# Action A.6 – Development of prototypes for deterring avifauna in medium voltage lines

**(LIFE14 NAT/PT/001081)**

## Technical Report

**QUERCUS A.N.C.N. - Associação Nacional de Conservação da Natureza**

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## Table of contents



## Acronyms

BACI – Before-After-Control-Impact,

ECO- HAL A2S - New structure to be applied,

EDP – Energias de Portugal (distributor company),

GAL - Power line cables in suspension,

HAL A2S – horizontal armless shape with 1 and ½ collision levels,

IBA- Important Bird Area,

SPA- Special Protection Area,

TAL - Fixed cable in triangle shape,

# 1. Introduction

In Portugal electrical transportation and distribution is made by aerial conductor cables. This brought several interactions between these installations and avian species due to their ability to use them as resting point, nesting, hunting strategical point, etc. However these interactions can result in mortality for avian through electrocution during their landing/taking off or standing on the structure that supports the cables and collision during the flight. Previous studies have shown that some power lines contributed for the regression of threatened species like the *Otis tarda* (Janss & Ferrer 1998), *Aquila adalberti* (Ferrer et al. 1984) or *Aquila fasciata* (Mañosa 2001). An electrocution occurs when the animal has contact between two conductive elements, with different potentials, allowing electric current to travel through the body. This can happen when the avian contacts with two different phases in tension or between a phase and other earthed non-conductive structure. Electrocution occurs above all in medium-to-large birds that habitually perch on top of the poles. Unfortunately, this description corresponds perfectly with birds of prey, which, moreover, are generally scarce and in many cases endangered.

**Figure 1. Bird of prey resting in a metal structure of medium voltage power line pole.**

**Figure 2. Several *Sturnus unicolor* in a pole GAL pole type.**

Collisions occur when the bird hits the aerial conductor of a medium or high voltage, earthed wire or guard wire of high voltage power lines. Many different species can collide with power lines but some are more prone to do so due to their less flight agility or gregarious behavior.

## 2. Objectives

To reduce and prevent the negative impacts caused by the interaction between power lines and birds Quercus and EDP developed under the scope of the LIFE LINES (action A6), an innovating pole frame called ECO- HAL A2S which aims to reduce the mortality from electrocution and collision at the same time. Birds are electrocuted when they touch at the same time two phases or one phase and a neutral conductor like the metal bars present in the top of the poles. The ECO-HAL A2S will reduce the distance between phases, isolate some electric parts, contiguous to the electric poles and alter the design of the top of the pole that difficult the birds landing. Regarding the collision problem, the new structure will reduce to a single horizontal plane, formed by aerial conductors where birds can collide.

## 3. Development and application

Since 1999 EDP, QUERCUS and other NGOs have been working together to identify the most dangerous power lines, elaborating risk maps (avian mortality predictive model) for some endangered species like *Aquila adalberti* or *Aegypius monachus* and promote isolation in existing structures and applying them with the objective to reduce mortality caused by power lines. The ECO- HAL A2S structure comes in the same line of work but with a new structural design of the electric pole that addresses the collision and electrocution problem at the same time. In figure 3 is represented the structure used as model for the design of the new ECO- HAL A2S. This structure has a number of levels formed by the conductors of 1 and ½. The implemented pole structure adopted by EDP for protected areas is GAL and some components (anti-collision and anti-electrocution) added to this structure have been tried but are not solving the problem according do collected data. The ECO- HAL A2S philosophy is entirely different and innovating because alters

the pole design entirely addressing the structural problems that affect birds mortality caused by collision and electrocution.

