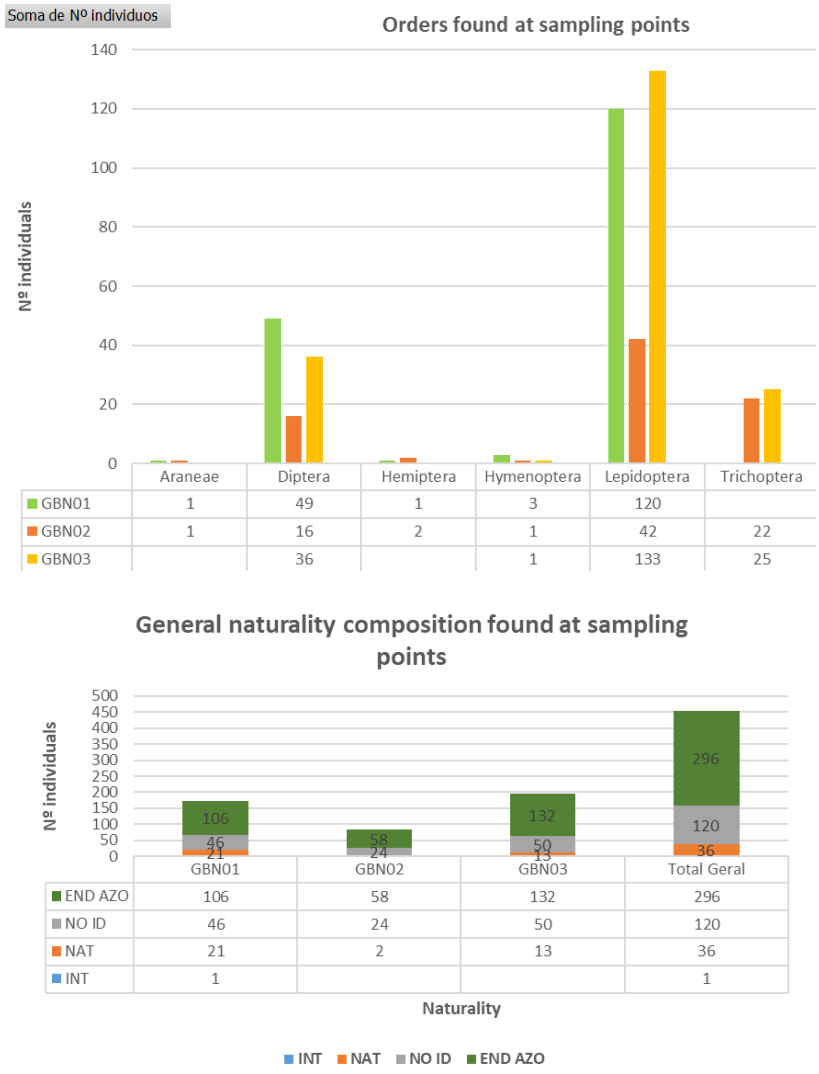

Figure 16. Top: Distribution of different invertebrate orders recorded at each sampling point. Bottom: invertebrate naturality composition (END AZO, NAT, INT).

Note: The general composition of invertebrates by naturality is strongly influenced by Lepidoptera, as most other orders were only identified to order level. Therefore, the proportion of endemic species among all invertebrates may be overestimated.

