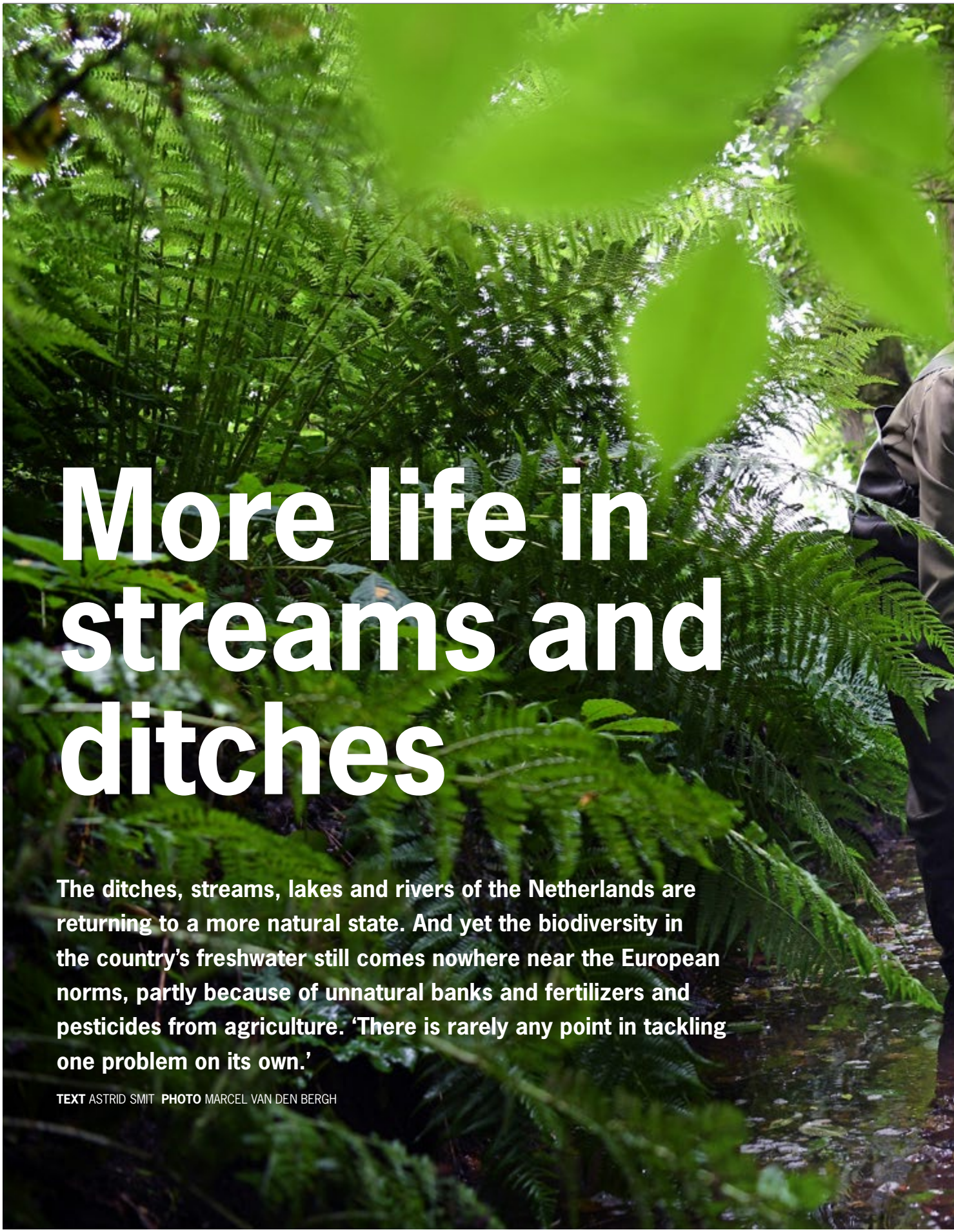

More life in streams and ditches

The ditches, streams, lakes and rivers of the Netherlands are returning to a more natural state. And yet the biodiversity in the country's freshwater still comes nowhere near the European norms, partly because of unnatural banks and fertilizers and pesticides from agriculture. 'There is rarely any point in tackling one problem on its own.'