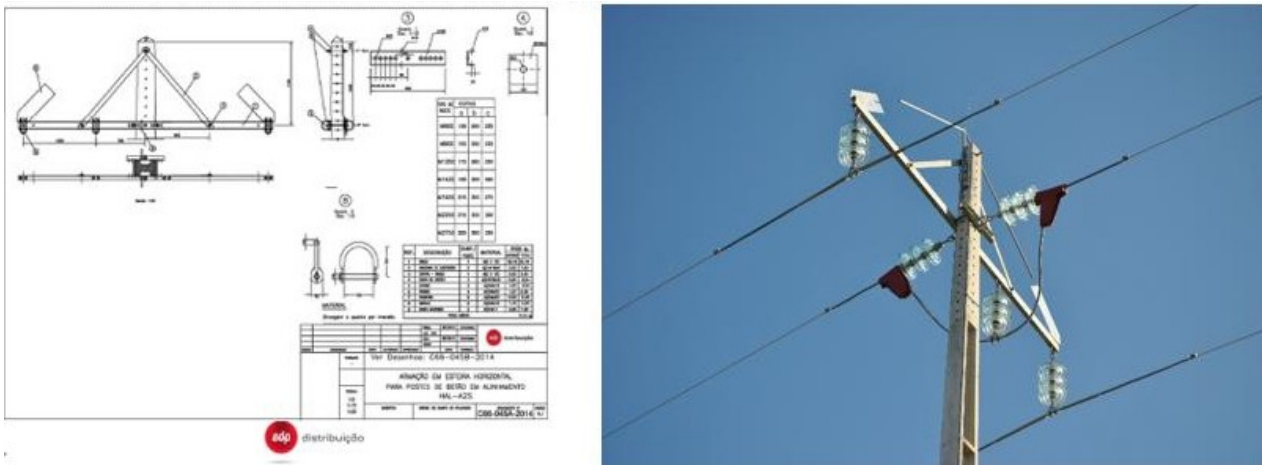

**Figure 3. technical design of the structure with 1 and ½ number of horizontal planes.**


**Figure 4. The alterations made in the actual HAL A2S will originate the new ECO- HAL A2S.**

## 4. Methodology

After the step of making a design based in the structure represented in figure 3 the production is made by external locksmith work. In figure 4 are represented the alterations intended for the ECO-

HAL A2S having the HAL A2S (1 and ½ horizontal levels) as model. The middle arm will be lowered (80 cm) and with it the correspondent cable to the same level of the exterior cables.

During the installation EDP and QUERCUS technicians will follow regularly in the field the operation development. Several generators will be installed to guarantee the continuous energy supply.

The new structure will be applied in power line sections with no other anti-collision or anti-electrocution with structures that have a very low efficiency rate to allow a good compared evaluation.

The ECO- HAL A2S is to be built by an external company, certified by the National Directorate of Energy and Geology in 85 poles over 13km of medium voltage power line where between the extensive list of species present inside the area of LIFE LINES are frequently found birds of medium/large size which use the pole tops as resting and hunting strategical points. These include birds of prey like *Falco naumanni*, nesting like *Ciconia ciconia* or feeding ground like the *Otis tarda* and *Vanellus vanellus* some of these included in the annex I threatened bird species of the Birds Directive and important species for defining Évora SPA area within Natura 2000 network.

The "before" phase for the BACI model application (to take place in action C5) foot surveys are being made, since October under selected power lines and control power line searching and registering bird carcasses. The surveyors prospect the ground and low vegetation 5m around each electrical pole. Between electrical poles the surveys were also made by foot along the power line with a 10m radius from the middle axis formed by the areal conductors. Each carcass or their remains was individually identified when possible by specie, age and cause of death. Since the surveys began 7 different bird species were already registered.

**Table 1. Field surveys dates before ECO- HAL A2S installation.**

| | |
|---|---|
| Survey 1 | 17 September 2018 |
| Survey 2 | 17/18 October 2018 |
| Survey 3 | 3/ 4 December 2018 |
| Survey 4 | 13/14 December 2018 |
| Survey 5 | 19/20 December 2018 |
| Survey 6 | 15/16 January 2019 |
| Survey 7 | 14/15 February 2019 |
| Survey 8 | 13/13 March 2019 |

| | |
|---|---|
| Survey 9 | 16/17 April 2019 |

**Table 2. List of species registered since the beginning of the surveys in October 2018, found dead by collision or electrocution.**

| | |
|---|---|
| *Bulbucus ibis* | *Falco tinnunculus* |
| *Buteo buteo* | *Parus caeruleus* |
| *Ciconia ciconia* | *Turdus merula* |
| *Corvus corax* | *Vanellus vanellus* |
| *Corvus corone* | |

