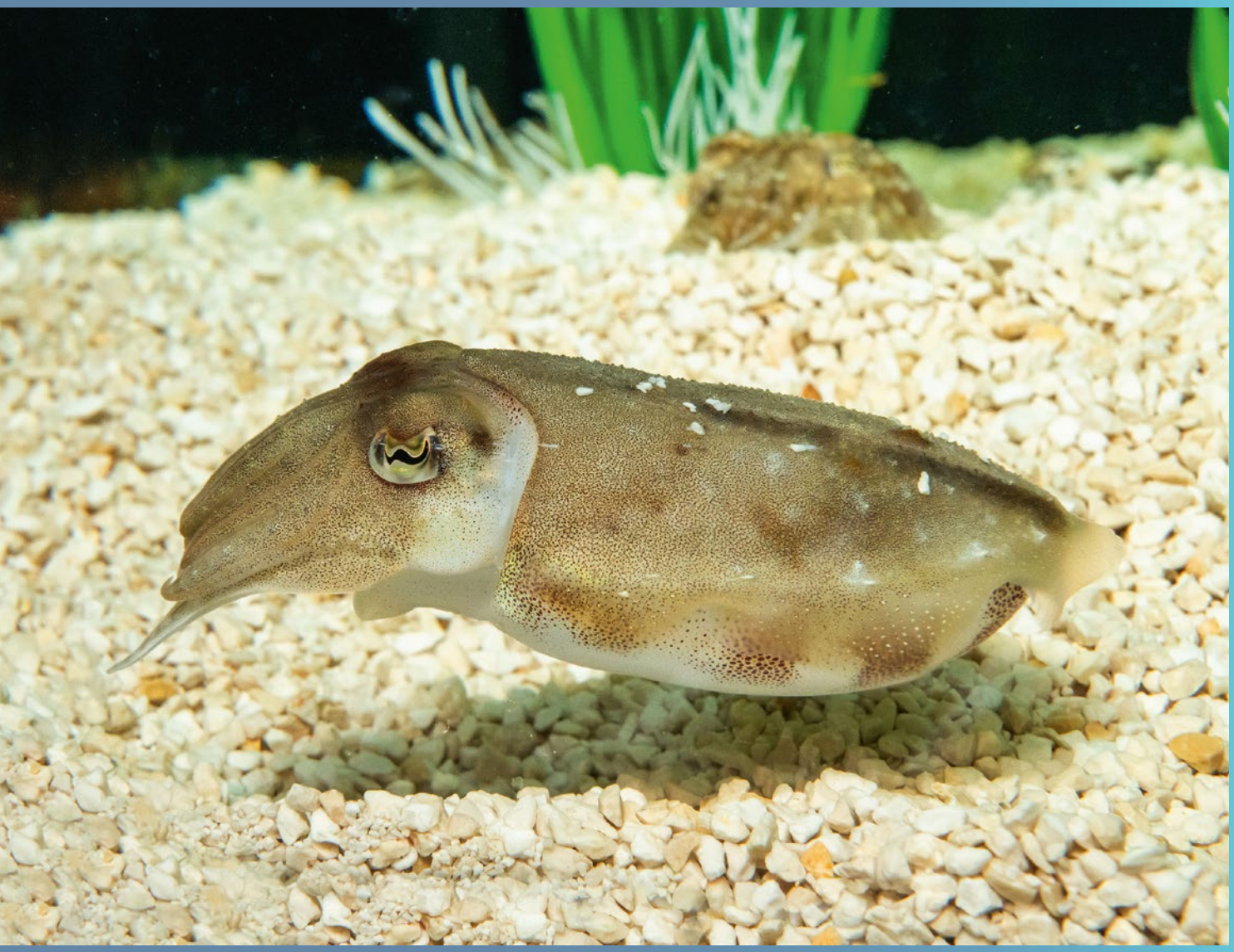
A DIFFERENT SPECIES OF INTELLIGENCE



The cuttlefish *Sepia officinalis* can change colour in a split second. The extraordinary creature also receives extraordinary protection as a laboratory animal.

On the one hand, Sepia is very similar to us. A visual creature like us humans, the sepia appears to attentively inspect us through its W-shaped pupils. Its many-armed head gives it an almost jolly look. Is it not smiling at us as it elegantly glides through the water, fins fanning, two tentacles raised as if in greeting? *Sepia officinalis*, the roughly hand-sized "common cuttlefish", is anything but common and according to everything we know, an intelligent creature.

