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THE PROPOSAL FOR MONITORING OF STEPPE POLECAT (*MUSTELA EVERSMANII*)

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Abstract. The article presents a proposal for the monitoring of a steppe polecat – a small predatory mammal of the Mustelidae. The recent expansion of the steppe polecat that occurred in central Europe in the 20th century, its small population in Poland and few inhabited sites, result in a low level of knowledge about this species. The population of this species is not constantly monitored, so it is impossible to determine exactly how many individuals live in Poland. In this work, the first attempt was made to define the methodology needed to start and conduct monitoring that may help manage the population in the future. The monitoring method of the steppe polecat presented in this article consists of the assessment of both the species' habitat and its population. Observations carried out during the monitoring process may additionally facilitate the acquisition of knowledge on the biology, behaviour and the impact of the steppe polecat on the others species and environment.

Key words: Steppe polecat, monitoring, *Mustela eversmanii*, Mustelidae.

INTRODUCTION

Steppe polecat (*Mustela eversmanii*) is a predatory mammal of the mustelid family (*Mustelidae*). It inhabits steppe areas in Central and Eastern Europe and Asia (www.iucnredlist.org). Due to its nocturnal and secretive lifestyle, species are rarely observed and poorly known, due to which information on its current population status and actual distribution is very limited. The appearance of steppe polecats in Central Europe is relatively recent and from there, it has been expanding its western range (Mináriková 2012, cited in: Anděra and Horáček 2005). In Poland, the steppe polecat was found for the first time in 1970 in Gliniska near Hrubieszów. Several more sites were detected in later years. All of them were located in the Lublin Upland and Rostocze (Romanowski 2004).

Species identification

Steppe polecats have a long, slender body, long neck and short legs, the silhouette typical for mustelids. The head is small and flat, with small, widely spaced ears. The body length is

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29–56 cm and the tail 7–18 cm. Depending on the subspecies, they can reach a weight of up to about 2 kg (Romanowski 2004; Mináriková 2012). Males are about 15% larger than females and 35–40% heavier (Mead et al. 1990). Both sexes have the same color. The back, nape and sides of the body of steppe polecats are covered with a yellowish, yellowish-brown or yellowish-grey coat and only the paws, thorax and tail tip are dark brown. The head is whitish, with dark spots around the eyes, forming a mask (Romanowski 2004; Mináriková 2012). The short and sparse guard hairs with black-brown tips give a frosting effect of varying intensity. The middle part of the back is darker than the sides (Maškin and Larionova 2013). There is considerable variation in steppe polecat populations in terms of colouration: both very light and darker individuals are encountered. Steppe polecats moult twice a year: in spring and autumn. In summer their coat is sparser and shorter than in winter, and the contrast between light and dark parts of the body is more pronounced (Romanowski 2004).

The 3.5–4 cm long paw prints of steppe polecats remain clearly visible on snow, sand and mud. The footprint shows the reflection of 5 fingertips and an elongated interdigital pad. The claw, interdigital pad and heel prints are sharp and distinct. The stride length ranges from 40 to 80 cm. It often moves at a trot. Burrows dug by the steppe polecat have ground thrown in two or three directions, which distinguishes them from burrows dug by the common polecat and Siberian weasel, which do not (Maškin and Larionova 2013). The droppings of steppe polecats are 6–8 cm long, spirally twisted and pointed at one end (Romanowski 2004).

There is a high phenotypic similarity between the steppe polecat and the European polecat (*Mustela putorius*), which increases the risk of incorrect species identification. Both species are similar in size and have a dark mask around the eyes. Due to the similarity of footprints and droppings, these tracks alone cannot provide a basis for distinguishing between species. At the same time, certain appearance features may allow species recognition. The steppe polecat is slightly smaller than the European polecat and its colouration is distinctly lighter. Its yellowish coat with dark hair tips allows it to be distinguished from the European polecat, whose fur is brown on the back and black on the belly. The mask of steppe polecats is less pronounced and may disappear completely in older individuals (Romanowski 2004; Mináriková 2012; Pelcaru and Alistar 2021). It is also possible to confuse the steppe polecat with the home-bred domestic ferret (*Mustela furo*), which comes in many colour varieties (Mináriková 2012). In order to completely exclude the risk of species confusion, it would be necessary to carry out an analysis of DNA taken from animals, from found remains or other biological traces.

