

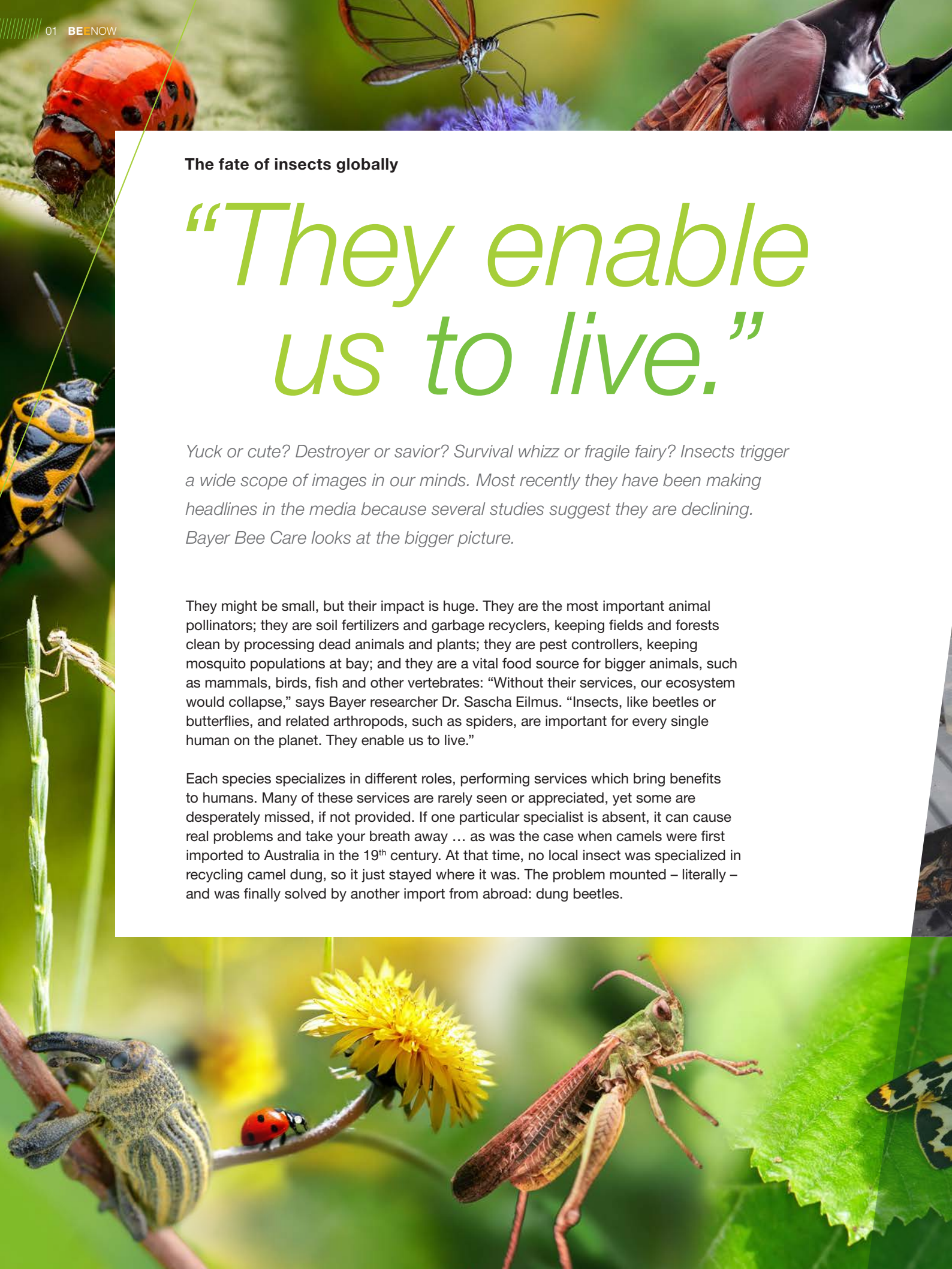
The fate of insects globally

