

**TUTORIALS TO SUPPORT PRACTICAL CLASSES****Tutorial 3. Habitat selection by polygons****Vanda Acácio and Susana Dias**

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**BACKGROUND**

EFFIS (European Forest Fires Information System) provides updated thematic geographic information on forest fires for Europe at <http://effis.jrc.ec.europa.eu/>. The Portuguese Institute for Nature Conservation and Forests (ICNF) provides information on burned areas in Portugal for the period 1975-2023 (<https://geocatalogo.icnf.pt/catalogo.html>), with more detail than EFFIS.

For this exercise we will use burned areas in mainland Portugal in 2010-2017, in order to analyse how these areas (polygons) select land use/land cover.

**OBJECTIVES**

- Work with polygon elements using burned areas in 2010-2017, for each study region (PROF region);
- Compare the number of fire ignition points and burned area in 2017, for each study region;
- Calculate the selection index and Ivlev index for burned areas, in order to identify which LULC classes have more or less tendency to burn in each study region (“preferred” or “avoided” classes);
- Compare results among regions.

**INSTRUCTIONS****In QGis:**

Part 1. Create a new project, add the study area (PROF region) with the burned areas in 2010-2017

Part 2. Assign different colors to the burned area to represent different years

Part 3. Compare the burned area in 2017 with fire ignition points for the same year

Part 4. Dissolve burned areas 2010-2017

Part 5. Unite the burned area with LULC (Land Use/Land Cover)

Part 6. Explore the attribute table and update the area of polygons

Part 7. Export the Union layer (COS2018\_AA\_RegiaoPROF.shp) as a csv to analyze data in MExcel

**In Excel:**

Part 8. Calculate total burned area and proportion of burned area by LULC class

Part 9. Calculate the selection index (IS) of burned areas in relation to LULC class


Part 10. Calculate the Ivlev index of burned areas in relation to LULC class

Part 11. Produce graphs to compare and discuss results. Compare results among regions

**PART 1. CREATE A NEW PROJECT AND ADD THE STUDY AREA (PROF REGION) WITH THE BURNED AREAS IN 2010-2017**

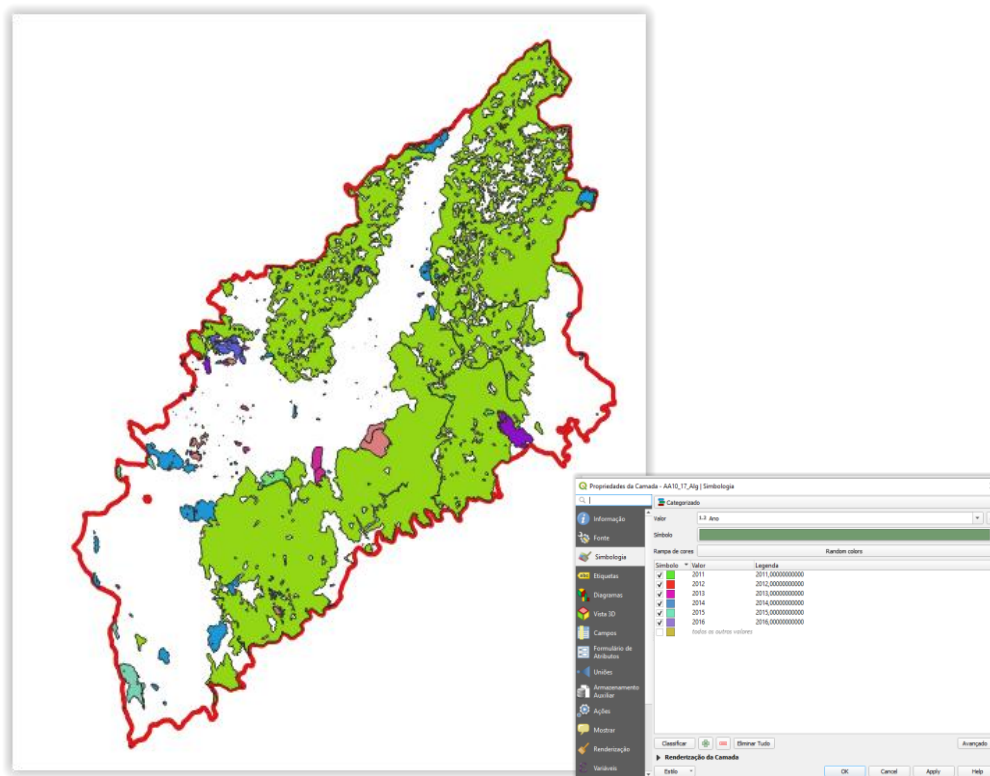
1. Open QGIS and create a new project named "EPA3.qgz" to save in the folder C:\(...)\EPA\Aula3\Results.

