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PROPOSAL OF THE MONITORING FOR THE ALPINE NEWT *ICHTYOSAURA ALPESTRIS*

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Abstract. Alpine newt *Ichthyosaura alpestris* belongs to the group of amphibians, which is particularly vulnerable to the negative effects of the degradation of aquatic habitats. Destruction and fragmentation of potential breeding and living sites occur due to intensive landscape transformations, construction works, or drainage treatments. In addition, climate change is affecting the availability of water resources, which may result in a reduction of breeding sites. Although the alpine newt is still considered a Least Concern species by the IUCN (2023), is given to disappear. However, in view of the risks both now and in the future, it is necessary to monitor the presence and breeding sites and their protection constantly. The article describes a proposal for research and monitoring methods for the alpine newt. Periodic inventories of complexes of potential water reservoirs should be carried out in search of adult specimens, mating in spring and early summer, and later developing larvae. Observation and scouring using a herpetological scoop to survey the bottom and vegetation of a water body for individuals and eggs. In addition, it is worth carrying out a Habitat Suitability Index (HSI), as suggested in this article.This will allow for monitoring of the local population status and the introduction of conservation measures for the species in a given area at the right time.

Key words: Alpine newt*, Ichthyosaura alpestris*, species monitoring, wildlife conservation, inventory methods, HSI.

INTRODUCTION

Species description

Alpine newt *Ichthyosaura alpestris* (Laurenti, 1768) syn. *Mesotriton alpestris* (Laurenti, 1768) *Triturus alpestris* (Laurenti, 1768)

Systematic membership

Order: Urodela
Family: Salamandridae

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Legal status and threat to the species
International law
Berne Convention Annex III
National law
Species protection: partial protection
IUCN Concern Category IUCN Red List (2023): LC (Least Concern)

The alpine newt is now considered to be a fairly common amphibian species in a suitable environment (IUCN 2023). However, the progressive interference and transformation of upland and mountain areas causes progressive fragmentation and conversion of terrestrial and aquatic habitats. As a result, they negatively affect the dispersion of amphibians and the preservation of their genetic diversity, reducing the quality of habitats (Emaresi et al. 2009). The north-eastern border of the occurrence of the alpine newt runs through Poland. Therefore, it is exposed to the effects of genetic isolation, especially since this species shows a short migration distance (Pabijan and Babik 2006). The study presented here is the first type of study method for alpine newts as has so far been available for the carpathian newt *Lissotriton montandoni* and great crested newt *Triturus cristatus*.

Morphology
The alpine newt is a medium-sized, tailed amphibian, with a broad, flat head and a rounded snout (Sparreboom 2014), marked neck narrowing, and a slight fold under the throat. Eyes set laterally, small, slightly protruding, pupils round, golden irises, parotoid glands barely visible. The tongue is small and oval. The maxilla and mandible are toothed, and bands of palatal teeth are slightly bent towards the axis of the body (Juszczyk 1974). The body is elongated, rounded, slightly flattened dorso-ventrally (Sparreboom 2014). During life on land, the skin is dry, dull, and grainy, and during the reproductive period, it becomes more smooth and velvety, which is associated with the aquatic lifestyle (Speybroeck et al. 2016). The body of females is larger, stockier, massive, and widened in the distal part (Juszczyk 1974). Individuals from populations found in higher areas reach larger body sizes. However, they mature later, which is associated with a shorter growing season (Miaud et al. 2010). The body length of males is 5–10 cm, and females are longer, 6–12 cm. Most males have a length of about 7–8 cm, and females 9–10 cm. Both sexes can reproduce after reaching about 6 cm in length. The body weight of males is 2–5 g, and females 2.5–7 g (Juszczyk 1974). Limbs are short, massive ended with short toes without interdigital webbing (Sparreboom 2014). There are four toes in the forelimbs and five toes in the hind limbs. The tail is low, laterally narrowed, ending in a sharp and abrupt narrowing (Sparreboom 2014). The length of the tail differs between sexes, in males, it is shorter than the body, and in females, it reaches a maximum of equal length to the rest of the body (Juszczyk 1974). During water activity, fins are distinguished: the abdominal fin is greater and the dorsal fin is less marked. In contrast to the males of the Carpathian newt, there are no glandular ridges on the back or a threadlike tail tip, and there are no calluses or a mating crest (characteristic of the males of the great crested and smooth newt during the breeding season). It is replaced by a fold of skin, visible especially during the mating season, starting at the neck, about 2 mm high, smooth and uninterrupted (Herczek and Gorczyca 1999), with shallow grooves on the sides. In females, there is neither a fold nor a groove on the back (characteristic of female crested newts), the surface of the back is smooth. In the male, the cloacal lips are strongly developed, swollen, and prominent during the mating season. Females have them small, low, and flat (Fig. 1) (Juszczyk 1974).