TEXT ASTRID SMIT **PHOTO** MARCEL VAN DEN BERGH

‘If you want to improve the biodiversity in ditches, you must change the way you farm’

‘Oh dear, there’s not much life in this,’ says Ralf Verdonschot as he combs through his catch from the Oliemolen stream near Renkum. You are supposed to be able to find about 40 macrofauna species here, such as beetles, caddisflies, worms or snakes. But the aquatic ecologist from Wageningen Environmental Research can only find five now, and most of those are species that thrive under low-oxygen conditions. ‘This is a rat-tailed maggot from a hoverfly,’ says Verdonschot, laying a wet, grey caterpillar with a huge ‘tail’ on the palm of his hand. ‘That tail is the windpipe, with which it can extract oxygen from the air and survive in water on little oxygen.’

And yet the Renkum valley was restored eight years ago. It looks very beautiful on this summer’s day in July, with its wide vista full of tall grass dotted with greater yellow-rattle. The stream looks as though it is teeming with life, too. Chestnut trees shade the water and large ferns grow on the bank. But the stream hardly flows at all, and the water level is low. ‘The supply of ground water has decreased, partly because drinking water is sourced here. That causes problems in years when there is not much rain, which will happen more often due to climate change,’ says Verdonschot.

WATER FRAMEWORK DIRECTIVE

The Oliemolen stream is not the only place in the Netherlands where the water plants and animals are not doing very well. In the last survey for the Water Framework Directive, which requires EU countries to bring their biological water quality and biodiversity up to standard, only six per cent of the fresh waters in the Netherlands passed muster on all points: algae, water plants, macrofauna and fish.

There has been a big improvement in the freshwater quality, though. It had suffered tremendously since the 1950s. A lot of factories used to dump waste into surface water, and both purified and unpurified wastewater in towns and villages contained too many harmful substances such as nitrogen compounds and phosphate. Agriculture was partly to blame too. After World War II, farmers went over to using artificial fertilizer and pesticides, and channelled or filled in their ditches. Many old farm ditches with a thick layer of mud and rich flora and fauna disappeared. Up until the 1980s, regional water boards also straightened streams and adapted their profile so that water drained as quickly as possible to keep crops and cows dry. The rivers were submitted to this standardization too, for the sake of shipping and fast runoff of river water.

DUMPING BY INDUSTRY

The tide turned in the 1980s, though. Dumping by industry was firmly tackled, sewage plants were obliged to extract more substances from the wastewater, detergents had to be phosphate-free, and on top of all that, the European Water Framework Directive was established in 2000 and set even stricter standards for water quality.

The ‘Room for the River’ project also started in early 2000, prompted by the severe flooding in the Netherlands in the 1990s. The idea was that rivers needed to store more water by means of wider and deeper water meadows, creating inlets, and removing dyke protection on farmland in a process known as depoldering. This benefitted aquatic nature as well, creating new flood plains and more biotopes. Streams were liberated from their straitjackets too and allowed to meander again, one of the aims of which was to retain more water.

All these measures have improved aquatic biodiversity considerably. ‘On land, what you see at the moment is a massive decline in biodiversity. In fresh water, that decline is actually already behind us,’ says Verdonschot. ‘In fact, aquatic biodiversity has been increasing again since the 1990s.’

MORE PIKE

Fish biologist Leo Nagelkerke of Wageningen’s Aquaculture and Fisheries chair group confirms this. ‘Since the 1950s, fish such as bream and roach – species that can thrive anywhere – have become dominant. Choosy species such as the Chabot bullhead, the brook lamprey and the weatherfish became rarer.’ But fish biodiversity is on the rise now too, partly thanks to the improved water quality. In many standing inland waters, for example, the pike – a predator that benefits from clear water full of fish – has become more plentiful. ‘That’s a good sign,’ says Nagelkerke.

The rivers have benefitted too. They are no longer as green with algae as they were in the 1990s, and the inlets that were created for Room for the River have worked as was hoped. Between 2017 and 2020, Wageningen PhD researcher Twan Stoffers did a study with Rijkswaterstaat (the executive agency of the Dutch Ministry of Infrastructure and Water Management) of various restoration projects along the Waal, Ijssel and Lower Rhine rivers. The extent of changes in fish stocks since the 1990s was assessed, and it was found that, as intended,

PHOTOS VAN BOVEN NAAR ONDER EN V.L.N.R. BLIK ONDER WATER, ANP (2X), BLIK ONDER WATER (2X)