2.) Add the shapefile "RegiãoPROF\_AA2010-17", provided as Data for this exercise and save it in C:\(...)\EPA\Lesson3\Data; this shapefile contains the burned areas in 2002-2017 in your

study region 

**PART 2. ASSIGN DIFFERENT COLORS TO THE BURNED AREA TO REPRESENT DIFFERENT YEARS**

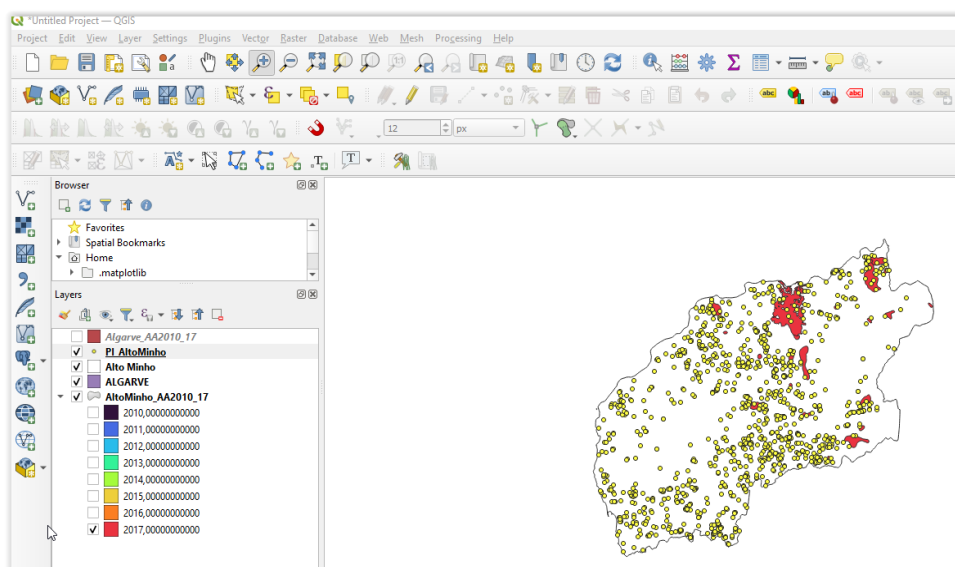
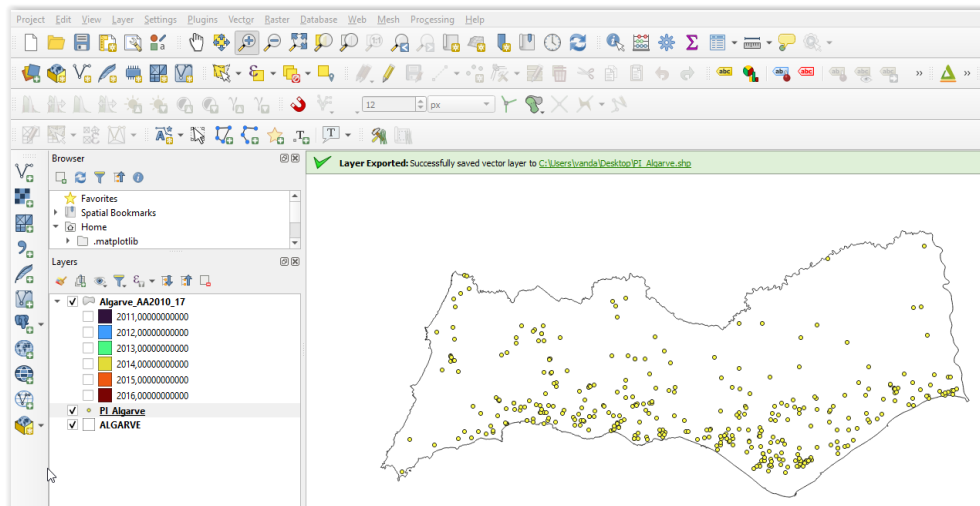
- Open "Properties" for the layer with the burned areas in your region (provided as data for the exercise)
- On "Properties", select Style > Categorized, in relation to "Ano". Click "Classify" to add all the classes of "Ano" and chose the colors for each year. Apply and close.



