



Doñana under plastic: the non-stop berries invasion

Monitoring the evolution of the extent of berry
crops in Doñana region after the entry into force
of the Special Land use Plan (2015-2019)

INTRODUCTION

In recent decades, berry crops (strawberries, blueberries, raspberries, and blackberries) cultivated under plastic have proliferated on the sandy soils around Doñana and have become one of the main crops in terms of extent and importance for the regional economy. This situation has provoked serious environmental impacts, in particular on the quality and quantity of water available for the Doñana Natural Area wetlands, as well as on Doñana's ecological connection with other areas of high ecological value, i.e. because of the occupation of forest areas and green corridors in streams.

To try to solve the land use planning problems, the Junta de Andalucía (Andalusian Regional Government) developed the **Doñana Land Use Plan (Plan de Ordenación Territorial del Ámbito de Doñana; POTAD)**, which came into force in February 2004, and, subsequently the **Special Management Plan for the Irrigation Zones located in the North of the Doñana Forest Crown**, officially approved in December 2014 (hereinafter, Special Plan).

In recent years, WWF Spain has conducted several remote sensing monitoring studies within the region to detect new non-authorised irrigation areas. This has become a fundamental tool for alerting administrations about the continuous misuse of land and water in the Doñana area. Due to modifications in the delimitation of the areas considered to be subject to legalisation by the Special Plan (irrigable agricultural land), with a new cartography layer delivered in June 2018 by the Regional government, i.e. Junta de Andalucía, WWF Spain has updated the analysis of the information generated in past studies for the period 2015-2019 which covers the approval of the Special Plan up to the presentation of this document.

For this reason, WWF Spain has prepared this report to estimate how intensive crops grown in greenhouses or under plastic have evolved since the entry into force of the Special Plan. To this end, distribution maps of these crops have been developed within the scope of the Special Plan for the *2014-2015, 2017-2018, and 2018-2019 irrigation campaigns*. From the maps, WWF has determined **the evolution of the berry-cultivated areas** over recent years, as well as the **tendency of land** considered to be **in an irregular situation** by not meeting the legal land and water use criteria established in the Special Plan.

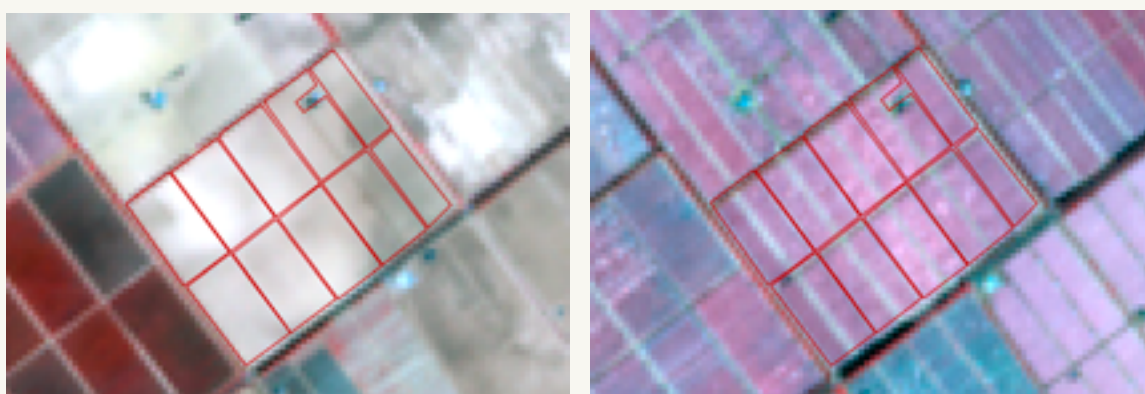
The data and maps generated in this study will be made available to the competent administrations so that they may take the appropriate action.

