

## INVASION OF THE CHINESE POND MUSSELS— WHAT MAKES THESE HARMLESS-LOOKING ANIMALS SO DANGEROUS?

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### REVIEWED BY:



**TESS**  
15 YEARS OLD

Imagine what you would do if someone took you far away from your home and brought you to a completely unknown and unfamiliar place? You would do your best to stay alive! Any living being, such as an animal or a plant, would react in the same way. This has happened to many living things, because people brought them to new locations—either on purpose or by accident. Some of those living things started to like their new homes so much that they spread all around, and while doing so, they endangered the “native” inhabitants of those areas. Because of the danger they pose to the creatures that normally live in those areas, these transported animals or plants are considered dangerous and are called “invasive species” by scientists. One invasive species is the Chinese pond mussel. Scientists still do not understand what makes this harmless-looking animal turn into a dangerous villain! So, we created a scientific experiment to find out!

## ENVIRONMENT

Everything that surrounds us, including everything living and everything nonliving.

## ORGANISM

Any living creature, such as a child, a mussel, or a plant.

## NATIVE SPECIES

Species living in their original home (environment).

## SPECIES

A group of similar organisms that can breed and have babies. Species have different names in every language, so-called common names. Some examples of species common names in English are cane toad, annual ragweed, and Chinese pond mussel. In German, these species are called Aga-Kröte, Beifußtraubenkraut, and Chinesischen Teichmuschel, respectively. To avoid confusion, biologists created scientific species names that are the same all around the world, in all languages. Scientific names follow certain rules: they are composed of two words that are usually in Latin and written in italics. For example, the scientific name for Chinese pond mussel is *Sinanodonta woodiana*.

## INVASIVE SPECIES

Species living outside of their original home (environment) and causing harm to other organisms in their new home.

## NATIVE VS. INVASIVE SPECIES

Living beings, including plants and animals, occupy various places on the earth. The place they live is their natural home, also called their natural **environment**. An **organism's** natural environment may be an ocean, a meadow, a forest, a desert, or even a city. Living beings usually stay in their natural environment all their life. They are used to living there and have all the skills that it takes to survive there. Think of a whale in the ocean or a gorilla in the African forest. Groups of living beings that are originally born in and occupy a specific natural environment are called **native species**.