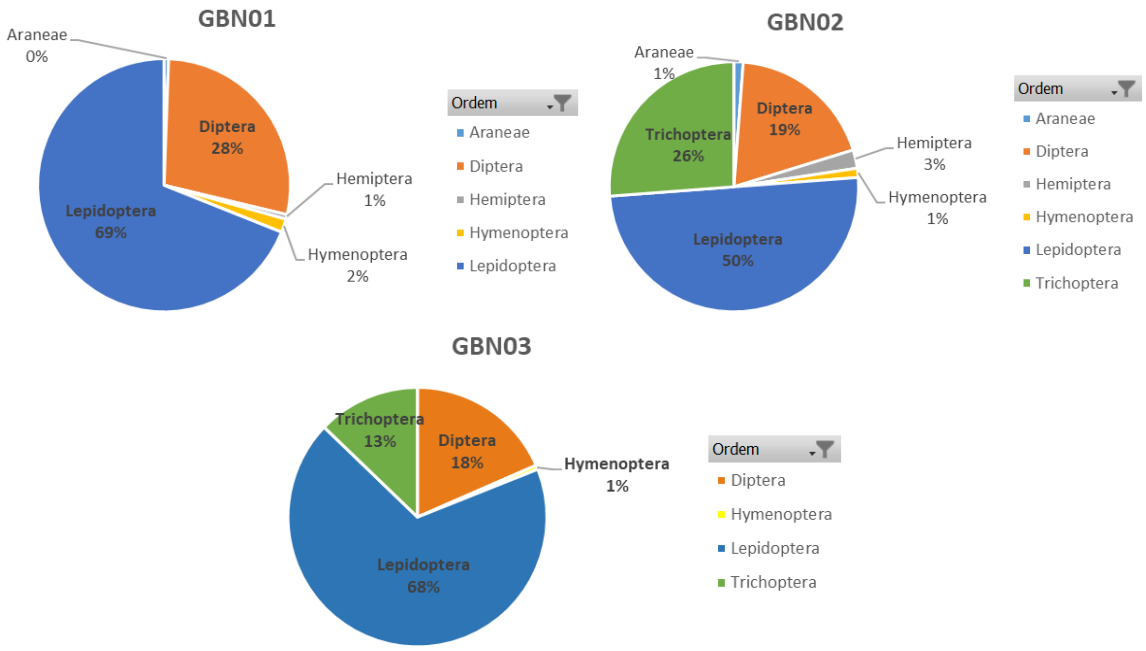

Figure 17. Circular diagram showing the distribution of invertebrate orders recorded at each sampling point. Note that in GBN01, Araneae corresponds to 1% instead of 0%.

Within Lepidoptera (Figure 18), a total of 295 individuals were recorded, with macrolepidoptera accounting for 205 individuals (corresponding to a 69%) and microlepidoptera for 90 individuals (31%). Commonly, macrolepidoptera are easier to identify than microlepidoptera. This pattern was also observed in this inventory, as the unidentified Lepidoptera largely corresponded to microlepidoptera. However, some microlepidoptera species were successfully identified, including *Udea ferrugalis*, *Argyresthia atlanticella*, and *Eudonia luteusalis*, alongside two unclassified morphotypes.

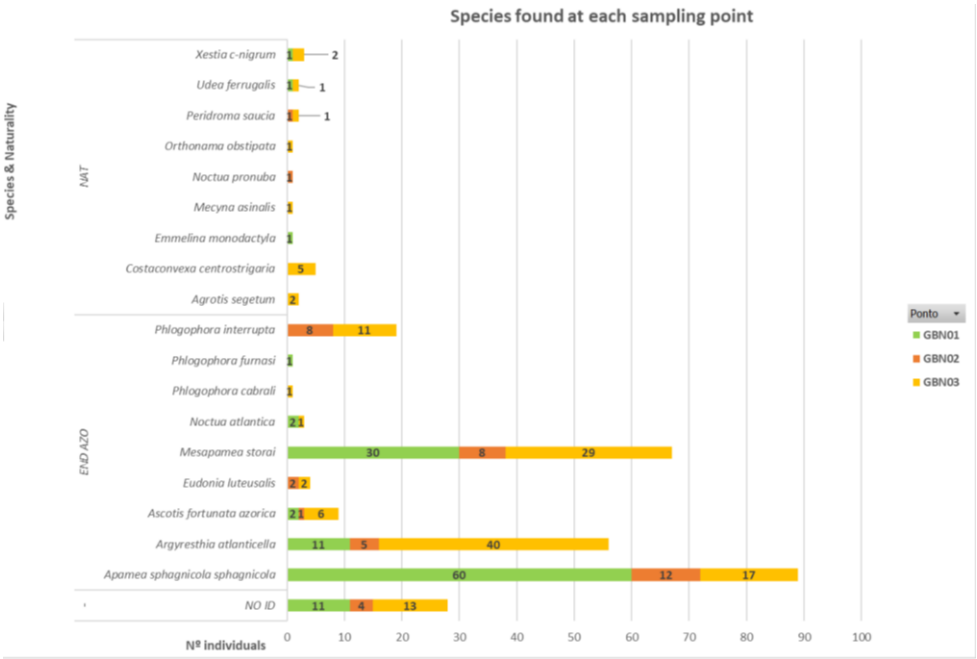

Figure 18. Lepidoptera species recorded at each sampling point, showing their naturality (only native or endemic species of Lepidoptera were found).

A total of 18 different species were identified across all sampling points (Figure 19). No single sampling site contained all 18 species, but four endemic species (*Mesapamea storai*, *Ascotis fortunata azorica*, *Argyresthia atlanticella*, *Apamea sphagnicola sphagnicola*) and two unidentified morphotypes were present at all sampling points. Specifically, GBN01 had 11 species with 120 individuals; GBN02 had 11 species with 43 individuals; GBN03 exhibited the highest diversity, with 16 species and 132 individuals.

