

R4.1. DataScEd4CiEn STEAM Scenario Template

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Introduction

Title

Insects in Danger: How Can We Help Them?

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Summary of the scenario

This lesson plan addresses insect decline. First, students will explore the functions and characteristics of insects and why they are so important to humans and nature. Next, they will learn that scientists have discovered that insect populations have been declining over time. Using data, students will examine which insect species are most at risk of extinction and the primary causes of insect decline.

To actively work on a solution themselves, the students will finally research which plants and flowers are particularly beneficial for the insects' habitat. They will then design an insect-friendly school garden and plant five of the best plants themselves in the next class.

In addition, during the final lesson of the unit, a simplified "insect hotel" is built to serve as a nesting aid for insects.

Age of the students

This lesson series is designed for fourth-grade students. Students should be able to read and understand continuous text well. It would be helpful if students already had some basic knowledge of insects and plants from their everyday lives. In general, we assume that students will be highly interested in and enthusiastic about the topic, as insects are often fascinating to children.

‘Data Science Content in STEAM for Civic Engagement and Social Justice from the Early Years’

Subjects and topics

The lesson unit has a science focus. Insect decline is a biological phenomenon that, however, has significant impacts on many other areas. Studies show that the sharp decline in insect populations has many negative effects on humans, animals, and the environment. Increasing urbanization and fewer areas for species-rich wild meadows are further driving insect decline, making it a relevant societal problem.

Using data on insect species, students will analyze how insect populations have declined over the past 10 years and identify the causes of insect decline. To do this, they must interpret and understand charts and relate the data to real-world issues.

By examining the data and the prevailing causes of insect decline, students move closer to addressing the problem. To this end, they are then asked to gather ideas and hypotheses on how to create a supportive habitat for insects. Civic engagement is fostered as students subsequently research which plants and flowers would be particularly suitable for this purpose and then actually plant them in the school garden. Creative and artistic processes are encouraged as students design their ideal school garden and then discuss their ideas with the entire class.

Through a holistic engagement with the topic and a focus on gathering potential solutions, the transdisciplinary STEAM approach makes a significant contribution to solving the problem.

Real-life questions

Overarching question:

Why are insects important for our environment, and what can we do to protect them?

Sub-questions:

Why do humans, animals, and plants need insects? What do charts tell us about insect decline?

What factors have the greatest impact on insect decline? How can we help insects in our environment?

What might concrete measures to protect insects look like?

Objectives for the scenario

Lesson 1:

Students draw on their prior knowledge by describing which insect species they recognize in their environment.

Students make predictions about the importance of insects for the environment.
Students work in groups to explore various aspects of the importance of insects for plants, animals, and humans.
Students can explain what they have learned to their classmates.

Lesson 2:

Using a diagram, students identify which insect species are particularly threatened with extinction.

Students answer questions about data on insect decline by analyzing the bar chart at different levels of data analysis (Reading the data, Reading between the data, Reading beyond the data).

Lesson 3:

Students understand the relationship between percentages and the length of the bars in charts by correctly reassembling a bar chart on insect decline.

Students explain which causes contribute most significantly to insect decline by analyzing a bar chart.

Lesson 4:

Students learn about designing an insect-friendly school garden. The class agrees on which 5 flower/plant species should be planted in their own school garden.

Lesson 5, Grade 6:

The students implement real-world measures for insect conservation by planting the school garden and building an insect hotel.

Skills and competencies

Math:

The students...

...compare and classify quantities (including data sets, lengths, weights) (Math curriculum "Concept of Quantities and Working with Quantities") —> Lesson 2: Task on "Reading (between/beyond) the Data"

...extract data from calendars, diagrams, and tables and interpret it to answer math-related and consumer-relevant questions (Math Curriculum "Data and Frequencies") —> Lesson 2: Activity on Reading (between/beyond) the Data

...interpret representations of data [...] (Math educational standards "Working with Data") —> Lesson 2: Assignment on Reading (between/beyond) the Data

Social Studies:

The students...

...explain human impacts on the habitats of animals and plants and

...evaluate the importance of nature conservation and environmental protection for preserving the living conditions of animals

(Curriculum for General Studies "Animals, Plants, Habitats")

—> Lesson 2: Starting with "What role do insects play in our environment?"