### PART 3. COMPARE BURNED AREA IN 2017 WITH FIRE IGNITION POINTS FOR THE SAME YEAR

1. Add the layer with fire ignition points in your study region (saved as Results from Lesson1; C:\ISA\EPA\Lesson2\Results\PI2017\_regiaoPROF.shp )
2. Unmark all years in layer regioaPROF\_AA2010-17, except 2017 (see images below)
3. Compare and discuss the location of fire ignition points and burned areas in the study region

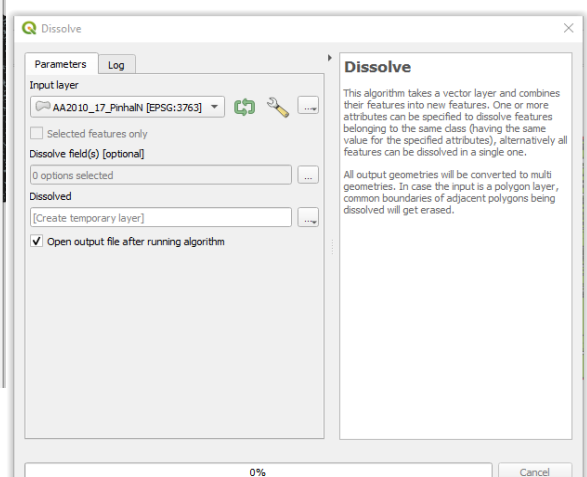
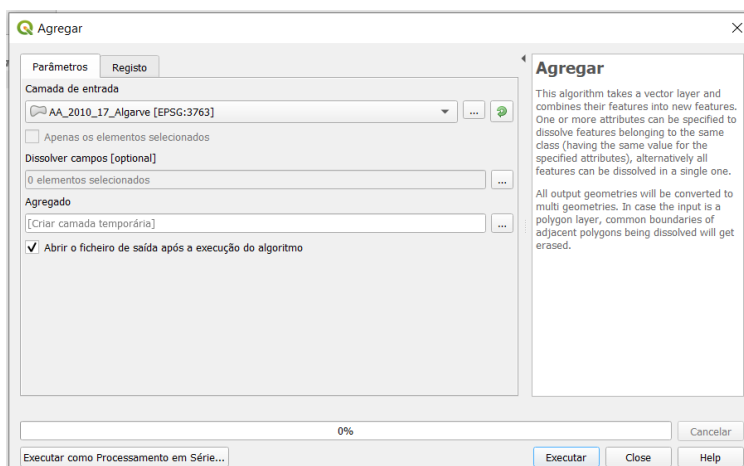
**Note:** Some regions may have fire ignition points in 2017 but no burned areas for the same year. This happens when fires are quickly extinguished and do not result in burned areas. For example, the figure below shows Algarve region (southern Portugal) with several fire ignition points but no burned areas in 2017 (upper image). On the other hand, the region of Alto Minho (northern Portugal) shows both fire ignition points and burned areas in 2017 (lower image).