Coloration and spotting

While living on land, the body of both sexes is dark in color, black, dark brown, dark olive or dark gray (Herczek and Gorczyca 1999; Speybroeck et al. 2016). Beyond the breeding season, the alpine newt is similar in color to the great crested newt. Both sexes take on blue and blue hues during the mating season, often with a silvery sheen. The color of males, starting from yellow, covered with black dots, fold on the back, through a dark background of the body, a light and blue band with black dots, passes into an orange belly (Speybroeck et al. 2016). On the background of the back and the sides of the tail, the blue spots are of different intensity, irregular shapes, and sizes, and vary in connection with each other. Females in the reproductive period have slightly marked blue, marbled spots of irregular shapes (Herczek and Gorczyca 1999) (Fig. 2). Moreover take on shades of blue of lesser intensity, the pattern of spots is more clearly marked, there may be two longitudinal spots or the entire surface may be of a relatively uniform, dark color (Juszczyk 1974). There are also dark orange females. The ventral side, starting from the lower jaw through the dewlap, neck, and belly, and the inner surfaces of the legs, is uniformly bright orange, without spots. It contrasts sharply with the color on the sides of the body (Speybroeck et al. 2016). The belly color distinguishes the alpine newt from the crested newt and smooth newt, which have a visible pattern of black spots (Bonk and Sochacki 2012). There are dark spots on the tail, on the lateral sides of the orange color range (Fig. 1). The plantar surfaces of the legs and the tips of the toes are yellow or orange (Juszczyk 1974), which is also similar to great crested newt.

Fig. 1. Ventral sides of alpine newts, the female is on the top photo (photo Zuzanna Kulis)

Biology and habitat requirements of the species

The alpine newt begins its migration from wintering grounds to breeding reservoirs in early spring, right after the thaws. It reaches full reproductive activity as early as 14 days after

waking up from hibernation (Diesener and Reichholf 1997). Usually, this period falls at the beginning of April, sporadically with an exceptionally warm early spring they can migrate as early as March. The alpine newt has a small dispersion range – up to about 500 m (Kurek et al. 2011). It has a sedentary lifestyle and is very much associated with a particular waterbody (Joly and Miaud 1989). The activity and intensity of migration, and thus the accumulation of newts in reproductive reservoirs, increases with temperature. The Alpine newt does not have excessive requirements regarding the place of mating and egg laying. It prefers mainly deciduous forests, near agricultural areas (Speybroeck et al. 2016) and mixed forests. It uses water habitats of natural and anthropogenic origin, with varying degrees of coverage with aquatic vegetation (Babik and Rafiński 2001). It usually uses ponds, lakes, springs, roadside ditches, flooded ruts and fields, drinking troughs for cattle, puddles (Juszczyk 1974; Speybroeck et al. 2016), oxbow lakes, mountain landslide ponds, springs (Juszczyk 1974) reservoirs on peat, gravel pits or clay pits (Babik and Rafiński 2001; Bobrek 2022).

Fig. 2. Lateral sides of alpine newts, the female is on the top photo (photo Zuzanna Kulis)