Lifestyle

They are generally nocturnal animals, with peaks of activity occurring at dawn and dusk. Females are seen more frequently during the day in summer, which may be due to the need to feed the kits (Mináriková 2012). They move agilely and quickly. On average, they cover few to several kilometers per day, with this distance likely to increase to 20 km under conditions of food scarcity. Steppe polecats hunt on the ground and in underground burrows. Furthermore, they use the burrows of ground squirrels and other rodents for movement and hiding (Romanowski 2004). Each individual occupies several burrows, which are being used in turns. In winter, during severe frosts, polecats are able to stay in their burrows for several days, using the supplies stored in there. The expanded and deepened burrow can be as deep as three meters deep. The nest chamber is lined with hay, nest remnants and rodent pelts. Corridors lead into the burrow, with an entrance opening diameter of 10–12 cm. Inhabited burrows can be identified by traces, droppings and remains of prey around as well as the soil strewn when the corridors are widened (Romanowski 2004).

The steppe polecat does not occupy a permanent territory. It usually remains in one place until the food source is exhausted (approximately 3–4 months), after which it moves to another location. In areas with abundant food, it forms colonies with a relatively high density of individuals (Mináriková 2012). It generally leads a solitary lifestyle, but may also form groups in which juveniles stay together until they find their place in the colony (Kaleta 1996). Depending on the amount of food available, its populations can be locally very numerous, with densities up to 1 individual/hectare. On the other hand, if the availability of prey decreases or there are unsuitable biotope conditions, the steppe polecat quickly moves to places with more optimal environmental conditions (Mináriková 2012).

Diet

The steppe polecats feed mainly rodents, such as ground squirrels of the genus *Spermophilus*, hamsters, mice, voles and other small mammals. They rarely prey on birds, lizards, snakes and insects. They can also eat carrion (Romanowski 2004). Due to its larger body and skull size compared to other weasel species, it is better adapted to hunt for larger rodents, such as steppe-dwelling gophers and hamsters, which make up the bulk of its diet (Abramov and Puzachenko 2012). Steppe polecats gather supplies from hunted game. At the same time, it behaves in a relatively opportunistic manner, primarily selecting food that is most abundant and available in the region (Mináriková 2012). In the Western Siberian region, it was observed that the diet of the steppe polecat included only 30% of mice and voles, a higher proportion of European water vole and large rodents: muskrats, ground squirrels and hamsters (Abramov and Puzachenko 2012). In Hungary, on the other hand, the most important prey were common vole, European hamster, European ground squirrel and brown rat. Consumption of small passerine birds increased in spring and autumn. In contrast to European polecats, steppe polecats did not consume food of anthropogenic origin, such as poultry eggs and slaughterhouse residues. Otherwise, both species share similar trophic niches, but the proportion of foods other than small mammals (among others: birds, fish, insects and plants) in the diet of steppe polecats was lower (Lanszki and Heltai 2007).

Reproduction

The steppe polecat is a polygamous species (Romanowski 2004). The mating period begins in early spring, usually in March. Mating occurs between March and April, and gestation lasts between 37 and 43 days. The kits are born in mid-May, in underground burrows located even a few metres underground. The number of kits per litter varies from four to 10 individuals. The cubs weigh about 6 g at birth. After 30–41 days they open their eyes (Mead et al. 1990). At this time they begin to leave the nest and hunt small rodents on their own, but still remain near the family burrow. Within 4 months the offspring reach their target weight and leave the family nest at the end of summer (Romanowski 2004).

Although studies by Mead et al. (1990) indicate that under laboratory conditions females can give birth several times, it is believed that in the wild they have only one litter per year. If the young die, the female may become pregnant again later in the year (Romanowski 2004). Sources are known to indicate possible interbreeding between steppe polecat and European polecat (Mead et al. 1990, cited in: Ternovskaya and Ternovskii 1977).

Status and threats

The species has LC status – Least Concern on the IUCN list due to its wide distribution and relatively abundant population. At the same time, it is protected in many areas of occurrence

in Europe and Asia, and the overall number of individuals is on a declining trend (www.iucnredlist.org). European populations are considered particularly threatened (Lanszki and Heltai 2007; Mináriková 2012). There is abundant evidence of a significant recent decline in steppe polecats in central Europe, probably due to food base depletion and habitat degradation (Šálek et al. 2013). It remains more widespread and abundant in eastern Europe and Asia.

In European Union countries, the steppe polecat is protected under Appendix II of the Bern Convention and Annexes II and IV of the Habitats Directive. In Poland it is strictly protected. In the Polish Red Data Book of Animals it has NT status – near threatened (Romanowski 2004).

