

Logbook for pupils

Name:

Date:

My Role:

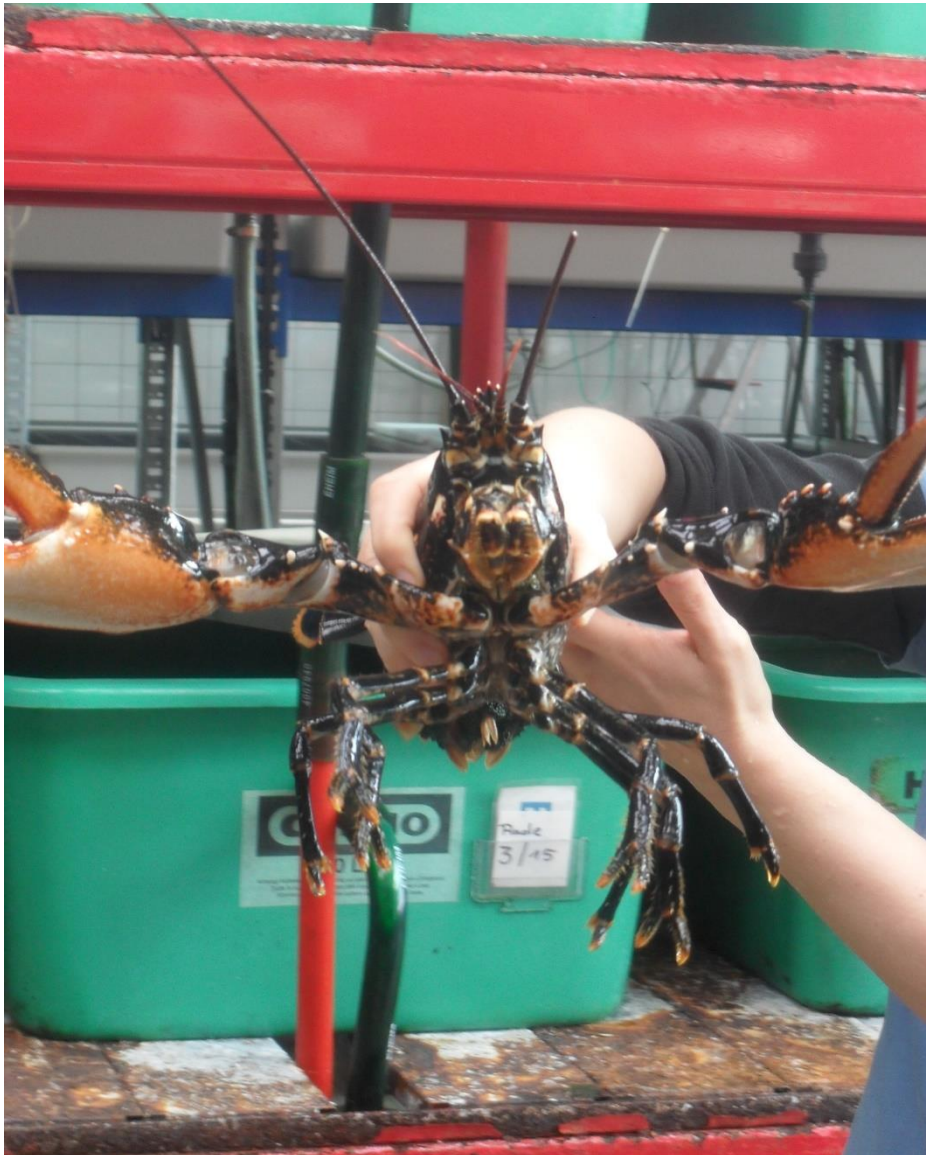


Fig. 1: Lobster in the AWI breeding department

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Literature

Now, the moment has arrived. You slip into your roles and are seventh´ graders on Helgoland. Your teacher wants to make the decline of the lobster a subject of discussion in your biology class. In the following biology lesson you will follow the traces of **lobster John II**.

Physique of a lobster

The European lobster of Heligoland belongs to the crustacean subphylum (lat. crustacea) like the edible crab.