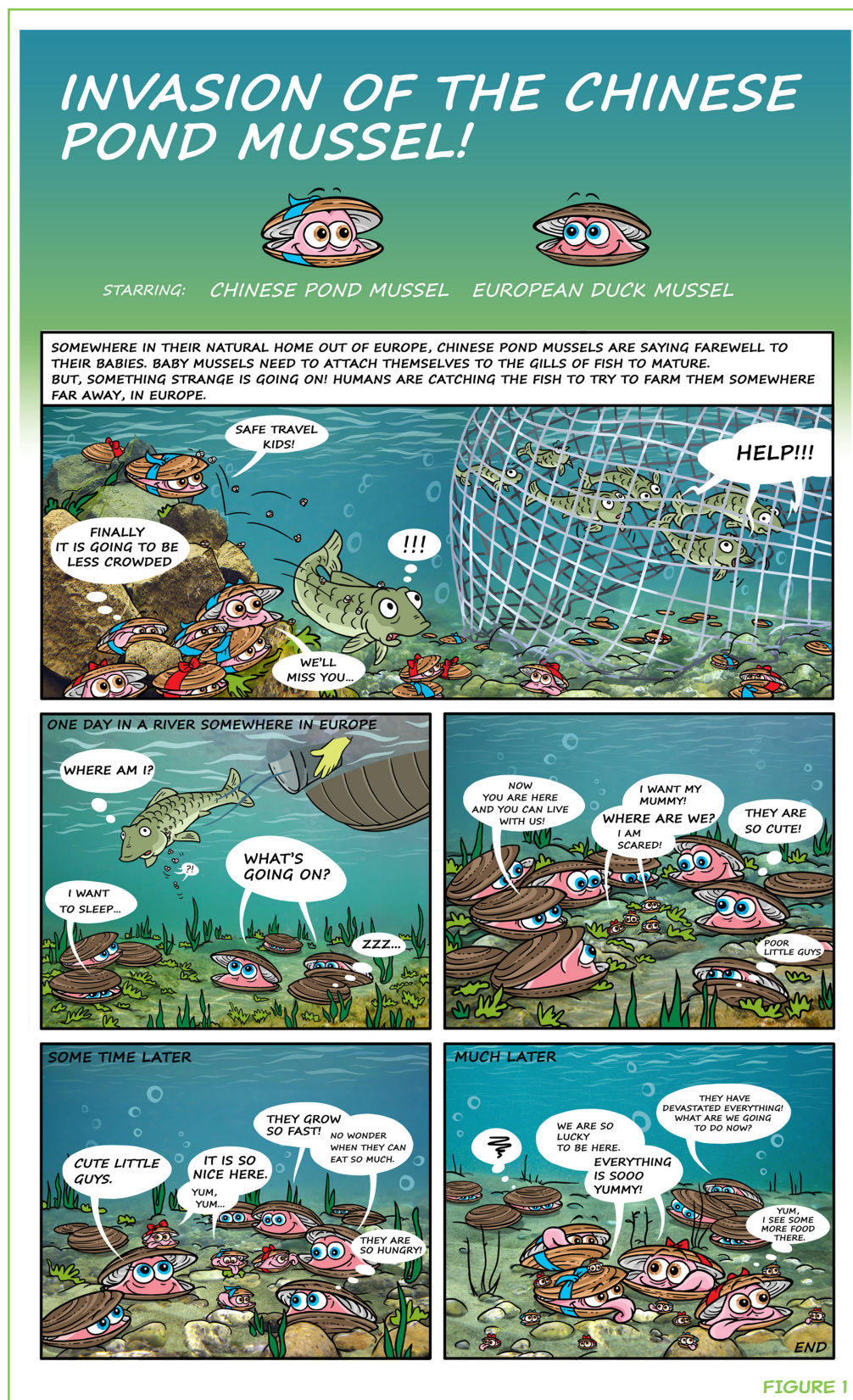
However, some living beings, for all sorts of reasons, move from their natural homes to other parts of the world. In scientific language, we say that these living beings are “introduced” into the new environment, so they are called *introduced species*. When an introduced species comes to a new and unknown environment the **species** tries to survive, although the new environment is usually very different from its home. Most of the time, an introduced species does not manage to survive and perishes. But sometimes an introduced species feels great in its new location, and the organisms start making babies, increase in number, and start spreading through the new environment. If this happens, it can be bad for the native species already living in that area, because the introduced species takes their space or eats their food. Introduced species that live outside their natural environment and cause harm to other organisms living there are called **invasive species** [1, 2]. Maybe all these terms will be clearer when you read the short comic “Invasion of the Chinese pond mussel!” (Figure 1). You might have already heard of some invasive species, such as the common ragweed (Figure 2).

## HOW DO THESE SPECIES ARRIVE IN THEIR NEW ENVIRONMENTS?

We help them get there! Throughout history, people have frequently moved species around the globe. Think of tomatoes or corn. Both of these plants originally grew in South America, but they were transported into new areas and are now common worldwide. We often transport species on purpose, such as tomatoes and corn, so they can be grown for food, or exotic plants and animals so that people can keep them as pets. But sometimes we also do it by accident. For example, an organism can be moved from its natural home as a stowaway on a boat—maybe it is accidentally stuck to the outside of the boat during the entire voyage! Chinese pond mussels, for instance, have very tiny babies that attach in high numbers to the **gills** of fish. Throughout human history, people grew fish for food and moved the fish, on purpose, around the world. That is how people accidentally transferred the tiny mussels, along with the fish, to the new environment. The mussels then detached from the fish and started their new life on the bottom of some lake or river

**FIGURE 1**

Invasion of the Chinese pond mussel!  
This comic shows how Chinese pond mussels came to Europe and how they caused harm to the native species, European duck mussel. Illustrations: Mirela Ivanković Bielen.



**FIGURE 1**

**GILLS**

Organs that fish and most other water creatures (including mussels) use to breathe under water.

on a new continent, as you can see in the comic (Figure 1). You can find more about invasive species and how they are transferred in Figure 2 or in other resources [1, 2].



## FIGURE 2

Examples of invasive species around the world.