Among the results concerning protected endemic species from the Azores (Figure 19) listed by the IUCN, a total of eight species were recorded: four are classified as Least Concern, one as Vulnerable (*Phlogophora furnasi*), two as Near Threatened (*Argyresthia atlanticella* and *Phlogophora interrupta*), and one as Endangered (*Apamea sphagnicola sphagnicola*), which was recorded at all three sampling points and is among the most abundant species across them.

Family	Genera	Species	Author	Category	Conservation Status	Sampling Presence
Argyresthiidae	Argyresthia	*Argyresthia atlanticella*	Rebel, 1941	END AZO	Near Threatened	São Miguel (GBN01, GBN02, GBN03).
Noctuidae	Mesapamea	*Mesapamea storai*	(Rebel, 1940)	END AZO	Least Concern	São Miguel (GBN01, GBN02, GBN03).
Crambidae	Eudonia	*Eudonia luteusalis*	(Hampson, 1907)	END AZO	Least Concern	São Miguel (GBN02, GBN03).
Noctuidae	Phlogophora	*Phlogophora furnasi*	Pinker, 1971	END AZO	Vulnerable	São Miguel (GBN01).
Noctuidae	Phlogophora	*Phlogophora interrupta*	(Warren, 1905)	END AZO	Least Concern	São Miguel (GBN02, GBN03).
Noctuidae	Phlogophora	*Phlogophora cabrali*	Pinker, 1971	END AZO	Near Threatened	São Miguel (GBN03)
Noctuidae	Apamea	*Apamea sphagnicola sphagnicola*	Wagner, 2015	END AZO	Endangered	São Miguel (GBN01, GBN02, GBN03).
Noctuidae	Noctua	*Noctua atlantica*	(Warren, 1905)	END AZO	Least Concern	São Miguel (GBN01, GBN03).

Figure 19. Identified endemic Lepidoptera species and their conservation status according to the IUCN.

These preliminary results demonstrate that even a small-scale, standardised nocturnal sampling protocol can provide valuable information on local insect diversity, particularly within the order Lepidoptera. Notably, all recorded species were native or endemic, with no introduced species detected, highlighting the high conservation value and natural integrity of the Graminhais Plateau insect community. Moreover, the presence of species with some form of legal protection underlines the importance of conserving this site, emphasizing its role in maintaining biodiversity and ecosystem health.

3.5 Awarness raising and communication

As an additional outcome, selected specimens could be prepared for an entomological display box for future educational purposes, illustrating the importance of protecting and restoring peatbog habitats.

In addition to the results presented for each intervention (see sections 3.1-3.4), the project successfully promoted awareness of the importance. As part of our outreach efforts, social media posts and volunteer activities were used to showcase the project, particularly highlighting the protection of the peatbog habitat where these interventions took place (Figure 20).

All activities were widely publicised through SPEA's communication channels, including Facebook events and posts and Centro Priolo website, which generated strong community engagement and positive feedback across social media (Figure 21).

Figure 20. Different awareness-raising activities conducted at Graminhais Plateau for GBTN project in 2025. Photos: Yasmin Redolosis.