Occasionally, the alpine newt uses wide streams with a calm current (Bobrek 2022). In a dense stand, possible breeding sites are small reservoirs on unpaved roads (Babik and Rafiński 2001). They show a wide tolerance to water temperatures. Mating alpine newt specimens were recorded even in springs with a temperature of 10°C (Juszczyk 1974). The egg-laying period usually lasts from April to July (in the high parts of the mountains even in August), the female can lay from 100 to 200 light brown 2–3 mm eggs with a proper egg cell diameter of 1.2–1.3 mm. The egg is light brown, and rounder than in other species of newts, and the creative pole is poorly pigmented (Juszczyk 1974). The female lays several eggs, almost daily, on tiny leaves which she carefully folds back with her hind limbs (Sparreboom 2014) for protection. If there are no plants in the tank, the eggs are glued to, for example, threads of algae, twigs, the surface of stones, or the bottom itself, there are packages of several eggs or short ropes. Alpine newt eggs laid in very warm water (20–22°C) leave their eggshells after 8–9 days (Juszczyk 1974), while on average 2–4 weeks from laying (Sparreboom 2014) and are 7–8 mm long (Diesener and Reichholf 1997). After hatching, the larvae have anlages of gills and forelimbs, and a formed caudal fin, much shorter than the rest of the body and blunt, it is almost parallel to the line of the caudal muscle (Juszczyk 1974). In addition, there are four melanophore bands characteristic of these newt larvae. Individuals are darkly colored with a marbled pattern on the sides of the caudal fin (Juszczyk 1974). The pointed tail with a dark tip allows it to be distinguished from, for example, the carpathian newt. After reaching the body length of 13–14 mm on average, the fourth finger develops in the forelimb, at 14–15 mm anlages of the hind limb appear, and at 25–30 mm, the fifth finger develops in the hind limb (Juszczyk 1974). Having reached 30–40 mm, it has distinctive features that distinguish it from other species. These are a large, broad head, a body with 9–10 poorly marked myomeres, a caudal fin with almost parallel edges and a sharp, dark tip, the side surfaces of the caudal fin covered with a characteristic, black marbled pattern, up to a completely black, characteristic tip of the tail (Juszczyk 1974). In addition, in the stage of maximum development, the alpine newt larva has a steeply marked beginning of the dorsal fold of the caudal fin starting at the level of the forelimbs and a developed ventral fold (Sparreboom 2014). The larvae metamorphose after about three months (Diesener and Reichholf 1997) and reach 40–50 mm (Juszczyk 1974; Sparreboom 2014). Like the larvae of other newts, they are predatory and very voracious, hunting mainly small planktonic crustaceans, mainly clavicles, mosquito larvae, chironomids, caddisflies, and other aquatic invertebrates (Juszczyk 1974). Due to the low number of available water bodies in the mountains, there may be a high concentration of larval individuals. This adversely affects their ability to survive due to the high level of cannibalism and mutual mutilation of limbs and tails. Young newts appear on land from August to October (later those from higher parts of the mountains). If the larvae do not manage to metamorphose in a given year, they can, under appropriate conditions in the tank, overwinter and metamorphose only in the spring of the following year (Juszczyk 1974; Herczek and Gorczyca 1999; Sparreboom 2014). The reservoir must be deep enough not to freeze completely, thanks to which the newt larvae can survive (Osikowski 2014). The alpine newt reaches sexual maturity after three years in males, 4–5 years in females, and at higher altitudes after about 9–11 years. In mountainous regions, they can live up to 30 years (Sparreboom 2014).

Alpine newts can breed in one tank together with Carpathian, crested, and common newts, but adults are easy to distinguish. Carpathian newts are relatively uniformly yellow or orange, males have visible furrows on the back along the body, and during the breeding season a threadlike tail tip and their larvae have a brighter and more uniform color and an oval tail

tip (Bonk and Sochacki 2012). Adult individuals outside of the reproductive period lead a terrestrial lifestyle. They then have quite dry and thick skin, so they spend the day in damp hiding places, for example under branches, roots, stones, or in rock crevices (Diesener and Reichholf 1997). They need high air humidity to be active (Speybroeck et al. 2016), which is why they move at night or during warm rainy days. In winter, adults burrow into the litter, hide under or in rotten trunks, rock crevices, and hibernate there. The food consists mainly of spiders, oligochaetes, shellless snails, and insects. In the period of aquatic life during reproduction, the food consists of clavicle moths, daphnia, chironomid larvae, mosquitoes, caddisflies, mayflies, stoneflies, and amphibian larvae (Juszczyk 1974; Sparreboom 2014; Speybroeck et al. 2016).

Species distribution

The alpine newt is more adaptable than other newt species. It can occur in both lowland and mountain environments. In Poland, the compact and indigenous area of occurrence of the species is the chain of the Sudetes and the Carpathians (Juszczyk 1974). There is also a completely isolated population in the Świętokrzyskie Mountains (Pabijan et al. 2009) and in Lower Silesia (Diesener and Reichholf 1997), among others in the areas of Twardogóra and Wołów, probably constituting the northern limit of its natural range (Kolenda et al. 2019) (Fig. 3). In Poland, alpine newts occur in areas between 100 and 1669 m above sea level (Juszczyk 1974). In the east and at lower altitudes it is rarer than in the west (Świerad 1988). In the Bieszczady Mountains, the range was up to Wyżniański Wierch 860 m above sea level, in the Babia Góra range up to Orawskie Duży Stawek 1468 m above sea level, and in the Tatra Mountains, the upper limit of the range includes the Valley of Five Ponds, 1700 m above sea level. The alpine newt is the only species of newt inhabiting areas above 1500 m above sea level (Sparreboom 2014).

