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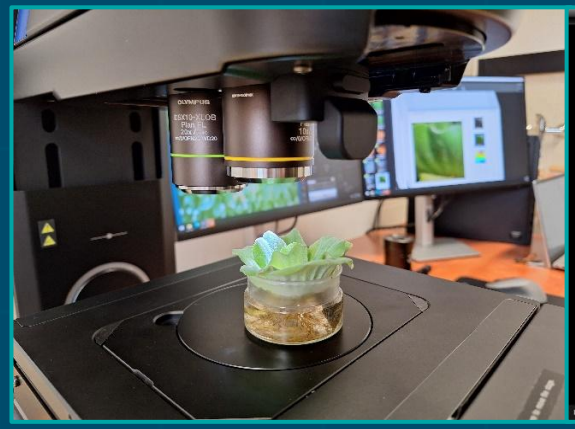
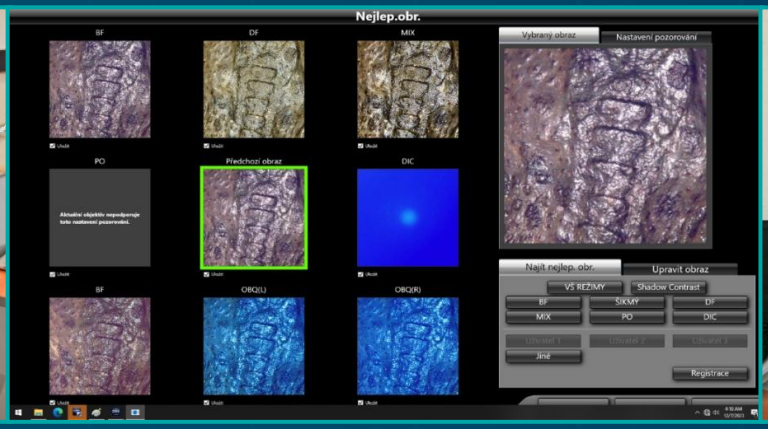
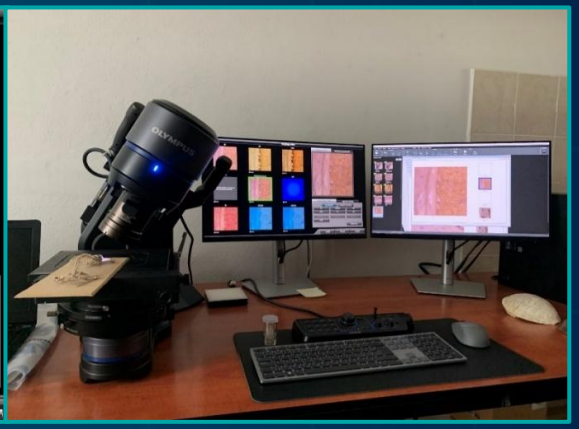
EFFUSE
RIVER LANDSCAPE
VOLUME 2

Guidelines for Experts







PAVOL JOZEF ŠAFÁRIK UNIVERSITY IN KOŠICE

Faculty of Science

EFFUSE – RIVER LANDSCAPE
Volume 2
Guidelines for Experts

EFFUSE team of authors

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EFFUSE – River Landscape, Volume 2: Guidelines for Experts

Educational text

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CONTENTS

EFFUSE – Guidelines for Experts

WHY TO VISIT A RIVERSIDE?

River landscape

- a unique place, concentrating and connecting landscape phenomena and biodiversity
- possibility to understand more comprehensively the environment that surrounds us in space and time
- collection of biological data important for the future
- excellent destination for excursions and relaxation, but you need to prepare them
- our rivers and their surroundings are among the least accessible places in nature and the most forgotten
- our rivers and their surroundings are among the most polluted and neglected places

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Lessons and perspectives

- the need for new „literacy“ and enthusiasm in relation to the acceptance of the phenomenon of river and river landscape
- cross-border exchange of inspirations and wider cooperation
- the need for communication across social and educational layers of society
- perhaps we should have the courage to be pioneers in this

Figure 1 Laborec and Uzh, a wonderful, but permanently stressed rivers and environment.

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Field work

- samples of animals in the littoral zone (sifting of vegetation and sediment, individual collection)
- 2 m^2/site examined
- sorting of drifted shells (on the Olšava River banks)
- collecting of environmental data (type of habitats, pH, temperature, conduction of water)
- growing season
- incomplete data for the Laborec River (in progress)

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Comeback of the European beaver

Beaver versus riverside human communities

- recent recolonization of habitats by beavers is observed in all three rivers
- at the Laborec River, the first observation of the beaver is perhaps 30 years old, and the colonisation was successful
- the first records of beaver in the Trnávka and Olšava rivers are not older than 5 years, and it is still irregular and rare inhabitant there
- the pronounced and positive impact of beavers on landscape regeneration is instructive for common visitors as well as for conservation practice

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BIOINDICATORS – A KEY TO LANDSCAPE

- a (river) landscape is too **large**, **diverse**, and **complex**
- animals (biota) can be **good guides** for us as the next guiders
- **selection** of a group of animals and plants for study is necessary
- each animal and plant group is **sensitive in a different way**
- species presence, biodiversity, community structure, rare species, allochthonous species, autecology, interactions

Figure 2 Crustacea: Branchiopoda.

Figure 3 Mollusca (aquatic, semiaquatic)

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Insects as effective bioindicators for determining the ecological state of a standing waters/watercourse

The existence of many insects is associated with fresh water bodies. Some of them live in reservoirs constantly; others, semiaquatic, only in the preimaginal stages. Inhabiting almost all types of water bodies, insects are able to live in moist places outside them for a short time and to fly from one water body to another, which indicates their high ecological plasticity and wide distribution. At the same time, they often react acutely to changes in environmental factors, as a result of which the aquatic insect fauna of each specific reservoir quite accurately reflects its type, as well as the processes taking place in this reservoir. Hence the great role of water insects as indicators of the environment, which is important for the comprehensive assessment of continental water bodies. The best indicators of the state of water bodies are representatives of mayflies, dragonflies, water bugs, beetles, and some dipterans.

Representatives of the Ephemeroptera order are typical semiaquatic insects whose larvae develop in water for 1-3 years. They play an important role in benthic coenoses of rivers and are used in biomonitoring. Their average number in rivers rhiches 100 individuals/m^2. These are mostly representatives of the genera *Baetis*, *Rhithrogena*, and *Cloeon*.

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Larvae of dragonflies (**Odonata**) are mostly inhabitants of plain rivers, while few species occur in mountain ones. In particular, such *rheophilous* species as *Calopteryx splendens* and *Platycnemis pennipes* are found in the upper reaches of the Uzh River. *Lestes sponsa* and some species of the genus *Coenagrion* develop in small stagnant water bodies in the riverbed. Some species periodically fly into the highlands. These are, in particular, *Cordulegaster bidentata* and representatives of the genera *Aeschna* and *Sympetrum*. They occupy an important place in the coenoses of rivers and are used in biomonitoring.

Figure 4 Species of dragonflies:

1 *Callopteryx splendens*
2 *Sympetrum vulgatum*

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Plecoptera larvae live almost exclusively in flowing bodies of water: streams and rivers. They are an important component of the benthic fauna, as well as bioindicators of the state of water bodies. Most often, these are representatives of the genera *Brachyptera, Nemoura, Leuctra.*

Among the bugs (**Hemiptera**) there are aquatic ones. They include the water scorpion, ranatra, wrens, and water gauges. They occur in various bodies of water: puddles, ponds, and swamps.

Figure 5 Plecoptera

Figure 6 *Notonecta glauca*

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Beetles from at least 25 families are associated with freshwater. True water beetles are representatives of the genera *Haliplidae*, *Dytiscidae, Noteridae, Gyrinidae, Hydraenidae, Hydrophilidae*. Their larvae and adults live in water bodies and play an important role in hydrocenoses.

Many of them inhabit the banks and are known as indicators of various waters.

Figure 7 *Chlaenius nitidulus*

Figure 8 *Carabus variolosus*

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Trichoptera is a semiaquatic insects order whose larvae live mostly in flowing water bodies. They prefer stony areas of mountain rivers, where they make up the main part of the benthos.

Larvae live in "caps", which are built from particles of detritus or other material from the bottom of the reservoir. Imagos live near water bodies and do not feed.

Several species of *Trichoptera* are known from Uzh valley, which are used in bioindication. These are mostly representatives of the genera *Rhyacophila, Hydropsyche, Potamophylax*

Figure 9 Trichoptera

The main factor that directly affects most of the characteristics of reservoirs is their flow rate. Species found almost exclusively in flowing water bodies belong to rheobionts. They include the larvae of many dayflies, dragonflies, and freckles. Most of them are also stenoxybionts.

Baetis beskidensis, *Hydroporus ferrugineus, Orectochilus villosus, Hydraena gracilis, Limnebius truncatellus, Elmis obscura;*

Figure 10 *Hydroporus ferrugineus*

Figure 11 Plecoptera

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Rheophiles are restricted to flowing bodies of water, while some dragonflies and water beetles are occasionally found in stagnant water. Moderate rheophiles (reoxenes) are found both in stagnant and weakly flowing water bodies.

Callopteryx virgo, Haliplus lineatocollis, Platambus maculatus, Agabus undulatus, Gyrinus substriatus, Helophorus arvernicus, Anacaena globulus, Laccobius obscuratus, Helichus substriatus, Sialis lutaria, Hydropsyche ornatula;

Figure 12 *Callopteryx virgo*

Figure 13 *Sialis lutaria*

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The species composition of water beetles also depends on the period of existence of the reservoir. Telmatophiles are adapted to life in temporary reservoirs, and therefore, they have a short development cycle. After the reservoir dries up, the insects bury themselves in silt until the next reservoir is filled, while the larvae that did not have time to complete their development and die. They are found mainly in the lowland temporary open swamps. The majority of stagnophilic aquatic insects migrate to other bodies of water during this period.

Coelambus confluens, Laccornis kocai, Agabus labiatus, Berosus luridus, B. signaticollis;

Figure 14 *Laccornis kocai*

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Several species are stenobiont in relation to one or more chemical factors and therefore can serve as natural biological indicators. So, in places of accumulation in reservoirs of species Hydroporus ferrugineus and *Limnebius truncatellus,* almost always surface water exits are observed.

Findings of the species *Hydraena pygmaea, Ochthebius metallescens*, *Riolus cupreus* in rivers and streams indicate that they flow over limestone rocks, and the species *Hydraena excisa* and *H. dentipes* indicate the probable absence of limestone there. At the same time, the decrease in the number or disappearance of rheobionts and rheophiles, as well as the appearance of stagnophilic forms in flowing water bodies, may indicate their organic pollution.

Figure 15 *Hydraena excisa*

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The structure of the bottom of the reservoir greatly influences the formation of the insect fauna. Sometimes this factor is considered to be decisive in its influence on the fauna of aquatic organisms. In this relation several groups of aquatic insects can be distinguished. *Pelophiles* include species that prefer water bodies with silty bottoms.

Peltodytes caesus, Haliplus obliquus, H. lineatocollis, H. fluviatilis, H. laminatus, Laccophilus hyalinus, Agabus paludosus, Ilybius fuliginosus, Rhantus notatus, Rh. bistriatus, Ochthebius flavipes, Laccobius gracilis;

Figure 16 *Halipus obliguus*

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Psammophiles are species confined to water bodies with a sandy bottom: *Bidessus delicatulus, Helophorus arvernicus, Laccobius albipes, L. simulatrix;*

Argillophiles are found mainly in water bodies with a clay bottom: *Haliplus laminatus, Scarodytes halensis, Ochthebius rugulosus, O. narentinus;*

Petrophils are species found in reservoirs with rocky bottoms. Most rheobionts (especially species from the *Hydraena* genus) belong here as well. Several petrophilic species from the genus *Ochthebius* (*O. exculptus, O. gibbosus, O. foveolatus, O. sidanus*) live mainly at the water-air interface.

Figure 17 *Halipus obliguus*

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The Uzh River in the village of Kamyanitsa is divided into two sections by a dam. Above the dam, the banks are steep, and the channel is widened and deepened. The entomofauna here is rather poor, insects are represented mostly by eurybionts. Below the dam, the river again acquires a mountainous character with characteristic species.