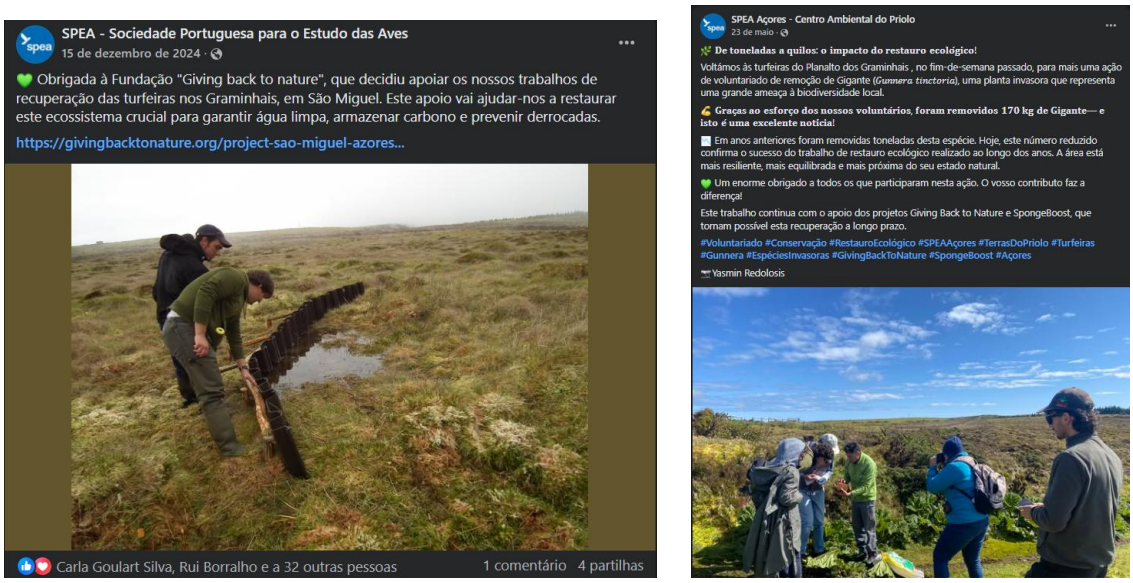

Figure 21. Social media posts referring GBTN project in 2025. Photos: Yasmin Redolosis.

4. FINNANCIAL EXECUTION

The following table shows the items on which the total amount of the donation made by the Giving Back to Nature Foundation was spent. The 10,000.00 € were distributed among the following expenses (Figure 22).

RUBRICS	VALUE
Technical Staff	1 705,27 €
Operacional Staff	3 817,48 €
Equipments	1 007,00 €
Consumables	3 490,13 €
TOTAL	**10 019,88 €**

Figure 22. Table showing the breakdown of expenses allocated to this project.

The largest investment in this project was in terms of personnel, with 22 days allocated to the technical team and 53 days to the operational team. In terms of equipment, the investment was directed towards the acquisition of portable Heath-type light traps. Consumables included various expenses such as fuel for vehicles, material for chainsaws and brush cutters, and personal protective equipment for chainsaw operators.

It should be noted that all the work carried out under this project was only possible thanks to the complementarity with other ongoing projects managed by SPEA, under which equipment and human resources were provided. Otherwise, it would have been impossible to achieve all the objectives described above with the allocated budget.

5. FUTURE STEPS

All the efforts that SPEA and its partners have been making since 2009 to conserve the peatbogs at Graminhais Plateau are a success story in terms of the ecological recovery of habitats that had been transformed into pastureland and are now returning to their original state as peatbogs.

However, this is a time-consuming process, requiring continued efforts to control invasive plants, both those already identified, such as *Gunnera tinctoria* (Chilean rhubarb) and *Dicksonia Antarctica* (Tasmania tree fern), and potential new invaders, as well as continuing to close the entire drainage system that was installed in the 1970s in order to ensure soil waterlogging and promote the development of native vegetation.

Future work should therefore include continued control of invasive alien species (IAS), as well as replacing existing plastic barriers with wooden dams. Several potential interventions have already been identified (Figure 23), including the construction of four additional dams (highlighted in fluorescent green) and the removal of newly identified areas of *Cryptomeria japonica* (Japanese red cedar) resproutings.

Furthermore, the nocturnal insect inventory should continue, with the possibility of conducting a preliminary study focused on Lepidoptera, given the promising results obtained so far.