METHODOLOGY FOR DEVELOPING UPDATED IRRIGATED CROP MAPS

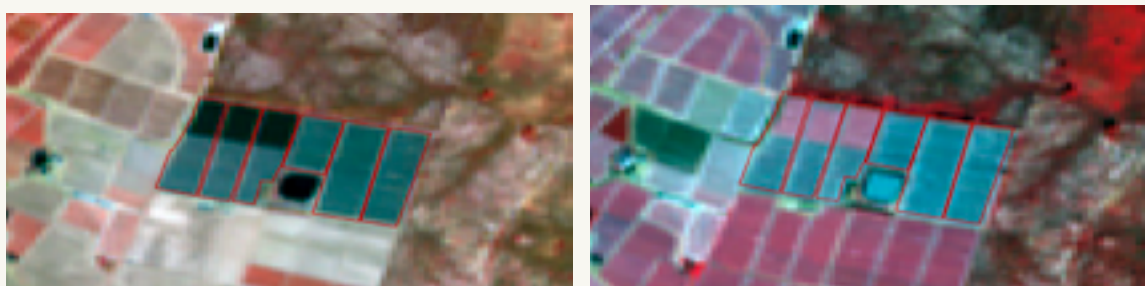
The method used for the detection and mapping of irrigated crops is based on the extraction of thematic information from satellite images and aerial orthophotos.

The spectral information recorded in the satellite images (see Figure 1) was used to detect areas occupied by crops grown under plastic, woody crops, and irrigated herbaceous crops, while the higher resolution spatial information from digital orthophotos was used to define the areas occupied by intensive red fruits crops at a more detailed geographical scale.

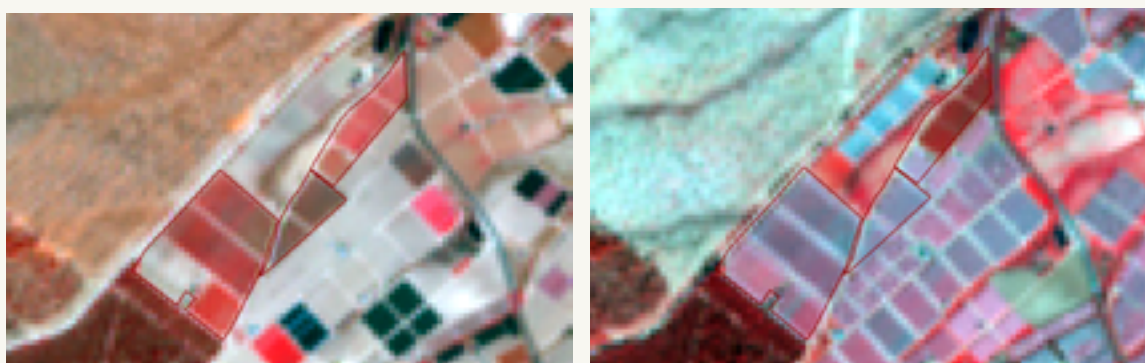
Figure 1. Examples of the spectral response of the most common berry crops in the study area.



Strawberry crops. Infrared images from summer 2017 (left) and winter 2018 (right)



Blueberry crops. Infrared images from summer 2017 (left) and winter 2018 (right)



Raspberry crops. Infrared images from summer 2017 (left) and winter 2018 (right)

As a result, WWF has produced maps of irrigated berry crops in greenhouses or under plastic in the 2014-2015, 2017-2018, and 2018-2019 campaigns. In addition, newly irrigated land in relation to previous campaigns has been identified for a wider range of years. These maps have been combined with official maps for a more detailed analysis of how non-authorized intensive berry crops have evolved following the approval of the Special Plan.

RESULTS

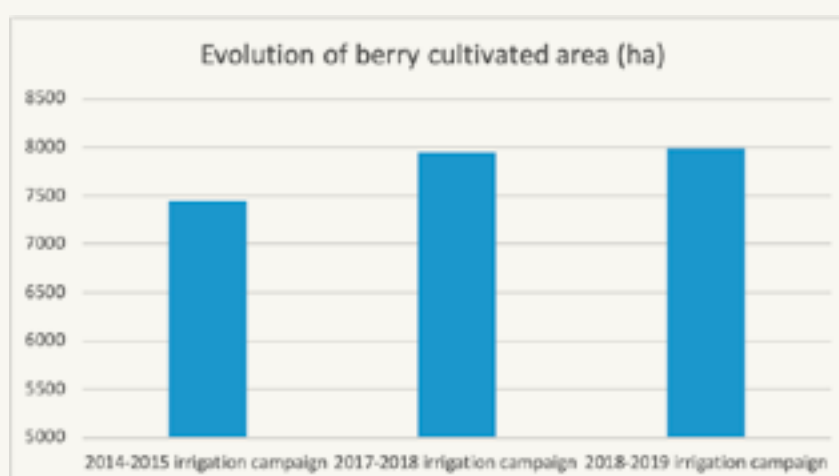
Quantification of berry cultivated area within the scope of the Special Plan