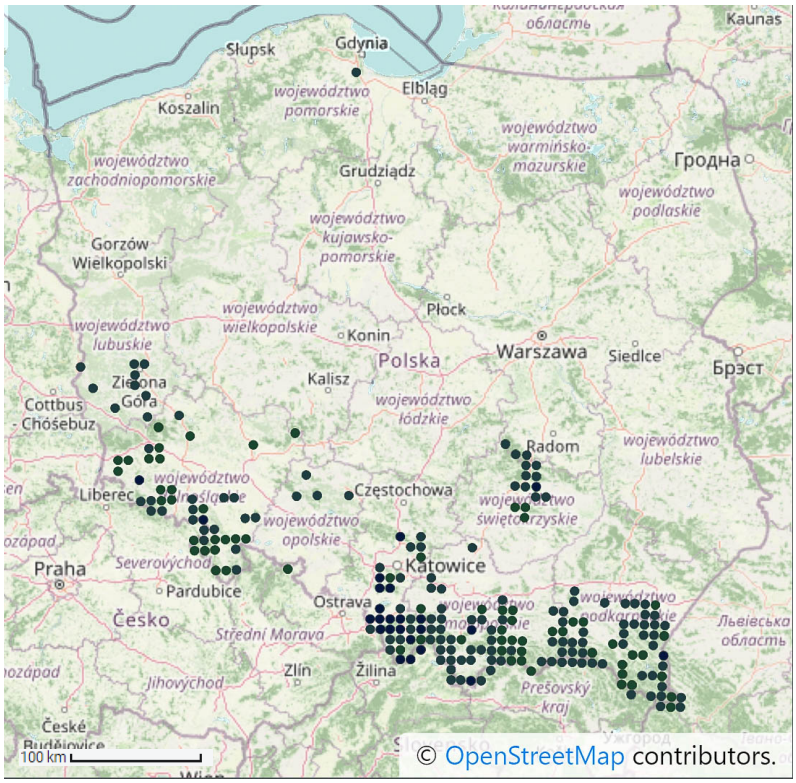

Fig. 3. Map of the distribution of the alpine newt in Poland (IOP 2023)

It is found in Central and Eastern Europe, in some parts of the Iberian, Apennine, and Balkan Peninsulas. In Central Europe, the range of occurrence covers mainly the Alps and is continuous, while in the eastern part, in the Carpathians, it is interrupted by lowlands (Pabijan and Babik 2006). The latitudinal range of occurrence covers the area from central France (Juszczyk 1974) to Ukraine and Romania (Babik and Rafiński 2001). In addition, isolated populations have been found in northern Spain and southern Italy. Successfully introduced in Great Britain and Spain near Madrid (Juszczyk 1974). Four subspecies are distinguished throughout the distribution area:

1. *Ichthyosaura alpestris alpestris* – the nominate subspecies occupies central Europe.
2. *Ichthyosaura alpestris apuana* – occurs in Italy, is characterized by more black dots on the throat.
3. *Ichthyosaura alpestris cyrene* – occurs in north-western Spain, difficult to distinguish from the nominate subspecies.
4. *Ichthyosaura alpestris veluchiensis* – occurs in Greece and southern Serbia, female with black dots on the belly (Sparreboom 2014).

Some authors distinguish six subspecies singling out: *I. alpestris serdarus* found in Montenegro and *I. alpestris inexpectatus* in southern Italy (www.amphibiaweb.org).

The purpose of this article is to submit a proposal for a method of monitoring the mountain newt, to introduce specific tools for conducting it, and to introduce the relevant elements of biology. They can be the starting point for planning and implementing studies of population, habitat conditions and conservation prospects in the field.