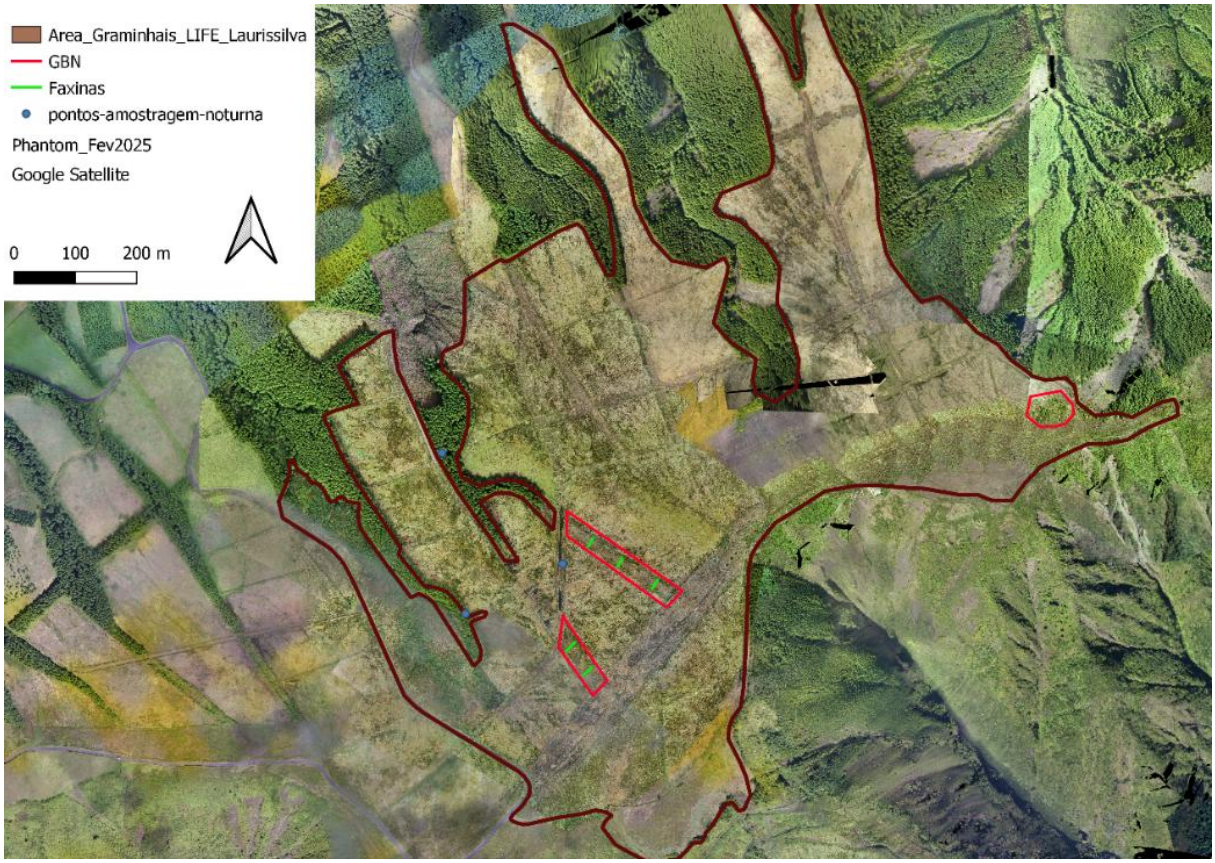

Figure 23. Potential future interventions that could be implemented in upcoming projects.

BIBLIOGRAPHY

Botelho, R & Peñil, L. (2013). Requalificação ambiental das turfeiras do Planalto dos Graminhais pelo projeto LIFE+Laurssilva Susténtavel - Ação C3, C5, E1. Sociedade Portuguesa para o Estudo das Aves, Lisboa (relatório não publicado).

Forest Carbon Ltd. (2024). *What are Peatlands?* Recuperado de https://www.forestcarbon.co.uk/knowledge-base/what-are-peatlands

Holden, J. (2006), "Chapter 14 Peatland hydrology", *Developments in Earth Surface Processes*, Elsevier, Vol. 9 No. C, pp. 319–346, doi: 10.1016/S0928- 2025(06)09014-6.

International Peatland Society. (2025), "Peatlands - International Peatland Society", available at: https://peatlands.org/peatlands/ (accessed 13 September 2025).

IUCN. (2021), "Issues Brief Peatlands and Climate Change", International Union for Conservation of Nature.

Joosten, Hans. and Clarke, Donal. (2002), *Wise Use of Mires and Peatlands : Back ground and Principles Including a Framework for Decision-Making*, International Mire Conservation Group : International Peat Society.

Mendes, C., & Dias, E. (2019). *Turfeiras dos Açores*. Pingo de Lava / Associação Os Montanheiros. Retrieved from https://www.montanheiros.com/wp-content/uploads/2020/04/PingoLava2019-Turfeiras-Acores.pdf

Pereira, D., Mendes, C. and Dias, E. (2022), "The potential of peatlands in global climate change mitigation: a case study of Terceira and Flores Islands (Azores, Portugal) hydrologic services", *SN Applied Sciences*, Springer Nature, Vol. 4 No. 6, doi: 10.1007/s42452-022-05066-0.

SPEA (2022). Plano Operacional dos Graminhais, São Miguel – Versão 1.0. Projeto LIFE IP AZORES NATURA – Proteção Ativa e Gestão Integrada da Rede Natura 2000 nos Açores. Sociedade Portuguesa para o Estudo das Aves, Nordeste, S. Miguel.

UNEP. (2022), *Global Peatlands Assessment: The State of the World's Peatlands - Evidence for Action toward the Conservation, Restoration, and Sustainable Ma nagement of Peatlands*, United Nations Environment Programme, doi: 10.59117/20.500.11822/41222.

van Koppenhagen, N., Gossner, M. M., Haller, J., & Bolliger, J. (2025). *Mitigating light pollution impacts on arthropods based on light-emitting diode properties*. *Conservation Biology*, e70137. https://doi.org/10.1111/cobi.70137

Wetlands International. (2008). *Annual Review 2008*. Wetlands International. https://www.wetlands.org/publication/annual-review-2008/

ANEXES

A Graminhais Plateau nocturnal insect inventory database.