The charred ruins of a forest: the fire that raged in the Saxon and Bohemian Switzerland National Parks in 2022, consuming 1100 hectares of forest, reached the striking sandstone cliffs.

PHOTO: PICTURE ALLIANCE / DPA | ROBERT MICHAEL

WORKING WITH FIRE

TEXT: TOBIAS BEUCHERT AND PETER HERGERSBERG

Incidences of forest fires are increasing worldwide, including around the Mediterranean and in Germany. The main driver here can be attributed to the ongoing drought stress to which forests are exposed as a result of climate change. The Global Fire Monitoring Center, led by fire ecologist Johann Georg Goldammer, is pursuing new approaches to fire management.

In July 2022, wildfires burned large areas of the Saxon Switzerland and Bohemian Switzerland National Parks, which adjoin at the border between Germany and the Czech Republic. Arson struck a forest that was completely dried out and infested with bark beetles. More than a thousand firefighters battled a conflagration that broke out on the Czech side and eventually engulfed 1100 hectares of forest. Fabian Hälschke, the local fire chief of the Großschönau Fire Department, and his team drove their fire truck to Mezní Louka, 30 kilometers across the Czech border as soon as the alarm went off. When the firefighters could no longer get through the forest with their vehicle, they fought the flames on foot. "The fire had tremendous power. We were right in the middle of the vortex, which was sucking in oxygen, and we ended up having to run for our lives," recalls Hälschke. "When it became clear that we couldn't stop the fire in the forest, we wanted to at least save the village." They pumped as much water as they could into Mezní Louka. "It was like a battle," says Hälschke. As the experienced fire chief knows, even though the inferno in the Saxon-Bohemian border region in 2022 was exceptional, the number and intensity of forest fires have generally increased in recent years.

Vegetation fires on the rise

In 2022, more than 3000 hectares of forest burned in Germany, which is equivalent to the area of Borkum, the largest of the East Frisian islands. In 2018 and 2019, the figure was 2000 hectares. Even that is more than double the average for the years 1991 to 2017. And globally, the wildfire situation has worsened even more, according to a study published in Nature Ecology and Evolution in 2024. The study analyzed nearly 90 million satellite images of fires not only in forests, but also in shrublands and grasslands. According to this research, extreme vegetation fires are about twice as frequent and severe today as they were 20 years ago, with the last six to seven years being the most extreme. With climate change leading to more intense and prolonged droughts, more vegetation around the world is at risk of burning. Regions around the Mediterranean are particularly affected, as evidenced by the almost annual reports of devastating fires in Greece. Even Canada's vast coniferous forests are burning like never before. In 2023, for example, 17 million hectares of forest succumbed to fire in Canada. To put this in perspective, Germany's total forest area is just under 11 million hectares.

Johann Georg Goldammer, who heads the Global Fire Monitoring Center (GFMC) and the Fire Ecology Research Group in Freiburg, a branch of the Max Planck Institute for Chemistry in Mainz, is investigating how to combat fires in forests and agricultural areas. This vegetation fire expert has his office on the top floor of a former air control tower in Freiburg. This is the headquarters of the organization, which is active in nine locations worldwide. Behind Goldammer's desk, a map of the world takes up almost the entire wall. Contrary to its name, the Global Fire Monitoring Center's main task is not to monitor fires around the world. Rather, the GFMC pools knowledge on fire ecology and regional experience in dealing with vegetation fires. Goldammer and his team make this knowledge available primarily to decision-makers in public administration and politics – but also to those who deal directly with fire, such as firefighters, foresters, and farmers. At the invitation of governments in a number of countries, the GFMC has convened and moderated roundtable discussions for representatives of administrative bodies and civil society to develop national strategies for dealing with vegetation fires. In Greece, for example, Goldammer chairs the National Committee "Perspectives for the Future Management of Landscape Fires." The GFMC is also active in Ukraine. There, however, the Russian war of aggression interrupted the development of a national strategy. Ten years before the war, Goldammer had brought Ukraine and Russia together in Krasnoyarsk, Siberia, because fires often cross the border between the two countries. "All the coordination that was achieved between these countries is now going up in flames," Goldammer notes. His team in Ukraine is now recording war-related fires in forests and protected areas on a daily basis. Such missions in crisis areas are a hallmark of the GFMC. The center has also been working with the United Nations for years. The UN is now elevating the GFMC to the status of Global Fire Management Hub, making it a central international point of contact for all aspects of fire management.