The basic body plan of these species is mostly very similar. In principle their body is divided into three segments (body regions):

- *head*
- *thorax*
- *abdomen*



Fig. 2: Lobster in the AWI breeding department

1st Task

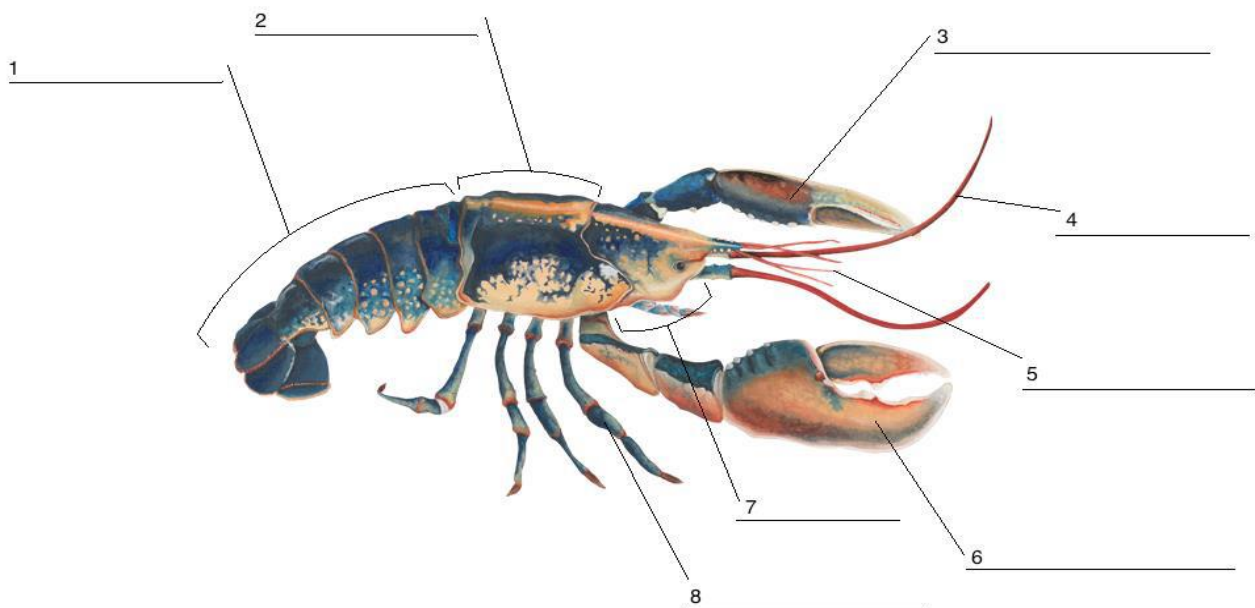
The figure below clearly shows the lobsters' appearance. Mark the picture with labels.



| | |
|--------------------|--------------|
| Morphologie | - morphology |
| Krebstier | - crustacean |
| Hummer | - lobster |
| Schere | - pincer |



Tip: If you don't know how to move forward, you may examine the tip card.



1st. Station: The „heraldic animal“ of Helgoland

2nd Task

Which differences are between a female and a male lobster?



Tip: You may use the prepared two models.

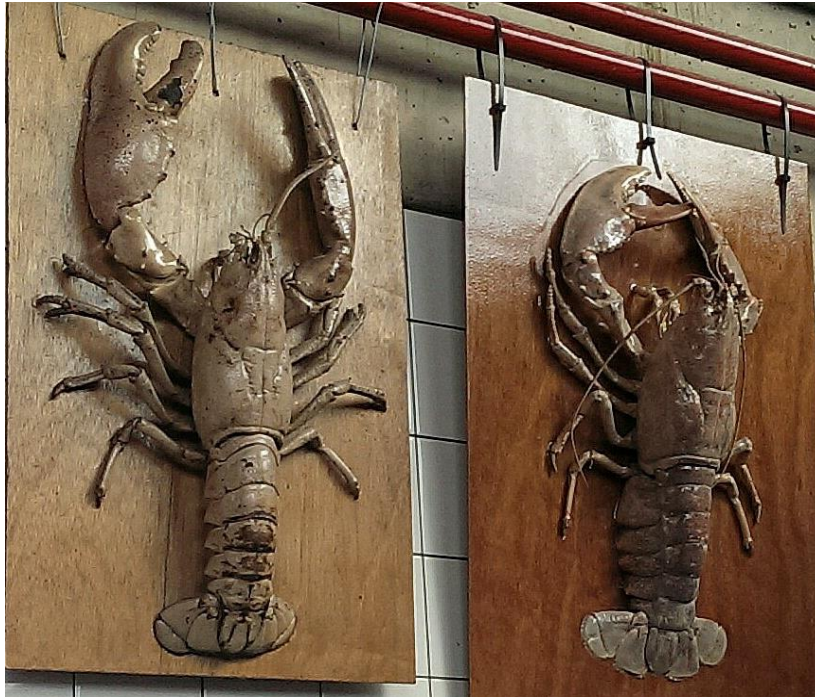


Fig. 4: Male and female lobster.