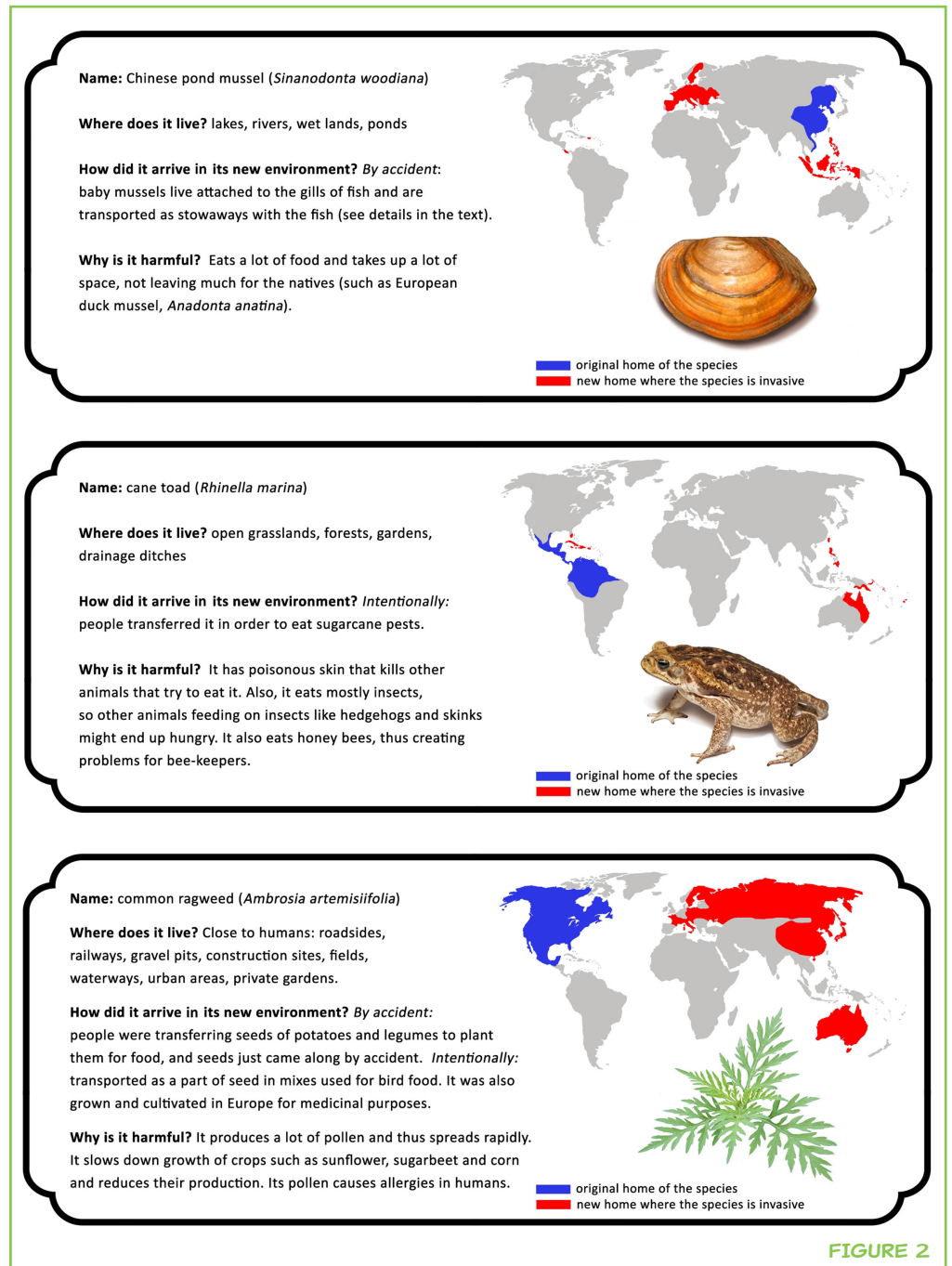


FIGURE 2

## WHY ARE INVASIVE SPECIES HARMFUL TO OTHER ORGANISMS OR THE ENVIRONMENT?

Because some invasive species start to enjoy their new homes too much. They eat a lot of food, use a lot of space, and spread by making a lot of babies—then they occupy even more space and eat even more food! As a result, the native species have less food and space, and they can even completely disappear from a particular area. Also, invasive species can cause harm in many other ways. For instance, cane toads are poisonous and when native lizards and snakes try to eat them, they die (Figure 2). Invasive species can also spread diseases,

such as the Asian tiger mosquito that became invasive in South America and brought the Zika virus with it. Another example is a plant called annual ragweed (Figure 2). Ragweed pollen causes allergies, making some people sneeze and causing their eyes to be very, very itchy.