MATERIALS AND METHODS

Species monitoring concept

The concept of alpine newt monitoring was developed based on research conducted in 2023 and 2024 in the Babiogórski National Park, a thorough analysis of literature, source materials, and expert consultations. The basic research unit is a body of water (taking into account all types possible to be inhabited by the alpine newt), in which the presence or absence of newts is determined. The quality and condition of aquatic and terrestrial habitats are also assessed according to standardized criteria provided in the detailed section. The research area should include at least a dozen potential reservoirs located in a coherent sequence of terrain, e.g. one mountain slope. Considering the activity dynamics and biology of the alpine newt, flexibility regarding habitat preferences, and the changing mountain landscape during the year, it is recommended to conduct at least three consecutive inventories forming an annual research cycle. Monitoring should cover at least three years of research. After analyzing the data, it will be possible to determine the conservation status of the alpine newt at the level of areas and biogeographical regions in Poland, by the adopted methodology. It will also make it possible to refer back to older studies and identify demographic trends in each area, allowing for comparative research. It is recommended to focus activities in the mountains and highlands.

Indicators and assessment of species protection

Studies, analyses, conclusions, and assessment of the population status should be developed in a certain area, biogeographically coherent, referring to a fuller ecological context. A single site should not be analyzed as an independent research area. It is advisable to conduct research in all potential breeding and living places of the alpine newt, including ponds, puddles, streams, reservoirs on peat and flush fens, ruts, creek bays, hollows filled with water, mammalian bathing areas, etc.

Assessment of the state of the population

The alpine newt population status index should be estimated based on:

1. Number of tanks where adults were observed during the breeding season and the number of sexes (exactly or estimated).
2. Number of tanks where alpine newt larvae were identified and their number (exactly or estimated).

Considering that a significant part of reservoirs selected by alpine newts for breeding sites is small, it is possible to count or estimate the number. Which can help assess which reservoirs should be prioritized for conservation. Such conclusions should be drawn based on several years of monitoring because the size of a given amphibian population can be significantly variable in each year. However, in the case of large water reservoirs, it may be impossible to estimate the number of individuals, so it is only necessary to determine whether the species occurs in a given reservoir or not (applies to the entire study area). Because the weather conditions in the mountains are dynamic, reservoirs may disappear and the breeding period may be elusive, it is recommended to check at least three times a year. Conclusion should be made only after three annual research cycles, due to the possible extended period of larval life with hibernation. The population status indicator remains the same if the number of sites occupied and the estimated number of individuals in successive inventories are similar. In the case of a similar or greater number of occupied sites compared to the previous research cycle, the conservation status of the population is defined as favorable (FV). When a species loses up to 15% of sites in a given year in the study area, the conservation status of the population is unsatisfactory (U1). Significant loss of the species' sites (>15% of sites) qualifies the conservation status of the population as bad (U2). Moreover, if in the first inventory, the number of inhabited reservoirs is small (less than 30% of all examined, potential sites), then the conservation status of the population is also defined as bad (U2). Changes may indicate natural phenomena (e.g. succession or landslides) or anthropogenic ones (e.g. melioration or construction of new reservoirs).

Habitat condition assessment

Habitat status determination is another key aspect of species monitoring. It is recommended to assess and compare the habitat at the first and last inspection of the year and collect for comparison with other habitats and study years. It is recommended to use ten assessed factors that make up the Habitat Suitability Index (HSI). The indicators take a value from 0 to 1, thus determining how much a given aspect is conducive to the occurrence of the alpine newt. A value of 1 means that the measured aspect is the best possible for the development of this species, while a value of 0 excludes its occurrence. The HSI value is derived from the following formula:

$$HSI = (SI1 \times SI2 \times SI3 \times SI4 \times SI5 \times SI6 \times SI7 \times SI8 \times SI9 \times SI10)/10$$

Predictive HSI scaling in the context of assessment: favourable (FV), unfavourable-inadequate (U1), unfavourable-bad (U2), as follows: if the HSI takes a value >0.8: FV means the indicator or habitat quality is highly suitable, allowing the population to thrive and grow. If HSI is 0.51–0.79: U1 suggests that conservation status is unfavourable, but not critical. If HSI <0.5: U2 The habitat is in a bad condition, which threatens the species' survival. Critical factors such as habitat quality, food availability, or other environmental conditions are severely inadequate. Immediate and decisive conservation actions are needed to prevent further decline and ensure the possibility of recovering the species population.

The specialist should approach the given indicators holistically. For example, a tank that will have a small surface area, but will be durable due to the stream that feeds it, will be advantageous in these respects, because the small size provides warmer water. The size and presence of plants in the tank will also affect predator pressure. In small reservoirs, the impact of dragonfly larvae on the survival of amphibian larvae will be greater than in a large, overgrown reservoir.