SUMMARY

As a result of climate change, vegetation fires in natural and cultural landscapes are becoming more frequent and more severe all over the world – including in Germany.

The Global Fire Monitoring Center conducts research on fire ecology and integrates its findings into the practice of nature conservation and forest fire protection in Germany and worldwide.

Internationally, the GFMC works at the interface between science and policy. It supports multilateral organizations such as the United Nations.

"The fire had tremendous power. In the end, we had to run for our lives."

FABIAN HÄLSCHKE

PHOTO: DMYTRO GILITUKHA

Seeing through the thick smoke: Johann Georg Goldammer (front) trains firefighters in Ukraine on how to combat wildfires.

Johann Georg Goldammer has been researching how humans, the environment, and fire interact, mainly at the Max Planck Institute for Chemistry, since his Ph.D. thesis at the University of Freiburg in 1975 – entitled Feuerökologie (Fire Ecology). His work also involves investigating how people use fire in many cultures around the world. One such culture is in Ghana, where the GFMC has a regional center. "Here, fire is an important part of the ecosystem and agriculture," says Lucy Amissah, who runs the center. In the savanna that characterizes parts of Ghana, fire is part of the natural cycle of vegetation. "But farmers also prepare their land for planting by intentionally setting fires," says Amissah. "Some plants even need fire for their seeds to germinate." In Germany, too, Johann Georg Goldammer has introduced fire into nature conservation and landscape management – for example, to preserve dwarf shrub heaths. Controlled fires are used in place of mowing and grazing.

But fire can also be a means of fighting fire. To show how this works, Goldammer opens a massive iron door on the first floor of the Freiburg tower, emblazoned with stickers from fire departments in various countries, including South Africa. In the workshop behind it, bright yellow firefighting gear hangs on a clothes rack – alongside a bright red helmet that Goldammer wears on his missions around the world. The simple equipment needed to "manage" a fire is laid out on a workbench: Goldammer shows off a small metal bottle filled with a mixture of gasoline and diesel. With it, firefighters can ignite a backfire in front of a head fire, in order to take away fuel from the approaching flames. If the fire jumps, they extinguish it with a handy backpack pump that holds up to 20 liters of water. Finally, Goldammer shows a combination tool that resembles a garden hoe and can be used as a rake, a hoe, and an axe. It can be used to remove flammable vegetation from a firebreak. Such techniques are now included in guidelines for policy and practice in Germany. The fire ecologist and his team are also training German firefighters in hands-on firefighting techniques. For example, the insight that a narrow firebreak is more effective than large equipment and using up precious water is now widely known: "Over the past 20 years, fire departments have purchased a lot of large firefighting equipment," says Matthias Ott, head of the Department for Fire Services and Disaster Control Operations at the Bavarian State Ministry of the Interior. "The goal now is to use knowledge from other parts of the world about how to fight wildfires rather than blindly relying on technology."