## WHY DO SOME SPECIES BECOME INVASIVE WHILE OTHERS DO NOT?

This is a really good question. When a species comes to a new environment, sometimes it will spread and become harmful, and sometimes not. In fact, out of 100 introduced species, only around 5 will become invasive. Some introduced species can live in their new home for many years before becoming harmful to native species. There are many reasons why some species become successful invaders and others do not. Scientists are still trying to solve this mystery. One obvious reason is that invasive species that grow fast and have lots of babies will spread more easily in the new environment. Another explanation is that some invasive species have no enemies in the new environment. Remember the example of the poisonous cane toads and the native snakes lizards that died when they tried to eat them. One other reason could be that that successful invaders can rapidly change their behavior or their habits (such as their eating habits) to better fit into the new environment. These successful invaders might not be so picky about their food and just eat whatever they find.

All these explanations are possible, but scientists still cannot predict if a certain species will become a dangerous invasive species after being transferred to a new environment. That means that there are many more unknown factors that make a species invasive. We have been interested in this problem and asked ourselves what would happen if the environment became less cozy. In other words, how will the invasive species and the native species feel if the environment becomes too polluted or too warm? These kinds of changes in the environment can cause stress for some organisms. Maybe native species will suffer from these kinds of stress and invasive species will still feel quite OK. So, we have asked ourselves a question:

*Could it be that invasive species are more resistant to stress in the environment?*

We designed a scientific experiment to find out!

## DESIGNING THE EXPERIMENT

To design an experiment, we first had to choose organisms to work with. We took two species that are similar, that live in the same place, but have one important difference: one is native and the other is invasive. Then, we put both

## ENVIRONMENTAL STRESS

A specific condition in the environment that causes an organism to feel stressed. For example, very high or very low temperature and polluted air.

species under stress to see how they felt. Think of it as the start of a comic book story—we have a “villain” and a “good guy” and we do not know which one will win! In our case, the “good guy” is a European duck mussel, with the scientific name *Anodonta anatina*, living in Europe (a native species) and the “villain” is a Chinese pond mussel, *Sinanodonta woodiana*, also living in Europe (an invasive species). You can find more information on freshwater mussels on the “Fun with Freshwater Mussels” webpage [3].

Next, to test how these two species of mussels cope with **environmental stress**, we had to choose a type of stress. In an environment, lots of things can act to stress the animals, such as pollution and lack of food. We bet you would feel stressed if you skipped several meals in a row—or maybe even one meal! We decided to use different water temperatures as the environmental stress.

To conduct our experiment, we collected the mussels from a nearby lake (we live in Europe), divided them equally into three groups, and placed them in specially prepared aquaria.

1. The “control group” (no stress) lived in the water at 18°C (64.4°F). Although you may think this is too cold for swimming, mussels find this temperature very comfortable—not too cold and not too hot.
2. The “polar group” lived in the water at 10°C (50°F). This was a bit too cold even for the mussels’ taste.
3. The “tropical group” lived in the water at 26°C (78.8°F). This was a little too hot for the mussels.

So, the three aquaria differed in only one thing—water temperature. The mussels living in the polar and tropical water experienced environmental stress. We wanted to find out if the “villain” could cope better in cold and hot environments than the “good guy” could. To draw the right conclusions about the result of this experiment, we had to include a control group—animals of both species that were kept at a comfortable water temperature, without stress. This allowed us see how the mussels reacted when they felt comfortable.