The main threats to the stability of the steppe polecat population are related to human activities. These are mainly changes in agriculture and its intensification, resulting in the alteration of the natural habitat. Habitat degradation, monoculture cultivation and conversion of steppe land to agriculture can result in a reduction in numbers and regionally lead to the extinction of the steppe polecat in a given area (www.iucnredlist.org; Yudin 2023). The reverse process – the abandonment of formerly agriculturally used land, resulting in overgrowth by shrubs and trees – is also unfavourable. Another problem is the decline of rodents that are particularly sensitive to environmental changes, such as ground squirrels and hamsters, which form the basis of the diet of steppe polecats. The population is also adversely affected by land fragmentation associated with the creation of transport infrastructure and housing developments. The proliferation of roads and other barriers can prevent migration, result in isolation of populations, as well as increased collisions with vehicles hunting of steppe polecats for meat and fur is common in some regions (including Russia). Although the steppe polecat is protected in European range countries (except Austria), it is legal to hunt the similar common polecat. The ease of confusion between the two species can result in poaching of the steppe polecat (Šálek et al. 2013). Unlike the European polecat, the steppe polecat avoids urbanized and highly transformed areas, yet it can be considered a pest and exterminated by local residents (Lanszki and Heltai 2007). Natural enemies of the steppe polecat include wolves, foxes, owls and birds of prey. An increase in their numbers may lead to predation and increased interspecific competition (Mináriková 2012). The presence of American mink and other invasive and alien species may also threaten the survival of populations (Sidorovich et al. 2000).

CURRENT DISTRIBUTION AREA

With changing climate and landscape transformations, the global-distribution of steppe polecat in the world has fluctuated. In the Pleistocene, the species was widely distributed, with a range extending from Western and Central Europe to Asia, but after the Holocene intensive forestation of the continent, the western limit of its range shifted eastwards. Subsequently, massive deforestation in the 20th century led to a renewed westward expansion. Until the mid-20th century, the steppe polecat was widespread in the open steppes and agricultural areas of Central and Eastern Europe. Since the 1960s, both in Europe and in some Asian countries, a decline in population has been observed (www.iucnredlist.org; Šálek et al. 2013).

The current range of the steppe polecat includes 21 countries. In Europe, this species has been observed in Austria, the Czech Republic, Poland, Hungary, Slovakia, Bulgaria, Romania, Moldova and Ukraine. In Asia, it occurs in Russia, northern Georgia, through Kazakhstan, Turkmenistan, Uzbekistan, Tajikistan and Kyrgyzstan to Mongolia and northern and western China. Single records also come from Nepal. The occurrence of the steppe polecat in Serbia and India is uncertain. In Europe, there is a western and southern range

limit (in the Czech Republic and Bulgaria respectively) (www.iucnredlist.org; Šálek et al. 2013; Ivanov and Spassov 2015). Despite its seemingly wide distribution in many regions, the population of steppe polecats is fragmented and dispersed. Descent in the numbers of steppe polecats in most European countries led to fragmentation and extinction of local populations in the early 2000s. Due to its secretive lifestyle, it is difficult to precisely define its distribution areas (Šálek et al. 2013).

Habitat

The steppe polecat is a species typical of open steppes, dry plains and semi-deserts with few trees. This habitat remains present in extensive areas of its eastern range – in eastern Ukraine, Russia and Central Asia. It also occurs in arable land and areas adjacent to arable land: meadows, pastures and uncultivated fields (Romanowski 2004; Mináriková 2012; Šálek et al. 2013). Particularly in the European part of its range, it is often found in areas consisting of a mosaic of meadows, small fields as well as mid-field shrubs, hedges and dry embankments, which it uses as shelters (Šálek et al. 2013). Steppe polecats also use ravines and abandoned quarries. Much less frequently it inhabits small groves with patches of meadows (Abramov and Puzachenko 2012; Ivanov and Spassov 2015).

Habitats of steppe polecats are very often associated with colonies of ground squirrels, hamsters and other small rodents, which are the main food source (Lanszki and Heltai 2007; Mináriková 2012). In contrast to the European polecat, it avoids wet and densely forested areas (www.iucnredlist.org; Šálek et al. 2013). Height above sea level seems to be of little importance in the distribution of the steppe polecat. In Europe it is found up to 800 m above sea level, in Asia up to 2600 m above sea level. A single observation of the steppe polecat in Nepal was made at an altitude of 5,050 m above sea level (www.iucnredlist.org).