Indicator		Value	Rating	SI
SI1	Locations above sea level (m.a.s.l)	100–800	FV	1.0
		800–1200	U1	0.8
		1200–1669	U2	0.6
SI2	Water reservoir area (m^2)	>200	FV	1.0
		80–200	U1	0.8
		<20	U2	0.6
SI3	The number of tanks drying out within 10 years, tank durability assessment (consultation recommended)	0–2	FV	1.0
		3–7	U1	0.6
		7–10	U2	0.3
SI4	Water quality	High: transparent, no signs of eutrophication, numerous species of invertebrates, including indicator ones (e.g. mayfly larvae, caddisflies)	FV	0.9–1.0
		Medium: bottom silt with a slight odor of hydrogen sulfide, larvae of species such as (mosquito larvae, roundworms)	U1	0.5–0.8
		Low: murky water, bottom silt with a strong smell of hydrogen sulfide, polluted, larvae of species such as *Eristalis*	U2	0.4
SI5	Shading of the reservoir (% of the area), average for a day, taking into account the landscape and vegetation	0–30	FV	1.0
		31–60	U1	0.7
		61–100	U2	0.5
SI6	Impact of fish, invasive species (e.g. crayfish), birds (waders and waders), and large carnivores (e.g. otters)	Not found	FV	1.0
		Few have been found	U1	0.6
		A lot has been found	U2	0.3
SI7	Possibility of destroying the tank by driving over it or other mechanical impact	Destruction is not possible	FV	1.0
		Destruction is unlikely	U1	0.6
		The tank is likely to be destroyed or will be destroyed	U2	0.2
SI8	Influence of predatory insects (e.g. dragonfly larvae)	No or few insects	FV	1.0
		Moderately numerous insects	U1	0.5
		Lots of insects	U2	0.3
SI9	Number of reservoirs potentially used by the alpine newt at a distance of 400 m	5 or more	FV	1.0
		2–4	U1	0.4–0.8
		0–1	U2	0.1–0.3
SI10	Assessment of the quality of the terrestrial environment	Good: good trophic conditions, numerous hiding places in the form of e.g. wood and roots, deciduous forest with rich undergrowth, no barriers to migration, the entire reservoir is surrounded by a natural habitat	FV	1.0
		Medium: good trophic and shelter conditions, but the surface of the reservoir is only partly adjacent to the natural habitat, there are anthropogenic obstacles	U1	0.7
		Bad: Poor trophic conditions, no shelter, isolated and/or barriers to migration	U2	0.4

Assessment of the prospects for population conservation

When assessing this parameter, the current state of the habitat, current natural and anthropogenic impacts, expected threats to the species and site as well as the condition and dispersion possibilities of the local alpine newt population should be taken into account. The assessment of the current state of the habitat has been presented above in the form of the HSI index. The prospects of the reservoir are forecasted by its area (SI2), the number of reservoir dryings within 10 years, the assessment of reservoir durability (SI3), and the stage of succession, overgrowing, and silting should be taken into account. The amphibian habitat outside the reservoir also includes the land area, the assessment of the quality of the land environment (SI10) proves not only its accessibility for amphibians but also the threats. In addition, it is necessary to consider the threats resulting from the interference not only of man as a tourist but also the potential impact of investments carried out in this area. Adjacent forest cultivation, the expansion of water sticks, contamination with fertilizers or municipal sewage, littering, melioration of the area, and disappearance of neighboring reservoirs – these are just some of the potential factors negatively affecting the prospects of maintaining the condition of the habitat. The effects of actions and the complexity of the influencing factors are usually not quantifiable in the long term. It is worth getting the opinions and observations of people responsible or familiar with a given habitat.

Overall rating

Based on the assessment of reservoirs in a common area, it is possible to estimate the general conservation status, i.e. the state of preservation of the research area. The overall rating is limited by the lowest rated factor among those previously mentioned: the state of the population, the state of the habitat, and the prospects for their preservation. If the conservation prospects are rated worse than the status of the habitat, they lower the overall rating accordingly (but not vice versa).