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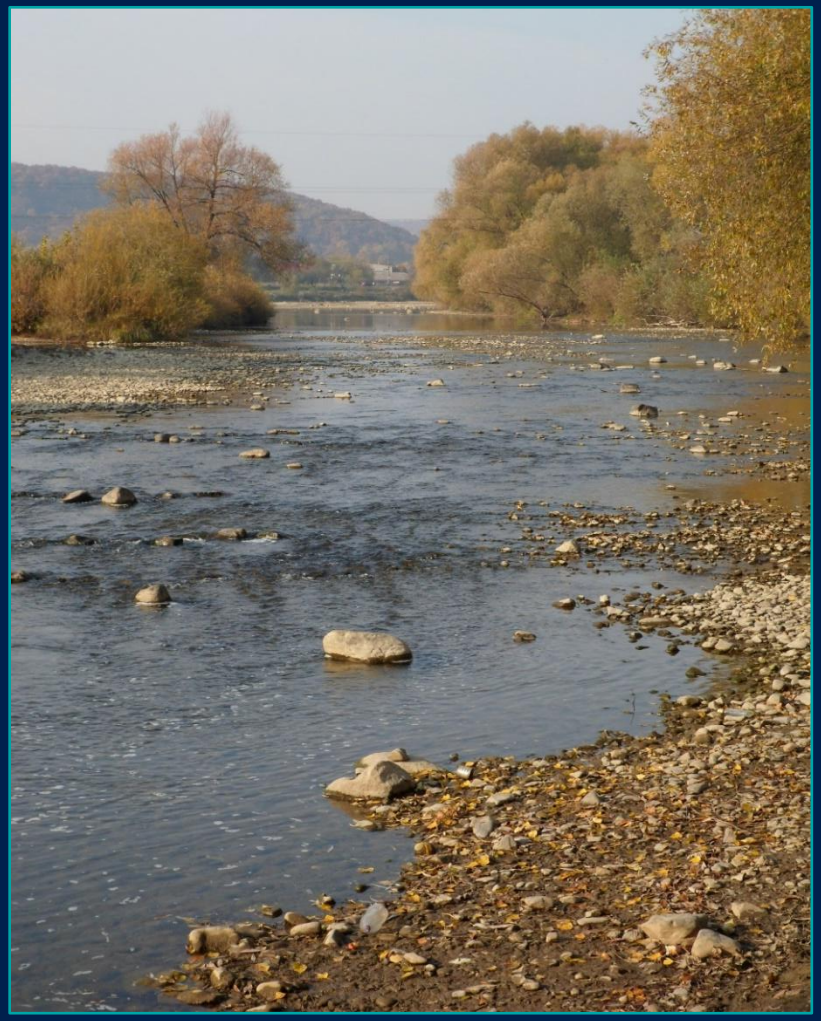
The banks of the river and tributaries are inhabited by numerous insect species.



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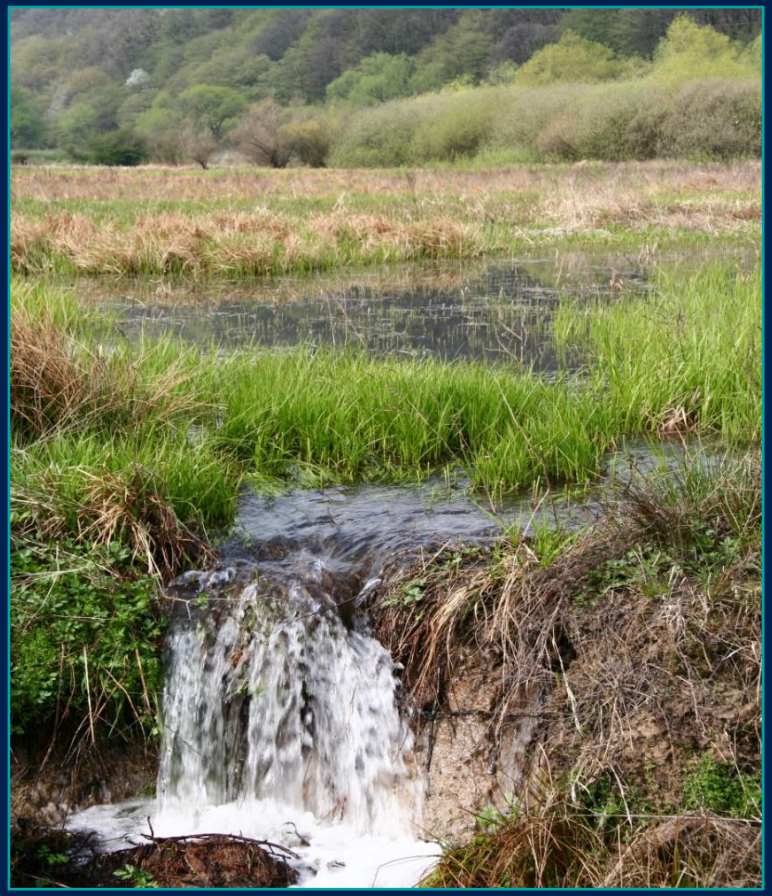
The entomological fauna of the marshy meadows and old shallow rivers is one of the richest in the Uzh valley.



Hyadicus transversalis

The lower part of the river Uzh (Bozdosh) is characterized by a decrease in the aquatic insect's diversity, mainly due to human activity.

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Aquatic macrophytes as effective bioindicators for determining the ecological state of a standing waters/watercourse

- Assessment of the state of ecosystems of rivers or reservoirs is carried out in various ways using a number of indicators.
- Bioindication methods, based on the laws of ecological tolerance of species, are becoming widely used.
- One of the directions of bioindication is phytoindication, in which signs and properties of plants or a certain combination of them (populations, species, groups) are used as indicators.
- Aquatic macrophytes are effective bioindicators for determining the ecological state of a standing waters/ watercourse.

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Indicator species of rheophilic conditions

These species are able to withstand a certain speed of the current and need a high concentration of oxygen dissolved in the water for their development.

Potamogeton perfoliatus, P. praelongus, P. crispus, Sparganium erectum, S. emersum, Butomus umbellatus, Sagittaria sagittifolia, Schoenoplectus lacustris;

Figure 18 *Potamogeton crispus*

Figure 19 *Potamogeton perfoliatus*

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Indicator species of limnophilic conditions

When the river is regulated, conditions close to lake conditions are crea-ted. Here, limnophilic groups develop, able to withstand siltation, deteriora-tion of the oxygen regime and an excess of organic matter in the water.

Phragmites communis, *Typha angustifolia*, *Nymphea alba*, *Potamogeton natans*, *P. lucens*, *P. nodosus*, *P. trichoides, Stuckenia pectinata*, *Myriophyllum spicatum;*

Figure 20 *Potamogeton natans*

Figure 21 *Myriophyllum spicatum*

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Waterlogging indicator species

Waterlogging processes are observed in old floodplain reservoirs and shallow rivers. At the same time, an excessive content of organic matter, a decrease in the level of oxygen dissolved in water, and an increase in the concentration of hydrogen sulfide and methane are noted.

Typha latipholia, Utricularia vulgaris, Ceratophyllum demersum, Lemna minor, L. trisulca, Spirodela polyrhiza, Statiotes aloides

Figure 22 *Statiotes aloides*

Figure 23 *Utricularia vulgaris*

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Macrophytes are indicators of the peat state of a standing waters / watercourse

Oligotrophic standing waters / watercourses – insignificant content of biogenic elements in water (primarily nitrogen and phosphorus) and a low level of primary production.

Myriophyllum alterniflorum, Potamogeton alpinus, Fontinalis sp., Chara sp.

Figure 24 *Fontinalis* sp.

Figure 25 *Chara* sp.

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Macrophytes are indicators of the peat state of a standing waters / watercourse

Mesotrophic — standing waters / watercourses with an average level of primary production and a moderate content of mineral nutrients.

Potamogeton perfoliatus, Myriophyllum verticillatum, Elodea canadensis, Sagittaria sagittifolia, Polygonum amphibium, Sparganum erectum, Nuphar lutea, Ceratophyllum submersum

Figure 26 *Polygonum amphibium*

Figure 27 *Sagittaria sagittifolia*

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Macrophytes are indicators of the peat state of a standing waters/ watercourse

Eutrophic – standing waters / watercourses with a high level of primary production, rich in biogenic elements.

Batrachium circinatum, Ceratophyllum demersum, Myriophyllum spicatum, Stuckenia pectinata, Nymphaea alba, Utricularia vulgaris, Hydrocharis morsus-ranae, Salvinia natans, Lemna minor, Spirodela polyrhiza

Figure 28 *Batrachium circinatum*

Figure 29 *Hydrocharis morsus-ranae*

The degree of representativeness and **preservation of aquatic and riverine habitats** can be used to classify and assess the state of standing waters / watercourses, as well as monitor their current state.

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Riparian habitats in the lower part of the river Uzh already show significant diversity, however, their representativeness and degree of preservation are average or low, and their distribution is very fragmented and represented in the form of broken loci.

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In its natural state, the basis of the river floodplain complex at this distance was made up of willow bushes and, mainly, **willow-poplar forests galleries**.

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These forests form **the willow-poplar forests of floodplains** biotope, a priority for protection in the EU (Berne Convention, Resolution 4: G1.11 Riverine Salix woodland; Annex 1 Habitat Directive: 91E0*Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)), with the participation of *Salix alba*, *S. fragilis*, *Populus alba*, *P. nigra*.

The forests of the habitat in the floodplain form strips, in places up to several dozen meters wide, are well representative, their shrub and grass layers are well developed. As an example, the **assessment of the representativeness and preservation** of this habitat can be used as an indicator of the state of the river.

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The evaluation can be carried out according to two criteria universal for all biotopes: **area loss - LA** (estimated according to IUCN categories) and **quality loss - QU** (estimated according to IUCN categories), with an additional criterion of **regenerability - RE**.

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However, it will be more reliable to evaluate the habitat using parameters that take into account its specific structure and function. The values of indicators of the structure and functions of a natural habitat, specified numerically or descriptively, must be valorized on a three-level scale: **FV – favourable; U1 – unfavourable-inadequate; U2 – unfavourable - bad** (the scale adopted by the European Commission).

Valorization of state parameters and indicators of the specific structure and functions natural habitat riparian floodplain forests-galleries

Parameter/ Indicator	Favourable FV	Unfavourable-inadequate U1	Unfavourable-bad U2
Habitat area at the site	It is not decreasing, it is not anthropogenically fragmented	It shows a slow downward trend or is anthropogenically fragmented	It shows a rapid downward trend or is highly anth-ropogenically fragmented
Specific structure and functions			
Characteristic species	Typical floristic combination	The floristic combination is poor, but based on species typical of the riparian forest	Floristic combination dominated by not riparian species, but meadow or ruderal species

Parameter/ Indicator	Favourable FV	Unfavourable-inadequate U1	Unfavourable-bad U2
Specific structure and functions			
Dominant species	All layers are dominated by species typical of the habitat, with natural quantitative ratios (no facies dominance).	All layers are dominated by species ty-pical of the habitat, but quantitative relationships are dis-turbed (facies domi-nance).	One or more layers are dominated by a species alien to the natural plant community
Geographically alien species in the forest stand	<1% and non-renewable	<10% and non-renewable	>10% or spontaneously renewing, regard-less of participation
Invasive alien species in the understory and undergrowth	There is at most 1 species present, but it is rare and sporadic	More than 1 species, or even 1 species if numerous	Facies dominance of an alien species

Parameter/ Indicator	Favourable FV	Unfavourable-inadequate U1	Unfavourable-bad U2
Specific structure and functions			
Expansive native species (apophytes) in the undergrowth	Not very strongly expansive	Strongly expansive, but not limiting the diversity of the undergrowth	Facially dominant in a way that limits the diversity of the under-growth
Dead wood	Dead wood resources qualitatively correspond to the stand structure (whole dead trees are present, not just branches), and quantitatively they exceed 10% of the stand volume.	Dead wood resources qualitatively correspond to the structure of the stand (whole dead trees are present, not just branches), and quantitatively they are between 3% and 10% of the stand's abundance.	Dead wood resources are less than 3% of the forest stand

Parameter/ Indicator	Favourable FV	Unfavourable-inadequate U1	Unfavourable-bad U2
Specific structure and functions			
Naturalness of the river bed (use only if the occurrence of riparian forest is associated with a stream)	No regulation or the stream has been completely renaturalized after previous regulation	The regulation was carried out using "soft" methods, while maintaining the hydromorphological features of the natural stream	Regulation that changes the rhythm of the floods or regulation that completely changes the line of the stream. The existence of damming devices changing the regime of the stream
Water regime including the rhythm of floods, if any)	Flood dynamics and subsoil hydration normal from the point of view of the appropriate ecosys-tem/plant community	Flood dynamics and substrate hydration are reduced compared to normal	No flooding or completely dry substrate

Parameter/ Indicator	Favourable FV	Unfavourable-inadequate U1	Unfavourable-bad U2
Specific structure and functions			
Age of the tree stand	>20% share of the volume of trees older than 100 years	<20% share of trees older than 100 years, but >50% share of trees older than 50 years	<20% share of trees older than 100 years and <50% share of trees older than 50 years
Vertical structure of vegetation	Natural, diverse	Anthropogenically changed but diverse	Anthropogenically homogenized
Natural tree regeneration	Yes, plentiful	Yes, but one at a time	Absent
Damage to ground cover and soil related to timber harvesting	Absent	Few traces, <1% of the area and number of trees disturbed	Significant, covering >1% of the land area, number of trees, etc.