The **total irrigated area** within the territorial scope of the Special Plan during the campaigns analysed is shown in Table 1 and Figure 2, and a distinction is made between irrigated areas within the **Guadalquivir River Basin District** (Demarcación Hidrográfica del Guadalquivir; DHG) and the **Tinto, Odiel and Piedras River Basin District** (Demarcación Hidrográfica Tinto, Odiel y Piedras DHTOP).

Table 1. Evolution of the berry cultivated area since the entry into force of the Special Plan

Irrigation campaign	Berry-cultivated area (hectares) within the scope of the Special Plan:		
	In DHG	In DHTOP	TOTAL
2014-2015	5,490.6	1,951.7	7,442.3
2017-2018	5,773.0	2,173.7	7,946.7
2018-2019	5,792.9	2,201.9	7,994.8

Figure 2. Evolution of the surface area of red fruits cultivated under plastic within the scope of the Special Plan in the period 2014/2015 – 2018/2019.



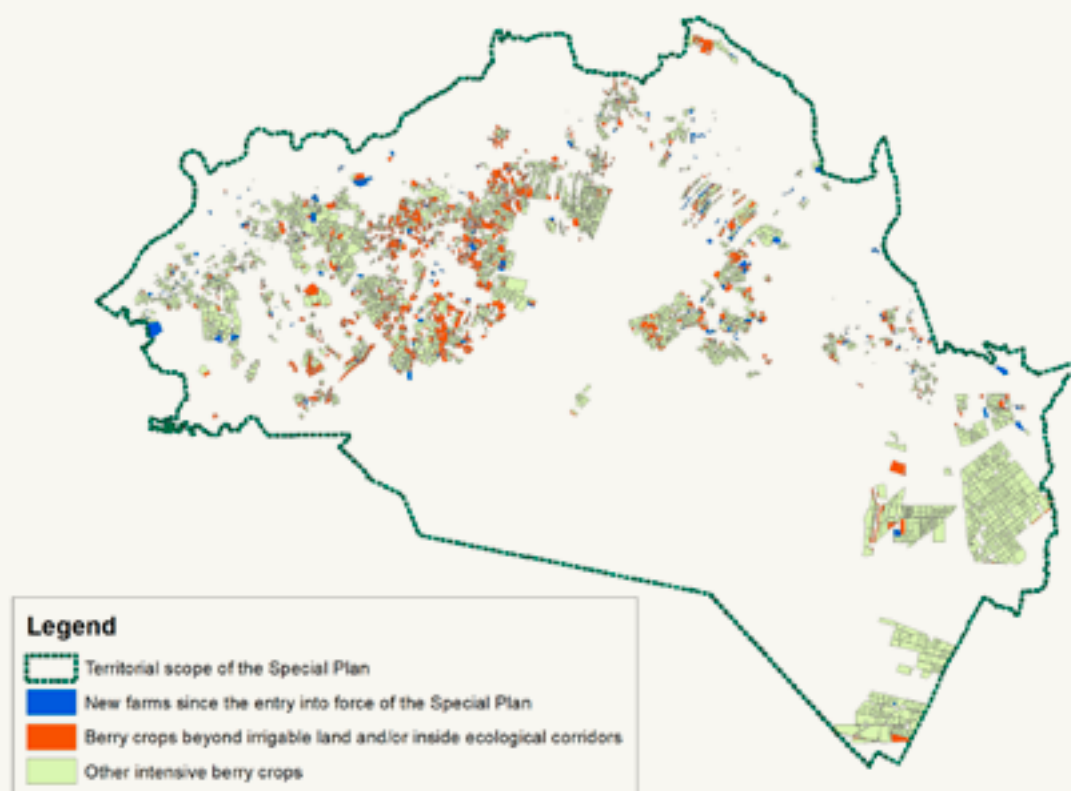
It should be noted that in the period 2015-2019 the area has increased by 552.5 hectares, of which 302.3 are in the Guadalquivir District, and 250.2 are in the Tinto-Odiel-Piedras District.