... describe principles of sustainable use of spaces (Curriculum for General Studies: "Using and Protecting Spaces") —> not in connection with a specific activity, but rather in general, by designing an insect-friendly space

... develop possible courses of action for using and protecting spaces (Social Studies curriculum “Using and Protecting Spaces”) —> Lesson 5 C 6 during the independent design of the school garden and construction of an insect hotel

Art:

The students...

... bring individual visual ideas to life in a thematic manner through the use of drawing and printmaking techniques and methods. (Art curriculum “Drawing and Printing”) —> Lesson 4: Design an insect-friendly garden and depict it appropriately on a poster

... experiment with different materials, tools (scissors, saw, pliers), material processing, and material connections while sculpting and assembling, and evaluate the relationships between technical procedures, suitability (stability), and effects (including in relation to space) (Art Curriculum “Drawing and Printing”) —> Lesson 6: Build an insect hotel

Teaching approaches and learning strategies/theories

Introductory inquiry-based learning:

- Insect decline as a real-world problem that can be approached transdisciplinarily and sparks students’ interest because the topic relates to everyday life.
- Students interpret real data and can use it to answer the following (research) questions, for example: Which insect species are becoming extinct? What are the reasons for insect decline? What solutions can be implemented in one’s own daily life to protect insects?

Problem-based learning:

- Insect decline as a real-world problem
- Developing possible solutions to address the problem
- Research and discussion of solutions

Project-based learning:

- School garden and insect hotel to put the knowledge gained (answers to the (research) questions) into practice
- Technological and other tools for (online) research on suitable materials (plants and flowers)

Collaborative learning:

- Group work, group puzzles, Think-Pair-Share
- Group activity to agree on suitable plants for the school garden

Learning through design/design thinking

- Designing one’s own school garden and insect hotel

Critical thinking:

- Reading beyond the data: Formulating assumptions and hypotheses

Problem-solving skills:

- Jointly planning the school garden and insect hotel
- thereby contributing to solving the problem of insect decline

Collaborative learning:

- Group work, group puzzles, think-pair-share
- Group activity to agree on suitable plants for the school garden

Ethics and a sense of responsibility:

- Raise awareness of the problem of insect decline, particularly by learning about its serious impacts on humans and the environment

Invention, Ingenuity, Imagination:

- Designing the school garden insect hotels

Communication skills:

- Group puzzle,
- Explaining what they have learned to other students
- Verbalizing processes

Equity, Diversity, and Inclusion:

- Natural differentiation through group puzzles, appropriate task distribution for planting and building the insect hotel

Educational Scenario planification

Lesson plan

	Lesson Description	Description of the activity	Material	Social form	Time
Lesson 1	Introduction to the topic Transition:	Questions for students: What insects do you know? Where do you see them? Which insects do you see often/rarely? Teacher: "Do you have any idea why insects are important?"		Whole-group discussion	5 min

	Question: Why are insects important?	The students first work on a group puzzle about the importance of insects as... ...food source	4 informational texts (Annex 1), worksheet "What role do	Group discussion	35 min
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		...pest controllers ...pollinators ...soil improvers/decomposers → Students develop reasons why insects are important for nature, animals and humans	insects play in our environment?" (Annex 2)		
	Reflection	Reflection with reflections pebbles: Reflection prompts: What I learned today; What I'd still like to know.; That surprised me.	Pebbles, Reflection prompts (Annex 3)	Whole-group discussion	5 min
Lesson 2	Topic: Insect Decline	Introduction tying in with the previous lesson (why insects are important) Watch a video on insect decline → social problems becomes clear	Video on insect decline (until 02:16)	Plenary	5 min

Question: Which insect species are going extinct?	Statistical activity: Data on insect species that are becoming extinct Read the data: (Annex 1) Students work on the worksheet about insect species by looking at the bar chart and answering the questions on the worksheet. Reading the Data: By what percentage has the total number of butterflies decreased over the last 10 years?; By what percentage has the total number of insects decreased over the last 10 years? Reading between the Data: Which insect species experienced the greatest decline?; By what percentage is the	Work sheet in “Insects Danger” (Annex 4)	Individual work	30 min
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Lesson 3		decline in beetles greater than the decline in mayflies? Reading beyond the Data: Make some guesses as to why there are 53% fewer butterflies than there were 10 years ago. → Individual work			
		Students compare their results with their neighbors.		Work in pairs	
	Reflection	Reflection with pebbles: Reflection prompts: What I learned today; What I'd still like to know.; That surprised me.	Pebbles, Reflection prompts (Annex 3)	Whole-group discussion	10 min
	Introduction	Activate prior knowledge: The students speculate on why the insects are going extinct.		Whole-group discussion	5 min
	Working phase: Reasons for Insect decline	Graph on reasons for insect extinction (Annex 2): Matching the percentages to the bars Speculating on the reasons for insect decline	Blank bars + cards with percentages + cards for potential reasons (Annex 5)	Work in pairs	15 min
	Review	Compare the hypotheses → show the correct matching	Solution to the exercise "Reasons for insect decline" (Annex 5)	Whole-group discussion	15 min
	Reflection	What can we learn from the bar chart? Reflection with pebbles: Reflection prompts: What I learned today; What I'd still like to know.; That surprised me.	Reflection cards (Annex 3)	Plenary	10 min