| Features | Male (left) | Female (right) |
|----------|-------------|----------------|
| Height | | |
| Abdomen | | |
| Pincers | | |

1st. Station: The „heraldic animal“ of Helgoland

3rd Task

Discuss about the reasons for the different appearances of male and female lobster. Subsequently, check your assumptions with the solution card.

Assumption

Hypothesis:



Fig. 5: Female lobster.

Food web

The Helgoland lobster is an omnivore and has no natural enemies. Consequently, it is on top of the food chain. As an omnivore, it ensures the persistence of biodiversity in the area of Helgoland.

1st Task: Create a food web with the following terms. Don't forget, that young lobsters are easy prey for other marine dwellers. Subsequently, check your web with the solution card.



Tip: If you don’t know how to move forward, you may examine the tip card.

| |
|---------------|
| Human |
| Lobster |
| Young lobster |
| Mussel |
| Shore crab |
| Crab |
| Codfish |

2nd Task: Justify the importance of the conservation of the Heligoland lobster for the diversity of species in the area of Heligoland.

The codfish preferably resides in temperature ranges between two and ten degree Celsius. Due to Climatic Change and the warming of the North Sea it migrates northwards.

3rd Task: Speculate about the effects of the codfish migration towards the north on the lobster.

„Heligoland basin“

Biodiversity not only describes the variety of animal and plant species, it also includes the diverse living spaces or habitats. The North Sea provides many variable habitats for animals and plants. There are e.g. different coastline habitats, river estuaries and open sea with various soils. Not every habitat of the North Sea can be populated by every sea dweller. In today’s introduction you already learned, that the Heligoland lobster lives on the rocks of the Heligoland submarine world.

1st Task:

Research question: What is your idea, what kind of habitat the lobster needs?

Hypothesis: _____

What is the actual meaning of biodiversity?

Diversity is another term for variety. The biological concept of **biodiversity** includes the variety of animal and plant species as well as of the multiple habitats.



Biodiversität – biodiversity
Lebensraum – habitat

In the “Zoo am Meer”-aquaria you can examine the different habitats of the North Sea. In the following experiment you compare the lobsters’ habitat with one recreating a part of the North Sea basin.

Implementation:

1. Look closely at the lobsters’ aquarium design („Heligoland basin“) and the North Sea basin aquarium.
2. Work in groups of two or three. With a pencil draw one of the habitats on the respective page and pay close attention to the differences.

The following questions may help with the observation and drawing:

- Which animals live in the aquarium?
- Which plants live in the aquarium?
- What does the soil look like?
- Are there hiding places for animals?
- Which salinity does the water have?

Habitat: Helgoland basin

Habitat: North Sea basin

Solution:

What kind of habitat does the lobster need?

Competition for habitats



Fig. 14: (Edible) crab

The Heligoland lobster has to share its habitat with another crustacean, the edible crab (generalist), which can populate different habitats of the North Sea coastline. It can be found in zones continuously covered by sea water as well as zones that run dry temporarily due to ebb and flow. For the edible crab, it

doesn't matter, if the spoil is sandy, muddy or rocky. At the bedrock lobster and crab compete on places in the cavities.

1st Task

If the rocky coastline would be destroyed and uninhabitable for both animals, what would be the consequences for them?



| | | |
|---------------------|---|-------------|
| Taschenkrebs | – | crab |
| Ebbe | – | ebb |
| Flut | - | flow |



Tip: If you don't know how to move forward, you may examine the tip card.

Experiment 1: Ocean pollution

For communication with conspecifics the lobster uses its olfaction. It communicates with **specific odorous substances**, which are emitted into the water. This way, e.g. the male lobster finds a suitable female for reproduction.

As a result of the heavy shipping traffic the **sea water** is contaminated with **oil**.