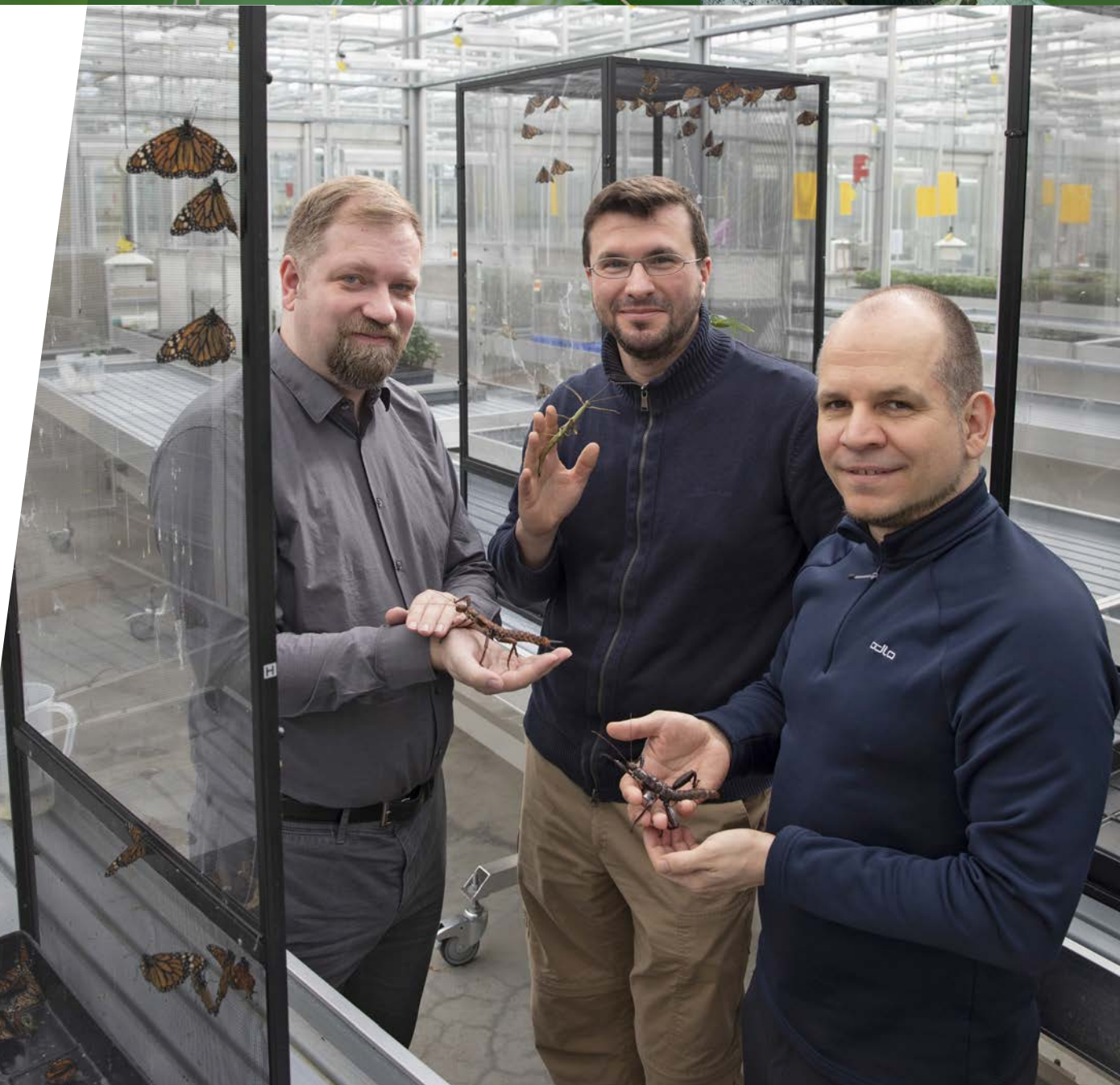
“They enable us to live.”