## 5. Selection of power lines

The selection of the power lines to be intervened were mainly based in preview field surveys made by QUERCUS inside the intervention area (2003-2004) searching for mortality under several power lines of medium and high voltage to understand their impact in avian species. This because a great variety of species are frequently present in the area where the more represented habitats are steppe, "montado", a high biodiversity habitat and pasture. Power lines present in steppe habitat revealed to have one of the higher mortality rates - 5,56 birds/km/year for collision and 0,24 birds/pylon/year. The absence of landing structures leaving for power lines this role revealed to be deadly for avian species (Infante et al 2005). The sites of the chosen power lines to apply the ECO-HAL A2S had a very high number for collision mortality rate of 6,17 birds/km/year (second biggest number in study areas in Portugal) with 630 estimated cases per year along 104km surveyed power lines and a electrocution mortality rate of 0,15 birds/km/year with 86 cases estimated cases per year along 568 surveyed power line poles. During those surveys 101 deaths by collision and 33 by electrocution, totaling 134 mortality cases registered. Among the large avian biodiversity present in the area, the *Ciconia ciconia* (21 collided, 9 electrocuted), the *Tetrax tetrax* (9 collided), the *Otis tarda* (3 collided), the *Buteo buteo* (6 electrocuted) where between the most affected species. Collision mortality occurred mainly in GAL typology, electrocution cases were confirmed in both TAL and GAL, particularly GAL in suspension. In figure 5 we can see their representative scheme.

Based in this data QUERCUS first proposed a power line section (figure 6) where mortality was found, with the pole typologies showed before, inside the intervention area in Évora plains IBA as showed in figure 6.

**Figure 5. From left to right a TAL and GAL in suspension pole types respectively.**

## 6. Selected power line for intervention

The power lines in this area are constituted mainly by TAL and GAL poles. Having in mind the fact that in previous studies made by the work group inside the intervention area revealed the high rates of collision and electrocution mortality in GAL and TAL in the present habitats. An agreement between the work group for the final selection of power lines sections was achieved. The main pole typology is GAL. The selection needed to be made of several power lines sections for intervention due to the impossibility to find a single straight power line that met the requirements (wanted pole typology, habitat and inside the intervention area). One section has 10km, (contiguous to a power line where bird mortality was registered between 2003 and 2004 but constituted by TAL poles) with 62 poles that are numerated and the interval for intervention goes from the pole 16 to 77 as represented in figure 8. The other sections in sum have 5km the poles have the following intervals: 2–15, 2–12 and 2–5 as represented in figure 9. The selected power lines where ECO- HAL A2S will be applied include 91 poles in a total distance of 14,8 km. The power line sections are located in the same area where bird mortality was registered between 2003 and 2004, inside the intervention area maintaining Évora plain IBA and SPA influence.