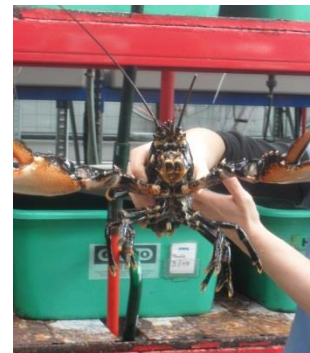


Fig. 15: Lobster in the AWI breeding department

1st Task

Research question: How does the oil pollution affect the lobsters' life?



| | | |
|----------------------|---|--------------------------|
| Kommunikation | - | communication |
| Geruchssinn | - | olfaction |
| Duftstoffe | - | odorous substance |
| Öl | - | oil |

Hypothesis: _____

Materials:

- Glas vessels
- Vinegar
- Edible oil

Implementation:

1. With the materials mentioned above plan an experiment that simulates the effects of the oil pollution on the specific odorous substances.



Tip: If you don’t know how to move forward, you may examine the tip card.

Observation:

Model critique

Juxtapose the model and respective original object (marked in the text above). Subsequently, criticize the model.

Tab. 3: Model and reality.

| Model | Reality |
|------------|---------|
| Water | |
| Vinegar | |
| Edible oil | |

Critique: _____

Solution:

Explain, how the oil pollution affects the lobsters’ life.

Alternative: Ocean pollution

For communication with conspecifics the lobster uses its olfaction. It communicates with **specific odorous substances**, which are emitted into the water. This way, e.g. the male lobster finds a suitable female for reproduction.

With begin of the European industrialization the shipping traffic on the North Sea increased drastically. The container vessels follow their route over the port of Antwerp, the port of Hamburg and the container terminal of Bremerhaven.

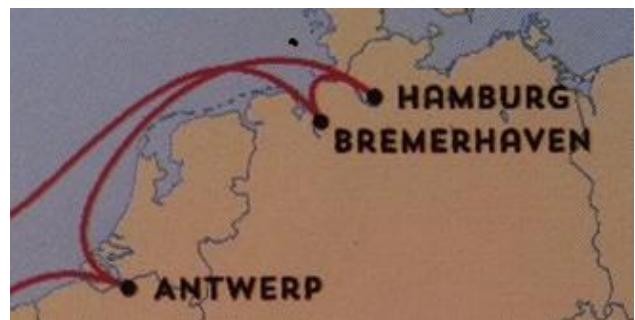


Abb. 16: Route der Containerschiffe

On this route the ships pass the East Frisian island

Wangerooge and take the way on the lower Elbe to Hamburg. The ships are powered by diesel engines. During their travels they loose oil, among other things, which contaminates the water. With the tides the oil reaches the open sea.

1. Task: Relate the oil pollution caused by container shipping to the communication of the Heligoland lobster.



Tip: You may find help on the tip card.

Scientists assume, that the increased shipping traffic is polluting the North Sea with oil since 20th Century. This probably has an impact on communication and reproduction of the lobsters.



| | | |
|---------------------------|---|--------------------------|
| Kommunikation | - | Communication |
| Geruchssinn | - | olfaction |
| Duftstoffe | - | odorous substance |
| Öl | - | oil |
| Containerschiffe | - | container vessel |
| Industrialisierung | - | industrialization |

2nd Task: Speculate about the role of the oil pollution in the decline of the Helgoland lobster. Justify your assumption.

Not only might the oil pollution be a factor on the lobsters decline, also the so called air pollutant emissions of the container vessels has to be considered. These pollutants accelerate the Climatic Change, the North Sea warms and the salinity decreases.

3rd Task: Explain the connection between the air pollutant emissions and the lobsters’ decline. Refer to the experiment „Salinity in the ocean“ and the „Ocean warming“ model.



Tip: If you need help, look at the tip cards.

With the container vessels e.g. imported cloths from India and Bangladesh are transported to Germany.

In this century the shipping companies outbid each other with the container vessels’ size. The MSC Zoe is the biggest container vessel at the moment. It has space for 19.000 containers. But with the increasing size comes increasing diesel consumption and air pollutant emissions, too.



Fig. 17: MSC Zoe

4th Task: Think about, what **YOU** could do to counteract climatic change. Think about your cloths and shopping habits as well as your transport choices (bus, car, bicycle etc.).

The shipping companies, too, could contribute. Onshore, effective exhaust technologies are stipulated, for container vessels there are no such regulations yet. Even though clean fuels and effective exhaust technologies are available. The expense increases would be marginal, when waiving heavy oil and applying exhaust technologies on all ships.