The **total irrigated area of berry crops per municipality** within the territorial scope of the Special Plan is shown in Table 2 for each of the campaigns analysed.

Table 2. Evolution by municipality of the surface area under intensive red fruits crops since the Special Plan came into force

Municipality	Surface area with red fruit crops (ha) in the scope of the Special Plan:			Increase in irrigated area of berry crops	
	2014-2015	2017-2018	2018-2019	Ha	%
Almonte	3,164.4	3,339.0	3,356.2	191.80	34.71%
Bonares	757.8	726.2	728.0	-29.80	-5.39%
Lucena del Puerto	1,462.4	1,517.2	1,515.4	53.00	9.59%
Moguer	1,785.1	1,975.3	2,002.1	217.00	39.28%
Rociana del Condado	272.6	373.0	377.1	104.50	18.91%
TOTAL	7,442.3	7,946.7	7,994.8		

Figure 3. Distribution of crops under plastic in the study area (2018/2019)



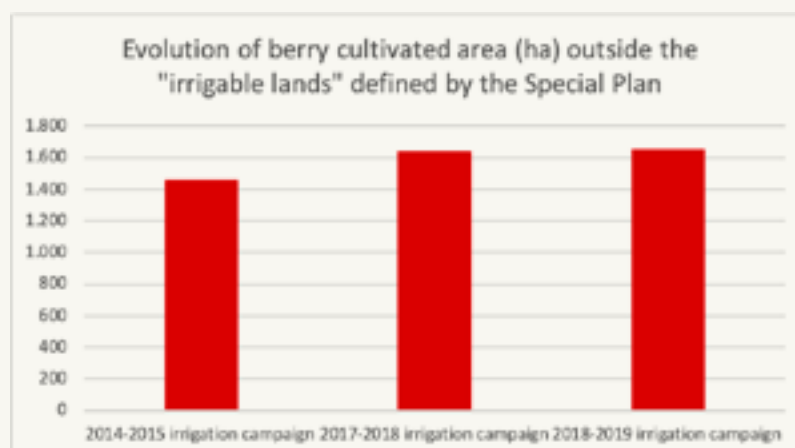
Berry production areas outside the irrigable agricultural land defined by the Special Plan

The Special Plan limits the possible legalisation of intensive irrigated crops to areas defined as “irrigable agricultural land”, for which the Junta de Andalucía recently generated an updated map, dated 20 June, 2018. The evolution of the land surface used for the intensive cultivation of crops grown either under plastic or in greenhouses beyond these designated “irrigated agricultural land” is shown in Table 3 and Figure 4.

Table 3. Evolution of berry cultivated area beyond the limits set on the official map of irrigable agricultural land (updated version of the irrigable agricultural land map, 20 June, 2018).

Irrigation campaign	Berry cultivated area (ha) beyond the designated irrigable agricultural land:			Percentage of berry production area beyond the irrigable agricultural land (TOTAL) in relation to the total cultivated area
	In DHG	In DHTOP	TOTAL	
2014-2015	1,079.0	382.3	1,461.3	19.6%
2017-2018	1,168.9	471.3	1,640.2	20.6%
2018-2019	1,170.6	482.4	1,653.0	20.7%

Figure 4. Evolution of berry crops (red fruits) beyond “irrigated agricultural land”.



On the date the Special Plan was approved, in December 2014, there were already 1,461.3 ha of irrigated surface area beyond the designated irrigable agricultural land. This has increased to the current figure of 1,653.0 ha, of which 1,170.6 correspond to the Guadalquivir River Basin District and 482.4 to the Tinto-Odiel-Piedras River Basin District.