## PART 4. DISSOLVE BURNED AREAS 2010-2017

1. Dissolve burned areas 2010-2017 in order to obtain one single polygon

➤ *Vector > Geoprocessing tools > Dissolve*

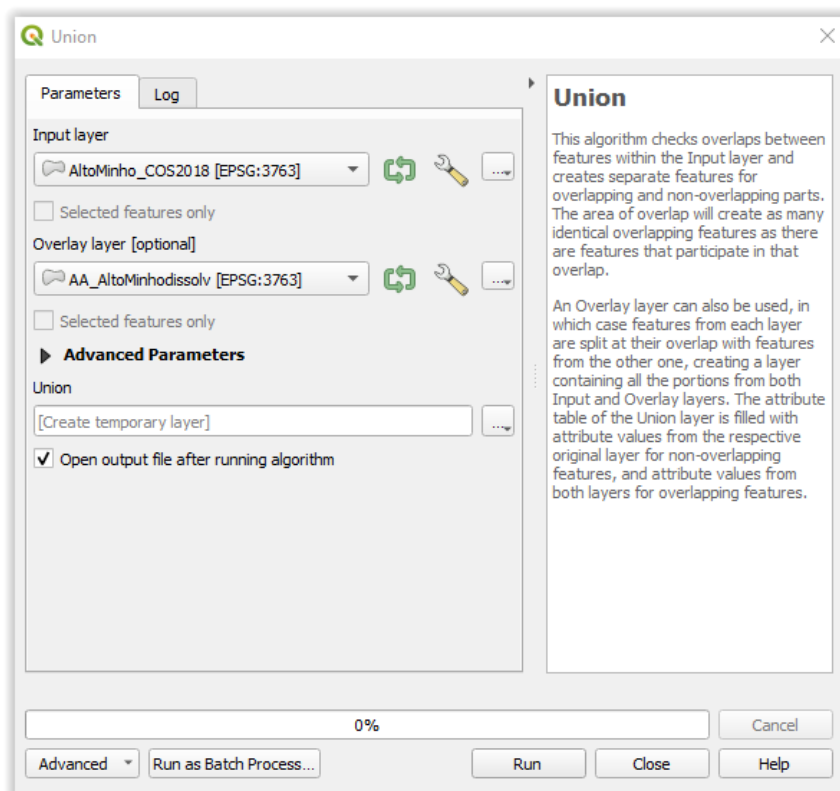


- Save the output in the Results folder as AA\_RegiaoPROF\_dissolv.shp
- Open and check the attribute table of this new dissolved layer. You will see that all polygons were united and are now identified as a single polygon, with only one value for year and area


## PART 5. UNITE THE BURNED AREA WITH LULC (LAND USE/LAND COVER)

1. Add the layer with LULC classes in 2018 for your PROF region: COS2018\_RegiaoPROF.shp (Data provided in Lesson 2)
2. The *Union* function will join the information contained in AA\_RegiaoPROF\_dissolv.shp and COS2018\_RegiaoPROF.shp, to identify the areas that burned or not within each LULC polygon
3. Apply the *Union* operation in *Vector > Geoprocessing tools > Union*
  - Input layer: "COS2018\_RegiaoPROF.shp"
  - Overlay layer: "AA\_RegiaoPROF\_dissolv.shp"
4. The operation may take a while. Save the output as "COS2018\_AA\_PROFregion.shp"