FRESH WATERS HOUSE THE MOST SPECIES

Worldwide, 50 per cent of fish species live in one per cent of all the waters, namely in fresh waters such as rivers, streams, lakes, ponds and ditches. That diversity is mainly found in South America, Central Africa and South-east Asia. In Western Europe, there are naturally fewer freshwater species, which is put down to the fact that during the last ice age the fish there couldn't trek south because most of the rivers run east-west. At present, there are about 50 indigenous and 30 exotic species of fish in the Netherlands. The latter often cause problems by squeezing out indigenous species or transmitting diseases. The diversity of invertebrate water creatures is enormous. There are about 3000 species of these, a large proportion of which are mosquito larvae. Ten per cent of these species have increased in numbers over the last 40 years. These are species that like clean water and species that are invading from further south, as well as common species that are found everywhere.

the new inlets attracted species such as the ide, the common nase and the common barbel, which use these more sheltered, shallow waters as nursery habitats. About 15 years later, however, these species are dwindling in numbers again, while less specialized species such as perch, roach and bream remain. The reason: the inlets silt up in the course of time and the current decreases. Nagelkerke: 'So inlets do need some maintenance.'

CHOKING

But in intensive agricultural areas, says Verdonschot, there is little or no improvement in the biodiversity in the water. The main reason for that is the still high load of nutrients coming from artificial fertilizer and the animal manure that farmers spread on the land. 'The monoculture in the fields and meadows is visible in and on the water.' The fertilizer nutrients benefit plants such as reeds and sweetgrass on the banks and algae and duckweed in the water – species that are not good for biodiversity. A massive growth in algae and duckweed can even choke the water, killing off other organisms such as submerged water plants and fish. In the past few years, and in collaboration with the University of Amsterdam, Verdonschot has been studying the biodiversity in a ditch that started in the wet meadows of De Wieden nature reserve and ended in an intensive agricultural area. 'Then you see the number of species dwindle fast.'
It is not just fertilizer nutrients from intensive farming that impact biodiversity, but also chemicals that are still ending up in the water. The macro-pollution of the 20th century has given way to micro-pollution with the likes of microplastics, flame retardants, UV filters, pesticides and drug residues. These substances get into surface water in low concentrations but can nevertheless have a considerable impact on the ecosystem, if only because they reinforce each other or are effective even in tiny quantities – an example being the neonicotinoids with which crops were sprayed and seeds were coated until just a few years ago.

PESTICIDES

The research group led by Paul van den Brink, personal professor of Chemical >

PHOTO SHUTTERSTOCK

The Netherlands has about 300,000 kilometres of ditches, in which the biodiversity is badly affected by the high nutrient load.

Stress Ecology, is working on documenting precisely the effects of micro-pollution such as drug residues and pesticides. They are studying the behaviour of individual organisms – to see, for example, whether psychotropic drugs cause them to speed up or slow down. They also research the persistence of the substances, and determine their effects on experimental ecosystems – ponds used for tests with alga, water plants and macrofauna. It is clear that a neonicotinoid such as imidacloprid can have a big impact. 'We have seen that a breakdown product from this pesticide sticks to receptors in the common freshwater shrimp and the larvae of the mayfly for a long time,' says Van den Brink. The overall toxic effect of micro-pollution on the aquatic ecosystems of Dutch waters has not yet been ascertained. 'But it is definitely a significant factor,' says Van den Brink. A German study in 2020, which the Dutch Radboud University helped with, estimated that micro-pollution is responsible for one quarter of the negative effects on freshwater ecosystems. Van den Brink: 'Which substances are responsible varies from place to place, but in the rural areas it's usually pesticides.' The provisional results of a study by Radboud University and STOWA, the Dutch water boards' research institute, point in the same direction. 'Aquatic communities are affected by toxic substances on about half of the 8000 locations. And that usually comes about due to interaction between ammonia, metals, polycyclic aromatic hydrocarbons and – above all – plant protection products,' says Bas van der Wal, water systems programme coordinator at STOWA.

What can be done to ensure that biodiversity improves in the intensive agricultural areas as well? 'There is no way around the need to really change the intensive farming system,' says Verdonschot. 'If you want to improve the biodiversity in the ditches, 300,000 kilometres of them, and the several thousand kilometres of streams, you must change the way you farm and make sure you cut the quantities of harmful substances getting into the water from the fields and meadows.'