Experiment 2: Salinity in the ocean

In the last centuries human actions led to rising temperatures worldwide and, therefore, to Climatic Change. In particular power plants are responsible for this, but also combustion engines of motor vehicles, which emit carbon dioxide (CO₂) by combusting fossil resources (e.g. coal and gasoline).

The rising temperatures cause melted ice at north and south pole. The water flows into the sea, with significant impact on the planet. Diverse habitats are lost in the increased sea levels to many animals and plants. This we call loss of biodiversity. But there are further serious consequences, which do not stand out as much. The sea water (salt water) salinity e.g. changes with more and more melt water (fresh water) flowing into the sea.

What does the term **Melt water** mean?

Due to global warming the glaciers are melting. The released fresh water flows into the oceans and leads to increased sea levels.

1. Task

Research question: How does the sea water salinity change?



| | | |
|----------------------|---|-----------------------|
| Klimawandel | – | climate change |
| schmelzen | – | to melt |
| Meeresspiegel | – | sea level |
| Salzgehalt | - | salinity |

Hypothesis: _____

Materials:

- 1 Beaker
- Salt water
- Ice cubes
- Heat lamb
- Stirrer
- Measuring instrument for salinity (Salinometer)

Implementation:

1. With the abovementioned materials plan an experiment that simulates the effects of the ice melt on the North and South Pole on the sea water salinity.



Tip: If you don’t know how to continue with the implementation, look at the tip card for the experiment.

2. Write down the results of the water salinity in the following table:

| | Start of experiment | End of experiment |
|----------------------------------|---------------------|-------------------|
| Water salinity in ‰ (per mil) | | |



Tip: Per mil means „per thousand“. 10 per mil are also 1 percent.

Solution:

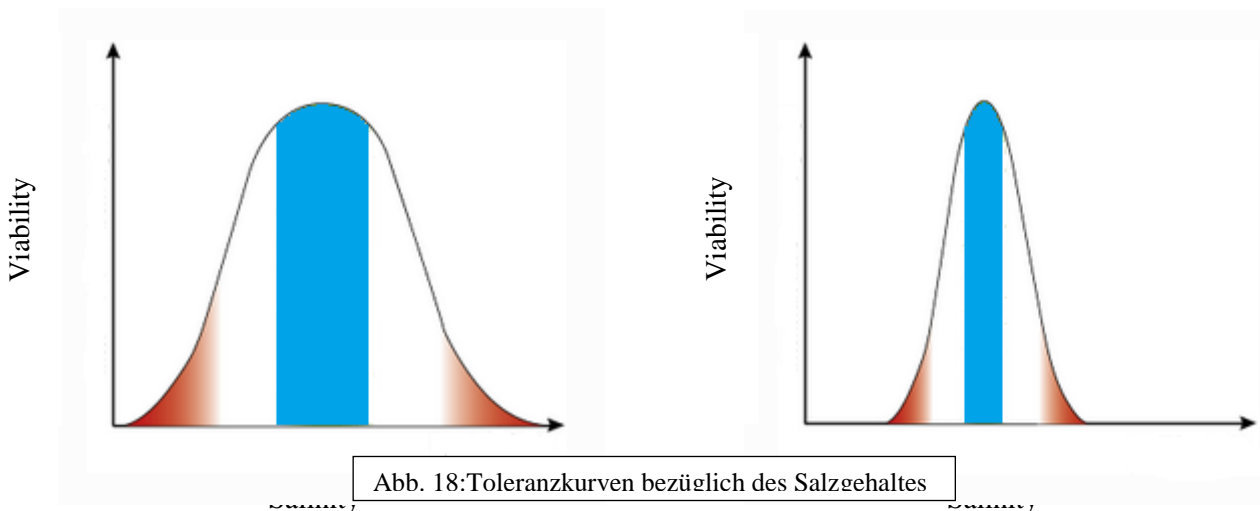
Explain the salinity changes in the experiment. Explain, how the salinity of the North Sea might change with continuous rising temperature on the planet.

All sea dwellers need salt water to survive. Some can only exist in water with a very high salinity, while others may withstand lower salinities in the sea water. As a specialist, the Heligoland lobster is dependent on a constant salinity of 3,5% in the sea water.

The crab, on the other side, is a generalist and may go well with even lower salinities.

2nd Task

Assign the right animal (lobster, crab) to the respective ecological tolerance curve regarding salinity.



3rd Task

Which one of the two species will be affected more negatively by future changes of the sea salinity?