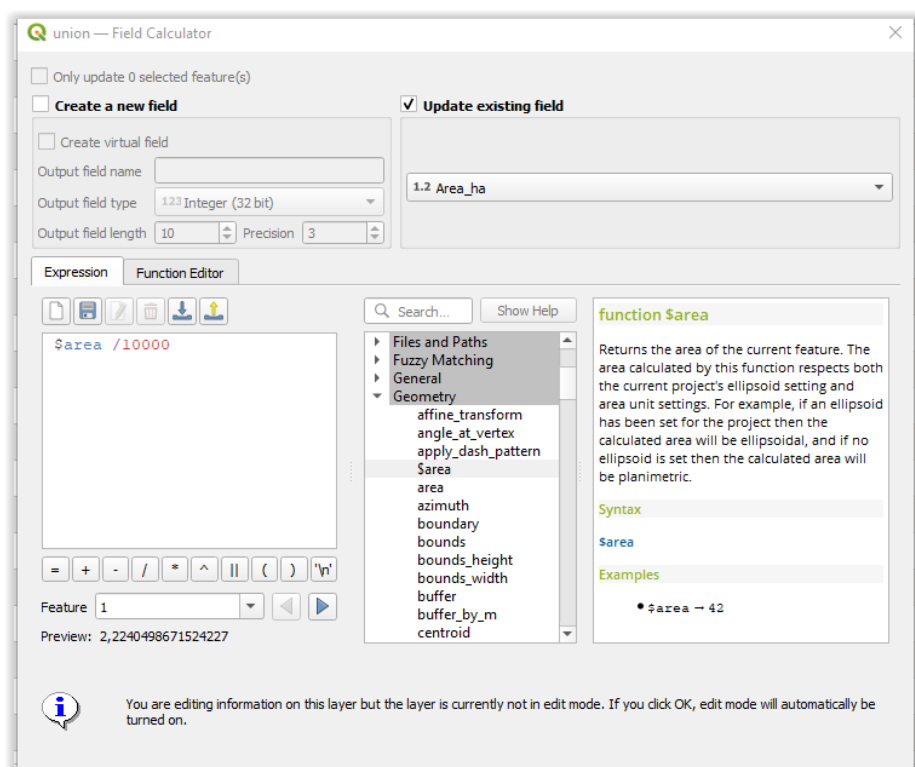
Note: In alternative, you may use *Union* in ArcMap, for faster processing.



**PART 6. EXPLORE THE ATTRIBUTE TABLE AND UPDATE THE AREA OF POLYGONS**

1. Open and check the attribute table of the new layer “COS2018\_AA\_RegiãoPROF.shp”. This new layer joins the attributes (columns with information) of LULC classes with burned areas
2. Recall that each line is a LULC polygon. The lines with information for “Ano” (year) and “Shape\_Area” identify burned polygons, that is, contain information from the layer of burned areas; the remaining lines only have information of the LULC layer (COS2018) and therefore do not include burned areas. In this way, it is possible to distinguish the LULC polygons that burned in 2010-2017 from the ones that did not burn
3. Update the field “Area\_ha” with “Field Calculator” 
  - Select *Update existing field* and select “Area\_ha”
  - Select the expression  $\$area$  in the Geometry menu and write “ $\$area / 10000$ ”, to obtain and update the area in hectares for each LULC polygon
  - Click OK, save changes and stop editing

Note: This operation will update the area for each polygon in the layer, which is necessary after a *Union* operation (since the original LULC polygons were divided in new ones that burned or not). When working with large land areas (as PROF regions), it is more convenient to use the units in hectares rather than square meters. It is calculated as “ $\$area/10000$ ” since the  $\$area$  is a function of QGIS that returns the area of each new polygon in square meters and 1 hectare = 10000 m<sup>2</sup>



## **PART 7. EXPORT THE UNION LAYER (COS2018\_AA\_REGIAOPROF.SHP) AS A CSV TO ANALYZE DATA IN MEXCEL**

Right-click on the layer and select “Save as”, chose the file extension csv and save it in in the Results folder of Lesson 3.