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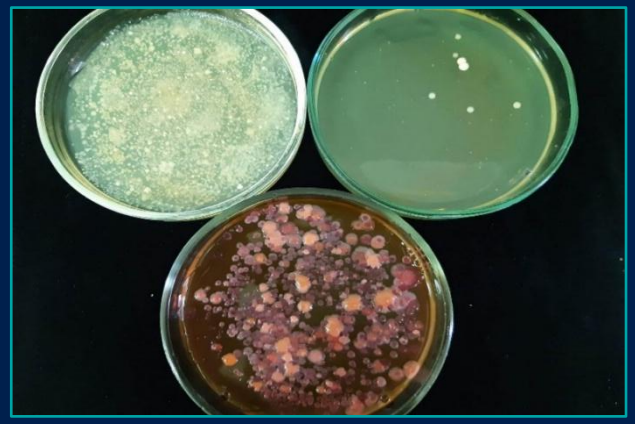
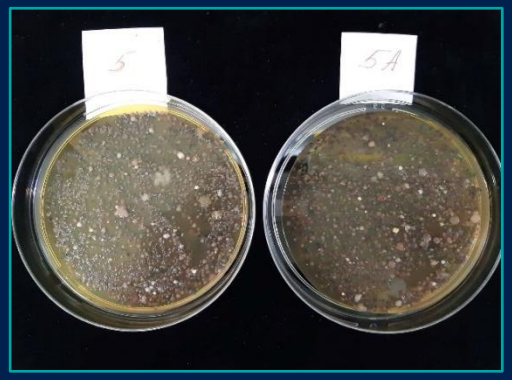
Parameter/ Indicator	Favourable FV	Unfavourable-inadequate U1	Unfavourable-bad U2
Specific structure and functions			
The status of key biodiversity species locally typical of the habitat (optional indicator, use only if appropriate data are available)	Fault status of all such species (FV)	The condition of some such species is unsatisfactory (U1)	The condition of some such species is poor (U2)
General structure and functions	All cardinal indices were rated as FV, the rest pointers at least U1	All cardinal indices were rated at least U1	One or more cardinal indices are rated U2

Parameter/ Indicator	Favourable FV	Unsatisfactory U1	Unfavourable-bad U2
Specific structure and functions			
Conservation prospects	No threats or negative trends. It is al-most certain that the habitat will remain intact in the next 10–20 years	It is not certain that the habitat will re-main intact in the next 10–20 years, but it is likely if the existing threats can be prevented.	Preserving the habitat in a non-deteriorated condition in the next 10-20 years will be very difficult: advanced re-cession processes, strong negative trends or significant threats
Overall evaluation	All parameters were assessed at FV	One or more para-meters were evaluated U1, absence of evaluations at U2	One or more parameters were evaluated U2

Microbiological analysis of water samples (near the intake of water from treatment facilities)

Microbiological analysis of a water sample - taken near the drain - on nutrient media to determine the sanitary and hygienic condition





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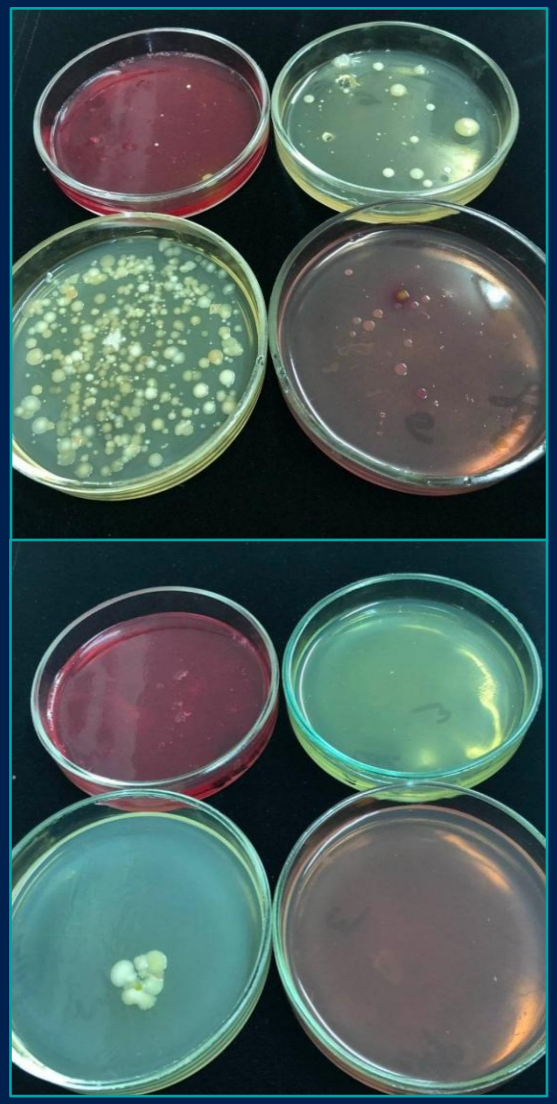

Storozhniva
village

Kamjanista
village

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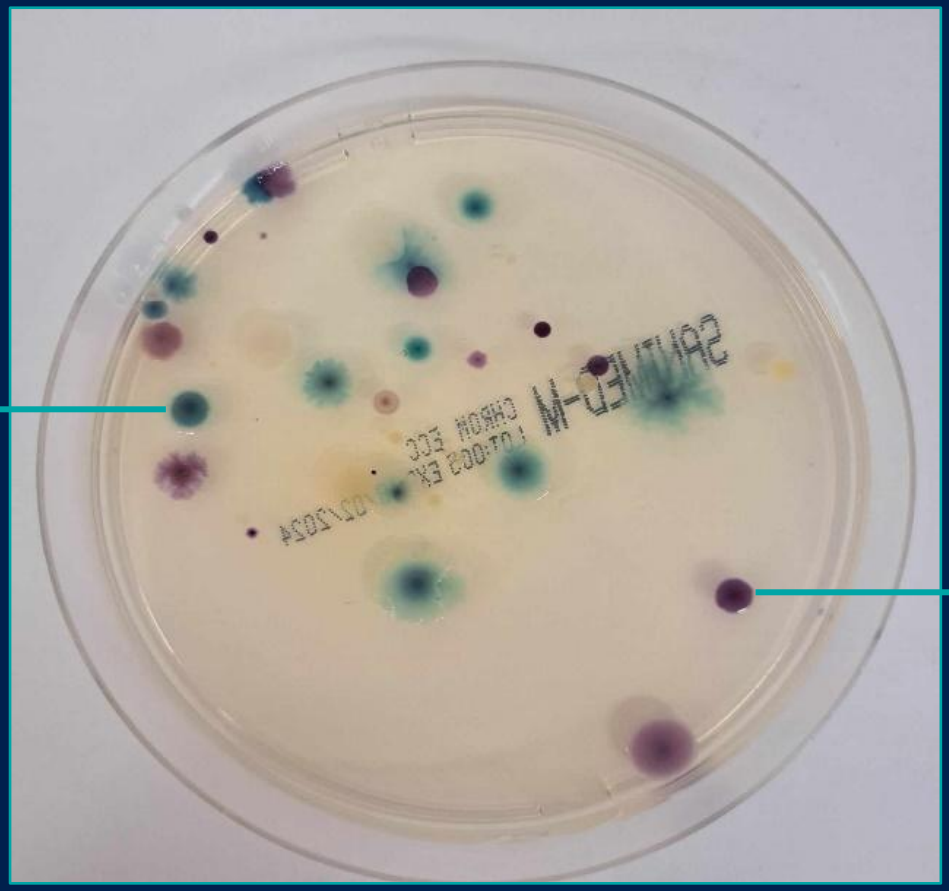

Enterococcus faecalis

Escherichia coli

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PRACTISE OF SCIENTIFIC EDUCATION

Possibilities of Olympus DSX-1000 High End Model

Olympus DSX-1000 High End Model use for observation of invertebrates

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Six **observation modes** allow different view on biological objects:

BF
(bright field)

DF
(dark field)

MIX
(BF + DF)

PO
(polarized light)

OBQ
(olique light)

DIC
(differential interference contrast)

The microscope allows observation of objects in 6 different observation modes. Changing the observing mode is done by simply **clicking on the selected mode** on the control panel of the operating software.

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All observation modes can be **seen at once on one screen**. Thus, it is possible to easily and quickly choose the most suitable observation mode.

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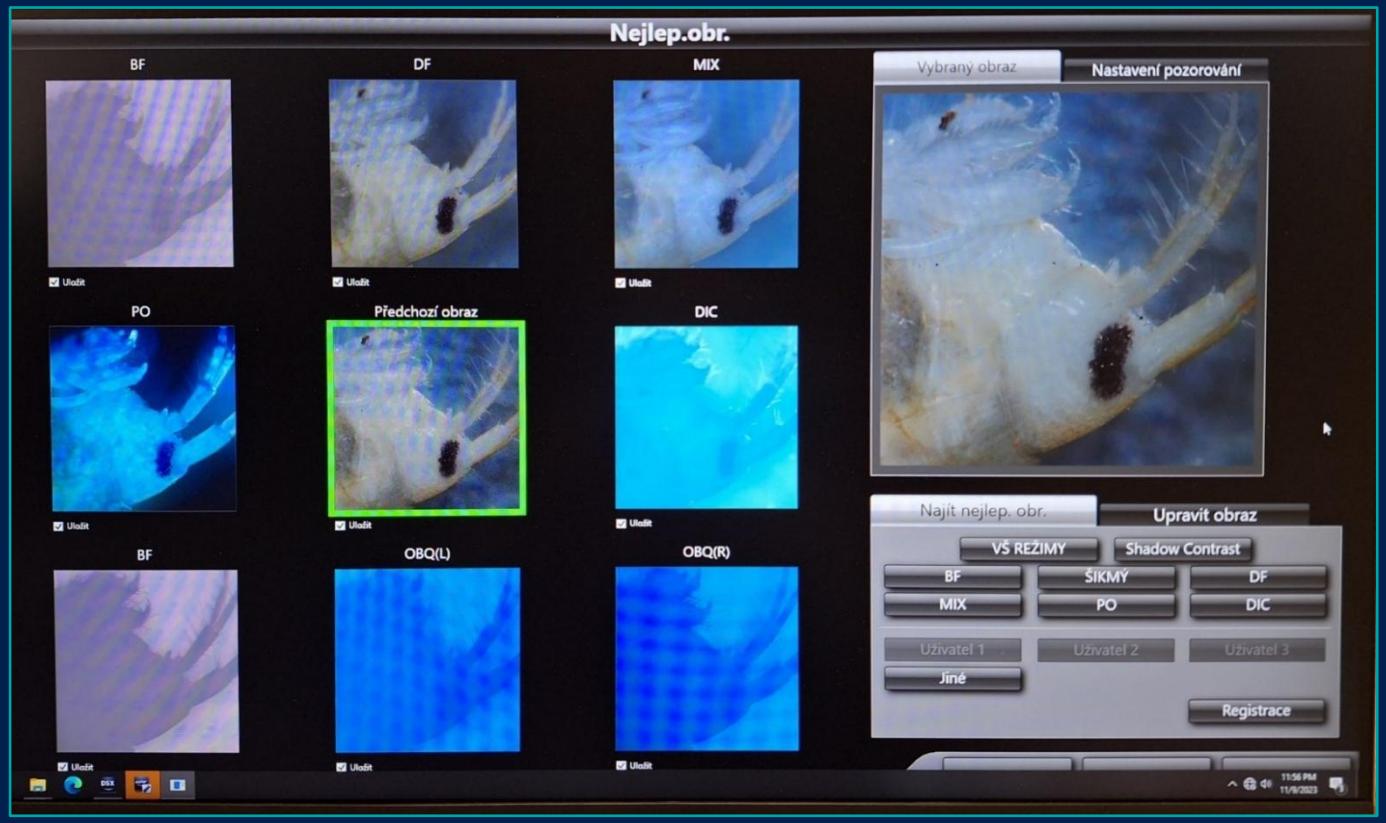
Observation of objects in liquids or mounted into microscopic slides

Different possibilities for wet and dry samples

Observation of specimens embedded in medium or mounted in a slide with a coverslip is limited. It seems that the only suitable observation mode for such preparations is **the dark field (DF).**

Amphipoda – wet sample.