Records indicate that the steppe polecat can adapt to less typical habitats. It can stay in river valleys and passes that act as habitat corridors. In addition, logging and road construction seem to facilitate its migration and spread to the west and south (Ivanov and Spassov 2015).

Distribution and characteristics of habitats in Poland

All sites of the steppe polecat found so far in Poland are located in the eastern part of the country. The steppe polecat is a very rare species, but it can be assumed that the Lubelska Upland and Roztocze are inhabited by a small population, occurring there permanently or periodically, and supplied from Ukrainian populations. All sites were associated with speckled ground squirrel inhabiting this area (Romanowski 2004).

In Poland, all sites of the steppe polecat are located in fallow, pasture and steppe-like meadows – on flat terrain and hill slopes. The species is associated with three types of habitats, designated as the a Special Area of Conservation in Annex I of the Habitats Directive: semi-natural dry grasslands and scrubland facies on calcareous substrates, xeric sand calcareous grasslands and lowland hay meadows (Romanowski 2004). The distribution of these habitats in Poland may indicate possible migration directions of steppe polecats and the possibility of occupying new areas.

Monitoring of the steppe polecat population in Poland should involve regular activities to help assess the status of the population and to gather information to facilitate the implementation of appropriate conservation procedures for the species. Due to the possibility of further shifting of the range boundary towards the west, the collected data on habitats may help forecasting in which areas the species could appear in the future. The collected data

should also help with better understanding of the impact of the steppe polecat on other species, particularly protected rodents such as ground squirrels and hamsters.

METHODS OF MONITORING

Indicators of the population and habitat status of the steppe polecat

The steppe polecat's behavior and habitat preferences are not well understood, so it is difficult to clearly establish a list of indicators of population and habitat status during monitoring. A proposal for indicators is given in Table 1 and valorization of the given indicators is described in Table 2. The impact of all indicators describing the state of the population and habitat status should be considered together. As mentioned by Yudin (2023), the deterioration of one or more indicators may result in the complete withdrawal of a species from an area.

Table 1. Indicators of the population and habitat status of the steppe polecat

Indicator	Measurement	Indicator description
Population:		
Population/burrows density	number of individuals /occupied burrows per 1 ha	Data collected on the basis of tracking, registration of burrows, photos from camera traps and registration of other traces of existence
Presence of mothers with kits	signs of presence or absence of litters	Observations at the sites conducted during the monitoring; the indicator should be used during spring and summer monitoring
Average number of kits per female	number of kits	Observations at the sites conducted during the monitoring; the indicator should be used during spring and summer monitoring
Habitat:		
Type of terrain	determination of the type of terrain	Passing the area on which the designated site is located to one of 3 classes: open, partially closed, closed
Way of the land use	determination of land use	Determine whether extensive, intensive or no farming is carried out in the area being assessed
Tree and shrub overgrowth	degree of land overgrowth [%]	Coverage of the area with species of trees and shrubs
Presence of habitat corridors	determination of the number and permeability of ecological corridors	Assessment whether habitat corridors enable migration between sites and colonization of new areas
Preferred food base*	availability of food base	Availability of preferred prey: spotted ground squirrels and European hamsters within 20 km from the site
Other food base*	availability of food base	Availability of other prey in the food base (other rodents, birds, lizards, snakes, insects) within 20 km from the site
Presence of predators*	density of predators	Presence and density of predators (e.g. wolf, fox, American mink, raccoon dog, birds of prey) that may pose a threat to the population
Buildings and road infrastructure	determination of distance	Proximity and development of residential buildings and development of road infrastructure in the vicinity of the site

* Density evaluated on the basis of data from the monitoring of given species.

Table 2. Valorization of the population and habitat status indicators of the steppe polecat

Indicator	FV	U1	U2
Population density	>0,5	0,5–0,1	<0,1 or complete absence
Presence of mothers with kits	the presence of a litter	signs of the possibility of the appearance of a litter	no sign of litter presence (?)
Average number of kits per female	>7 kits in the litter	7–4 kits in the litter	<4 kits in the litter
Type of terrain	open area	partially closed	closed
Way of the land use	extensive agriculture, multiple crofts and buffer strips*	partially intensive agriculture, rare crofts and buffer strips	intensive agriculture, monocultures
Tree and shrub overgrowth**	<30	30–50	>50
Presence of habitat corridors	multiple and pervious	moderately numerous or with difficult migration opportunities	few or none
Preferred food base*	high density of prey	medium density of prey	low or no prey density
Other food base*	high density of prey	medium density of prey	low or no prey density
Presence of predators	no or low density of predators	medium density of predators	high density of predators
Buildings and road infrastructure	location of the site away from built-up areas, low density of roads	location of the site middle distance from built-up areas, medium density of roads	location of the site near built-up areas, high density of roads

FV – proper condition; U1 – condition unsatisfactory; U2 – bad condition.