This underlines the fact that approximately 20% of **the surface area of crops under plastic in the scope of the Special Plan is beyond the designated irrigable agricultural land.**

The method followed for defining intensive cultivation beyond the irrigable agricultural land is graphically shown in Figures 4 and 5.

Figure 5. Identification of berry production areas beyond the “irrigable agricultural land”, using PNOA aerial orthophotos (scale 1:5 000).

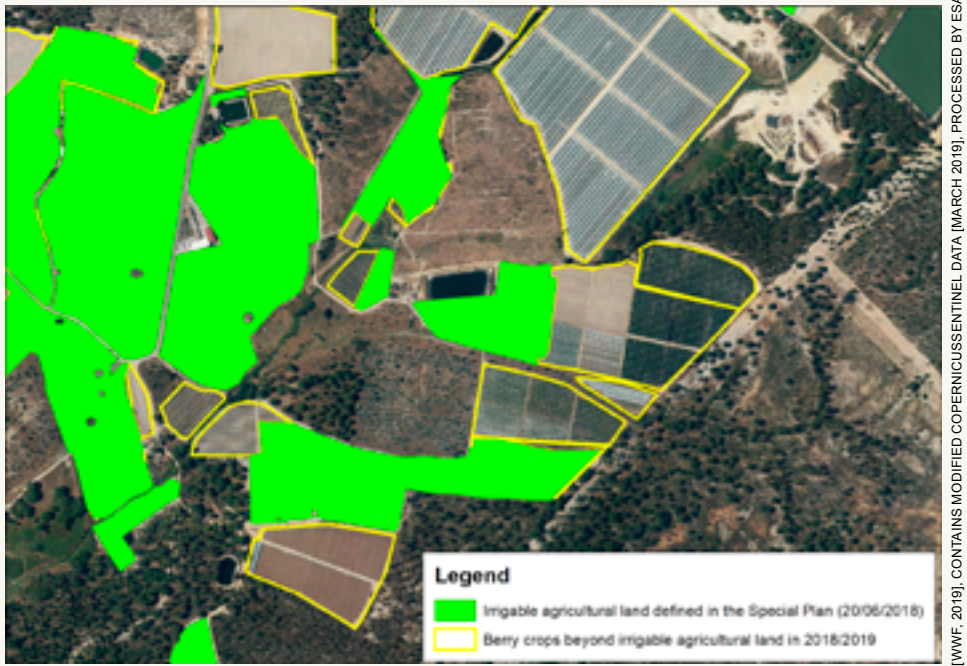
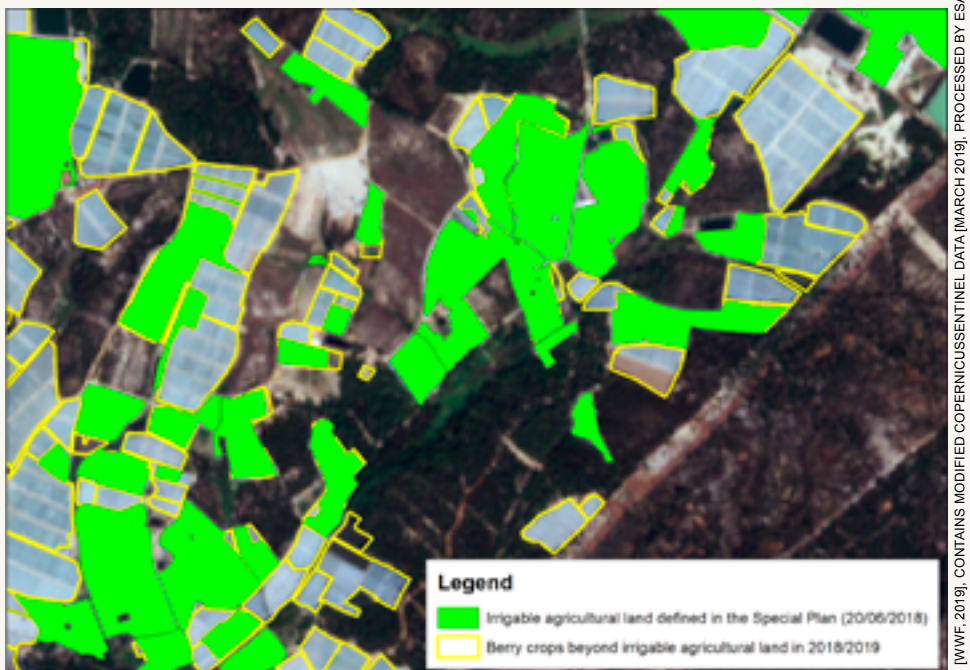