1. After exporting as csv, open MExcel

### **IN EXCEL:**

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#### **PART 8. CALCULATE TOTAL BURNED AREA AND PROPORTION OF BURNED AREA BY LULC CLASS**

1. Open the exported csv within Excel (*Data > from Text/CSV*)
2. Copy the imported csv file as paste as values in a new worksheet
3. Substitute points by commas, if necessary
4. Delete the columns that are not necessary, leaving only the columns below:
  - COS18n4\_L (to identify the original LULC classes of COS2018)
  - Area\_ha (contains the area in hectares of each LULC polygon)
  - LULC2018 (contains the grouped LULC classes)
  - Ano (allows to identify if: the polygon burned – with information; the polygon did not burn – without information)
5. Rename the column “Ano” by “Burned” (“Ardeu” in Portuguese) and use a filter to substitute the cells with information with a “yes” and the cells without information with a “no”
6. Use a pivot tale to calculate the burned area by LULC class
  - *Insert > Pivot Table*
  - Select LULC2018 for *Rows* and Sum of Area\_ha for *Values*; select “Burned” (“Ardeu”) for *Filter*

### Campos da Tabela Dinâmica

Escolha campos para adicionar ao relatório: ⚙️

Procurar 🔍

- ☐ COS18n4\_L
- ☒ Area\_ha
- ☒ LULC2018
- ☒ Ardeu

Mais Tabelas...

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Arrastar campos entre as áreas abaixo:

Filtros	Colunas
Ardeu	

Linhas	Valores
LULC2018	Soma de Area_ha

7. Before you active any filter, copy the pivot table and paste as values (you will get the total area in ha of each LULC class in your PROF region)

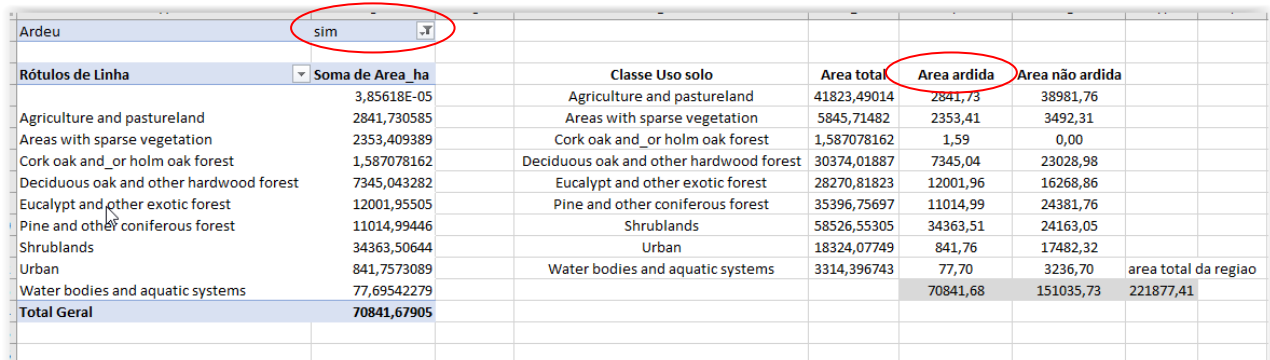
Note: The total area should be equal (or approximate) to the area of the PROF region (you may check this for example with the shapefile PROF\_Regiao.shp saved in Lesson 1)

Ardeu	(Tudo)			
<b>Rótulos de Linha</b>	<b>Soma de Area_ha</b>		<b>Classe Uso solo</b>	<b>Area total</b>
	3,85618E-05		Agriculture and pastureland	41823,49014
Agriculture and pastureland	41823,49014		Areas with sparse vegetation	5845,71482
Areas with sparse vegetation	5845,71482		Cork oak and_or holm oak forest	1,587078162
Cork oak and_or holm oak forest	1,587078162		Deciduous oak and other hardwood forest	30374,01887
Deciduous oak and other hardwood forest	30374,01887		Eucalypt and other exotic forest	28270,81823
Eucalypt and other exotic forest	28270,81823		Pine and other coniferous forest	35396,75697
Pine and other coniferous forest	35396,75697		Shrublands	58526,55305
Shrublands	58526,55305		Urban	18324,07749
Urban	18324,07749		Water bodies and aquatic systems	3314,396743
Water bodies and aquatic systems	3314,396743			
(em branco)				
<b>Total Geral</b>	<b>221877,4134</b>			