Lesson 4	Developing ideas to improve the living conditions of the insects	First, the students brainstorm by themselves about how to maintain insect diversity. Then they	Pens, colored cardboard strips	Think-Pair-Share	25 min
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		discuss their ideas in pairs and write them down on strips of cardboard. Finally, the ideas are presented to the whole class and posted on the board.			
	Working phase: Research on insect-friendly flowers and plant species	Research which flower species are good for insects (online on the iPad and using additional books/sources) e.g. https://www.nabu.de/umwelt-und-ressourcen/oekologisch-leben/balkon-und-garten/tiere/insekten/22629.html → Create a poster featuring your insect-friendly garden	Posters, iPads		45 min
	Collection of possible flowers & plants	As a class, agree on five flowers/plants which you want to plant in the school garden.			20 min
Lesson 5	Activity: Flowers and plants are being planted in the school garden	Students plant the chosen flowers and plants in the school garden.	Chosen flowers and plants	Gruppenarbeit, im Schulgarten	45 min
Lesson 6	Activity: Construction of an insect hotel	Students build an insect hotel using a template (e.g., from NABU (Annex 3))	Instructions on how to build an insect hotel (Annex 5)		90 min

References:

<https://nationalgeographic.de/tiere/2020/06/5-wichtige-aufgaben-von-insekten-und-was-in-einer-welt-ohne-sie-passieren-koennte/>

<https://www.dw.com/de/wie-können-wir-eine-insekten-apokalypse-vermeiden/a-50384558>

<https://www.dw.com/de/wie-können-wir-eine-insekten-apokalypse-vermeiden/a-50384558>

<https://de.statista.com/infografik/21750/hauptursachen-fuer-das-weltweite-insekten-sterben/>

<https://www.youtube.com/watch?v=L9ddltHGepk>

https://www.youtube.com/watch?v=Y3Db_1hZ1aQ (Video on insect decline)

Timing

Science: The overarching theme of our lesson series is insect extinction and its underlying causes. The scientific aspect is therefore addressed in all six lesson units (6 lesson units)

Technology G Engineering: 6th lesson: Planning and building an insect hotel

Art: 4th period: Creative design of selected posters; 6th period: Building an insect hotel

Math: Periods 2 and 3: Analyzing and interpreting selected data sets in the form of diagrams

Assessment

At the end of many units, reflection takes place using the “steinechenreflexion” method, in which each child has the opportunity to reflect on the newly acquired knowledge. In addition, learning outcomes are often recorded on worksheets and thus reinforced. This serves as a means of assessing learning objectives.

Annex

Annex 1

Pollination

Insects such as bees, butterflies, flies, wasps, and beetles play a very important role in nature. They ensure that plants are pollinated. Pollination means that pollen is transferred from one flower to another. This happens when insects fly to flowers to collect nectar and pollen as food.

Pollination allows plants to produce seeds and fruits. About 90 percent of all flowering plants in the world depend on it. In tropical regions, the number is even higher more plants. Without insects, many plants would be unable to reproduce and would eventually disappear.

Pollination is also very important for us humans. About a third of our food exists only because insects pollinate plants. This includes many types of fruits and vegetables, as well as grains. Other animals, such as birds and bats, sometimes help with pollination, but insects do the lion's share of this work.



In addition, pollinated plants create habitats for many animals. Meadows, hedges, and trees provide shelter, food, and space to grow. Many birds feed on seeds, nuts, or fruits that would not exist without insects. That is why insects are crucial for the diversity of plants and animals on Earth.

Pest control

Insects are important regulators in nature. This means they help maintain the balance between different animal species. They play a particularly important role in agriculture and forestry because they eat harmful insects and prevent them from multiplying rapidly.