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Observation of objects in liquids or mounted into microscopic slides

Different possibilities for wet and dry samples

Observation of specimens embedded in medium or mounted in a slide with a coverslip is limited. It seems that the only suitable observation mode for such preparations is the **dark field (DF).**

Gastropoda, shell detail – dry sample.

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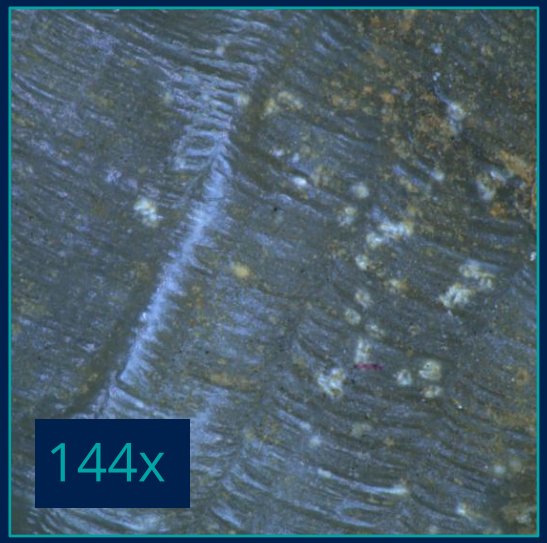
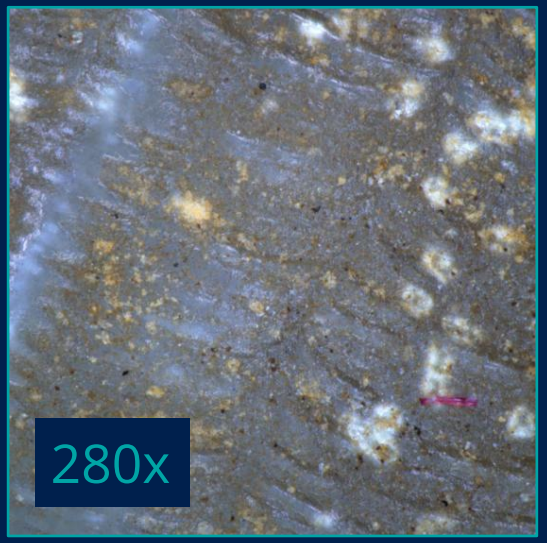
Magnification range: 20x – 7000x

Suitable for observation of very small but also big organisms

Combination of streomicroscope and routine microscope, objectives must be changed **manually**.





Lymnaea peregra

The magnification range allows for an overall view of the entire object as well as a detail of small structures on the surface. There is no need to specially prepare the sample for detail photography.

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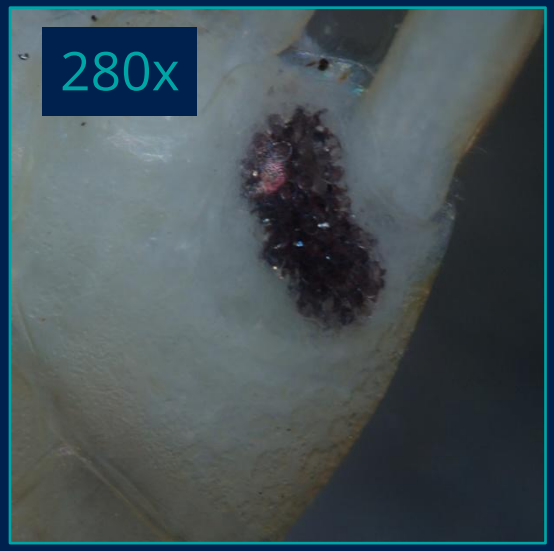
Amphipoda



Before photographing, it is advisable to stick the object to a mat (dry samples) or cover it in a liquid with a glass plate (wet samples) to **prevent movement of the sample** when the microscope stage is moving during photographing.

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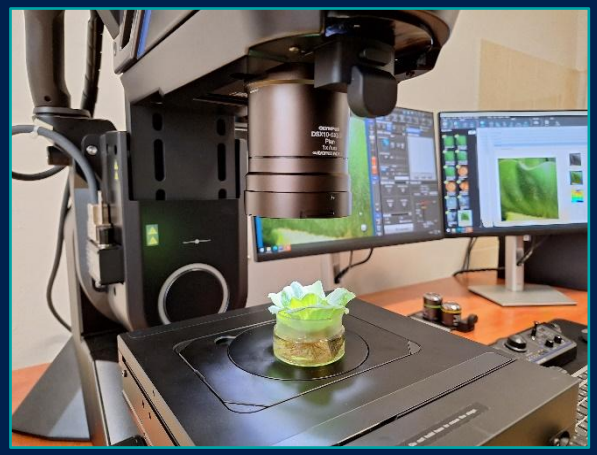
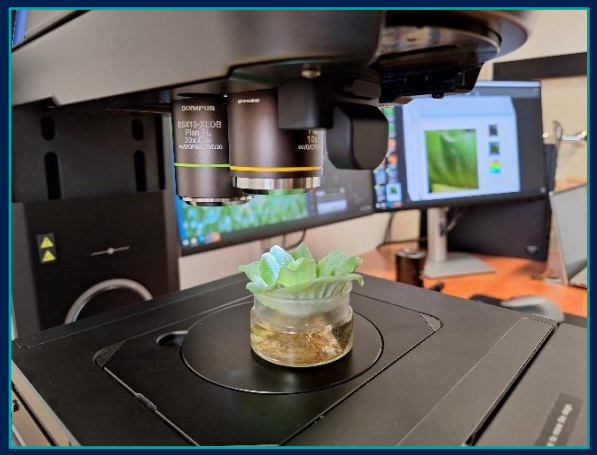
Objectives with long work distance

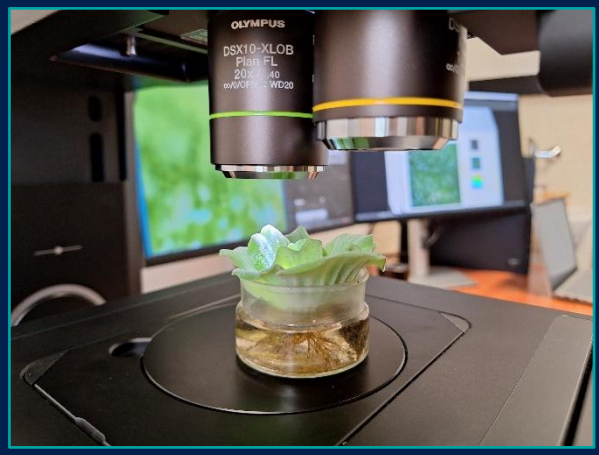
Possibility to observe organisms in liquid fixation under higher magnification, details of bigger organisms without section



20x



114x



280x

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3D pictures

Possibility to take pictures with high depth of field

Daphnia sp.

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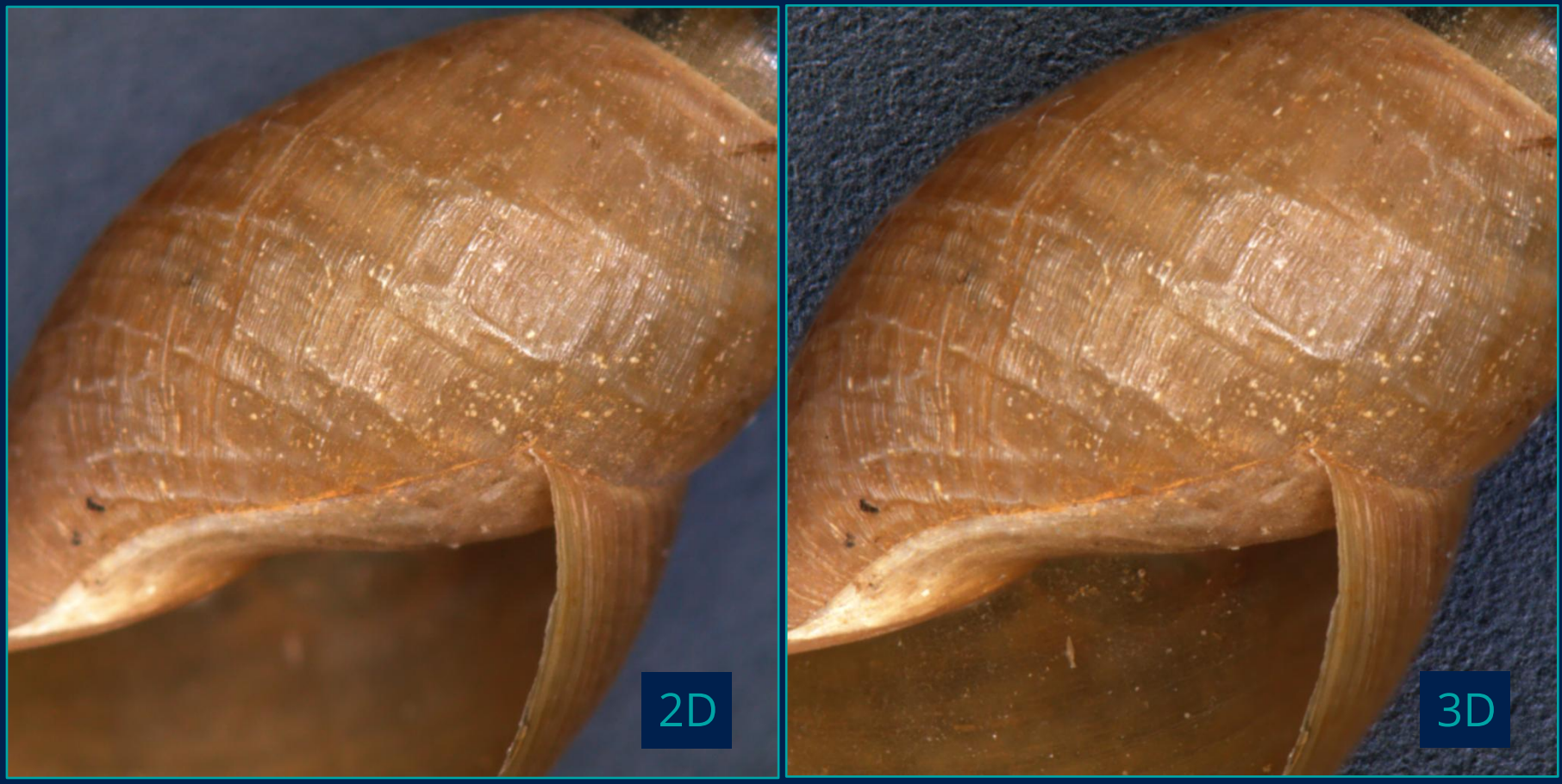
Lymnaea peregra



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Pictures from different angles without sample manipulation

Quick photo series from various angles

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Magnification: 20x

Viviparus sp.

A view of the **top** of the shell.

Side view of the shell.

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Magnification: 20x

Lymnaea peregra

Front side of the shell.

Top of the shell.

Back side of the shell.

The use of tilting the objective when photographing small objects is problematic due to the possible collision of the objective with the microscope stage during 3D imaging. This can be partially prevented with dry samples by gluing the object to a longer stick, which is fixed to the microscope stage. Objects immersed in liquid and objects mounted on a microscope slide can only be observed to a limited extent using the tilted objective.

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Image stitching

The image stitching method makes it possible to obtain images of objects that exceed the field of view of the selected lens. At the same time, the image stitched together from several 3D images has a great depth of field. However, the light built into the objectives can cause uneven lighting in the resulting image when composing 3D images. In such cases, it is useful to use external lighting.