Yet on the other hand, the cuttlefish is very different from us. Our paths diverged more than 600 million years ago when our last common ancestor lived. Humans are more closely related to fish than to cuttlefish (which is, incidentally, not a fish). The cuttlefish's eyes (like other cephalopods) and its intellectual abilities have developed independently to those of vertebrates. With its ten suckered tentacles or "head arms", two of which act as lightning-fast "prey catchers", a shield-shaped backbone of limestone called cuttlebone which protects the soft parts, ink which is released to confuse other animals, and the powerful and deadly horned beak, Sepia is living proof of evolution's ingenuity.

TWO PATHS, ONE DESTINATION

As an invertebrate, Sepia has no spinal marrow that runs protected along the canal in the spine and directs signals to and from the brain. The brain of the sepia is concentrated in rings around the gullet forming two centres, one in front and one behind the oesophagus. In addition to other ganglia (especially in the tentacles) the sepia also has very large bean-shaped optic lobes where nerve cells process the optic signals. A visual creature, indeed. Despite its decentralised thinking organ there are some parallels to the centralised brains of vertebrates. As with the eye, this is an example of a parallel "convergent" development: different paths to the same destination.

Among invertebrates, cephalopods are the most intellectually developed. Their perception, learning capability and memory are likely comparable to that of some vertebrates. These capabilities have made the animal group an interesting object of study in terms of nervous system research for some time.

CEPHALOPODS ON SAME LEVEL AS VERTEBRATES

Against this background, in 2010 the European Union (EU) included cephalopods in its directive on the protection of animals used for scientific purposes 2010/63/EU. The directive justifies this protection in that there is scientific evidence that these creatures "can feel pain, suffering and anxiety as well as suffer permanent damage." Thus a whole group of invertebrate animals with almost 700 known species has been placed under the same protection as vertebrates for the first time. This is one of the main reasons why biologist Dr Johannes Pucher researches the husbandry and breeding of *Sepia officinalis* at the German Centre for the Protection of Laboratory Animals (Bf3R) in Berlin-Marienfelde.

GOOD HUSBANDRY FOR A DECENT LIFE

The Bf3R is obligated to adhere to the 3R principles in its work. 3R stands for "reduction" (reducing animal experiments), "replacement" (replacing animal experiments) and "refinement" (improving). Husbandry of the Sepia

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is an issue of “refinement” as well as of suitable living conditions for the laboratory animals and the reduction of stress.

One of the important foundations for a good life is water quality. At the Bf3R it is possible to adapt the water conditions, such as temperature, salt content, pH value, and nitrogen concentration, very precisely to the needs of the animals. The water used at Bf3R is first desalinated (deionised) so as to create “bespoke seawater”. Johannes Pucher’s experience with research projects on aquacultures with different animal species for whom water quality is always a significant factor serve him well here.

ONE OF THE EXTRAORDINARY SKILLS OF THE ANIMAL IS ITS ABILITY TO CHANGE ITS SKIN SURFACE AT HIGH SPEED: FROM SMOOTH TO ROUGH OR PRICKLY.

THE POISONOUS SIDE OF THE SEPIA

Sepia´s nutrition, which consists primarily of shrimps and fish, is just as important for the creature’s well-being. Pucher is looking for alternatives to such live feed.

Due to the arrangement of its brain around the gullet, the Sepia cannot simply swallow large prey. “The brain would rip,” explains Pucher. Crabs or large fish are instead gripped by the tentacles, opened with the “parrot beak” and paralysed with a poison. Then the parts of the prey containing enzymes are dissolved and thus made ingestible for the Sepia.