* Extensive farming means land use in accordance with traditional agricultural activities, which allows the preservation of biodiversity and prevents overgrowth by trees and shrubs (mowing or grazing).

** The degree of land cover can be supplemented by detailed information on the presence of tree species that tend to quickly overgrow new sites and rebound from the roots, such as black locust, blackthorn, common dogwood and hawthorn.

Most important current and anticipated impacts (threats) on the species and its habitat

Negative and positive impacts on the population and its habitat that may improve or worsen habitat conditions in the area should be considered in the assessment. Selected threats and impacts are listed in Table 3.

Table 3. Current and anticipated impacts and threats on the species and its habitat

Impact	Influence	Intensity select the appropriate (A, B, C)	Impact		Description
			current select the appropriate (YES/NO)	future	
Agricultural intensification	–	A	YES	YES	Fast pace of field work, the transformation of the mosaic of the farmlands into monocultures, the use of pesticides and artificial fertilizers
Forest succession	–	A	YES	YES	Overgrown with bushes and trees of steppe areas, fallow lands and wastelands
Capturing, poisoning, poaching	–	C	YES	YES	Cases of capture and deliberate killing of steppe polecats (poisoning, shooting); poaching due to confusion with European polecat
Progressive urbanization, proximity to urban and rural areas	–	B	YES	YES	Increasing influence of urbanized areas (especially large cities) and inhabited areas on the site; prospective development of urbanized areas and planned investments
Roads	–	B	YES	YES	Building new roads and city bypasses – further fragmentation and isolation of habitats and populations; creation of barriers, increase in road traffic – increased mortality, increased noise emissions
Depletion of the food base	–	A	YES	YES	Declines in the rodent population in the site, especially the preferred hamsters and ground squirrels <i>Spermophilus</i>
Presence of European polecats	–	C	NO	YES	Possible competition for resources; possibility of hybridization
Predation	–	B	YES	YES	Observed predators (fox, wolf, birds of prey) in the site
Presence of invasive species	–	B	NO	YES	Observed alien and invasive species and their numbers; possible predation and competition for food resources
Protection area	+	A	YES	YES	Presence of a protection zone (reserve, Natura 2000, other) in a given site

Coding: influence of impact: „+” positive, „–” negative; impact intensity: A – strong, B – moderate, C – low; impact current/future: “YES/NO”.

Prospects of maintaining the population

The assessment of the prospects of maintaining the population of the steppe polecat at given site should be an expert assessment and should take into account current and predicted (in the perspective of 10–15 years) population status, habitat status, impacts and threats that may affect the local population in the future. It should include elements such as:

1. Assessment of the size of the occupied area and whether there is a potential for further population development at the site.
2. The presence of steppe polecats in neighboring habitats and the status of these populations.
3. The presence or absence of habitat corridors, enabling migration to other potential sites of occurrence and possible barriers preventing the migration of the species (for example: roads, built-up areas, large forest complexes).
4. Assessment of neighboring habitats in terms of the possibility of colonization by the steppe polecat.
5. Activities and investments planned in the vicinity of the site, which may have a negative impact on the steppe polecat population (for example: road infrastructure development plans, residential development plans).
6. Assessment of the rate of change associated with agricultural intensification (conversion of steppe areas to farmland, establishment of monocultures, change in crop structure, intensification of field work, chemicalisation) or the rate of overgrowth of open areas with forest as a result of the cessation of agricultural activity.
7. Threats to prey populations that form the basis of the diet of steppe polecat in the site.
8. Other threats to the population within the site (poaching, hybridization with the European polecat, high anthropogenic pressure, mortality on local roads, transmission of diseases and parasites).