Yuck or cute? Destroyer or savior? Survival whizz or fragile fairy? Insects trigger a wide scope of images in our minds. Most recently they have been making headlines in the media because several studies suggest they are declining. Bayer Bee Care looks at the bigger picture.

They might be small, but their impact is huge. They are the most important animal pollinators; they are soil fertilizers and garbage recyclers, keeping fields and forests clean by processing dead animals and plants; they are pest controllers, keeping mosquito populations at bay; and they are a vital food source for bigger animals, such as mammals, birds, fish and other vertebrates: “Without their services, our ecosystem would collapse,” says Bayer researcher Dr. Sascha Eilmus. “Insects, like beetles or butterflies, and related arthropods, such as spiders, are important for every single human on the planet. They enable us to live.”

Each species specializes in different roles, performing services which bring benefits to humans. Many of these services are rarely seen or appreciated, yet some are desperately missed, if not provided. If one particular specialist is absent, it can cause real problems and take your breath away ... as was the case when camels were first imported to Australia in the 19th century. At that time, no local insect was specialized in recycling camel dung, so it just stayed where it was. The problem mounted – literally – and was finally solved by another import from abroad: dung beetles.





At a glance

- // Insect groups, like beetles or butterflies and related arthropods, such as spiders, can survive almost anywhere: From the arctic to the tropics, from the desert to wetlands, swamps, creeks and lakes.
- // Their services to the ecosystems of our planet include soil fertilization, pollination and organic waste recycling. Unfortunately, they have a downside too: Mosquitos transmit diseases such as malaria, Zika and dengue, while caterpillars, beetles, moths or locusts can destroy crops and cause famine, if left uncontrolled.
- // Bayer researchers are passionate about them all: They work to promote them where they are beneficial, control them where they cause harm and protect them where they don't.

Are insects declining?

Recently, scientists in several countries have rung the alarm bell: Their studies indicate that the abundance of insects in certain areas has decreased. Environmentalists, politicians, concerned citizens and scientists are trying to verify the figures and identify the causes.

Looking for causes, many people think that they have found an easy equation: Insecticides kill insects, so they must be the culprit. But a reality check shows that there is no such simple explanation. “Instead, it is a whole bunch of factors that combine to impact insects,” says Bayer entomologist Dr. Christian Baden. “Most of the causes are the result of how we treat nature: In the past 20 years or so, we for instance have been optimizing our landuse in all possible ways, sacrificing the habitats of insect species. Hedgerows, field edges, weedy patches, meadows, meadow orchards, pasture, meandering brooks and fallow land – they have largely disappeared, leaving many insects without their natural environment and food source.” Christian Baden adds soil sealing and urbanization as contributory factors and also emphasizes the role of light pollution by street lamps, billboards and industrial lighting: They can confuse or attract nocturnal insects, making them easy prey for spiders and bats.

“Most of the causes of a decline in insect numbers are the result of how we treat nature: In the past 20 years or so, we have been optimizing our landuse in all possible ways, sacrificing the habitats of insect species.”

Dr. Christian Baden

Pest insects continue to thrive, however, despite being exposed to crop protection products, says Sascha Eilmus, explaining: “We are actually creating habitats for them. They are specialists at consuming our crops and we cultivate power food for them in our fields. So they have a heyday, while the specialist insects which rely on rare wild plants are declining because their homes are in the shrinking natural or semi-natural landscapes.”

A highly destructive pest – the Colorado Beetle can decimate potato crops by devouring the plants' foliage. On occasion, it can also impact tomato and eggplant production.

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Dr. Sascha Eilmus



Researchers for biodiversity

Being a global player in agriculture, Bayer has a vested interest in healthy ecosystems and the company's researchers are passionate about striking a balance for bees, bugs, spiders & co.: Controlling them where they cause harm, protecting them where they don't and promoting them where they are beneficial to humans.