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Olympus DSX-1000 High End Model use for observation of reptile and amphibian structures

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Exuvia (shed epidermis) of the snake from Colubridae family

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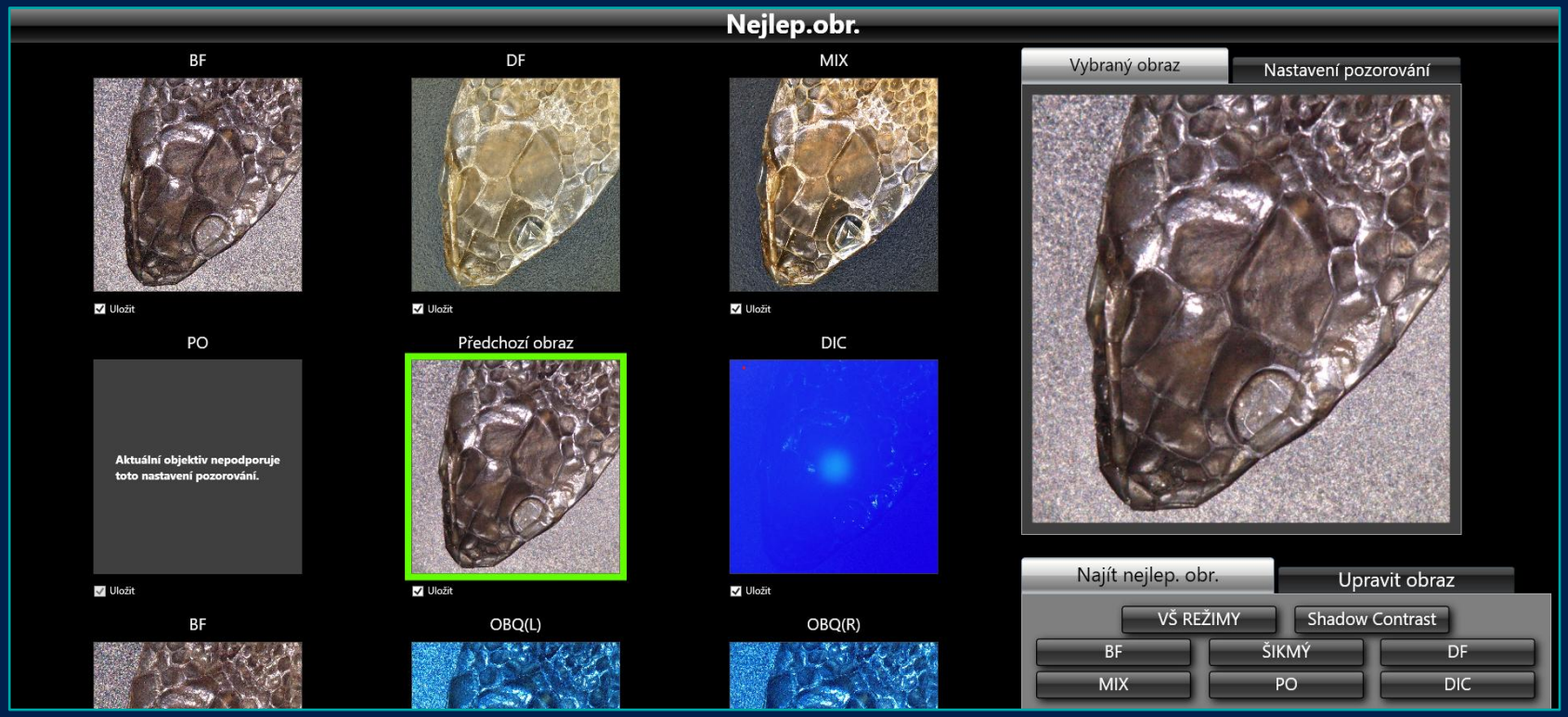
6 observation modes of a snake pileus

A set of scales on the top of snake or lizard head



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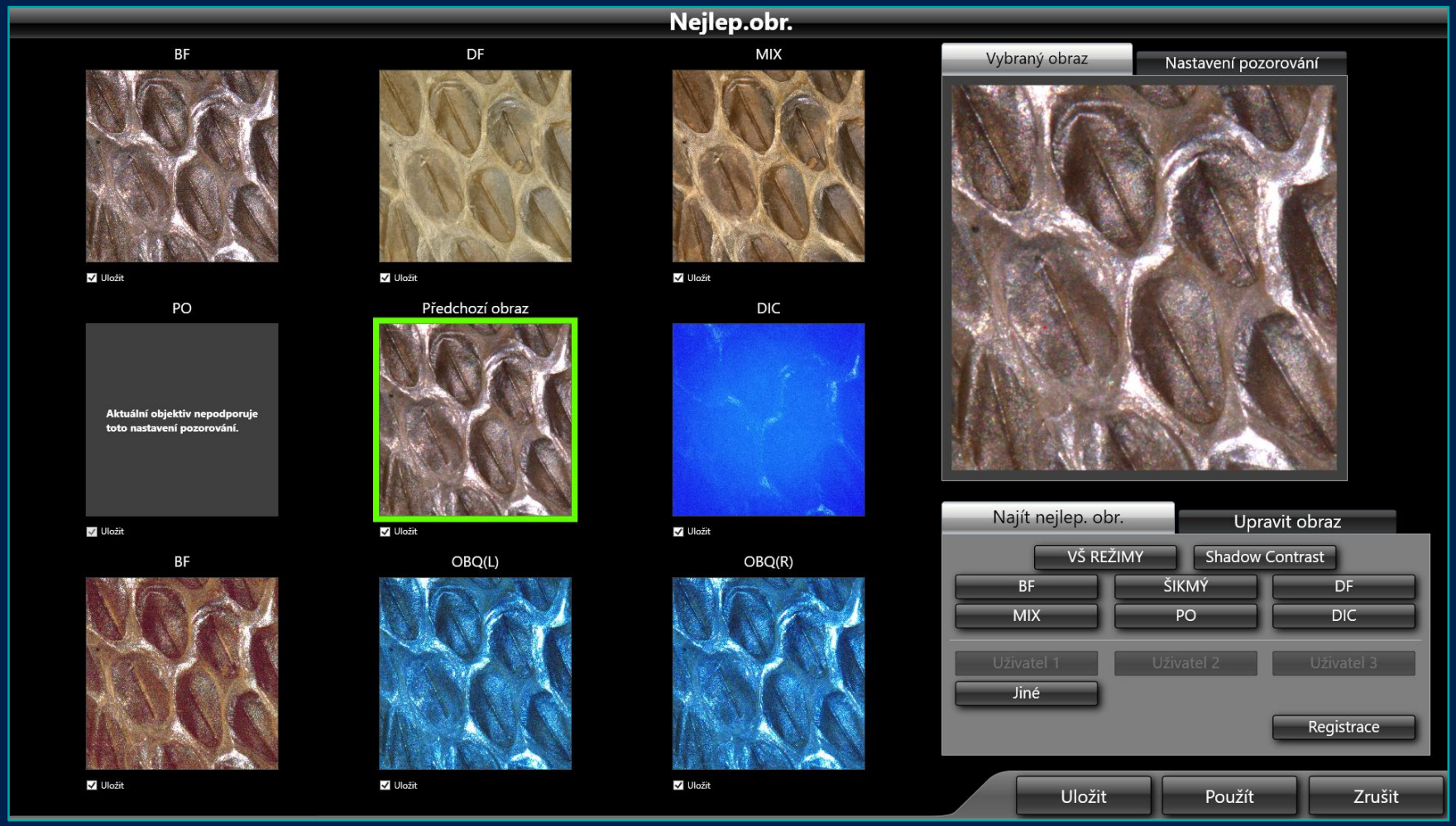
6 observation modes of Colubrid snake scales



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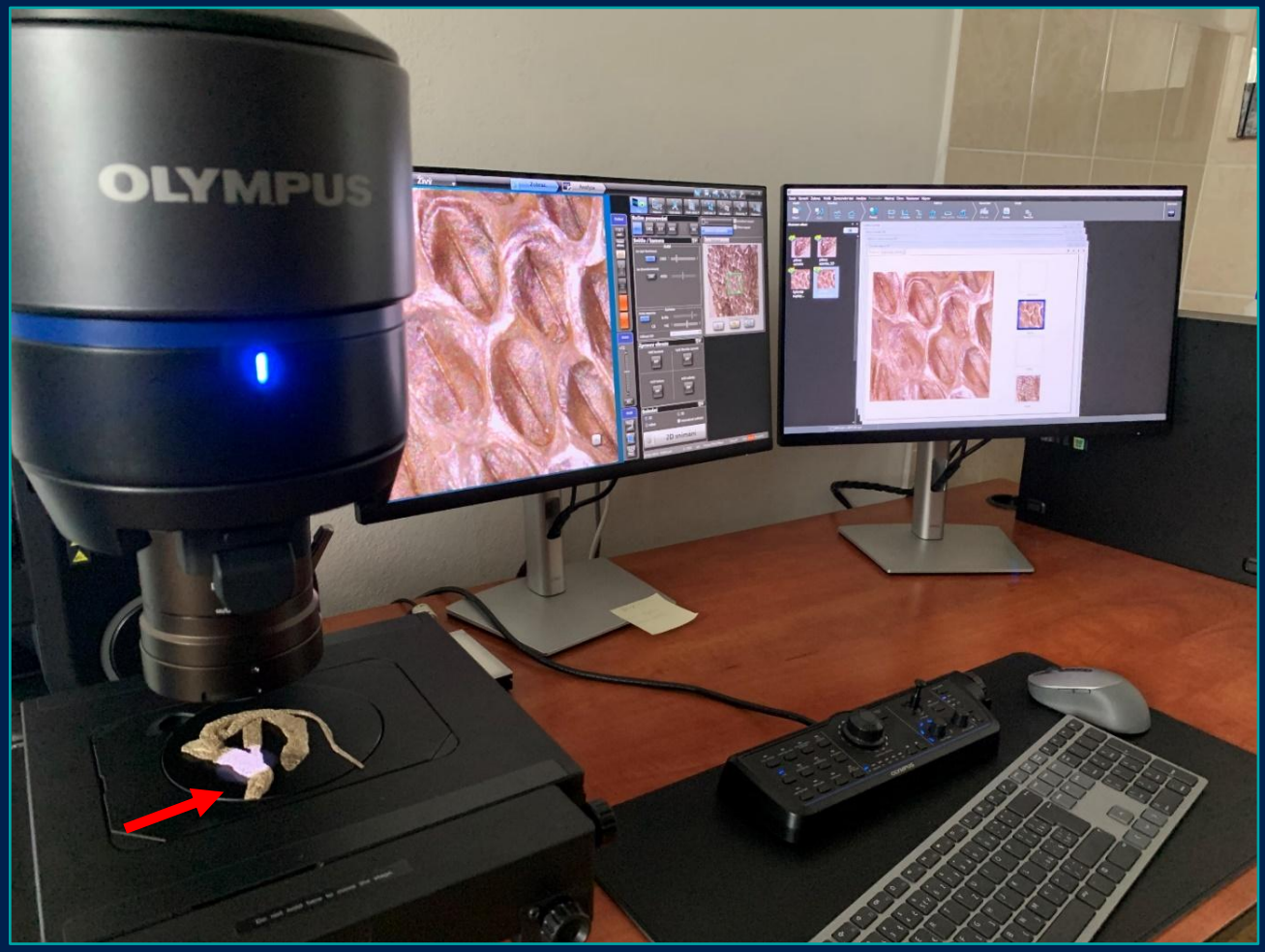
Process of making photos of exuvia parts



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Detailed view of the toad warts *Bombina* genus