The perspectives for the persistence of the species in a given habitat can be assessed as favourable (FV), when the density of individuals is medium or high and the habitat conditions are favourable for the survival of the population; unsatisfactory (U1), when the abundance does not guarantee the survival of the population and the condition of the habitat is deteriorating; poor (U2), when there are no perspectives for the persistence of the species in a given area due to low abundance and poor condition of the habitat and no conservation measures can bring any more positive results. The general evaluation should be based on indicators of population status, habitat conservation status, current and anticipated threats, prospects for the survival of the population in the site and potential migration.

Determining the sites for monitoring

Due to the small number and limited range of occurrence in Poland, regular monitoring should include all the sites identified so far, as well as other areas in the Lubelskie Voivodship with optimal environmental conditions, which may provide potential habitat for the steppe polecat (e.g. including all known colonies of speckled ground squirrel). In confirmed areas of occurrence, it would be optimal to conduct regular data collection activities, at least once every six months. If population densities increase, consideration should be given to increasing the frequency of surveys. Only conducting systematic, repeated monitoring activities can help to determine whether Poland is inhabited by a temporary or permanent population and the rate of migration of individuals from the eastern border.

At new, potentially inhabited sites, the first step should be to confirm the presence of the steppe polecat by finding traces of its existence (e.g. burrows with tracks, remains of victims

and droppings), obtaining photographic evidence or genetic testing of the collected material. Subsequently, an area within a 20 km radius of the identified presence (e.g. occupied burrow) should be assessed.

According to Romanowski (2004), the phenomenon of steppification of some areas in Poland may be favourable for the steppe polecat and may increase its range limit. Due to this and its relatively high migratory abilities, in other areas of Poland that may be colonized by polecats, information on the population and condition of the habitat should be collected once a year. The monitoring should especially include areas with habitat corridors leading from the sites of confirmed occurrence.

A known occupied site should be considered as an area where the presence of the steppe polecat has been confirmed (the species has been identified from a photograph or its presence has been confirmed by DNA testing). If new sites are identified, they should also be included in the monitoring. Monitoring of known sites should be carried throughout the year. The best chances of confirming the presence of polecats by direct observation (e.g. through binoculars) are in summer, when the female feeds and leads kits. Registration of burrows should take place at a time when vegetation on a given site is relatively low. This will increase the chances of finding all occupied burrows. The condition of the habitat should be determined in the period from late spring to autumn, when the most intensive agricultural production is also taking place.

Methods of research

In the area inhabited by polecats, it is possible to record traces of their presence: tracks, claw marks, droppings, burrows and the remains of prey. Direct observations of adults and kits are also possible, but difficult to carry out and do not guarantee success. Therefore, according to Romanowski (2004), the basis for field research should be the registration of burrows with traces of the presence of polecats, supplemented with photographic recording. A certain presence of polecats in a given area can only be indicated by regular, repeated and numerous found tracks and occupied burrows. Single tracks may indicate the possible movement of steppe polecats in a given area, but they cannot be evidence of a permanent population. Due to the similarity of the steppe polecat's tracks to those of other mustelids, particularly the Eurasian polecat, registration of burrows may be a better option than tracking along transects. However transects can help identify places where steppe polecats may be. Due to its low abundance and uncertain occurrence in most areas, monitoring should be carried out in several ways. Thus, inferences about the status of the population should be made on the basis of results collected by different methods. Suggested methods of monitoring are: tracking on transects, year-round observations, recording and monitoring of burrows and community-based monitoring.

Data should be collected by authorized individuals (including employees of nature reserves, parks, hunters, etc.) with appropriate knowledge and then recorded on appropriate observation forms. People involved in monitoring, e.g. tracking on transects, should be adequately trained before they start working. A regional coordinator- supervising the work of all units that monitor steppe polecat, should be responsible for the actions taken on a site.

Tracking along transects

Tracking traces on previously selected transects can be a method to determine whether the steppe polecat is present in a particular area as well as helping to determine how large a population lives in the monitored area. Transects should be designated by a specially

selected person – a coordinator who has experience in working with this species and will oversee all activities. At the same time, several people should go “into the field” (the more, the better the chances of collecting the necessary data, but too many may cause excessive agitation). Each transect should be covered within one day. Transects, depending on the researcher’s experience and habitat conditions, should be 10–20 m wide. Transects of the maximum width can be set when vegetation cover is sparse, stubble is low and there are no weeds with visibility being good. Those involved in monitoring should be spaced approximately 5–10 m apart and record any signs of polecats existence: tracks (their size, direction, number of individuals), droppings, potential burrows, remains of prey and others. All tracks found should be recorded on a GPS map and biological samples collected and subjected to genetic testing to exclude the possibility of confusing the steppe polecat with the European polecat. Photographic documentation of all tracks of presence should also be carried out. Maps of transects and the results from each tracking should be sent to the site selected as the monitoring coordination centre, where they would be analysed by a team of experts.