"I believe in modern agriculture," says Christian Baden, "after all, we need to eat. That is why it is our responsibility as researchers to help control insect pests: It makes the difference between hunger and no hunger." He illustrates the importance of controlling harmful insects by highlighting the impact of the invasive Fall Army Worm *Spodoptera frugiperda* in Africa, where up to 80 percent of the harvest in the past has been lost because the small-scale farmers had no tools to fight the pest. And even the crops they managed to reap from the field were not secure: Pantry pests were threatening to soil, eat and damage their stored harvest. "We help farmers, big and small, to protect their yields," says Baden, "and this makes my job rewarding and worthwhile. I can help shape agriculture and feed the world!"

When developing the tools to control insect pests, Bayer researchers never lose sight of beneficial insects or the environment. Sascha Eilmus works in early-stage research and explains that the screening of molecules for their impact on beneficial insects starts nearly as early as the discovery of their insecticidal potential. "A molecule will not be pursued further, for those uses which are not compatible with beneficial insects like bees," he says. "Farmers need both chemicals AND beneficial insects."

Bayer researcher Dr. Michael Marx from Environmental Safety adds another dimension of Bayer's commitment to insect biodiversity: "During development of suitable compounds, our selection process looks beyond beneficial insects: We want to protect aquatic organisms, non-target plants, vertebrates, soil organisms, bees and other pollinators, non-target arthropods and even potential insect pest species – as long as they are outside the crop. Bayer tests about 250,000 molecules before we find the one suitable compound that meets all our requirements."



Folsomia candida, a species of springtail, is found in the soil and has been used as a beneficial model organism in research studies.



Dr. Christian Baden checking one of the breeding boxes.



The Fall Army Worm is an insect pest, native to tropical and sub-tropical regions of the Americas and Africa.



The insect team requires a special license to breed invasive pest species which must be contained in special facilities.



Dr. Christian Baden, lab leader entomology

Dr. Michael Marx, expert in ecotoxicology

Dr. Sascha Eilmus, expert in entomology

Bugs

Protein suppliers



Bugs in all shapes and sizes are the passion of entomologist Christian Baden. But what does he think about edible insects?

“In many Asian countries, fried bugs are a popular snack and they are considered delicacies. I’ve tried them, too and they are quite tasty. In Brazil, queen ants are served fried or dipped in chocolate and 19th century cookbooks from Germany still offer recipes for “May bug soup”. From a nutritional point of view it makes sense: Insects are top protein suppliers that can easily keep up with popular meat sources such as beef. As with every food source, however, you need to take care that the way they are produced en masse is still sustainable.

And trendsetters are hopping on the bandwagon: “ENTO-preneurs” are popping up like mushrooms all over the world, challenging daring consumers with insect pizzas and pastas or bug burgers.

Spiders

Good for you



Michael Marx has loved spiders as long as he can remember. As a child, he even took them home, and while his mother was not really amused by his collection of living creepy crawlies in the house, he loved to observe and study them.

His tip for dealing with spiders: “If you see a spider in your home, don’t kill it, it’s a beneficial! Gently escort it outdoors so that it may do its job of controlling the flies and mosquitos outside your bedroom window.”

Butterflies

Delicate but tough



Sascha Eilmus’ favorite insects are native and exotic butterflies and tropical stick insects & katydids (large green American long-horned grasshoppers). He has made them his hobby since childhood. He breeds some very exotic species like the giant stick insects or leaf-imitating grasshoppers and also keeps native butterflies, like the beautiful European Peacock with its blue and yellow eyespots on the wings, in abundance in his garden. What does he like about them?

“They are fragile and delicate but, at the same time, their stamina and assertiveness are remarkable: They can even travel across whole continents. The Monarch Butterfly, for example, spends the winter in Mexico and the first generation sets out in spring to fly north for the summer. It takes four generations of butterfly before they finally arrive as far as Canada. The last generation then returns to Mexico in one go when the weather gets cold.”