Many insects are considered beneficial. These include, for example, ladybugs, lacewings, parasitic wasps, and earwigs. These animals feed on so-called pest insects such as aphids, mites, or beetles that can damage plants. A lacewing larva can eat several hundred aphids during its development. Ladybugs and their larvae are also very effective, as they devour many pests every day.



The use of such beneficial organisms reduces the need for chemical pesticides. This protects the environment and other living creatures. However, many beneficial organisms are themselves threatened by pesticides and habitat loss.

Today, some native beneficial insects are specifically bred and deployed. In greenhouses, for example, parasitic wasps help control whiteflies that damage vegetable plants. Certain wasp species are also used in grain storage to combat pests. In this way, insects demonstrate how important they are for sustainable agriculture.

Food Source

Insects play a very important role in nature. They are a vital part of the food chain and serve as food for many animals. These include, for example, birds, bats, amphibians such as frogs, reptiles, and fish. Some mammals, such as hedgehogs and shrews, also eat insects. Even other insects feed on them.

In a food chain, one organism eats another in order to survive. Insects often occupy the bottom of the food chain. When there are fewer insects, many animals lose an important food source. This can lead to these animals reproducing less successfully or becoming increasingly rare.

A shortage of insects can also explain the decline of bird species, since many birds depend on insects. That is why insects are a vital component of the balance in nature and for the coexistence of many different animal species.



Soil improvers

Insects play a vital role in soil health and waste decomposition. They break down organic material such as dead plants, animal droppings, and dead animals. This process releases nutrients that plants need to grow. Without this activity, nutrients in the soil would become



available again only very slowly.

Many insects also improve the soil through their

behavior. Ants dig tunnels and burrows, which loosens the soil and mixes it with organic material. In hot and dry areas, termites can loosen hardened soil and enrich it with nutrients. In this way, even infertile

soil can become usable farmland within a year. Some insects eat waste directly. Dung beetles break down animal droppings and make the nutrients they



contain available to the ecosystem. As a result, these substances do not remain in the environment for long.

Beetles also contribute to soil fertility. Many species spend at least part of their lives in the soil, especially as larvae. They participate in decomposition and nutrient cycling processes, thereby helping to keep the soil alive.

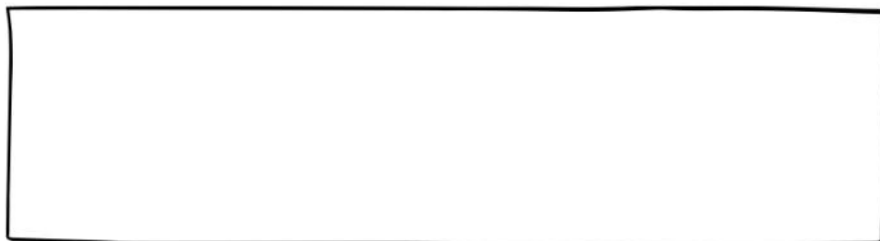
Through all these activities, insects help keep soils fertile. Without them, soils could become infertile, crops could fail, and deserts could spread.

Annex 2

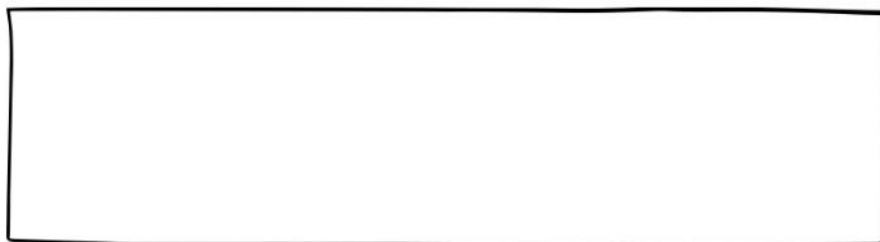
What role do insects play in our environment?

First, read the text you have been assigned on your own and then answer the questions. Get ready to present your findings to your classmates.

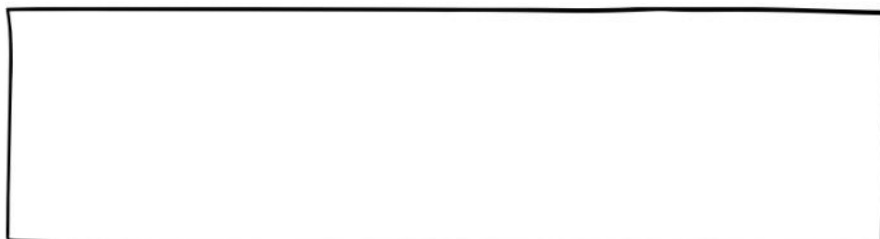
1. Why are insects important for plants?