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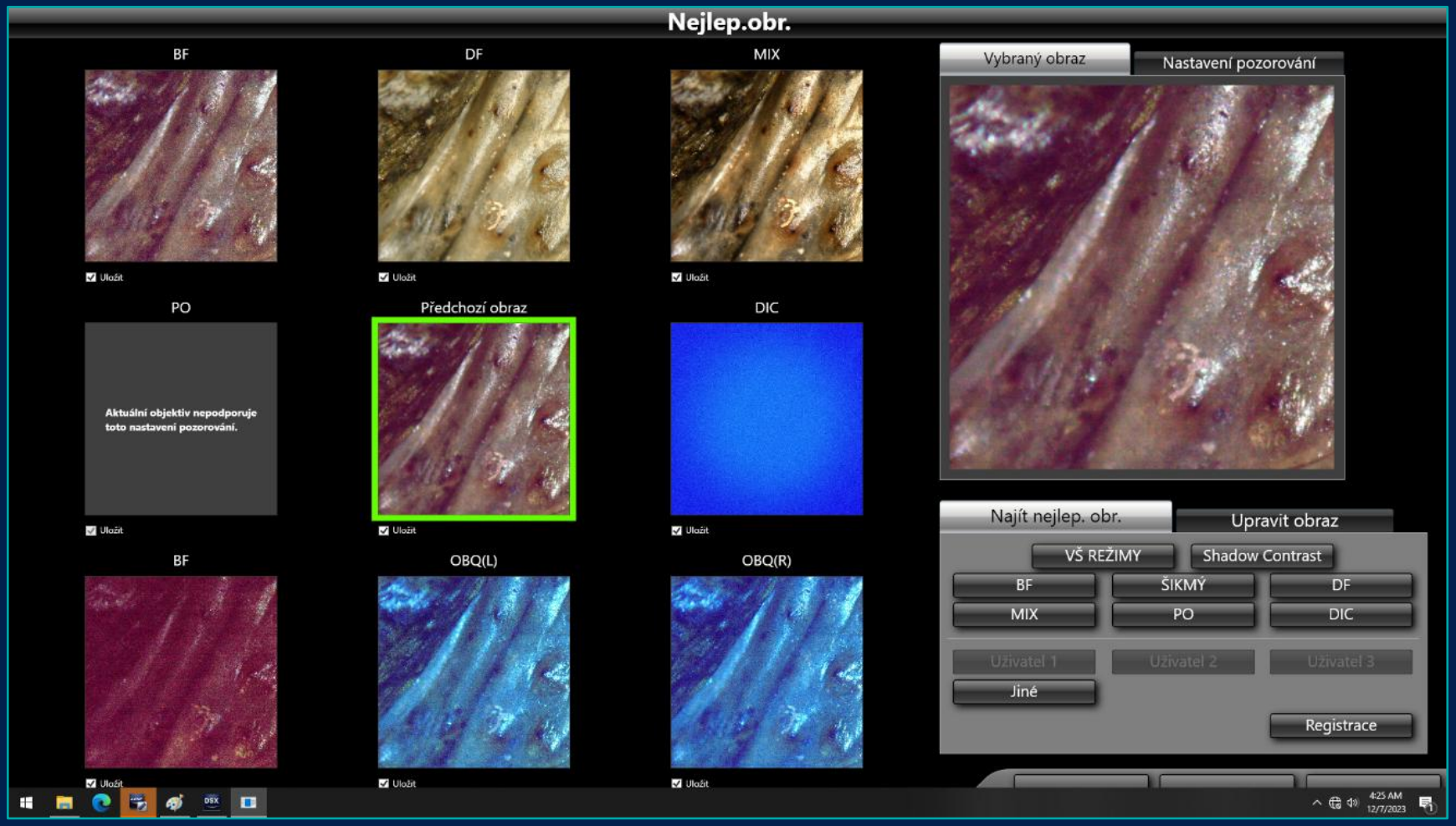
6 observation modes of the warts



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Detailed view on the dorsal side of the toad *Bombina* genus

The outlines of the vertebrae clearly visible

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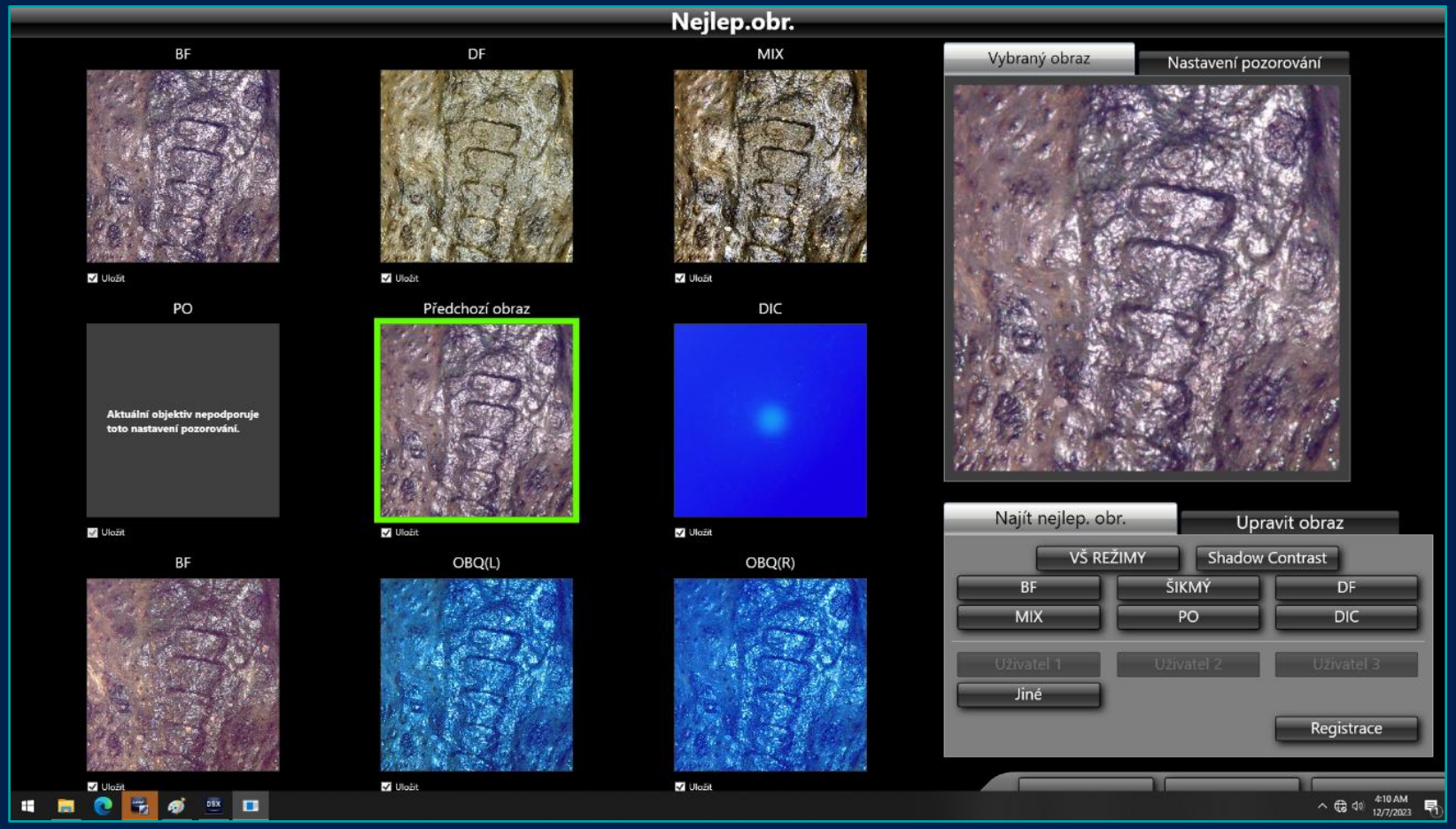
6 observation modes of the dorsal side of the toad from *Bombina* genus



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Detailed view on the lizard teeth

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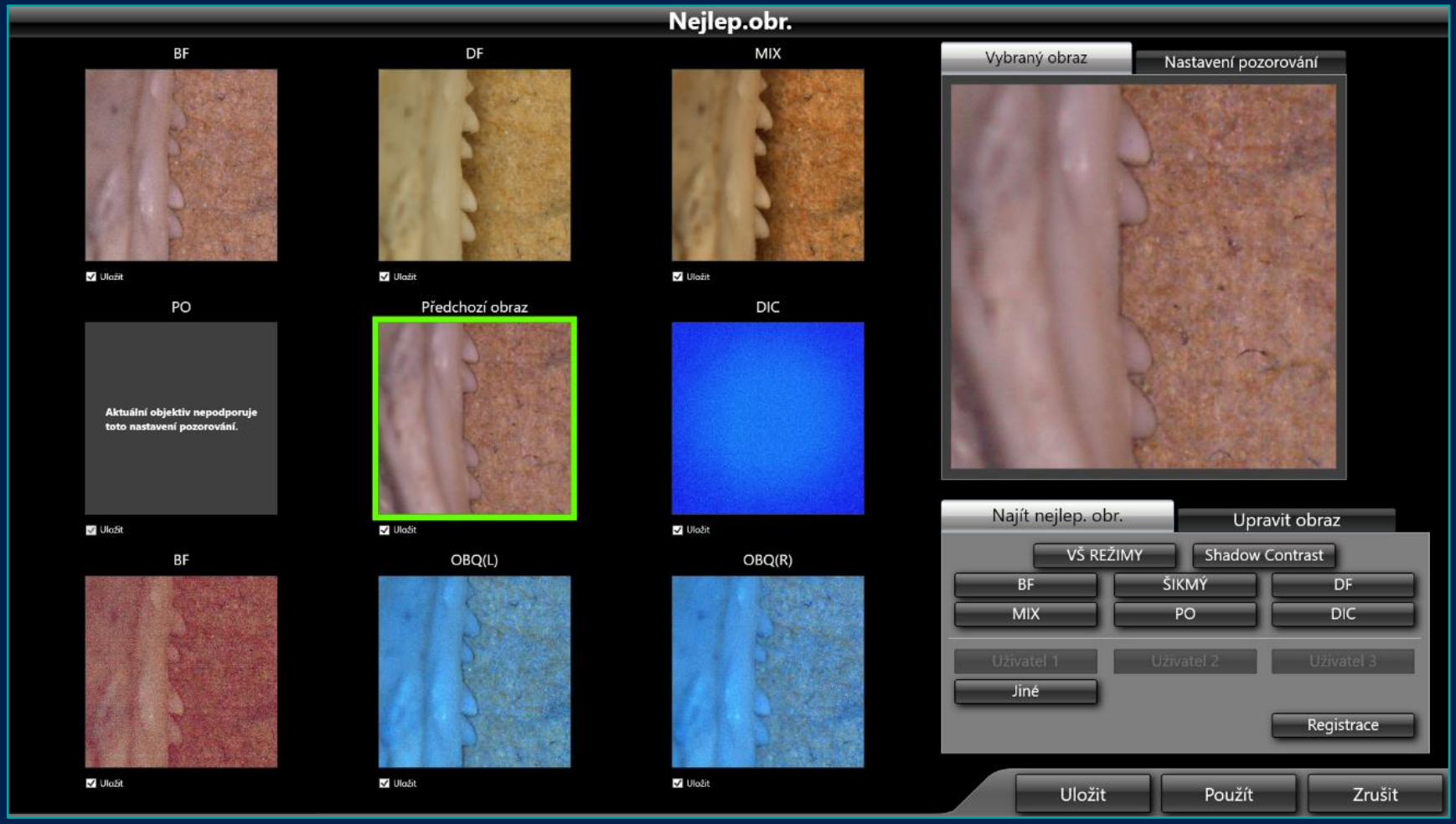
6 observation modes of the lizard teeth



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Making photos of the lizard teeth with the lateral position of the microscope

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Detailed view on the lizard exuvia