Model: Ocean warming

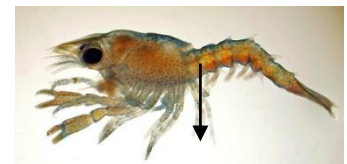
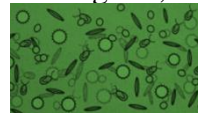
The increasing sea water temperature, caused by the Climatic Change, affects the development of the Helgoland lobster. Female lobsters may lay 1.000 up to 40.000 eggs. The larvae, emerging from the eggs, need large nourishment and, therefore, are dependent on small sea algae. After moulting several times they develop into young lobsters.

Development cycle



Eggs on female lobster

In June, July and August there is enough food for the larvae to grow, because at this time the sunlight is sufficient for algae growth. In 1962 the larvae of the Helgoland lobster



emerged at this time. But the North Sea warming nowadays causes the right hatching temperature to be reached earlier in the year (in May). But then there is not enough food.



Fig. 19: Development cycle of the lobster

1st Task

Research question: What happens, when the larvae don't find enough food? Which effects does this have on the lobster stocks (number of lobsters)?



| | |
|-----------------------------|-------------|
| Entwicklung/Wachstum | – growth |
| Larven | – larvae |
| Algen | – algae |
| Häutungen | - skinnings |

Hypothesis: _____

Materials:

- Wooden block with:
 - lobster eggs
 - larvae
 - algae
 - young lobsters

Implementation:

1. Built a tower out of the different wooden blocks. Previously, think about how to simulate the effects of absent nourishment (algae) for the larvae and their development into young lobsters.

Observation:

Solution:

Explain, how the sea warming may affect the Heligoland lobster stocks.



Fig. 20: (Edible) Crab

The hatching of the crab larvae is temperature dependent, too. These larvae develop very similarly to the larvae of the lobster. They, too, depend on the small algae. But adult crabs, in contrast to adult lobsters, are able to walk long distances. A marked female crab was found after a year more than 180 km apart from her place of origin.

2nd Task:

Speculate about the importance of the sea warming for the edible crab! What consequences would it have on this animal?

Conclusion: specialist and generalist

The Helgoland lobster and the edible crab – like all animals and plants – can only live in habitats with tolerable living conditions. These conditions are influenced by various factors, which we call environmental factors.



Tip: If you don't know how to continue on this task, look at the tip card „specialist and generalist“.

1st Task


List the environmental factors that you investigated in the previous experiments.

-
-
-
-


2nd Task

Write down in the boxes below how these environmental factors should be in each case, for the Heligoland lobster and the edible crab to live well.

Specialist



Generalist



Research question: How was the lobsters' habitat destroyed during the 2nd World War?

Hypothesis: _____

The project „lobster claw“

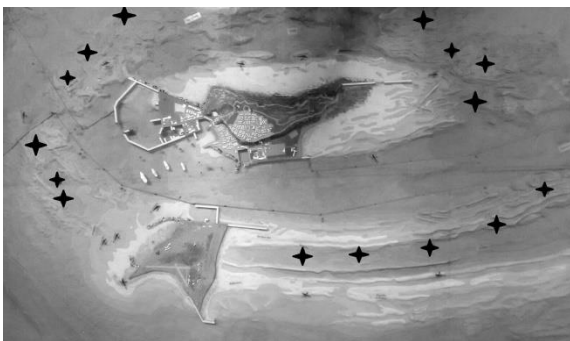


Fig. 21: Lobsters' habitat (stars)

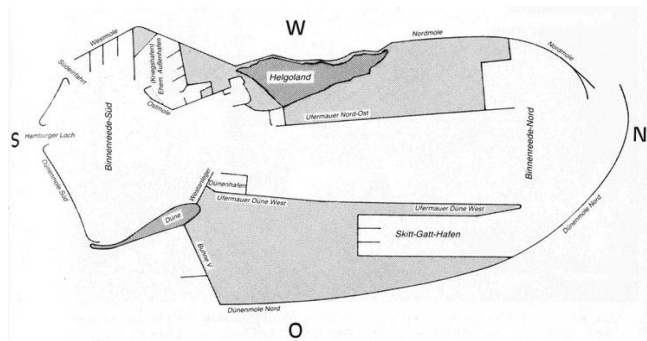


Fig. 22: Project lobster claw

1. Task:

Compare the project lobster claw map to the lobsters' habitat. Explain possible impacts of the construction project!