The GMFC is not only there to fight fires, however; its main objective is prevention. Fire can also play a role in this, but more on that later. In Germany, preventing forest fires means restructuring forests. German forests have limited means to combat climate change and fire. A look at history shows why this is the case: since the late Middle Ages, many trees have fallen victim to slash-and-burn agriculture and logging, and after World War II, reparations were paid in the form of timber. "Considering the circumstances at the time, reforesting with fast-growing spruce was justifiable," says Goldammer. Today, spruce trees stand in rows in many places. They currently make up a quarter of the forest. But it's getting too warm and dry for spruces, and bark beetles often finish them off. What's more, other trees are also finding it increasingly difficult to cope with the drought. According to the annual national Forest Condition Survey, drought is already tearing holes in the canopy of about 80 percent of the forest. In turn, more sunlight falls on the forest floor, which dries out even more. This becomes a vicious cycle. Dead and dried-out trees are particularly vulnerable to fire.

Spreading the risk through forest conversion

There is a social consensus that forests should be preserved. They are part of the cultural landscape shaped by humans. Not only do they provide timber, but they can also promote biodiversity; protect settlements from floods, landslides, and avalanches; provide recreation; and sequester CO_2 – although nowhere near as much as humans release by burning fossil fuels. To ensure that forests can continue to perform their functions in the future, foresters are increasingly focusing on mixed forests. These forests are designed to contain at least 30 percent more drought-tolerant deciduous and coniferous trees, such as oak, beech, Douglas fir, and pine. The idea is to spread the risk: even if it gets too hot for one species, another may survive. "But even foresters have to be careful here," says Goldammer. There is no single answer to the question of what forests will look like in the future.

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PHOTO: GFMC

Landscape Fire Task Force: under the direction of Johann Georg Goldammer (front left), the Freiburg fire department practices setting a backfire on a harvested field.

To make matters worse, forests are a place in which a number of conflicting interests converge. For example, in Bavaria, the most densely forested state in Germany, more than half of forests are privately owned. Some of them are interested in high timber yields, while others seek to cultivate the largest possible game populations for hunting. Others, though, are more concerned with the forest's ability to perform all of its functions in a sustainable manner. This also happens to be the goal of the forestry services, which are responsible for the 30 percent of forests owned by the state. Fire departments, on the other hand, want to reduce the amount of highly flammable material, and some want a better-developed road network for their fire trucks. With all of these mixed interests, it is difficult to pursue a consistent strategy for forest conversion. While some see dead wood as a biodiversity hotspot, others see it as additional fuel. How to renew forests to reduce the risk of fire was the topic of a conference on vegetation fires held in the townhall of the spa town of Bad Kötzting, near Regensburg, last December. More than 130 representatives from the Bavarian forestry services, private owner associations, local authorities, state governments, and fire departments attended. "For the first time, we brought everyone together to talk about solutions," says Matthias Ott from the Bavarian Ministry of the Interior, who helped organize the conference. As the irony of climate change would have it, the meeting took place amid the chaotic snowstorms that paralyzed much of southern Germany in December 2023. Snow piled up several meters high overnight, bringing all local and long-distance transportation to a standstill. "In summer, not a drop of precipitation falls for weeks, and in winter it all comes down at once," said District Administrator Franz Löffler at the opening of the symposium.

Clear-cut firebreaks

Johann Georg Goldammer was invited as a keynote speaker. The respect that the other participants had for him as a forest fire expert was palpable. But he had come not only to share his knowledge, but also to listen – especially to the firefighters, who were easy to identify among the group. The invitation had stated: "For those with uniforms, the event will be held in uniform." Goldammer is fluent in the jargon of various interest groups, which makes it easy for him to talk to people in the field and get his message across to his audience. In his talk, he presented statistics on the forest fire situation and pictures of forests that are easy prey for the flames. Take the Harz Mountains, for example: hanging branches, more brown than green; spruce trunks

lying crisscrossed like matchsticks. The audience nodded. But what Goldammer really wanted was to offer a way out of the misery. He showed the audience a photo of a cross-section cut from the ground-level part of a pine trunk in the Siberian taiga. It was roughly the shape of a crescent moon and as long as a person's forearm. Fires had apparently repeatedly eaten into one side of the pine. Dents showed where the tree had tried to grow over the fire scars. The message: although the pine has been attacked by flames many times over the centuries, it had survived.