Figure 6. Identification of berry production areas beyond the “irrigable agricultural land”, using an image from the Sentinel satellite, March 2019 (scale 1:10 000).



The total irrigated surface area under red fruits crops beyond the irrigable agricultural land is shown in Table 4 by municipality for each of the campaigns analysed.

Table 4. Evolution by municipality of berry cultivated area beyond the official limits defined on the irrigated agricultural land map (20 June, 2018)

Municipality	Surface area under red fruits crops (ha) beyond the designated irrigable agricultural land:		
	2014-2015	2017-2018	2018-2019
Almonte	281.6	342.5	340.7
Bonares	148.5	119.9	123.0
Lucena del Puerto	627.0	674.7	675.0
Moguer	304.4	365.0	373.8
Rociana del Condado	99.8	133.1	135.5
TOTAL	1,461.3	1,640.2	1,653.0

The Special Plan updates the designation of what is known as Zone A, or area of special protection for natural resources, according to Article 45 of the POTAD, which includes land that is protected or that have a forest use, and which is not compatible with intensive agricultural activity. Table 5 shows the **total irrigated surface area of red fruits beyond the irrigable agricultural land and within Zone A**, detailed by municipality for each of the campaigns analysed.

Table 5. Evolution by municipality of the surface area under intensive red fruits cultivation beyond the official limits on the map of irrigated agricultural land (20 June, 2018) and within Zone A.

Municipality	Surface area under red fruits crops (ha) beyond the designated irrigable agricultural land and within Zone A:		
	2014-2015	2017-2018	2018-2019
Almonte	16.8	22.2	26.5
Bonares	64.9	26.8	26.7
Lucena del Puerto	134.0	136.1	133.5
Moguer	169.2	183.6	184.6
Rociana del Condado	4.7	7.0	7.3
TOTAL	389.4	377.7	380.6

The geographical scope of the Special Plan includes areas classified as Public Forests. Table 6 includes the data on the **irrigated surface area under red fruits beyond the designated irrigable agricultural land and within public forests**, detailed by municipality for each of the campaigns analysed.

Table 6. Evolution by municipality of the surface area under intensive red fruits crops beyond the official limits on the irrigated agricultural land map (20 June 2018) and within public forests.

Municipality	Surface area under red fruits crops (ha) beyond the designated irrigable agricultural land and within public forests:		
	2014-2015	2017-2018	2018-2019
Almonte	174.1	210.4	206.2
Bonares	16.5	16.7	16.7
Lucena del Puerto	598.1	621.9	622.5
Moguer	134.4	141.2	143.7
Rociana del Condado	0.3	0.2	0.2
TOTAL	923.4	991.4	990.7