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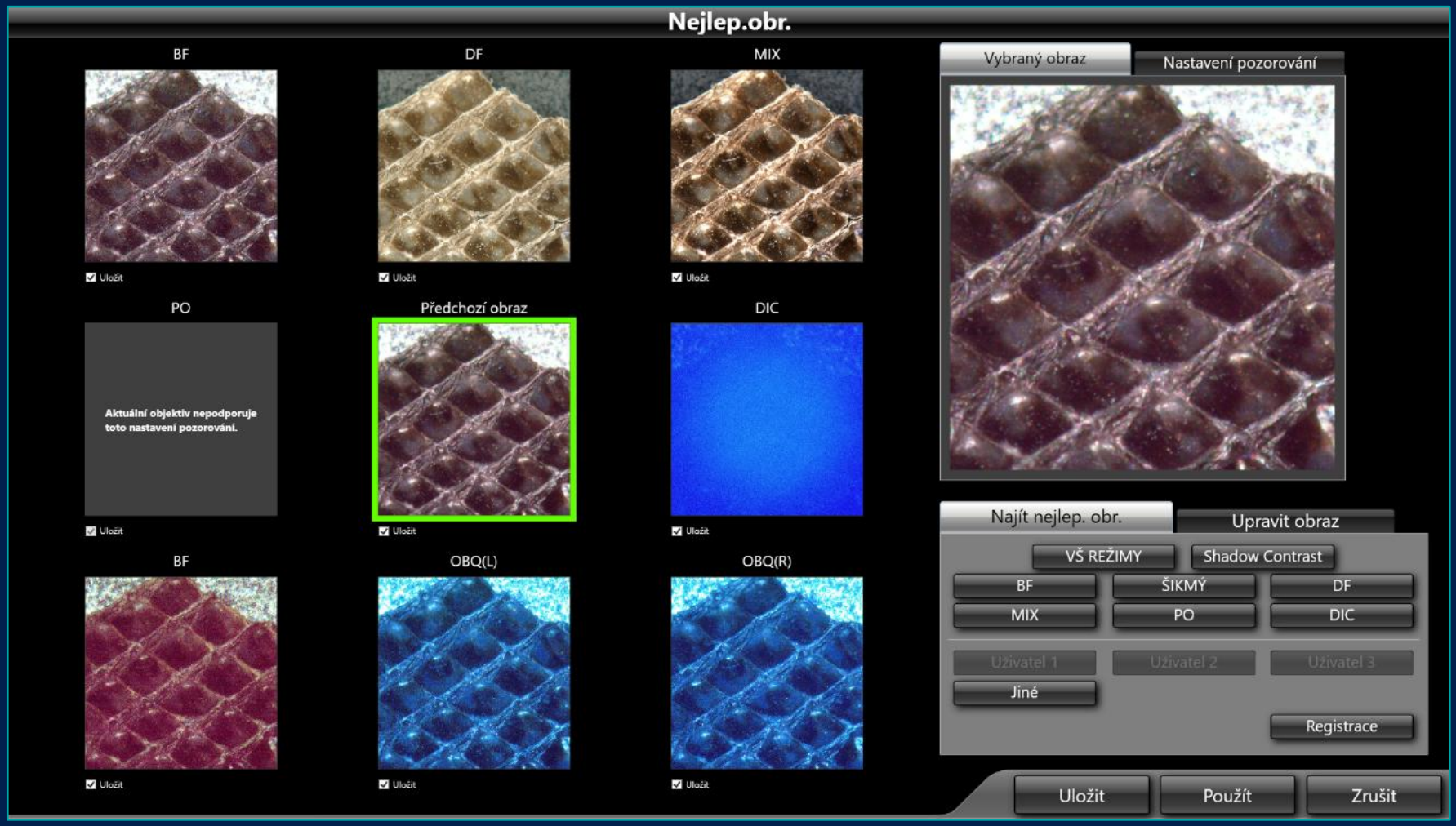
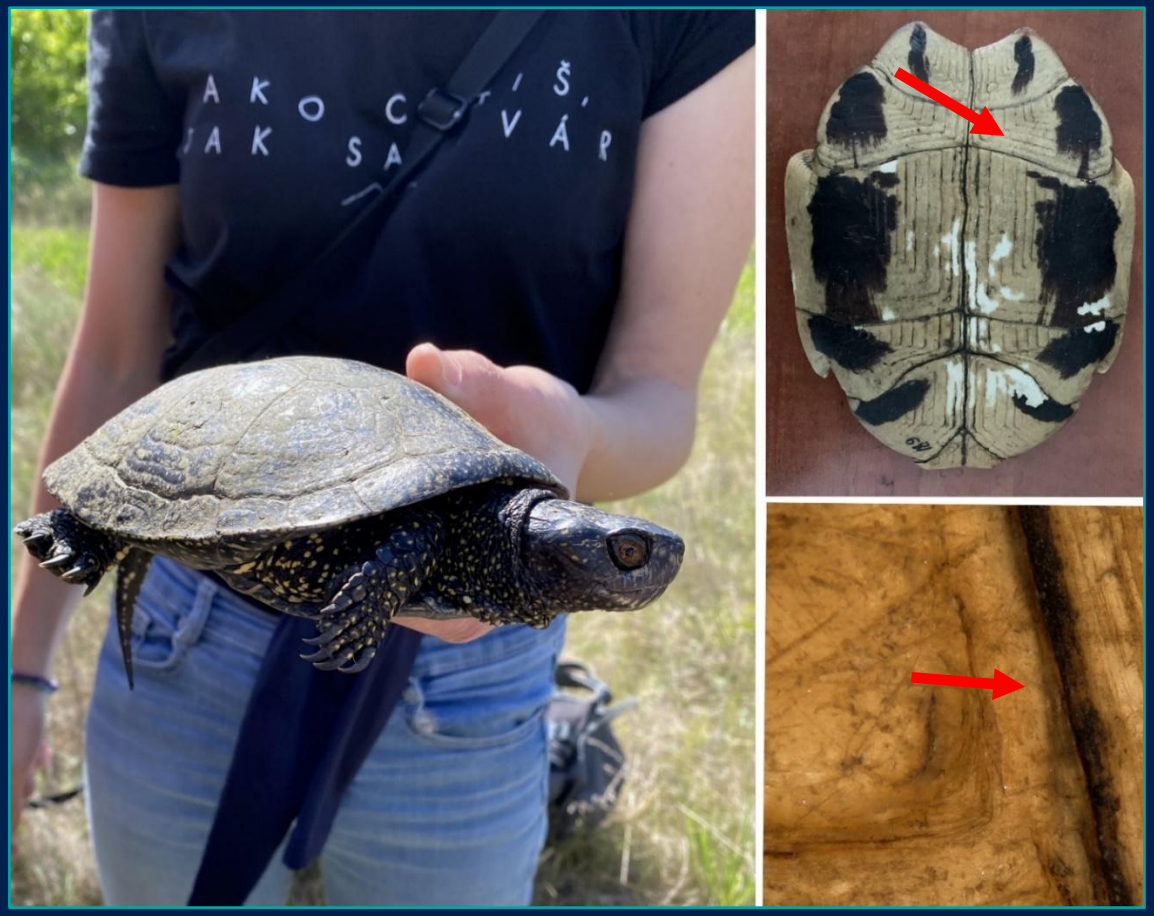
6 observation modes of the lizard exuvia



Detailed view on the turtle scute and suture on the plastron (ventral part of the shell)



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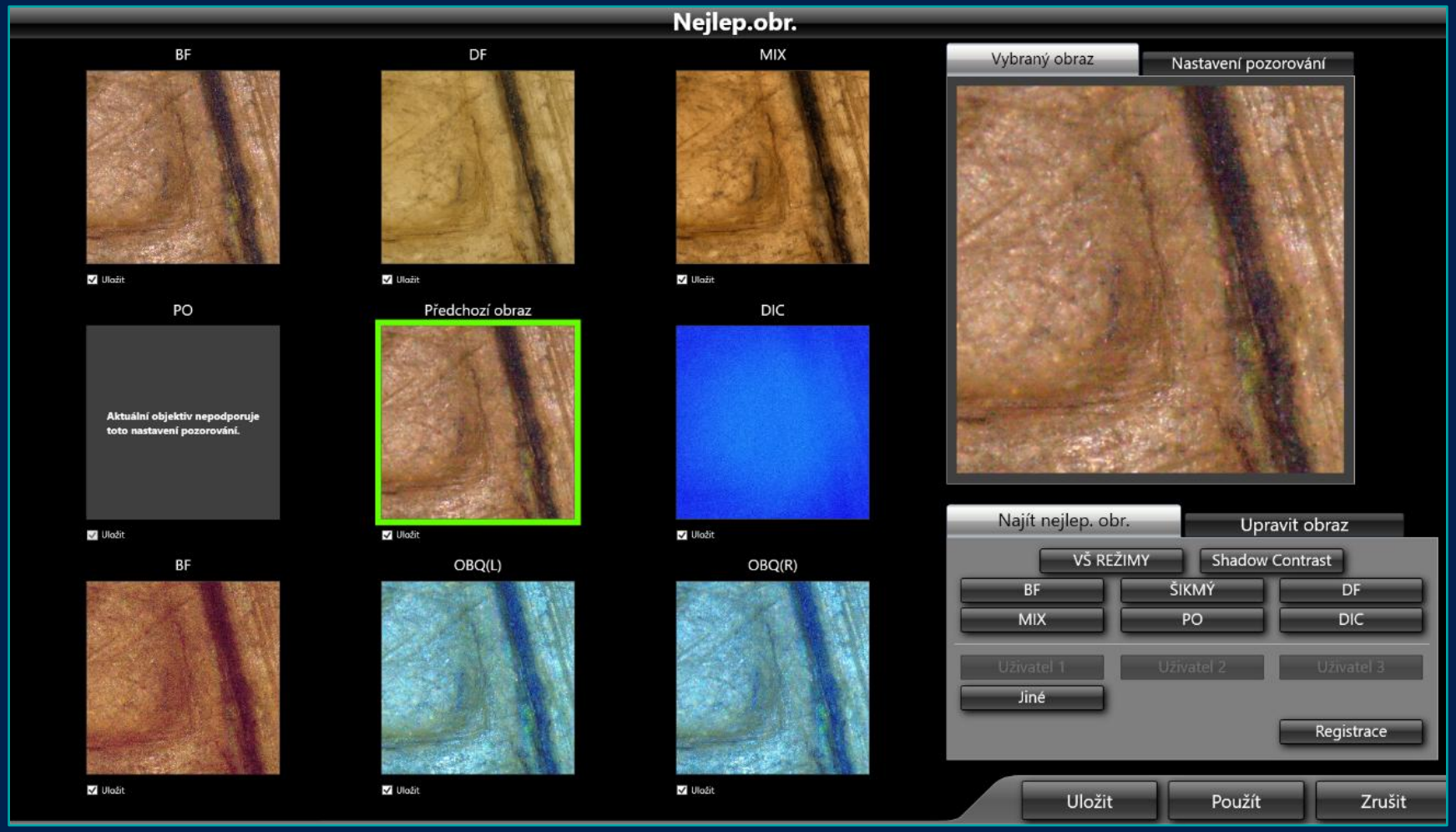
6 observation modes of the turtle scutes



Detailed view on the yellow spot on the belly of the *Bombina* toad

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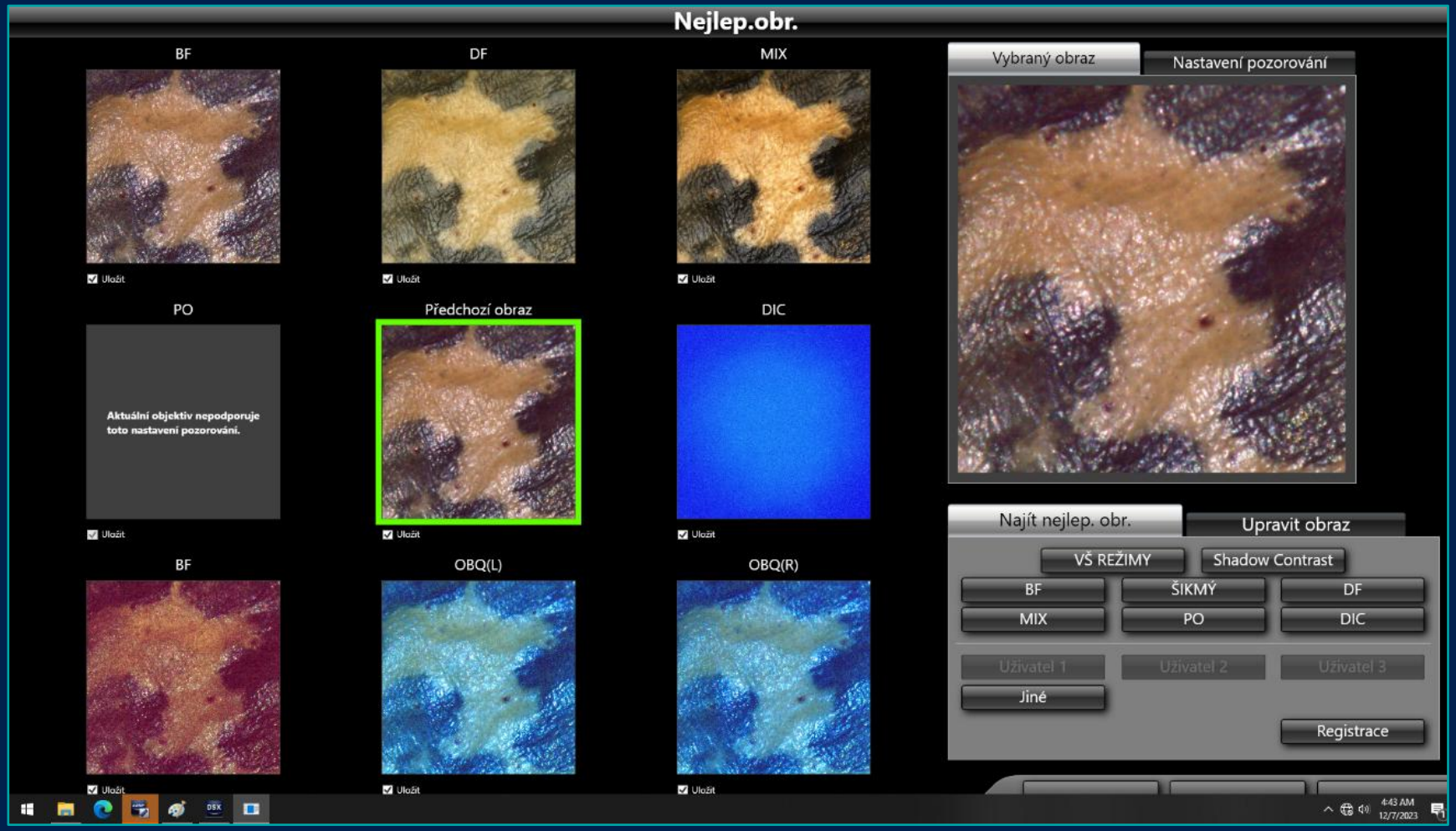
6 observation modes of the *Bombina* spot on the belly



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Olympus DSX-1000 High End Model use for observation of algae and lichens and cyanobacteria

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Observation of the lichen and demonstrating the presence of the secondary metabolite parietin

Xantoria parietina

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Qualitative evidence of the presence of the secondary metabolite parietin in lichen

Parietin reacts with potassium hydroxide (KOH) to form an intense magenta-red color.