Year-round observations

Year-round tracking should be based on observations made by people constantly working in the field, such as: nature reserve workers, hunters, members of local environmental organizations, etc. These observations can also be made when monitoring other species occurring in the area or when monitoring protected habitats. Their aim should be to determine the possible abundance, distribution, facts of polecats entering breeding and approximate locations of breeding sites (based on burrows found, observations of kits or mothers). Persons involved in monitoring activities while in the field should record all chance encounters and traces of presence found, record on maps (GPS locations on digital maps) and enter on observation cards, which should then be sent to the coordinating centre for steppe polecat monitoring. The observation card should include the following information:

- date, time and location of each observations or signs of their presence,
- all observations (preferably together with evidence of observations in the form of a photo or camera recording) with the numbers of individuals or dead individuals and, if possible, also the age and sex,
- information about active burrows or other shelters and the possible presence and numbers of kits,
- other traces of presence, including: tracks, droppings, remains of victims (if it possible with species identification); it is advisable to include evidence of sightings as photographs and to collect biological samples for further genetic analyses.

All data should be enter into a computer databases. Systematic data collection and analysis can provide important information for the management of the steppe polecat population and the conduct of species conservation efforts.

Monitoring of burrows

Monitoring of burrows aims to gain more detailed data on the distribution, number of individuals, behavior or biology of the species. In selected areas that have been designated as potential steppe polecat sites, burrows that may be used by the steppe polecat should be found. Active burrows will be characterized by unobstructed openings that are free of cobwebs and have tracks accumulated in vicinity. In order to confirm that a particular burrow is inhabited by a steppe polecat, observations must be made either directly or indirectly. Direct observation of burrows will consist of observing the burrow with binoculars, during evening

or dawn hours, for at least one week or until the presence of the polecat is confirmed. Observations should last at least 2–3 hours at a time and should take place daily.

The second way of conducting research involves the use of camera traps. Due to the many benefits, camera traps are a tool commonly used in field research. They are particularly good at detecting the presence of rare and timid species of mammals, as they enable non-invasive observation of animals and the quick and efficient collection of large data sets (Pyšková et al. 2018; Poledník et al. 2019). The use of camera traps is also recommended when the presence of a steppe polecat is already initially confirmed. The camera traps should be setup to register animals entering and leaving the burrow. Moreover, they should be placed in places where polecats move, for example along animal paths leading to a watering place. Camera traps should be placed about 0.5–1 m above the ground. Data collection from camera traps should take place in all locations at least once a month. It is important to acquire good photographic documentation, as identifying the steppe polecat is not entirely straightforward nor easy. For this reason, it is best to use photo traps that also allow colour images to be taken at night, which enable reliable identification of the species recorded.

Data collected with camera traps should be standardized before interpretation to reduce the risk of multiple counts of the same animal. Therefore, an animal registered as moving in a series of consecutive photos taken in less than two minutes or entering and exiting the same burrow should be considered as one individual and considered as one record. It should also be borne in mind, that there may be even several burrows per individual, so it is not appropriate to infer population size directly from active burrows found alone.

Monitoring based on cooperation with the local community

A program of cooperation with the local community should be introduced to increase the success of monitoring. Questionnaires and addressing the public still remain a method that is successfully used in species monitoring of the various species (Poledník et al. 2019, cited in: Červený et al. 2006). The program should involve local residents in monitoring and protection activities. It is necessary to carry out an educational and information campaign in the area and the local community should be familiarised with the typical signs of the presence of steppe polecats. Invitations to cooperation can be addressed to both to professional and hobby nature conservationist, farmers, hunters and other residents of the surrounding areas through: e-mails, letters to selected people or organizations, information in schools and offices or articles in local magazines. Invitations should also include a short description of the species, including identification instructions. Application forms should be prepared in which those involved would post their sightings, as well as any additional information about found dead polecats. Observation forms should be simple and accessible to the public (e.g. possible to be completed and sent in an electronic version from the phone). It should be also possible to attach a photo or video. In addition, a website should be set up to facilitate the transmission of information. Community-based monitoring will require a coordinator to oversee the activities at the local level. The coordinator should be a person with appropriate training and knowledge of species biology and nature conservation.

