Summary

Diatoms (Bacillariophyta) are commonly occurring photoautotrophic unicellular organisms in the environment that have developed many adaptive features that allow them to live in a variety of aquatic ecosystems. Their silicon-rich cell wall, which also constitutes their exoskeleton, is extremely resistant to physical and chemical factors, including strong inorganic acids, hydrogen peroxide, and high temperatures. Furthermore, the structure of this exoskeleton has numerous morphological features that allow for the identification of diatoms down to the species level. Diatoms are found in all ecosystems where water is available or where appropriate humidity conditions prevail, and they can also be found in extreme environmental conditions, with their quantitative and qualitative composition reflecting these conditions. The autecology of diatoms and their species diversity make them suitable for use in forensics. In this aspect, diatomology, as a specialty of environmental biology, brings benefits to forensics and offers many opportunities in combating crime. The use of diatoms in forensic medicine dates back to the early 20th century when Revenstorf (1904) detected diatoms in the lungs of a drowning victim. Since then, diatoms have been used as a helpful tool in diagnosing drownings. There have also been many questions and doubts that have led to research and experiments regarding the use of diatoms in forensic medicine. The presence of diatoms has been analyzed not only in the lungs but also in other organs, such as the kidneys, stomach, liver, and bone marrow, and comparative studies have been conducted with environmental samples taken from the sites where human remains were found. Owing to these studies, we know that diatoms not only serve as a tool in diagnosing drownings but also enable the confirmation, exclusion, and identification of the drowning site. It turns out that bone marrow, especially from the ribs, can be an excellent tool for diatom analysis to confirm drowning as the cause of death. However, there have been skeptical voices regarding this method, mainly concerning situations where corpses that have been in water for a long time have undergone decomposition. Therefore, studies were conducted to determine whether diatoms can passively penetrate the bone marrow of ribs when human remains are submerged in water for an extended period. Research on ribs, using an animal model, excluded the possibility of passive penetration of diatoms into the bone marrow, thereby confirming the usefulness of rib studies in diatom assessment of drowning.

The species diversity of diatoms and the fact that they inhabit practically all aquatic and moist environments formed the basis for conducting research on their potential use in linking individuals and objects to specific environments. Through studies of diatoms conducted in a water-land transect, changes in the qualitative and quantitative structure of diatom communities were observed as the distance from the water body increased. Additionally, studies

of diatoms from samples taken from various aquatic and soil environments located in close proximity to each other showed that the structure of diatom communities in these environments is different. The analyses mentioned above may serve as a basis for using them in detection processes, and thus they have significant implications in forensics.

Research on the transfer and persistence of diatoms on various textile materials has clearly shown that diatoms not only transfer and persist on these materials but also reflect the environment with which the material has come into contact through their quantitative and qualitative composition. In this case, even the washing process did not remove diatoms from the material, and their analysis confirmed contact with a specific environment. Despite diatoms showing preferences for specific habitats, studies on the colonization of various usable materials have demonstrated that the structure of diatom communities inhabiting different materials reflects the environment in terms of both quantity and quality. Furthermore, the type of material did not matter in terms of colonization. The conducted studies confirmed that diatoms can be an excellent tool for law enforcement to confirm, exclude, or identify the location with which a suspect had contact.

Numerous studies on the qualitative and quantitative diversity of diatom communities in aquatic ecosystems provide information about the environment, particularly regarding changes occurring within it. Therefore, this group of algae serves as an ideal tool for assessing and predicting the state of the studied ecosystem. Their rapid response to environmental changes, manifested in the restructuring of diatom communities, forms the basis for using them as bioindicators of environmental conditions. However, for forensic purposes, the quick reaction of diatoms to environmental changes can be both an advantage and a disadvantage. The advantage arises when environmental material containing potentially diatoms is collected for forensic proceedings immediately after an event. The disadvantage occurs when a longer time elapses between the event and the collection of diatom samples for comparative studies, which is related to seasonal changes and anthropogenic influences.

Mapping aquatic ecosystems for diatom analysis to investigate how the structure of diatom communities is shaped, for example, by seasonal changes, is another step towards the development of forensic diatomology, as this information could, for instance, be the basis for indicating a drowning site.

To properly secure material that may be subject to diatomological research for forensic purposes, a methodology has been developed containing practical guidelines and recommendations dedicated to officers securing evidence and comparative material at the scene.

The environmental requirements of diatoms, their adaptive capabilities, and their ability to rebuild the structure of a community disrupted by environmental changes are features that can benefit forensics in diagnosing drownings, identifying, confirming, and excluding drowning sites, as well as linking a suspect or victim to a specific environment.

Ihona Bogucka