LIFE
Eikenprocessierups

Why did Calosoma sycophanta disappear in the 1950's?

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1. Historic and current situation of *Calosoma sycophanta*

The *Calosoma sycophanta* beetle (Linné, 1758) is an indigenous species for Europe (Weber, 1801). In the last century however, its numbers have decreased drastically in Central and Western Europe (Trautner, et al., 2014; Desender, et al., 2008; Turin, et al., 2000; Nederlands Soortenregister, 2014; Lepri & Mériguet, 2018; Görn, 2019)

In **Belgium**, for example, records reveal a vast decline of *C. sycophanta* from before the 1950s up to 2007, with the species being found in 63 UTM5 kilometre squares before 1950, in 3 UTM squares between 1950 and 1980, and in only 1 UTM square from 1980 until 2007. These numbers contrast with the higher amount of sampling actions by means of pitfall traps during the period of 1980-2007 (Desender, et al., 2008). Based on these findings and the IUCN criteria, *C. sycophanta* is classified as 'critically endangered' on the Red List of Flanders, updated in 2008 (INBO - Instituut voor Natuur en Bosonderzoek, 2008).

In **The Netherlands**, *C. sycophanta* occurred mostly in the south. Records show that the species was frequently found until 1923, with occasional records until just before the start of the Second World War in 1940. The species is currently considered extinct in the Netherlands, because it hasn't been observed since 1940 (Turin, et al., 2000; Nederlands Soortenregister, 2014).

The same trend can be seen in **Germany**. At the beginning of the 20th century *C. sycophanta* was considered a common species. With the exception of large parts of Bayern, the beetle occurred across Germany (Trautner, et al., 2014). Nowadays, five regions in Germany list *C. sycophanta* as critically endangered: Brandenburg, Niedersachsen and Bremen, Mecklenburg-Vorpommern and Sachsen (Hille & Kehl, 1999; Assmann, et al., 2003; Müller-Motzfeld & Schmidt, 2008; Gebert, 2008). The Bayern region was recently able to update the listing for the species from 'critically endangered' to 'endangered' due to a very recent increase in the population (Lorenz & Fritze, 2020). Two additional regions list the beetle as endangered: Hessen and Baden-Württemberg (Malten, 1997; Trautner, et al., 2005). One region lists *C. sycophanta* as vulnerable: Rheinland-Pfalz (Schüle & Persohn, 2000). Five German regions consider the species as extinct: Schleswig-Holstein, Nordrhein-Westfalen, Thüringen, Sachsen-Anhalt and Berlin (Gürlich, et al., 2011; Hannig & Kaiser, 2011; Hartmann, 2011; Schnitter & Frank, 2014; Kielhorn, 2005). In Baden-Württemberg, a state in southwest Germany, *C. sycophanta* is apparently present throughout the state.

In **France**, *C. sycophanta* populations are mostly concentrated in the south near the Mediterranean (Fig. 1). Of the total amount of 141 observations in France until 2017, only a few came from the northern part of the country, Île-de-France. Since 1995, it took about 20 years before another sighting of living individuals in this area (Lepri & Mériguet, 2018). With five observations of at least one individual between 2016 and 2017, the presence of populations of *C. sycophanta* in Île-de-France is now confirmed. Two observations also reported the proximity of the oak processionary caterpillar (Lepri & Mériguet, 2018).