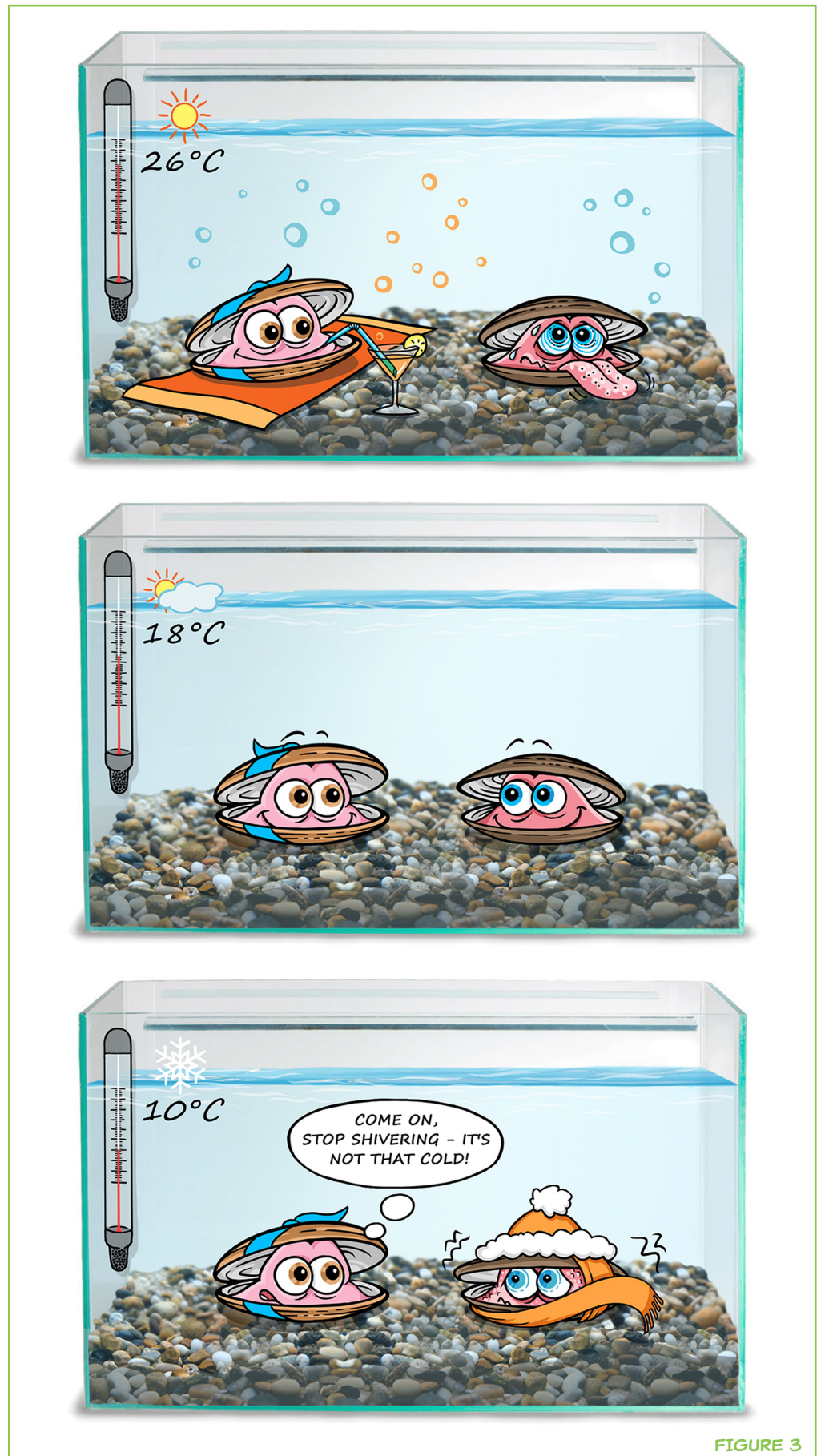
## WHAT WERE THE RESULTS?

We wanted to know how the mussels felt after spending 2 weeks in the polar, tropical, or control aquaria. To do that, we had to “measure” the impacts of both “polar” and “tropical” water temperatures on the mussels and compare the measurements with the control group (no stress). Unfortunately, we could not just ask the mussels how they felt, so we had to do several sophisticated tests to find out. These tests are similar to blood tests you may have at the doctor, to check whether you are ill. The doctor will know how healthy you are from the results of the blood tests, without having to ask you how you feel. In our case, these tests have complicated names, such as Rhodamine B accumulation

**FIGURE 3**

Temperature stress experiment.

In each aquarium, the invasive Chinese pond mussel is shown on the left, whereas the native European duck mussel is shown on the right. The water temperature of 18°C (64.4°F) is comfortable for both mussel species. However, when the water temperature is too high (26°C = 78.8°F) or too low (10°C = 50°F), the European duck mussel feels stressed, whereas the Chinese pond mussel feels fine. This proves that the invasive species (Chinese pond mussel) copes better with the temperature stress than the native mussel does. Illustrations: Mirela Ivanković Bielen.

**FIGURE 3**



assay, INT reduction capacity assay, and glutathione-S-transferase activity assay! Luckily, it is not important to learn these names to understand the results of our research, so just remember that these tests help researchers determine how healthy the mussels are.