Demonstration video available here.

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Observation of the lichens

Stereocaulon

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Polytrychon

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Umbilicaria

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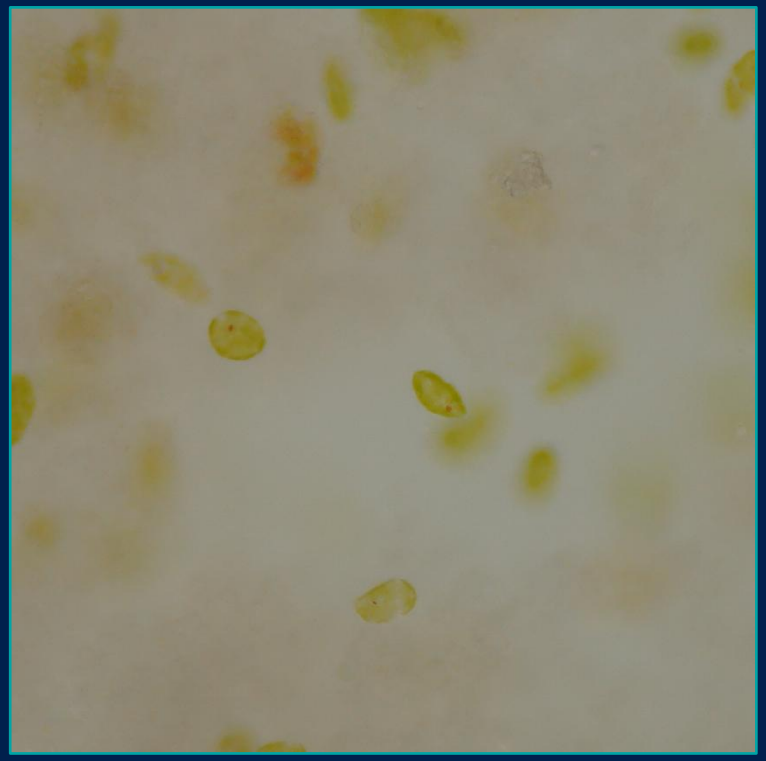
Observation of unicelular organism Cyanobacteria



Synechocystys

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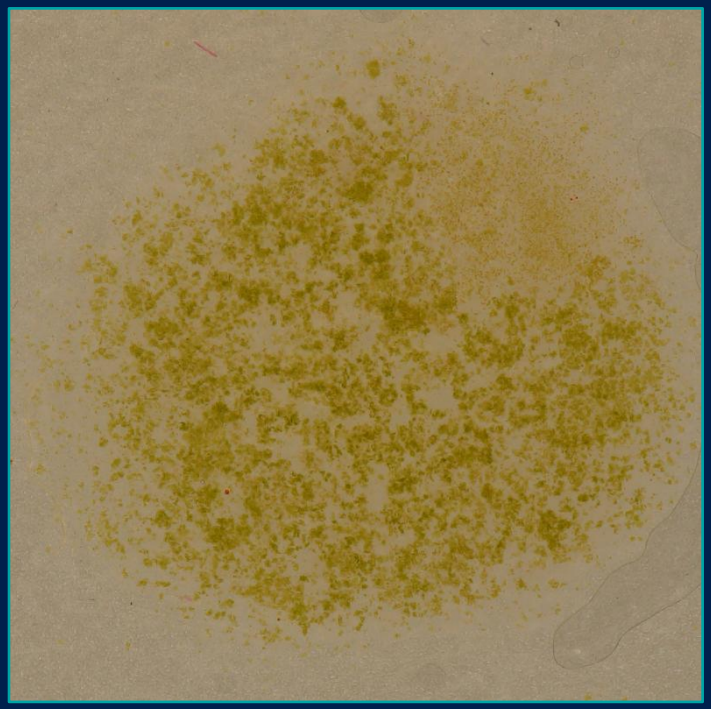
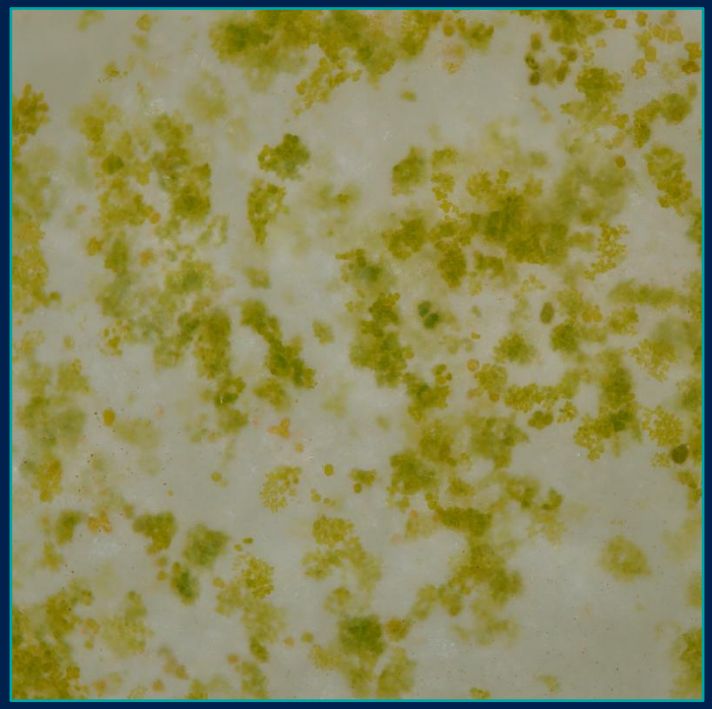
Observation of a photoautotrophic, cenobial green algae from the green algae genus Hydrodictyaceae





Pedastrium

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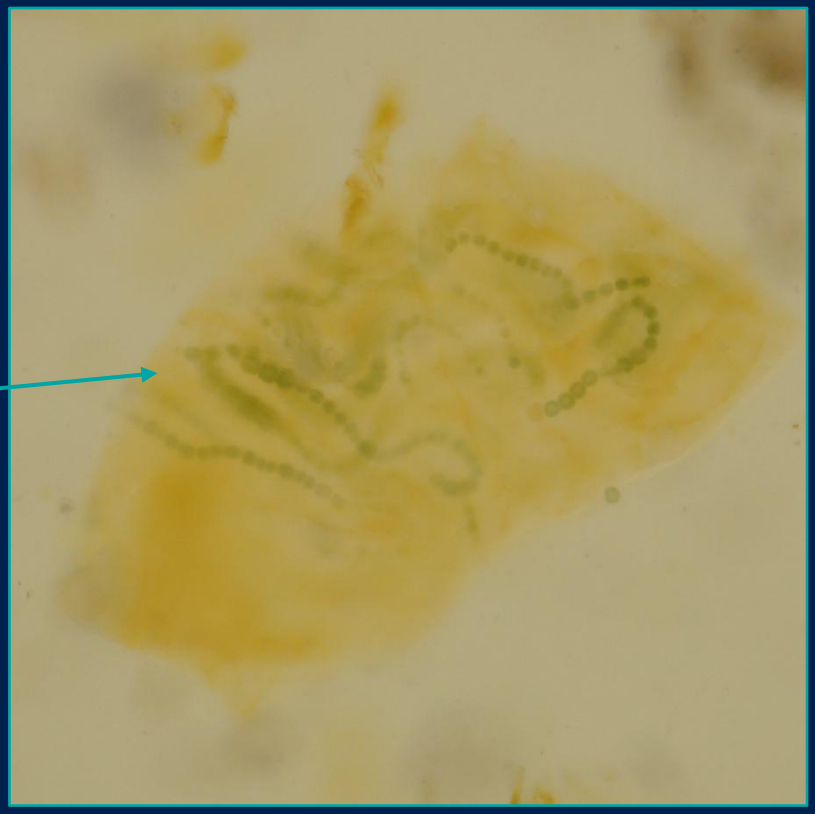
Observation of typically gelatinous *Nostoc* colonies

Nostoc

Dehydrated cyanobacteria.



Wet sample.

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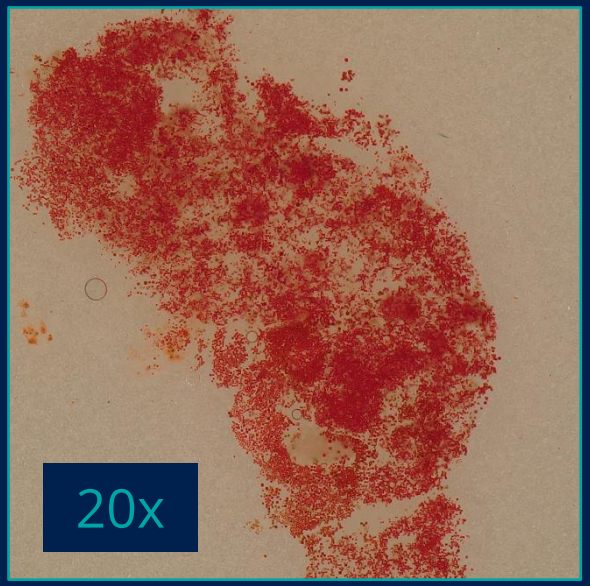
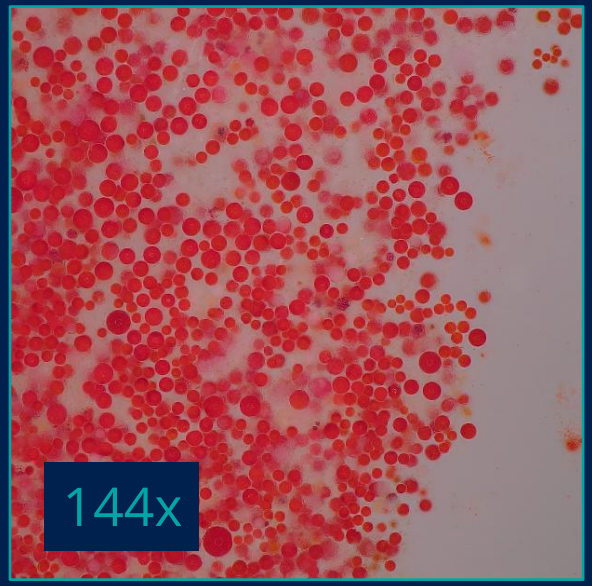
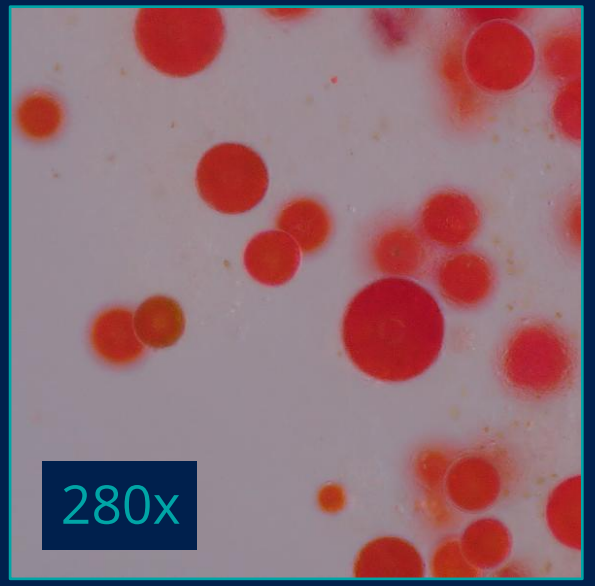
Observation of ability Hematoccocus to transform from a green form to a red, when exposed to environmental stresses







Hematoccocus

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EFFUSE – River Landscape, Volume 2: Guidelines for Experts

Educational text

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