Bombardierung – **bombing**
Auswirkung – **consequence**
gezielte Sprengung - **targeted detonation**

Bombardements

1st Task:

Describe the bombings consequences on the lobsters' habitat.



Tip: For help look at the tip card.



Fig. 23: Lobsters' habitat



Fig. 24: Bombing of Helgoland

The Big Bang

2nd Task

Speculate about possible influences of the blast on the lobster stocks!



Tip: If you need help, look on the tip card.



Hypothesis: _____

Lobster fishery



Fig. 25: Report about Heligoland

1st Task

Watch the video again, if necessary.
Together think about, what you have learned about the fisherman and the hunt for lobsters.

Write down the three most important key points.

- _____
- _____
- _____

2nd Task

How many lobster fishermen are there on Heligoland and how many lobsters are they catching compared to earlier days?



Fischerei - fishery
Fischer - fisherman
Hummerkorb - lobster creel

Number of lobster fishers: _____

Lobsters earlier: _____

Lobsters today: _____

3rd Task

What did you learn about the edible crab? Again, write down three key points.

- _____
- _____
- _____

4th Task

Is the lobster still an essential element for Helgoland fishery?

The lobster creel

1st. Task

Label the figure.



Fig. 26: Lobster creel

Catch statistics

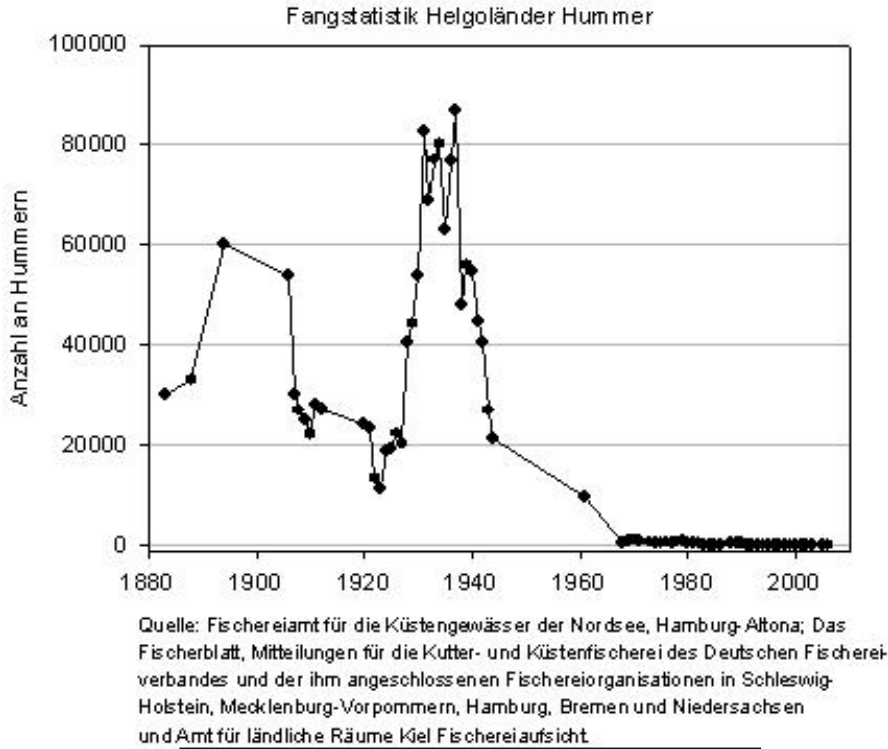


Fig. 27: Catch statistics on the Helgoland lobster

1st Task

Describe the graphic. Watch out for special features. What was the number of lobsters caught in 1895, 1930 and 2000?

2nd Task

Which conclusions can be drawn out of the catch statistics regarding the stock (population)? Additionally, read the “Landesverordnung über die Ausübung der Fischerei in den Küstengewässern”. In 1930 there was no such regulation.

What does the term **population** mean?

By **population** the biologist understands a group of individuals of the same species (e.g. lobster), that are found in one habitat (e.g. bedrock).