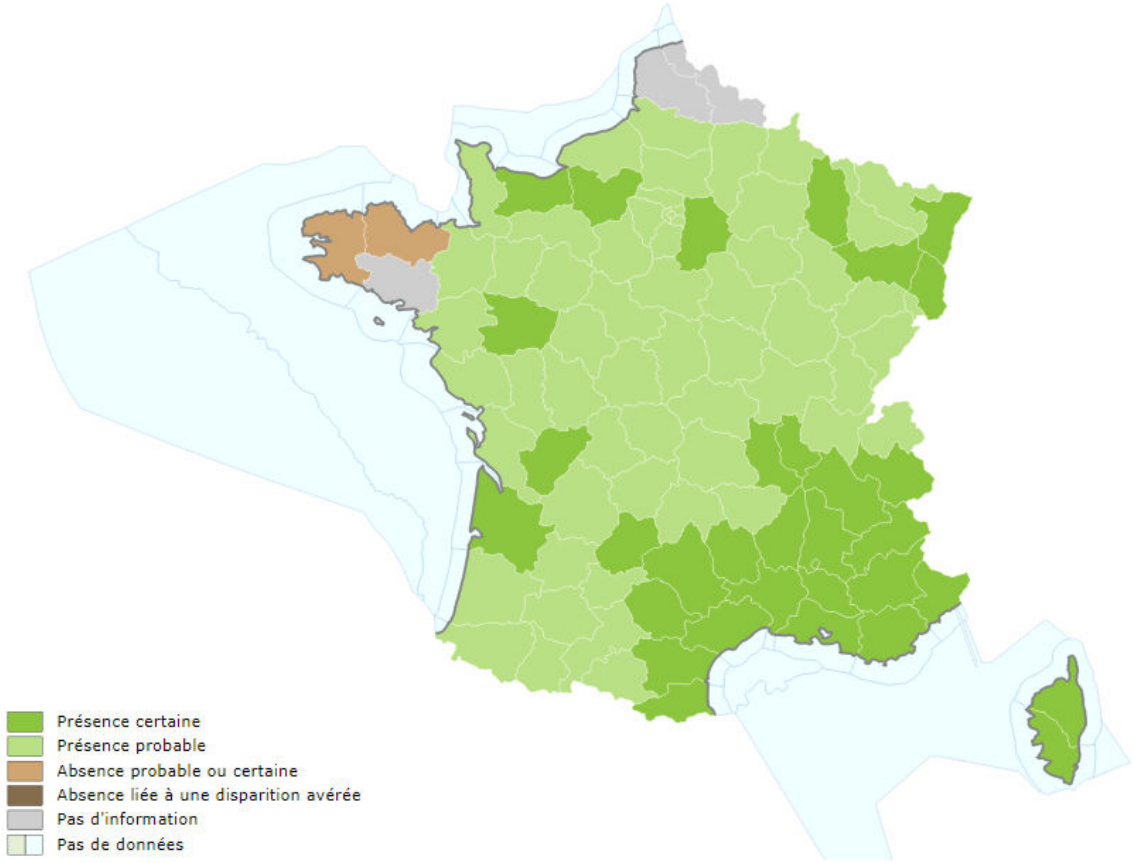

Fig. 1. Current distribution of *Calosoma sycophanta* in France. Drawn up based on the research of Maguerre (2016). The map was updated on 22/11/2019 by HORELLOU, Arnaud (INPN - Inventaire National du Patrimoine Naturel, 2020).

While *C. sycophanta* is extinct or endangered in large parts of Western and Central Europe, the species can still be found quite frequently in **Southern Europe** (Görn, 2019) (Fig. 2).

This might be related to the increase in populations of the pine processionary moth (*Thaumetopoea pityocampa*) in this region in Europe. In some countries, for instance in Bulgaria, *T. pityocampa* is rapidly expanding its range into new areas. Between 1951-1972, on average 5163 ha of pine trees were attacked, whereas between 1973 and 2017 the average attacked area was 22929 ha. One of the main reasons why pine processionary moths can expand their range, is climate change (Mirchev *et al*, 2017). The increase in the pine processionary moth in Bulgaria seems to concur with a boost in *C. sycophanta* populations.

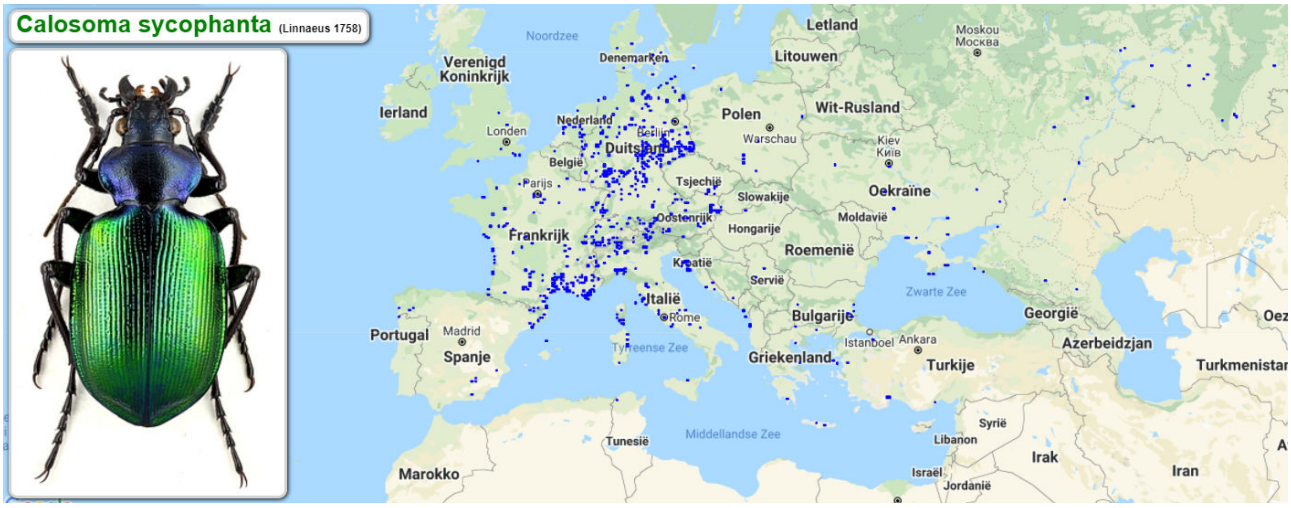

Fig. 2: *Observations of Calosoma sycophanta in Europe (www.coleoweb.de, 2021-05-05).*

2. Causes of the decline of *Calosoma sycophanta* populations

With the dramatic decline of *C. sycophanta* populations, Central and Western Europe are losing a key pest regulator. This loss can be attributed to the vast use of pesticides, combined with the lack of correct management of forest edges and the decrease of open forests, causing habitat loss (Trautner, 1996).