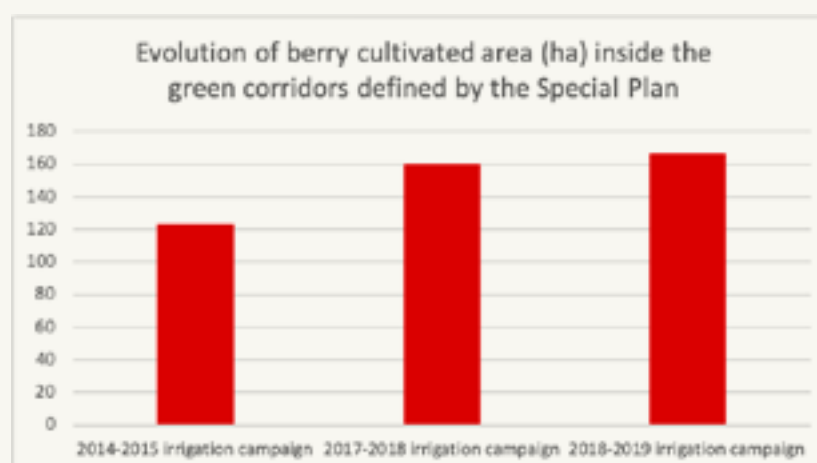
Surface area in ecological corridors

On the other hand, the Special Plan defines a set of ecological corridors within which infrastructure for intensive agricultural uses (wells, ponds, warehouses, iron infrastructures for greenhouses, etc.) are not permitted. Table 7 and Figure 7 show the evolution of the intensively cultivated area under plastic located within ecological corridors and which should be eliminated.

Table 7. Evolution of the surface area under intensive red fruits cultivation within ecological corridors

Irrigation campaign	Surface area under red fruits crops (ha) within ecological corridors:		
	In DHG	In DHTOP	TOTAL
2014-2015	60.9	62.2	123.1
2017-2018	77.3	83.3	160.6
2018-2019	80.7	85.6	166.3

Figure 7. Evolution of the surface area with red fruits crops in the scope of the Special Plan within ecological corridors.