Insect pest management and pollinator protection

The times of fighting pests with only chemicals are long gone. Today, many farmers minimize the use of pesticides by embracing “Integrated Pest Management” which includes stress- and pest-resistant crops, crop rotation and beneficial insects like ladybugs (a.k.a. Aphid Exterminator), parasitic wasps (a.k.a. White Fly Killer) and even bees (which can be employed to spread biological plant disease control as they fly from flower to flower).

To promote the wellbeing of bees and other pollinators, Bayer founded its Bee Care Program in 2011. The program’s agricultural projects include advancing beekeeping practices in African and Asian smallholder communities. Farmers whose crops are dependent on pollination are trained to live alongside bees and learn how pollination and crop protection go hand-in-hand in sustainable agriculture. Like the project with the National Museums of Kenya (NMK), looking to identify important insect pollinators for vegetable farming in Kenya and learning about ways to conserve them. Or the CropLife project in India. Michael Marx elaborates: “For pomegranate farmers in the Indian province of Maharashtra, the yield was up by almost 35 percent and the fruit quality improved, while the training they received helped them to use chemical crop protection in a more targeted and thus efficient way, resulting in higher profit margins. As a result, they saw a welcome increase in their net income of 42 percent.”

The Bayer Bee Care Program is also engaged in a project to test ecological enhancement measures to enrich the diversity and abundance of wild bees and butterflies in intensively-farmed areas in Germany’s Upper Rhine Valley: It involves sowing interconnected wildflower areas to create a network of natural and semi-natural habitats on five to ten percent of the farmland, and creating ‘bee banks’ which are soil mounds to attract ground-nesting wild bees.

The results look promising and will hopefully inform farmers, policy makers and agricultural planners on measures that can support wild pollinators as a part of sustainable farming efforts. Yet supporting insects is not limited to the agricultural setting. Every garden can be a paradise for insects, by introducing native, pollen- and nectar-rich plants, or features that offer shelter like insect hotels, dead wood or natural stone walls.

Bayer is getting ready for the future, preparing for agriculture 2.0: “There will be big changes in agriculture in the next 20-30 years,” predicts Michael Marx. “By using digital farming technologies, we can fight pests where and when they appear, controlling them in a very precise way, using less chemicals. And there is the genetic potential of plants. We can breed crops that will resist their hungry antagonists and even withstand the impact of climate change, to survive drought and flooding. All of this means that the agricultural sector will make great progress in the years to come.”

“Adequately tested chemicals, with a proven track record for safety, will be just one tool in a highly-sophisticated and diverse toolbox for growers.”

Michael Marx

The future of insects

Future crops will be tougher, use of chemicals more targeted and human technologies smarter, say the researchers. So where does that leave their favorite passion? What do they think about the future of insects? “If you look at it from an evolutionary point of view – over a period of, let’s say, the next 60 million years – their odds are very good even under adverse conditions,” says Christian Baden. “Their capability for adjustment is high and over the millennia they would evolve new varieties that could render all the specialist services that we need. Our problem is: We can’t wait that long. We need them now. So if we want them to maintain our ecosystems, we must do everything we can to protect them.” And the good news is: There are agricultural landscape management practices that can support wild pollinators and many other insects, so they can thrive.

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Facts & figures

- // Insects are the largest and most diverse animal group on earth. There are over **one million** catalogued insect species but scientists believe there are millions more waiting to be discovered.
- // There are around **400,000** known species of beetle. And even though butterflies are much more visible due to their striking beauty, there are “only” **160,000** known species.
- // With their eight legs instead of six, spiders are not insects but arachnids. They eat a lot of insects, consuming some **400 - 800 million** tons each year.
- // Most individual insects are small, but of the land animals their **total biomass** is the biggest of all. In the African savannah, for example, their biomass exceeds that of the local antelope, giraffe and elephant populations.
- // As far as numbers go, insects dwarf mankind: It is estimated that there are some **10 quintillion** (10,000,000,000,000,000,000) individual insects on Earth.