"Getting soot on our noses one day and standing in front of the United Nations the next day with a collar and tie"

JOHANN GEORG GOLDAMMER

Pines, along with larches and Douglas firs, could make Germany's forests more resistant to fire too. They have roots that reach water in deep soil layers and suffer less from drought than the shallow-rooted spruce. Goldammer also advocates the creation of clear-cut strips a few hundred meters wide at regular intervals in forests. The trees in these strips should be about ten meters apart – this does not stop forest fires, but it does prevent their uncontrolled spread. Siberian sparse forests can serve as a model. There, lightning repeatedly ignites fires to which the forest has adapted. Larches and pines are spaced far apart. This means that fires run out of steam quickly before reaching other trunks, and the trees end up not depleting each other's increasingly scarce water. However, sparse forest corridors must be intensively maintained and the undergrowth kept to a minimum. One option is to graze the firebreaks or mulch the grass regularly and process the undergrowth into pellets or wood chips as a renewable energy source. Alternatively, the low vegetation could be burned out as a preventive measure.

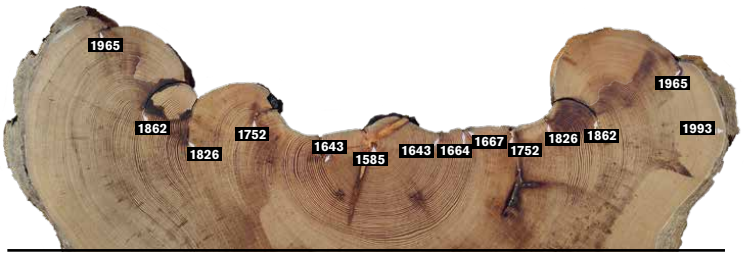
During his talk, Goldammer held up the red metal bottle that is usually kept in his materials warehouse in Freiburg. "This is almost everything you need," he said. It may sound surprising to intentionally utilize fire – an approach known as a "prescribed" or "controlled fire" – but fire management has a long tradition in Germany, for example, in the reclamation of agricultural land through slash-and-burn. In today's densely populated cultural landscape, however, greater caution is required when dealing with fire. After all, 99 percent of wildfires in Germany are caused by people, whether accidentally or on purpose. Sometimes all it takes is a spark from a combine harvester hitting a stone for a field of grain to catch fire. This not only threatens the harvest, but also spreads quickly to towns, villages, and forests. However, Germany does not record statistics on fires on agricultural land, with the result that they do not receive as much media attention as forest fires. This is a problem. "We have been observing for years that agricultural fires repeatedly occur on a massive scale," says fire chief Fabian Hälschke. And they cause a lot of damage.

Farmers as an auxiliary fire department

In the future, farmers may be able to help themselves if their fields catch fire. Participants at the Bad Kötzting conference were able to see how this might work in front of the town hall. There, a massive yellow steel cage had been set up, holding a tank with up to 1600 liters of water. Goldammer developed the concept with Welte, a company that manufactures forestry and other specialty vehicles. The idea is simple: the tank is quickly strapped onto a tractor, which takes it to the source of the fire. The fire can then be efficiently put out with an extinguishing lance that looks like the gun on a pressure washer. "Tractors are faster in the field than firefighters. Farmers can help us in such situations, and we can ensure their safety," said Sebastian Muth, District Fire Inspector from Kitzingen. Practical solutions for firefighting and prevention are just as much a part of Goldammer's team's work as appearing at conferences or talking to politicians: "Getting soot on our noses one day and standing in front of the United Nations the next day with a collar and tie – that's been our exciting routine for decades."

www.mpg.de/podcasts/lebensgrundlagen (in German)

From the Siberian taiga: cross-section of a pine tree that has survived many fires. The numbers mark the years of big fires. In these places, the tree has grown over the fire scars.



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