Landesverordnung über die Ausübung der Fischerei in den Küstengewässern
(Küstenfischereiverordnung – KüFO -)
Vom 11. November 2008

| Fischart | Mindest- maß | Schonzeit |
|--|-----------------|---|
| Hummer (<i>Homarus gammarus</i>) in der Nordsee gemessen von der Spitze des Stirnhornes bis zum Hinterende des Brustpan- zers eiertragender weiblicher Hummer (<i>Homarus gammarus</i>) in der Nord- see | 11 cm - | 5. Juli bis 31. August ganzjährig, sofern er nicht an die Bi- ol. Anstalt Helgoland zu Zuchtzwe- cken geliefert wird |

Fig.: 28: Landesverordnung über die Ausübung der Fischerei in den Küstengewässern

3rd Task

What might be the reasons for the reduced stock?

Off- Shore parks

„Animal rights activists are concerned about migrating birds and bats to be drawn into wind turbines.“

„The construction of the wind farm brought new guests to the island: craftsmen, technicians and business people. Therefore, new money goes to the restaurant owners and landlords, even in the winter, when there are no tourists.“

"The wind power will strongly support the economic development of Heligoland"

„The wind farm employees work for 10 days and then are on leave for 10 days. They don't really participate in the life on Heligoland.“

„Only a few Helgolanders work at the wind farms. For the most part they are Danes and Britons.“

„After finishing the wind farm construction, many of the workers will migrate, because for maintenance there are less personal needed. Then the hotels are ...“

"Helgoland is* predestined for the development of a Offshore operating basis."

*predestined = very suitable for something

"THE OFFSHORE WIND ENERGY IN GERMANY IS FINALLY ON GROWTH COURSE AGAIN."



Windpark - offshore wind farm
Windenergie - wind energy
Tierschützer - animal welfarist
Wirtschaft - economy

1st Task

Research question: What impact do offshore wind farms have on Helgoland economy and population?



Tip: If you need more information about offshore wind turbines in the North Sea, read about it in the info texts on the wall.

What does the term **offshore** mean?
 Originally, "**offshore**" meant deep sea islands belonging to a country. The term "offshore" means: "in front of the coast". [...] In the wind power area there are "**offshore wind farms**", which produce energy through wind turbines near the coastline.

2nd Task

What arguments are there speaking for offshore wind farms as new habitat for the lobster? What difficulties might arise? Create a pro and contra table!



Tip: For this task, watch the film excerpt on the laptop!

| PRO | CONTRA |
|-----|--------|
| | |
| | |
| | |
| | |
| | |

Artificial land bridge



Fig. 29: Land reclamation project Heligoland

In 2011 the question, if the main island of Heligoland should be connected to the Düne through an artificial land bridge, was put up for vote.

The connection would result from sand fillings. This means many dredging vessels dumping sand on the areas marked on the map over many years. For as long as there is enough new „land“ to build upon. As protection from the sea, the island would additionally be fastened through tetra pods.

Allover, there would be created an area of 295.000 m². Approximately 42 football pitches. The people of Heligoland voted on this question: 45% were in favour of it, 55% were against it.

1st Task

Speculate in written form, which consequences a connection of the two islands would have had for *tourism, animal habitats, number of population, economy and traffic!*



Insel – island
Düne – dune



Tip: If you need help, use the tip cards!

Tourism: _____

Habitat: _____

Population: _____

Economy: _____

Traffic: _____

In addition to your own experiences and considerations you find some arguments pro and contra the protection of the lobster and the lobsters' habitat. You can select one or more if you want. Do you now further arguments?

Biodiversity means diversity of species, genes and habitats. Humans should only act if they have caused the imbalance (e.g. the reduction of the lobster population caused by the fishery).

Biodiversity means diversity of species, genes and habitats. Humans should act because they are responsible for the reduction of the lobster (during the 2nd World War).

„The lobster is deserving protection because as an omnivore the lobster contributes to biodiversity.

„The lobster is the heraldic animal of Helgoland. It is offered in exclusive restaurants and brings tourists to the island. The people of Helgoland are living from tourism - and from the lobster, too.”

„There is no way to protect the lobster for extinction. The crabs have taken over the habitat, they are the generalists. If the humans reduce the crab population, they again will disturb the natural living environment. This is a mistake.”

„How can we make a decision which living being is deserving protection? Isn't it better to let nature flow and decide?”

„At the Alfred Wegener Institute many scientists are working. They investigate strategies to protect the lobster. Many student groups visit the island –each one brings about 100 € a day to Helgoland.”

„Fishing crabs protects the lobster population – and is good for the tourism, too..“

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Abb. 1: Hummer in der AWI-Aufzuchtstation

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