8. In the pivot table activate the filter Burned = yes (“sim” in the image below) to obtain the total burned area by LULC class and the filter Burned = no, to obtain the total unburned area by LULC class

9. Copy and paste (as values) next to the previous results



Rótulos de Linha	Soma de Área_ha	Classe Uso solo	Area total	Area ardida	Area não ardida
	3,85618E-05	Agriculture and pastureland	41823,49014	2841,73	38981,76
Agriculture and pastureland	2841,730585	Areas with sparse vegetation	5845,71482	2353,41	3492,31
Areas with sparse vegetation	2353,409389	Cork oak and_ or holm oak forest	1,587078162	1,59	0,00
Cork oak and_ or holm oak forest	1,587078162	Deciduous oak and other hardwood forest	30374,01887	7345,04	23028,98
Deciduous oak and other hardwood forest	7345,043282	Eucalypt and other exotic forest	28270,81823	12001,96	16268,86
Eucalypt and other exotic forest	12001,95505	Pine and other coniferous forest	35396,75697	11014,99	24381,76
Pine and other coniferous forest	11014,99446	Shrublands	58526,55305	34363,51	24163,05
Shrublands	34363,50644	Urban	18324,07749	841,76	17482,32
Urban	841,7573089	Water bodies and aquatic systems	3314,396743	77,70	3236,70
Water bodies and aquatic systems	77,69542279			70841,68	151035,73
<b>Total Geral</b>	<b>70841,67905</b>				<b>221877,41</b>

10. Calculate the proportion of your region that burned in 2010-2017, by dividing the total burned area by the total area of the region

#### PART 9. CALCULATE THE SELECTION INDEX OF BURNED AREAS IN RELATION TO LULC CLASS

As we learned in Lesson 3 (in relation to fire ignition points), the selection index shows the “preference” of the burned area in regards to specific LULC classes and is the ratio between the proportion of burned area of a certain class (or “habitat used by fire”) and the proportion of the area of that class in the PROF region (or “habitat available in the landscape”)

**IS = Selection Index for burned area**

$$IS = P_{aa} / P_{classe}$$

**P<sub>aa</sub> = Burned area by class/ Total burned area** (represents the proportion of burned area within a specific class in relation to the total burned area or “habitat used by fire”)

**P<sub>classe</sub> = Area of LULC class / total area of the region** (represents the proportion occupied by each LULC class within the study region or “habitat available in the landscape”)

Formula bar:  $=F4/F\$13$

D	E	F	G	H
<b>Classe Uso solo</b>	<b>Area total</b>	<b>Area ardida</b>		<b>Paa (proporcao de area ardida)</b>
Agriculture and pastureland	41823,49014	2841,73		0,040
Areas with sparse vegetation	5845,71482	2353,41		0,033
Cork oak and_ or holm oak forest	1,587078162	1,59		0,000
Deciduous oak and other hardwood forest	30374,01887	7345,04		0,104
Eucalypt and other exotic forest	28270,81823	12001,96		0,169
Pine and other coniferous forest	35396,75697	11014,99		0,155
Shrublands	58526,55305	34363,51		0,485
Urban	18324,07749	841,76		0,012
Water bodies and aquatic systems	3314,396743	77,70		0,001
<b>Total</b>	<b>221877,4134</b>	<b>70841,68</b>		<b>1</b>