Just as important as community's involvement is conducting appropriate educational activities. The steppe polecat can be confused with the common polecat, considered a pest and eliminated. Therefore, it is important to raise awareness that this species avoids human habitats, rarely hunts poultry and other farm animals, and is under strict protection.

A good source of data on the occurrence of various animal species comes from the collection of road casualties (Ash 2012; Poledník et al. 2019). As part of the activities,

road inspections of all classes should be carried out (especially in the vicinity of confirmed sites and in potential ecological corridors), as well as responding to reports coming from people from the local community. Very often, bystanders are the first people to find animal carcasses along roads. Dead polecats should be collected and forwarded to the monitoring coordination centre for further analysis (e.g. determination of age, sex, collection material for genetic testing).

Any accidental observation or encounter should be reported. Evaluation of the submitted forms would rest with an independent team of experts. Confirmed observations recorded in the system and maps could greatly the recording of burrows and the selection of camera traps sites, and ultimately the determination of the species distribution. However, the disadvantage of this method is the possibility of misidentification of the species in the absence of supporting documents, such as carcasses or photographs.

Complementary methods

Genetic monitoring, for example analysis of the DNA isolated from collected biological samples, can be used as a complementary method. This type of monitoring makes it possible to accurately identify species and as well as examining various aspects of population dynamics, such as those concerning dispersal, age structure, gene flow and phylogeographic patterns. In addition, it allows to determine the level of genetic diversity, which is especially important in small, isolated populations. It can also provide information on possible interbreeding between the steppe polecat with the common polecat or domestic ferret.

CONCLUSIONS

To date, few studies have been written on the monitoring of small carnivorous mammals populations (including mustelid family) in Poland and worldwide, as their occurrence was and still is considered to be common. However, due to the constant increase of anthropopression and changes in habitats, the risk of decreasing numbers or local extinction of these species. Therefore, there is an increasing need to assess the size of their populations.

The expansion of steppe polecats into Poland occurred relatively recently. Currently, this species inhabits isolated sites and it is difficult to determine what its distribution is going to look like in the future. Due to the small amount of data on its population, the primary need should be to better understand its trends, migration opportunities and identify potential risks. In addition, the knowledge of the exact number of polecats, their biology and habitats may be crucial for effective conservation of native rodents, especially the protected speckled ground squirrels and European hamsters. Therefore, it is important to implement appropriate monitoring activities that will allow to acquire knowledge about the steppe polecat and may help in managing its population in the future. Monitoring of the steppe polecat population in Poland should be carried out regularly, at least once a year. The current state of the population, which is small and dispersed, does not guarantee the survival of steppe polecats in Poland. It is important to maintain strict protection of the species, and also to ensure the creation of temporary conservation zones around breeding sites. In addition, within known sites of regular occurrence, human penetration should be restricted. It is also recommended to introduce appropriate conservation measures (e.g. mowing to prevent overgrowth by trees and shrubs) in habitats that will keep them in good condition. Furthermore, increasing the numbers of ground squirrels, hamsters and other small rodents may be essential to maintaining the population of the steppe polecat.

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PROPOZYCJA MONITORINGU TCHÓRZA STEPOWEGO (*MUSTELA EVERSMANII*)

Streszczenie. W artykule przedstawiono propozycję monitoringu tchórze stepowego – małego drapieżnego ssaka z rodziny Mustelidae. Niedawna ekspansja tchórze stepowego, która nastąpiła w XX w. w Europie Środkowej, jego mała liczebność na terenie Polski i nieliczne zasiedlone stanowiska wpływają na niski poziom wiedzy na temat gatunku. Populacja tchórze stepowego nie jest na bieżąco monitorowana, nie można więc określić, ile dokładnie osobników znajduje się w Polsce. W niniejszej pracy podjęto pierwszą próbę określenia metodyki potrzebnej do rozpoczęcia i prowadzenia monitoringu, który może pomóc w zarządzaniu populacją w przyszłości. Monitoring tchórze stepowego przedstawiony w artykule obejmuje zarówno ocenę siedliska, w którym występuje, jak i samą populację. Obserwacje prowadzone w trakcie monitoringu mogą dodatkowo ułatwić zdobywanie wiedzy na temat biologii, zachowania i wpływu tchórze stepowego na inne gatunki i środowisko.

Słowa kluczowe: tchórze stepowy, monitoring, *Mustela eversmanii*, łasicowate.