

Long term snow tracking data of red fox (*Vulpes vulpes*) and martens (*Martes* sp.) indicates an increase in number of meso-carnivores in urban area of Warsaw

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Abstract: We investigated density changes of red fox and martens (stone marten and beech marten) in urban area of Warsaw in the years 2015-2021. Winter snow tracking was used for monitoring density in the whole city area and separately for different habitats within the city. The obtained results were compared with two earlier periods of snow tracking: 1976-1978 and 2005-2008 (Goszczyński J., unpubl.). The average fox density in the study period was 0.9 ind./km² and 0.3 ind./km² for martens. The highest densities of foxes was registered in forests, riparian and ruderal area, and the lowest in built up area, low-density housing and cemeteries. Martens reached the highest densities in allotment gardens and cemeteries, whilst in other habitats it was on a similar level. We found a decrease in density of both mesocarnivores in winter season 2017/2018 regardless of habitat type, although the densities were stable in forests and riparian area. The average density of both mesocarnivores rose gradually since 1970s in all habitat types, but in a quite stable proportion between habitats. In the first period (1976-1978), fox tracks were registered only in forests and riparian areas, while martens tracks, mostly in parks and forests. In the second period, tracks of these species were noted in each habitat type. In the third period, tracks were also present in each habitat, but their average number rose. Our results indicate progressive colonization of Warsaw and increase in abundance and population numbers of urban carnivores, continuously since 1970s. Independently of study period, the highest densities of mesocarnivores were recorded in forests and riparian area, what underlines the role of these habitats in development and maintenance of wildlife populations. The reasons of population decline in season 2017/2018 are not clear, but we suspect the potential role of sarcoptic mange in shaping population dynamics of urban carnivores.

Keywords: mesocarnivores; snow tracking; urban carnivores; urban ecology; urban wildlife