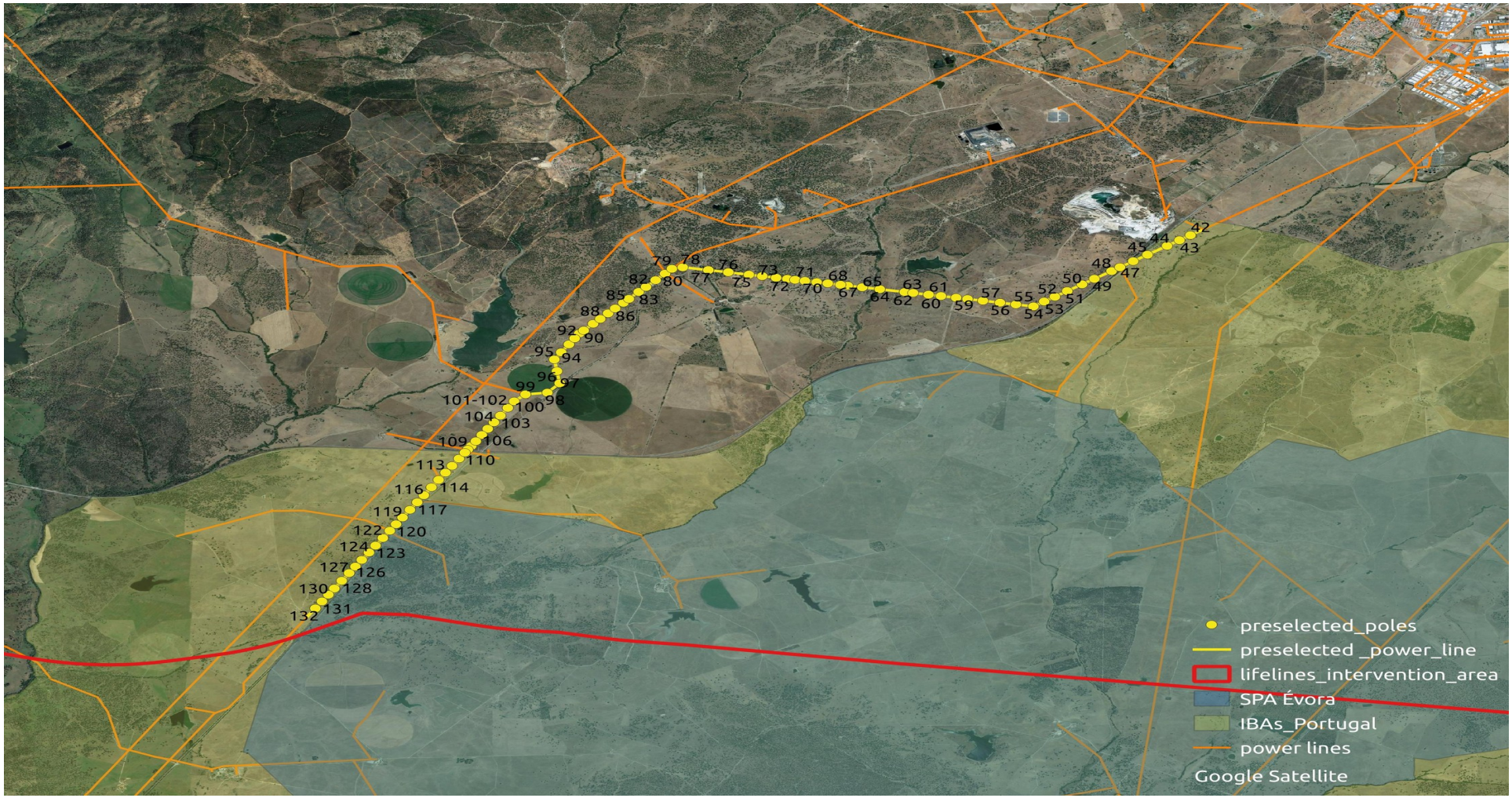


**Figure 6. Map of the initially selected power line.**

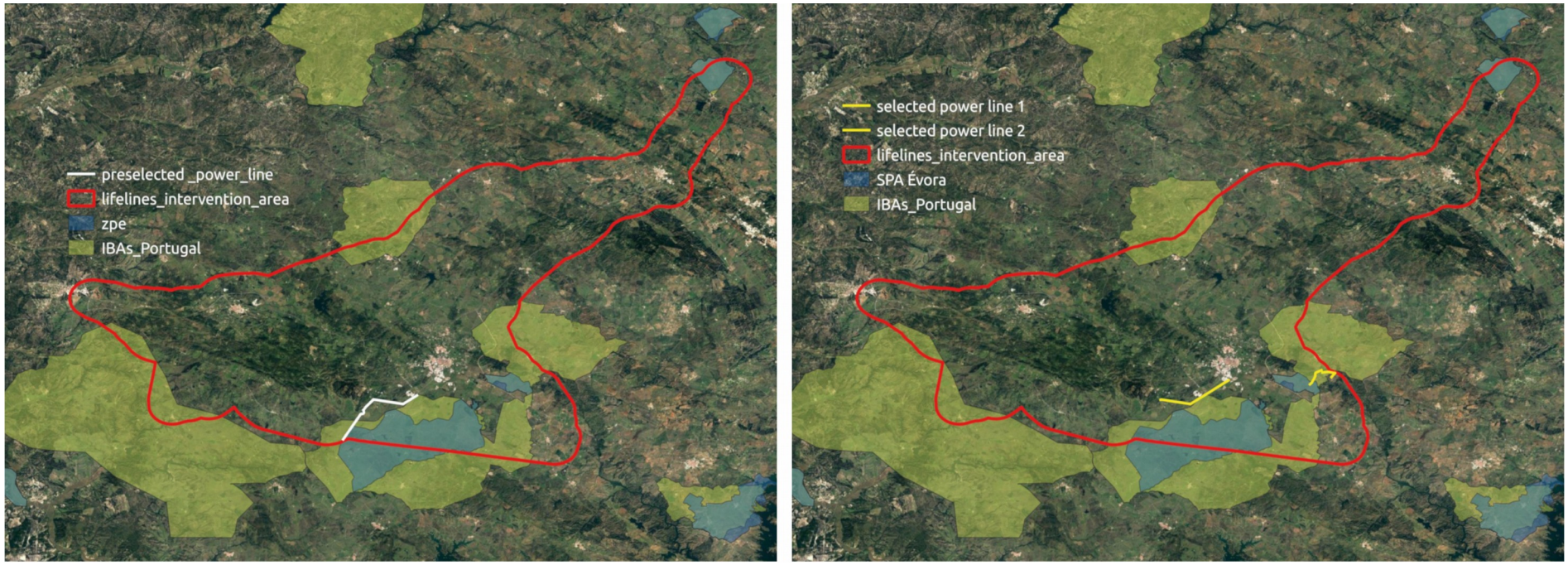


**Figure 7. Initially selected power line for alteration, due to technical issues was not possible (left image) and selected power lines for alteration (right image).**