The Sepia’s perhaps most spectacular property comes into play when they are hunting: its talent to change skin colour within a split second

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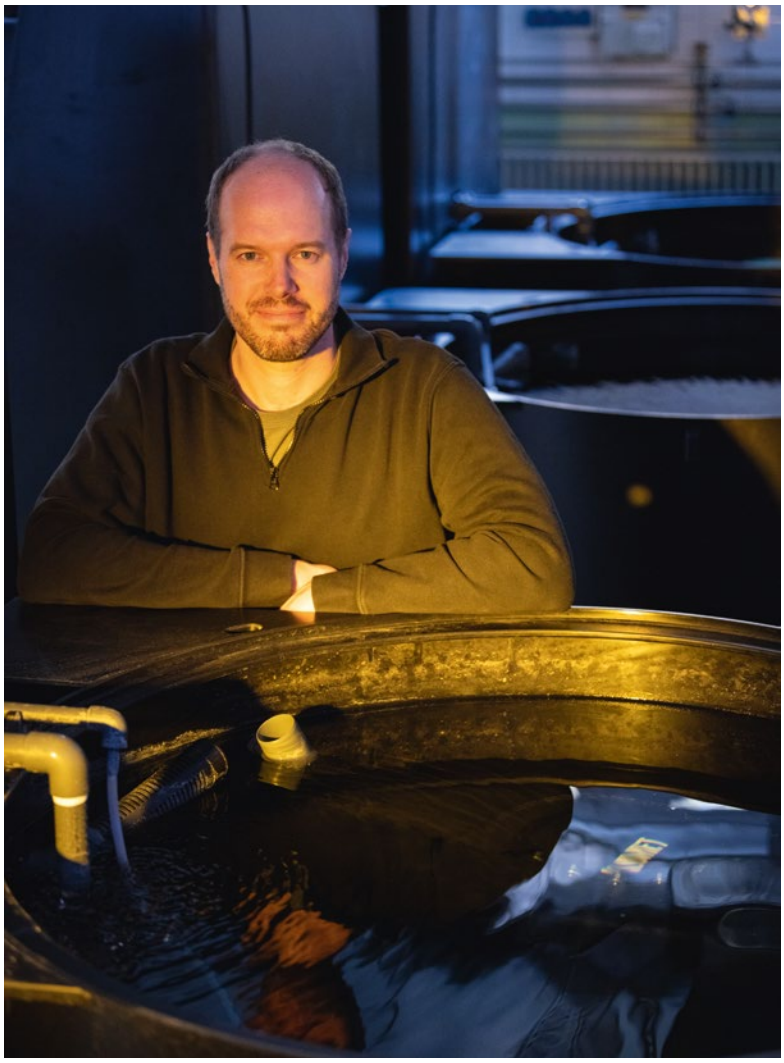
Husbandry and breeding of Sepia officinalis is researched at the German Centre for the Protection of Laboratory Animals (Bf3R) in Berlin-Marienfelde.



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One of the important foundations for a good life for cuttlefish is water quality. Biologist Johannes Pucher German Centre for the Protection of Laboratory Animals (Bf3R) draws on his experience with research projects on aquacultures with different animal species for whom water quality is always a significant factor.

– whether to camouflage itself, threaten enemy predators, defend its territory, or interact with other sepia. The "communicating skin" is nothing short of a natural wonder. And as if that was not enough, it is also able to transform the surface of its skin lightning fast: from smooth to raw or prickly, for example. "In the future we may be able to read what the animal is thinking about from its skin," says Johannes Pucher. It becomes a window into its reality and its experience and could give potential clues about its well-being.

Johannes Pucher and his team are on their way to finding out what good animal husbandry could look like for the Sepia. The creatures in the Marienfelde aquarium have spawned – a breakthrough, but breeding is difficult. "We've closed the life cycle," says Pucher. He is proud of this achievement: the strange creature has become a little more accessible. —

A HEAD FULL OF ARMS

In some regards, cephalopods such as *Sepia officinalis* are unique creatures. For example, the brain is arranged very differently to those found in vertebrates – the oesophagus runs right through it. However, Sepia have excellent learning capabilities that are otherwise only seen in vertebrates. More and more of these talents have been brought to light through behavioural experiments over the years. This is how Sepia learn to no longer grab a shrimp protected by a glass tube. If sepia are suitably trained, this experience – glass tube protects shrimp – can be even permanently imprinted in their memory.

In addition to such comparably simple learning abilities the Sepia also have very clever talents. They have an episodic memory and are thus able to remember certain events, which makes it easier for them to lay in wait for prey at a certain place at a certain time. Self-control is also no foreign concept to them. They can hold back from a less desirable prey in case a better meal comes along – at least for a couple of minutes. And that is something that even humans do not always manage ...