2. Why are insects important to other animals?



3. Why are insects important to humans?



Annex 3

That's what I learnt today.



I'd still like to know that.



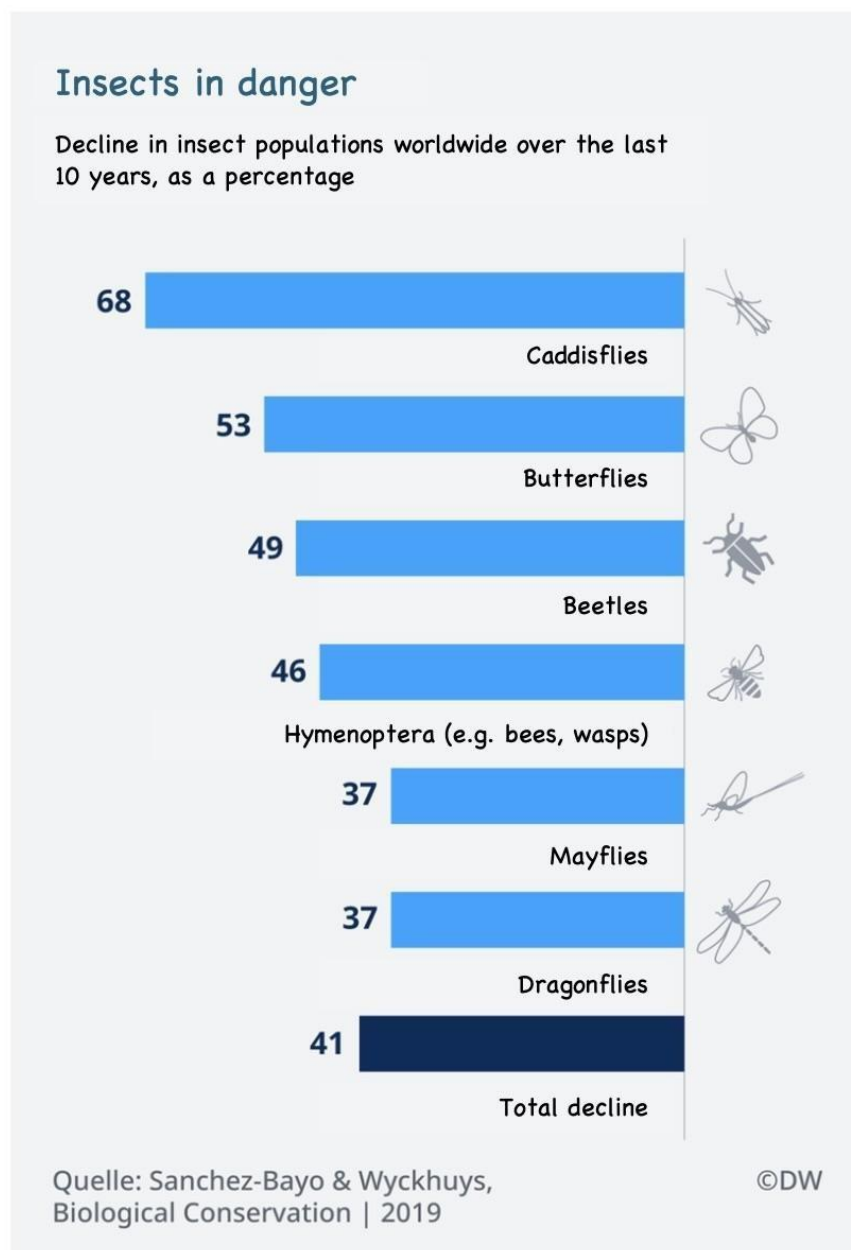
That really took me by
surprise.



Annex 4

Insects in danger

The bar chart shows the extent to which the various insect species have declined over the last 10 years. Take a close look at it and answer the questions on the next page.



Annex 5

By what percentage has the number of butterflies fallen over the last 10 years?



Help: Tip Card 1

How great has the overall decline in insect populations been over the last 10 years?



Help: Tip Card 1

Which species of insect saw the greatest decline?