Description of monitoring studies

The research area should be as large as possible within the cohesion of the area or physiographic units. The study area should represent the entire range of the species. One should focus on the number of breeding sites, which is a better indicator of the current status and prospects for the future of the amphibian population than the number, which often shows large, natural fluctuations over the years (Babik and Rafiński 2001). Consultations with people responsible for a given area and map analyses may suggest the selection of research areas. Ideally, they should cover all or most of the reservoirs in the area. It is recommended to make a local vision of predisposed locations walk or drive along forest roads, and mark areas with high humidity, e.g. along streams, riparian wetlands, or peatlands. On the surfaces, a straight line with a length of 1 km and four parallel transects at a distance of 30 meters should be marked out. Every inspection of the entire route should be repeated due to hydrological dynamics. Potential spawning reservoirs (all places with flowing or stagnant water) are searched, and then they are inventoried, and marked with GPS coordinates on the map, photographic documentation is made (photo of the general picture of the habitat and the water surface with at least one shore) and re-checked. Tanks connected or within 10 meters are considered and evaluated as one.

Description of the location of the species

Each position should be described and valued in a consistent and precise manner. It is recommended to include such information as location, name of the site, forms of protection,

geographical coordinates, altitude, habitat characteristics (type, durability, type of reservoir, surroundings), weather of the current and previous day, date and time, and person performing the observation.

To determine the quantity of an alpine newt in tanks too big to use the bucket method, live traps can be used in the form of fencing the reservoir and burying the buckets on the outside (Kurek et al. 2011). This method requires a lot of commitment and careful planning of counting, accounting for the appropriate weather. The best would be a warm (over a dozen degrees Celsius) afternoon and night, with light rain in early spring. It is necessary to perform several repetitions of the research (Kurek et al. 2011). But it is not necessary to know the exact number of newts living in the tank.

During each inspection, adult alpine newts and larvae should be identified, by observing individuals swimming or approaching the surface, you can use a herpetological net with a diameter of 30–60 cm and meshes with a side of 3–5 mm, usually mounted on a stick 1.5 m long or aquarium net in smaller tanks by combing the water column. At the beginning of the breeding season, it is recommended to comb the vegetation several times in search of adults, because the alpine newt adapts to life in water during the breeding season, where it spends most of its time. Thanks to this, it is easy to observe, especially since it usually chooses shallow tanks with a visible bottom. Pay particular attention to plant clusters. On the other hand, during the period of larval growth, it is more effective to comb the bottom of the tank. During the day you can search for eggs of newts, characteristically curled up in mostly small leaves of underwater vegetation (Pabijan 2010). This method indicates the presence of newts but does not indicate the species. This is possible after opening the glued plant and assessing the color and shape of the egg.

Accurate determinations and measurements can be made in a petri dish with water: species, sex, developmental stage, or presence as larvae if determination of species is not possible and compared at the next inspection. Four inspections per season are recommended. They should be carried out during the day, preferably in the afternoon, because the activity of amphibians in water reservoirs increases with temperature, and thus the possibility of recording individuals. Checks should be carried out to:

1. The first inspection (April, May) – a few days after the snow has receded from the area of the tested reservoirs, if they are located on a mountain slope, then after the snow has melted at the foot or about half the height of the massif, to capture the moment of increasing amphibian activity and the critical period of exposure to frost. Early inspection enables detection of individuals that have been hibernating since the previous year. Where possible, determine habitat status indicators.
2. The second inspection (June, early July) after the snow cover has vanished from all or most of the reservoirs, to capture the moment of breeding in the higher parts of the massif and to check how the reproduction is progressing in the lower parts. In addition, the number of tanks available and used for breeding at that time should be specified. In the absence of statements in some of the tanks, it is recommended to repeat the inventory. Where habitat condition indicators have not been estimated so far, they should be supplemented.
3. Third inspection (recommended in July, but may be omitted) to verify where breeding is successful (presence and development rate of larvae) in tanks at all heights.
4. A fourth inspection (August, September) is recommended at the end of the development period, in the last larval stages, to estimate how many larvae will metamorphose or how many at higher altitudes will do so in the spring. Probably some of the hibernating larvae

will not survive the winter, so it is worth checking in spring what is the real reproductive success. It is important to determine in which part of the tanks, about those in which the start of breeding was observed, there are sufficient conditions to end the larval life stage. In addition, reservoirs in which survival and metamorphosis were not possible can be analyzed in terms of causes and possible ways to improve the conditions. Fill in the Habitat Status Index again to summarize.