Pesticides, like DDT, were optimised during World War 2 and very effective to eradicate pests (lice, bedbugs, mosquitoes, …) among the soldiers. After wartime, DDT made its entrance in the agricultural sector because it has the ability to kill all insects present with a small quantity of product. Therefore, farmers only had to use one product to protect their crops (Flint et al., 1981).

Firstly, the use of DDT may have directly killed the adult beetles by poisoning. An example of the direct impact of pesticide usage can be seen in an oak forest at the Spanish Costa Brava, where in 1974 a total amount of 6,976 poisoned specimens of *C. sycophanta* were collected shortly after DDT treatment. Since this sampling happened within a short time span, it clearly illustrates the terrible damage insecticide treatments can have on beetle populations (Görn, 2019)

Secondly, the use of DDT contributed to a decline in the food source for *C. sycophanta* in the early 1900s. This decrease caused a shortage of food for the larvae and adult beetles such that they couldn't maintain a healthy population. Many adults probably starved directly by lack of food. Moreover, a poverty of food (protein) can also negatively affect the oviposition of females (Spieles & David, 1998). A reduction in survival rate of adults and limited offspring may have contributed to the extinction of *C. sycophanta* in certain regions.

In Belgium, habitat loss, in combination with the use of pesticides, most likely resulted first in the isolation of *C. sycophanta* populations and subsequently in their disappearance.
The distribution of OPC in Belgium and the Netherlands is confined to rows of trees, hedgerows and forest edges. Consequently, this is the habitat where we find *C. sycophanta* in our regions. This is opposed to southern and central Europe, where the OPC often occurs more deeply in the woods, and therefore has a better chance to survive.

3. Expected developments of the reintroduction

When *C. sycophanta* will be reintroduced in Belgium, there are no guarantees for success. However, one of the reasons why the species probably won't get extinct again, is that *C. sycophanta* is known to show local boosts in abundance in case of pest caterpillar outbreaks (Freude, et al., 1965). This is currently the case in The Netherlands and Belgium, where populations of oak processionary moths are booming. Expectations are that *C. sycophanta* can survive with the current amounts of oak processionary caterpillars (OPM). OPM has more or less the same habitat preferences as *C. sycophanta*, and therefore *C. sycophanta* could potentially flourish in some regions (Müller, 2018).

Burmeister (1939) described the beneficial appearance of *C. sycophanta* as follows: 'In years of high caterpillar occurrence it appears massively and spreads over vast distances by flight. It comes in flocks into the gardens of the cities, where it successfully supports the destruction of the tree pests.'

During the LIFE-project, the beetles will be released in habitats suitable for their survival. That is why we first wish to develop a habitat model, which will help us to identify, find and select suitable locations for *C. sycophanta*. The habitat model is a GIS exercise, which makes use of the most recent habitat map of Flanders. On the basis of the habitat requirements that we know for beetle populations from neighbouring countries (Germany/France), the Research Institute for Nature and Forest (INBO) will draw up a habitat model for *C. sycophanta*, which will also be verified in the field. This model can be used to select the most promising locations for reintroduction.

The reintroduction starts with a low number of *C. sycophanta* beetles. This number can be increased according to the effects on their environment. It is a very mobile species on the ground and in the air. The adult beetles can disperse over six kilometres a year (Schaefer et al., 1999). On the ground there's a difference in land use between sexes. The female lives more hidden, sometimes under the cover of leaves at the bottom of trees where she lays her eggs. Male beetles can often be seen at the tree trunk or even higher up when searching for food and other females.

After releasing the beetles, they will be monitored very closely. In the first instance by visual observations, but some of the individuals will also be equipped with a radio-telemetry transmitter. The movement of these adults can be mapped very precisely and can provide important information on the lifestyle and behaviour of adult *C. sycophanta* beetles.

Previously, *C. sycophanta* has been introduced to control gypsy moth outbreaks in North-America. In the years after introduction, researchers concluded that there was a predation degree of 40% of all pupal gypsy moths (Weseloh, 1985). This predation rate was only reached when each female beetle had 30 offspring in the area. This research concludes that the introduction of a low number of beetles could have substantial impact on pest species like gypsy moths.

As conclusion, we are convinced that it's possible for *C. sycophanta* to survive and thrive in certain areas in Belgium and the Netherlands. Hopefully this will result in a substantial reduction of oak processionary caterpillar populations.

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