Formula bar:  $=E4/E\$13$

D	E	F	G	H	I	J
<b>Classe Uso solo</b>	<b>Area total</b>	<b>Area ardida</b>		<b>Paa (proporcao de area ardida)</b>	<b>Pclasse</b>	<b>IS (área ardida)</b>
Agriculture and pastureland	41823,49014	2841,73		0,040	0,188498	0,21
Areas with sparse vegetation	5845,71482	2353,41		0,033	0,026347	1,26
Cork oak and_ or holm oak forest	1,587078162	1,59		0,000	7,15E-06	3,13
Deciduous oak and other hardwood forest	30374,01887	7345,04		0,104	0,136895	0,76
Eucalypt and other exotic forest	28270,81823	12001,96		0,169	0,127416	1,33
Pine and other coniferous forest	35396,75697	11014,99		0,155	0,159533	0,97
Shrublands	58526,55305	34363,51		0,485	0,263779	1,84
Urban	18324,07749	841,76		0,012	0,082586	0,14
Water bodies and aquatic systems	3314,396743	77,70		0,001	0,014938	0,07
<b>Total</b>	<b>221877,4134</b>	<b>70841,68</b>		<b>1</b>	<b>1</b>	

### Interpretation of the selection index (IS):

Recall that:

- $IS > 1$ , fire occurs more than expected by chance in this LULC class (or positive selection: there is a “preference” of the fire for the LULC class)
- $IS < 1$ , fire occurs less than expected in the LULC class (negative selection: the fire “avoids” the LULC class)
- $IS = 1$ , neutral selection (no selection: there is no “preference” of the fire for the LULC class)

**PART 10. CALCULATE THE IVLEV INDEX OF BURNED AREA WITH REGARDS TO LULC CLASS**

The Ivlev index has an identical interpretation to the selection index but varies between -1 and 1. This index is calculated using the following formula:

$$Ivlev = (P_{aa} - P_{classe}) / (P_{aa} + P_{classe})$$

If Ivlev index is:

- > 0, positive selection, there is a “preference” of the fire for the LULC class
- < 0, negative selection, the fire “avoids” the LULC class

D	E	F	G	H	I	J	K	L	M
Classe Uso solo	Area total	Area ardida		Paa (proporcao de area ardida)	Pclasse	IS (área ardida)	Ivlev		
Agriculture and pastureland	41823,49014	2841,73		0,040	0,188498	0,21	-0,64907		
Areas with sparse vegetation	5845,71482	2353,41		0,033	0,026347	1,26	0,1154		
Cork oak and_ or holm oak forest	1,587078162	1,59		0,000	7,15E-06	3,13	0,515975	area da classe < 2%	
Deciduous oak and other hardwood forest	30374,01887	7345,04		0,104	0,136895	0,76	-0,13805		
Eucalypt and other exotic forest	28270,81823	12001,96		0,169	0,127416	1,33	0,141503	preferido	
Pine and other coniferous forest	35396,75697	11014,99		0,155	0,159533	0,97	-0,01284		
Shrublands	58526,55305	34363,51		0,485	0,263779	1,84	0,295513	preferido	
Urban	18324,07749	841,76		0,012	0,082586	0,14	-0,74844		
Water bodies and aquatic systems	3314,396743	77,70		0,001	0,014938	0,07	-0,8632		
Total	221877,4134	70841,68		1	1				

**PART 11. PRODUCE GRAPHS TO COMPARE AND DISCUSS RESULTS. COMPARE RESULTS AMONG REGIONS**

Make graphs to compare and analyze:

- Selection index and Ivlev index of burned area in 2010-2017 in regards to LULC class in the study region
- Selection index (and/or Ivlev index) of fire ignition points and burned areas for each LULC class (for this analysis, if you want to use only data for 2017, you will need to create a new shapefile with the burned area in 2017 and calculate the indices)
- Selection index for burned area for all regions (comparison of results)

Note: For our analysis we will not consider LULC classes that occupy less than 2% of the total area of the region