The date and frequency of the inventory must be determined based on the specificity of a particular site, due to the start of vegetation depending on, among others, height above sea level. Indicatively, for the search for adults and eggs, it can be April–June, while larvae can be found from the moment of resumption of vegetation (last year's hibernating individuals before metamorphosis) until August or even September, depending on the specificity of a given reservoir.

Species protection

The alpine newt is partly protected in Poland. The number of the species will probably decrease, for example, due to the disappearance and transformation of habitats. Shallow tanks holding warm water, beneficial for the development of amphibians, increasingly dry up before the larvae undergo metamorphosis. The intensification of agriculture causes a decrease in grazing in mountain areas and the liquidation of small but permanent drinking bowls on mountain slopes. In forest areas, there is a big problem with the formation of anthropogenic traps in the form of ruts, which often fill with water. If the road is used, the animals on it have no chance of survival. The protection of the alpine newt should consist of identifying its breeding sites, development, shelters, migration routes, and wintering grounds, protecting them against destruction, and maintaining or improving their conditions (Babik and Rafiński 2001). In addition, disappeared, vanishing, or degraded habitats should be restored, and new reservoirs should be created, especially where population losses are noticeable or there are development opportunities. The effects of drainage should be avoided and mitigated. Small water retention measures and nature-based solutions in water should be supported. The continuity of ecological corridors should be maintained, the mosaic nature and naturalness of habitats should be maintained, and monocultures should be avoided in forest management. Investments should be carried out outside valuable natural areas or have limited impact on habitats. In addition, it is advisable to educate people who would have direct contact with the habitat and conduct it on a larger scale. This is especially important because the awareness of amphibians in society is negligible, and amphibians are the fastest-disappearing group of vertebrates in the world.

CONCLUSIONS

This paper is a proposal for a method for monitoring the alpine newt. At the examined sites, the state of the habitat, population, and prospect of conservation should be assessed, and the presence of the alpine newt at various stages of development should be recorded. During fieldwork and data analysis, a wide spectrum of factors influencing the occurrence or disappearance of a species in a given area should be taken into account. Expert knowledge and experience are necessary for proper monitoring.

In times of intensive urbanization and transformation of the landscape, including inaccessible mountain areas, there is a significant decline in aquatic habitats suitable for inhabiting amphibians, including the alpine newt. Furthermore, current and future climate changes will

have an impact on the availability of water resources. Currently, the species is considered common, but constant monitoring of numbers is necessary to determine when numbers will start to decline and the species will become endangered. The information obtained will make it possible to plan and undertake measures to protect the species to prevent the disappearance of the population.

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PROPOZYCJA MONITORINGU TRASZKI GÓRSKIEJ *ICHTYOSAURA ALPESTRIS*

Streszczenie. Traszka górska *Ichthyosaura alpestris* należy do gromady płazów, która jest szczególnie narażona na negatywne skutki degradacji siedlisk wodnych. Niszczenie i fragmentacja potencjalnych miejsc rozrodu i bytowania następuje na skutek intensywnych przekształceń krajobrazu, prac budowlanych czy zabiegów melioracyjnych. Ponadto zmiany klimatu wpływają na dostępność zasobów wodnych, co może skutkować zmniejszeniem liczby miejsc rozrodu. Pomimo że traszka górska nadal jest uważana przez IUCN (2023) za gatunek najmniejszej troski (LC), jest podatna na zanikanie. Biorąc pod uwagę obecne i przyszłe zagrożenia, konieczne jest stałe monitorowanie stanowisk występowania i rozrodu oraz ich ochrona. W artykule opisano propozycję metod badań i monitorowania traszki górskiej. Należy wykonywać cyklicznie inwentaryzacje kompleksów potencjalnych zbiorników wodnych w poszukiwaniu osobników dorosłych, podchodzących do rozrodu wiosną i wczesnym latem oraz w późniejszym czasie rozwijających się larw. Zaleca się przeprowadzanie obserwacji dna i roślinności, odłowów z użyciem czerpaka herpetologicznego oraz wyszukiwania jaj. Ponadto warto szacować Indeks Przydatności Siedliskowej (HSI), jaki zasugerowano w tym artykule. Umożliwi to monitorowanie stanu lokalnej populacji oraz wprowadzenie działań ochronnych na danym terenie w odpowiednim momencie.

Słowa kluczowe: traszka górska, *Ichthyosaura alpestris*, monitoring gatunku, ochrona przyrody, metody inwentaryzacji, HSI.