Help: Tip Card 2

By how many percentage points is the decline in beetle numbers greater than the decline in mayfly numbers?



Help: Tip Card 3

Come up with some theories as to why there are 53 per cent fewer butterflies today than there were 10 years ago.



Help: Tip Card 4

Annex 6**Tip Card 1**

You can read the figure straight off the chart.

**Tip Card 2**

Compare all the bars and their numbers with one another. You are looking for the largest number.

**Tip Card 3**

- | You'll need to do some maths for this problem. Look at the percentages for the beetles and the mayflies. Work out the larger number minus the smaller number.

**Tip Card 4**

You're also welcome to carry on with your research on your iPad.



Annex 7

Vocabulary bank

Percent

It is written using the symbol = %
A percentage indicates how many parts out of 100 are meant.

Bar chart

A bar chart is a way of presenting data. Each bar represents a single item or group.
The length of the bar shows the quantity. This makes it easy to compare different quantities.

reduce

A number is lower or smaller than before.

Assumption

An initial idea for a solution, which may not necessarily be correct.

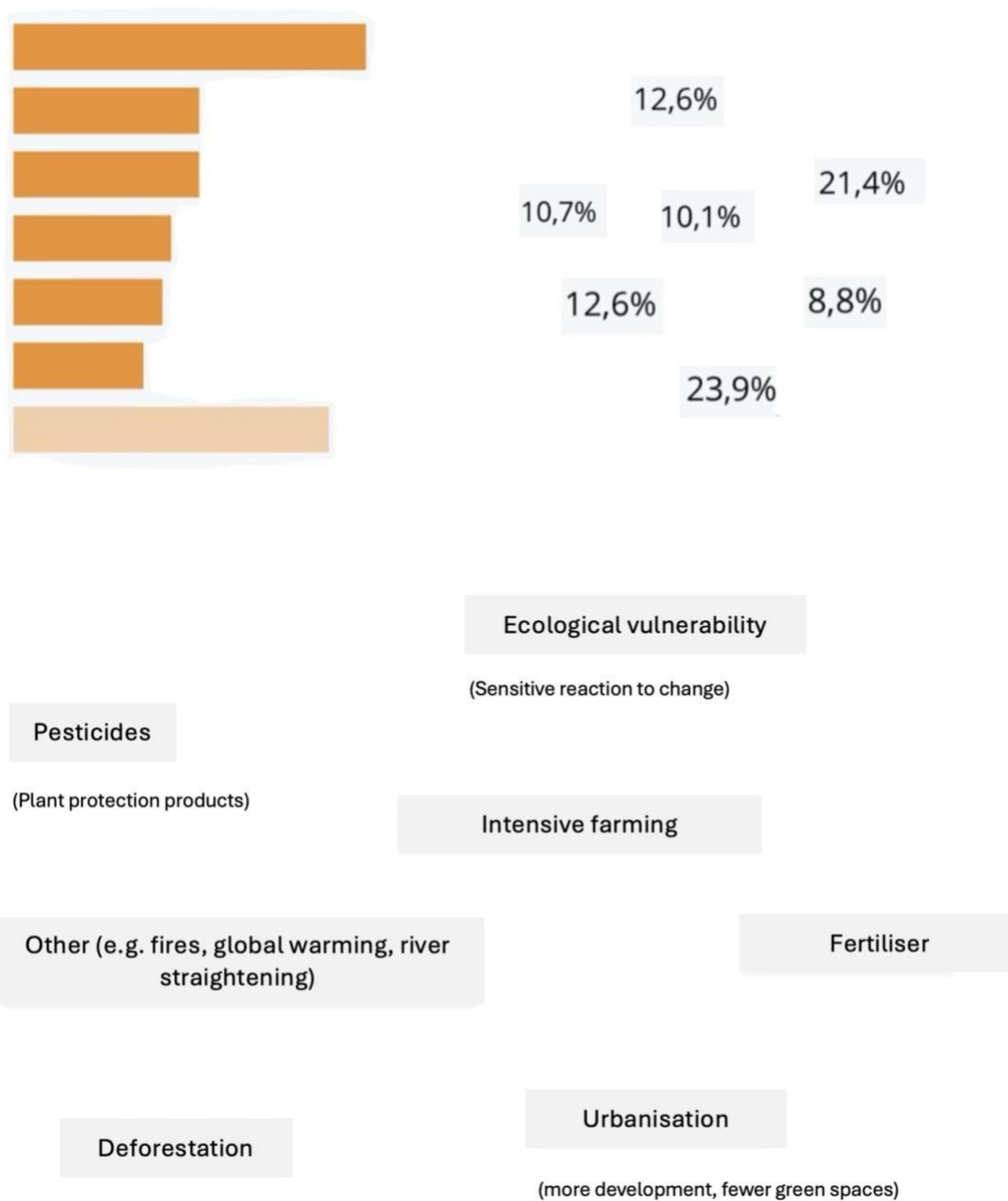
Insect population

An insect population consists of all the insects of a particular species that live together in one place.