The results of our experiment are shown in Figure 3. As you can see, in the control group (no stress) both mussel species were happy and healthy. That was proof that they liked this water temperature. But, the “good guy” (the native mussel *A. anatina*) had a really hard time coping in either “polar” or “tropical” temperatures. Based on the test results, we saw that the animals felt very weak and unhappy. They felt too cold in the “polar” aquarium and too hot in the “tropical” aquarium. Our “villain” (the invasive mussel *S. woodiana*) was a completely different story. Based on the test results, we found that these mussels felt very good in the “tropical” aquarium and only slightly unhappy in the “polar” aquarium.

### **So, the answer to our question is**

*The invasive Chinese pond mussel copes better with temperature stress than the native European duck mussel.*

The results of our experiment provided another possible explanation for what makes an invasive species a supervillain: the invasive species feels good even when the conditions in the environment are not nice, in our case when the water temperature is slightly too hot or too cold, while the native species feels bad in the same situation. We think that this is one of the reasons why the Chinese pond mussels can spread in the new environment, whereas the native European duck mussels do not do so well.

## **WHAT HAVE WE LEARNED FROM THIS STORY?**

Invasive species are harmful for native species and often for humans as well. However, the majority of species that come into a new environment do not survive and are not a threat to the natives. The question still remains—what makes some introduced species invasive? In our study, we showed that invasive species can better handle stressful conditions in the environment. If water temperature increases, invasive species will have fewer problems dealing with it than native species will. Maybe you have already heard that our world is getting warmer and warmer—this is called global warming [4]. As you can see, our results show that invasive species might thrive, even when conditions in the environment get warmer. This is an advantage over the native species, which will not be able to handle increased temperature so well. So, being better able to handle environmental stress contributes to the spreading of an invasive species.

Finally, we would like to make sure you understand that most of the movement of plants and animals into new environments is caused by us, the humans.



Therefore, we hope that our research will encourage people to try to stop moving animals and plants around the globe, and to try to find ways to protect the endangered native species.

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## ORIGINAL SOURCE ARTICLE

Bielen, A., Bošnjak, I., Sepčić, K., Jaklič, M., Cvitanić, M., Lušić, J., et al. 2016. Differences in tolerance to anthropogenic stress between invasive and native bivalves. *Sci. Tot. Environ.* 543:449–59. doi:10.1016/j.scitotenv.2015.11.049

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## REVIEWED BY



### TESS, 15 YEARS OLD

Hi! My name is Tess and I am a girl interested in science, specifically Biology and Chemistry. My goal is to someday work in a position where I can use my research to contribute positively to finding answers/cures to diseases affecting our world. I am also a competitive gymnast, and have been for about 9 years. Another passion of mine is writing, whether it is informative or creative. I am honored to be part of the Frontiers for Young Minds community!

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### IVANA BABIĆ

My name is Ivana Babić and I am a biologist working momentarily as a research associate at the Faculty of Science in Zagreb, Croatia. As a scientist I have specialized in the fields of ecotoxicology, molecular biology, and microbiology. The main focus of my scientific work are aquatic organisms, both freshwater and marine, and their interaction with their living environment: how they respond to and if they can defend themselves from the pollution or global warming events. My scientific research experiments were among all done with algae, mussels, and sea urchin embryos. In addition to my scientific research work at the Faculty I am also participating as a teaching assistant. I love to transfer my knowledge to students through lectures, laboratory practical work, and different interesting interactive workshops.



### SANDRA HUDINA

My name is Sandra and I am a biologist. I study animals so I am a zoologist. Also I mostly study freshwater species so I am a freshwater scientist. I work at the Faculty of Science at the University of Zagreb where I perform my research and teach students about various topics in biology such as general biology, zoology, invasive species, and biology of crayfish. My research is mostly based around freshwater invasive species—I look into what drives the invasion success of these species and the dynamics and patterns of their dispersal. I love my job and I love to share my interest in studying invasive species and their impact on freshwater ecosystems with everyone.



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I am molecular microbiologist working as assistant professor at Faculty of Food Technology and Biotechnology in Zagreb, Croatia. My daily activities include planning and performing scientific experiments, as well as teaching. I investigate how freshwater living beings interact with their environment: how they deal with other organisms that surround them, and how they deal with various other things, such as changes in the temperature or pollution. Also, I enjoy working with students—giving lectures in biology and helping them in practical work in the laboratory. I am very happy to publish an article in Frontiers for Young Minds journal. Normally, scientists understand each other, but other people cannot participate, think about and understand scientific problems because they are presented in a too complicated manner. Thanks to Frontiers for Young Minds I can present my research and discuss it with children and everybody else who is interested. \*abielen@pbf.hr