**Figure 8. Selected power line 1 to apply the ECO- HAL A2S with the intervals pole number between 16 – 77.**

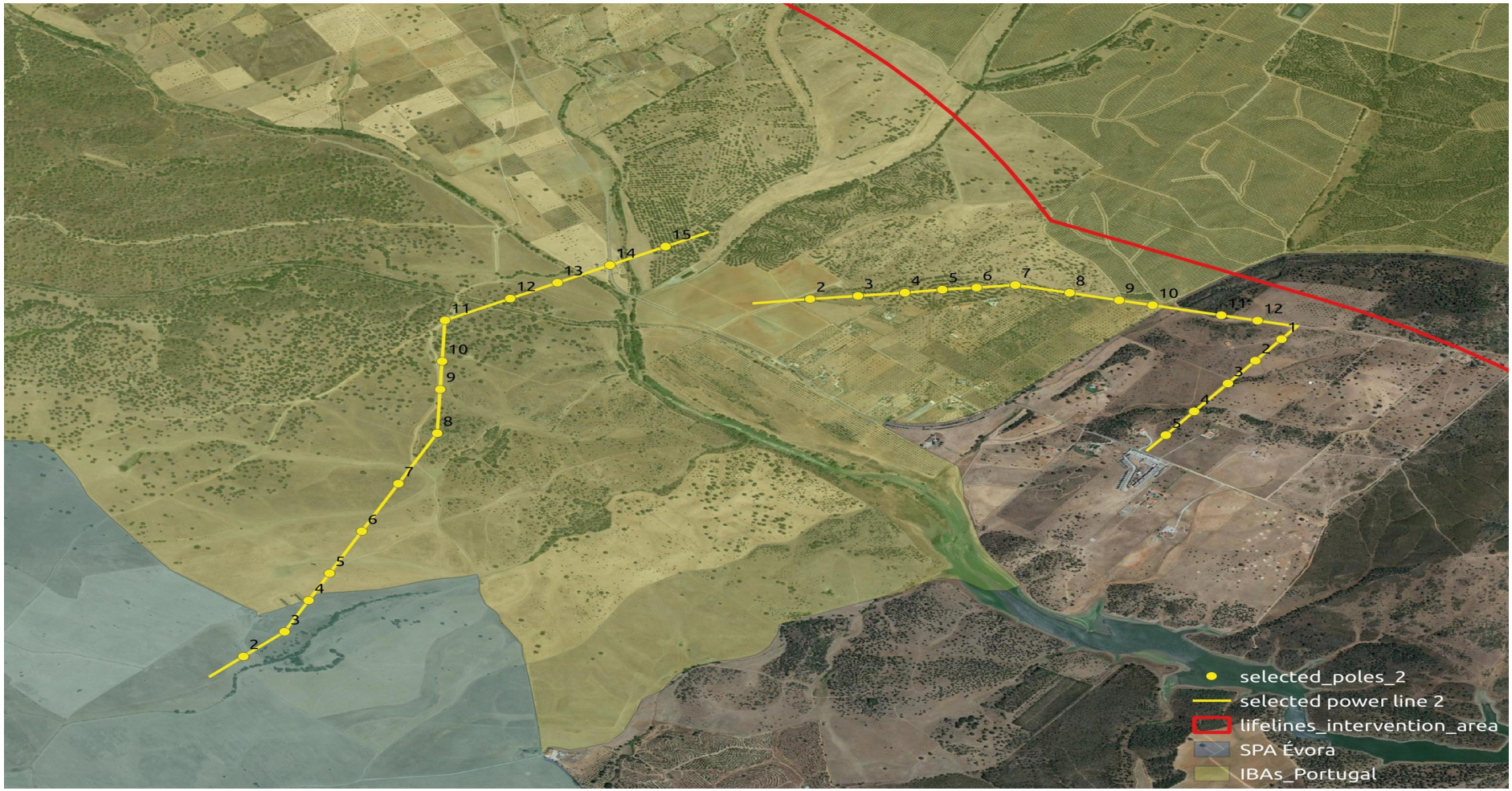


**Figure 9. Selected power line 2 to apply the ECO- HAL A2S with the intervals pole number between 2 – 15, 2-12 and 1-5.**

## 7. Problems encountered and solutions

After preselecting a power line QUERCUS and EDP in 17 September 2018 visited the sites to analyze the changes to make in the poles. According to EDP technicians power lines where avian mortality was found between 2003-2004 technically could not be altered. The power lines were too close to an electrical sub-station making the intervention and applying ECO- HAL A2S to TAL poles would lower aerial conductors at the level of the crown trees and that would not be viable. After a thorough analysis, power lines with equal habitat types, the same avian species present, same pole typology, inside the intervention area and located as close as possible to the ones where collision and electrocution mortality was registered were chosen to apply ECO- HAL A2S, figure 8 and 9. The team also choose a control power line with the same requirements described above. The control line had to have the same distance and number of poles, figure 10 for the BACI model (Before-After-Control-Impact).

**Figure 10. Pole typology (GAL) used in the selected lines to install ECO- HAL A2S.**

# 8. Conclusion

Despite EDP providing a public service, the power lines are inserted in private proprieties, they have need to access private land and guarantee electric supply for all at the same time while the work is been carried out. Therefore EDP began the field step of contacting with the land owners owners to discuss the terms for the ECO- HAL A2S structure installation.

After the final ECO- HAL A2S final design (Annex I) we expect that the ECO- HAL A2S will be produced at an experimental stage by the end of the first half of 2019, and later in full operation for monitoring purposes, as defined in the application. The technical design went through an EDP internal approval process to check if it is within all the technical requirements. This step was a delicate process and is now concluded and its production approved, after this important phase the negotiations between QUERCUS and the external locksmith company are being concluded so its constructions can begin rapidly. During the installation also carried out by an external company, certified by the National Directorate of Energy and Geology, EDP and QUERCUS technicians will visit regularly  the operations development in the field

Both the selection of the power lines phase and the final design for the ECO- HAL A2S are concluded. Section of dangerous power lines were selected according to previous studies and C5 action is already taking place with field surveys to check avian mortality in the selected power lines. The surveys are being made for a posterior analyses using BACI design. During the surveys carried out bird mortality caused by collision and electrocution in the selected power lines have been registered already in 7 different species.


**Figure 11. Turdus merula whose death killed by collision with a selected power line during the "before" field surveys.**


**Figure 12. Picture of a Vanellus vanellus whose death was caused by collision with the control selected power line during the "before" field surveys.**


**Figure 13. Picture of a Corvus corax whose death was caused by electrocution with the control selected power line during the "before" field surveys.**

# 9. Bibliography

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INFANTE, S., NEVES, J.,Ministro,J & Brandão, R. 2005. Estudo sobre o Impacto das Linhas Eléctricas de Média e Alta Tensão na Avifauna em Portugal. Castelo Branco

**Annex I –** ECO- HAL A2S approved technical draw from three different perspectives (frontal, lateral and from above).