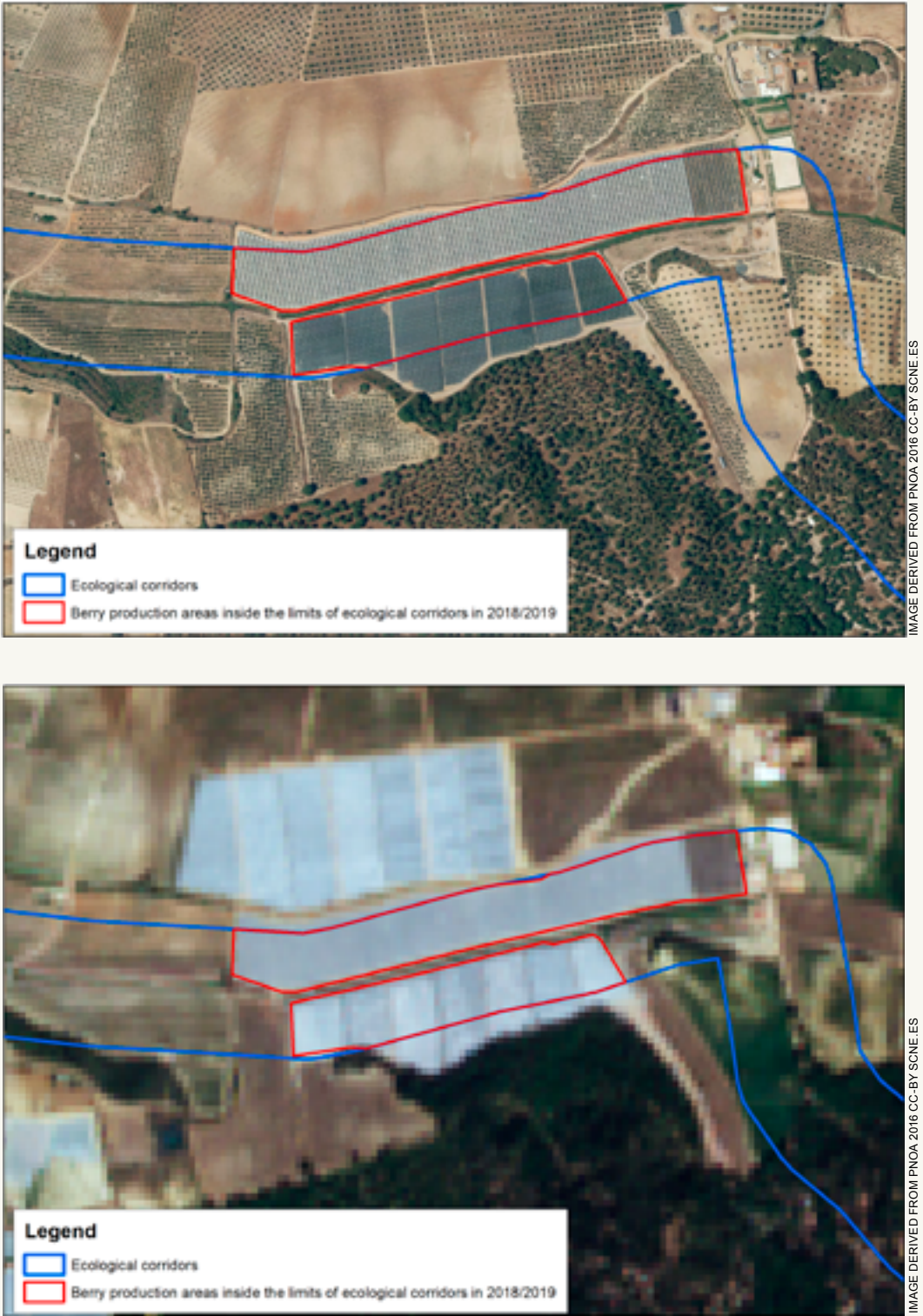


After analysing the surface area of ecological corridors, it appears that there are currently 166.3 ha of crops under plastic within the area designated for these connectivity elements, 80.7 ha in the Guadalquivir River Basin District and 85.6 ha in the Tinto-Odiel-Piedras River Basin District.

In relation to this information, it must be stressed that a large part of the area occupied by berry crops grown under plastic within ecological corridors is located within irrigable agricultural land. These are, therefore, plots on which irrigation is permitted but greenhouses, wells, and similar structures are not allowed, because these are not compatible with the protective function of ecological corridors.

The method followed for defining intensive cultivation beyond the irrigable agricultural land is shown graphically in Figure 8.

Figure 8. Identification of surface area under red fruits crops within ecological corridors, using PNOA orthophotos (top image) and an image from the Sentinel satellite (bottom image). Scale 1:5 000.



CONCLUSIONS AND DATA SUMMARY

In the scope of the Doñana Special Forest Crown Plan, according to the analysis carried out by WWF in 2019, the following figures have been obtained:

- > there is a surface area of **7,994.8 hectares of crops grown under plastic, of which:**
- > a total of **1,653 hectares corresponds to irrigated land beyond that deemed “irrigable agricultural land”**, which cannot therefore be legalised. That surface area represents **20.7% of the crops under plastic** in the area. Of these:
 - **There are 380.6 hectares of crops outside irrigable agricultural land in Zone A, an area for the special protection of natural resources.**
 - **There are 990.7 hectares of crops beyond the limits of irrigable agricultural land in areas listed as public forests.**
 - **166.3 hectares are situated within ecological corridors.**

Additionally, after analysing the expansion of irrigated land, it should be noted that **in the period 2015-2019 the berry cultivated area has increased by 552.5 hectares, of which 302.3 are in the Guadalquivir River Basin District and 250.2 are in the Tinto-Odiel-Piedras River Basin District.**

REQUESTS

The critical situation in Doñana has provoked, among other things, the initiation of an infringement procedure by the European Commission, action by the Environmental Prosecutor's Office, and monitoring by international organisations like Ramsar-IUCN-UNESCO, as well as the stance taken by the major European supermarkets regarding responsible purchasing. In this context we have to add the data provided in this document.

For this reason, WWF requests that the Junta de Andalucía:

1. Implements all the criteria included in the Special Forest Crown Plan and complies with the regulations established in that document.
2. Provides legal security to the farmers considered within the criteria for legalisation set out in the Special Plan, and who do not yet have it, to guarantee their activity in the long term.
3. Eliminate the irrigated area beyond the limits of the irrigable agricultural land and create ecological corridors.
4. Call periodic meetings of the Commission for Monitoring the Special Forest Crown Plan, to coordinate actions with other administrations, including the Guadalquivir River Basin District and local councils.

In addition, WWF requests that the competent administrations (water districts, etc.), city councils, farmers, and agrarian associations:

5. Comply with the Special Plan and report any new expansions that pose a risk to the sector and the image of farming in Doñana.

WWF would like to point out that the success of the Special Plan depends on the involvement of all sectors.

Note: The results and maps prepared for this report will be brought to the attention of the various administrations and authorities so that they may take the appropriate action.