He also thinks is would be a good idea to get rid of abrupt transitions between land and water. For a rich flora and fauna, banks should be gradual, so you get marshy zones or banks that get flooded occasionally. 'Biodiversity does well when there is a mosaic of biotopes. Species often use different parts of the ecosystem over their life cycle. Water beetles lay their pupae in the film of water between, say, mosses and sedges of the water's edge. They need such fringe zones around the water.'

VALLEY-WIDE

A plan has already been worked out for the streams: 'valley-wide stream restoration', a concept developed by Verdonschot and his father Piet, head of the Freshwater Ecosystems chair group at Wageningen Environmental Research, and professor of Aquatic Ecology at the University of Amsterdam. The key message is: don't look only at the stream as such but involve the whole valley and create five zones in it. The stream itself with a gradually sloping bank and flood areas , a woodland zone, a shrubland zone, a buffer zone with

> ‘The monoculture in the fields and meadows is visible in the water’

extensive organic farming, and only then intensive farming or an urban area. The valley of the Groote Molenbeek, a stream in Limburg, is currently being landscaped along these lines.
Another important factor in the restoration of biodiversity is that waters should be interconnected so that populations can spread and fish such as eel, river lamprey or salmon can migrate back and forth. On this point too, action has been taken in recent decades. Water boards and the Water Works directorate have restored a lot of old links by, for example, creating fish ladders or passes around locks, dams and pumping stations. Nagelkerke: ‘We have now started a national project with Rijkswaterstaat, STOWA and the water boards, in which we are researching how well those fish ladders work. Which ones are functioning well, which ones less so, and why?’

TREE TRUNKS IN A STREAM

There are lots of factors, then, that play a role in the improvement of biodiversity. There is rarely any point in tackling one problem on its own, according to Ralf Verdonschot. For the water boards and nature organizations, he has studied the effect of small-scale restoration interventions such as placing tree trunks in a stream, which creates variation in the current and provides shelter for animals, or partial mowing of water plants. ‘In itself, that works perfectly, but it only goes well in streams where other measures are taken too, such as improving the flow and reducing the nutrient load.’
STOWA is thinking along the same lines, and has developed what are known as the key ecological factors for the water boards to work with. There are nine factors for standing water and 10 for flowing water: these include productivity (due to the nutrient load), light climate, connectivity, habitat suitability and toxicity. Only if the water scores well on all these factors can the biodiversity really improve. Van der Wal: ‘The water boards now have useful tools for restoring their waters and achieving the goals of the Water Framework Directive.’
If this is not done, or not done enough, the Netherlands risks being taken to court by the European Commission from 2028. This could eventually lead to a big fine being imposed by the European Court of Justice.

RECOVERY LOSING STEAM

When it comes to climate change, however, there is not much water managers can do. And yet periods of drought, high temperatures or extreme rainfall are having a seriously negative impact on biodiversity in regions without much influence of agriculture. ‘So sadly, the upward curve of recent decades has flattened in the past few years, as we see here in the Renkum stream valley,’ says Verdonschot.
The aquatic ecologist continues his search of the Oliemolen stream. He doesn’t want to go home without having spotted a single caddisfly, a species typically found around streams. He carries on searching, inspecting tree trunk after tree trunk. He scores at the fifth. ‘See that little web? That belongs to a net-spinning caddisfly. It uses the web to catch its prey. Look, there it is, behind that little ridge.’ Relieved, he returns the tree trunk to the stream and we can go home. ■

www.wur.eu/biodiversity-freshwater

THE WAGENINGEN BIODIVERSITY INITIATIVE

Wageningen University & Research launched the Wageningen Biodiversity Initiative in June 2021. Researchers from all sorts of disciplines are working on it – ecologists, soil scientists, plant and animal scientists, technologists, economists, behavioural scientists, and other experts – with the aim of better understanding and stemming the worldwide loss of biodiversity. Wageningen expressly invites scientists, students, PhD researchers and societal groups and stakeholders such as policymakers, industries, companies, and NGOs to join the initiative.
The initiative addresses three areas: Biodiversity in the Food System, Human-wildlife Interactions, and The Value of Nature.
Professor Liesje Mommer, founder of the initiative: ‘We have 10 to 15 years left to turn the tide, and we are not going to make it at our current rate. There is no quick fix, and a major revolution is needed, with the form it takes varying per region. That is why it is imperative that we join forces now – from sociology to agronomy, ecology and technology.’