Decline

A decrease or reduction in something over time.

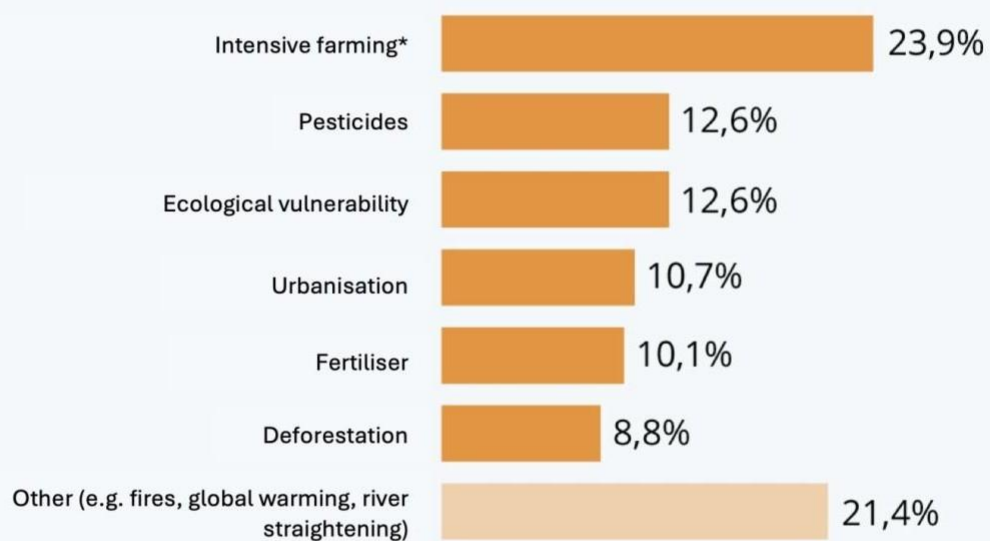
Annex 8



Solution:

These are the causes of insect decline

Main causes of global insect decline in 2019



*modern agriculture aimed at achieving the highest possible yield per unit of land or per animal

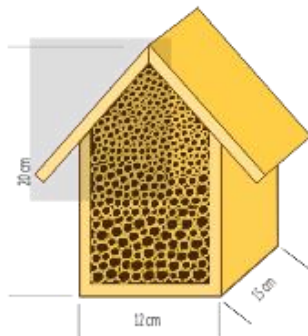
Quelle: Biological Conservation (2019), F. Sánchez-Bayo, K. A. G. Wyckhuys



Annex 9



Insect nesting aids – nesting sticks



What you'll need

Hollow stems of varying thicknesses (4–7 mm) from your latest hedge trim, bamboo canes, old stems from large perennials, reed stalks or dead elderberry branches you've collected.

Tips and tricks

Material

- Where possible, use FSC-certified timber from local forests, or breathe new life into untreated and clean offcuts by reusing them as building material.
- Avoid using wood preservatives so as not to endanger the animals' health. To protect the nesting box from moisture and fungal attack, you can paint the outer walls with linseed oil or environmentally friendly paints or varnishes.
- Use only screws to join the parts together, not nails. This saves on additional glueing.
- For rain protection, you can also fit roofing felt or galvanised sheet steel to the roof.

Here's how

1. Bundle the different stems together and store them in a rainproof container, such as a specially built little house or even a tin can.
2. By placing a fine-mesh wire mesh 5 cm from the opening, you can prevent woodpeckers and other birds from pulling out the bamboo sections to get at the wild bee brood.

How to make it a proper home

- If possible, install the nesting aid in the autumn so that insects can use it for sleeping and overwinter.
- Fix the insect nesting aid in a sunny, south-facing spot.
- Ensure that the nesting aid is positioned so that it is sheltered from the rain.
- Align the tunnels horizontally.

