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Bats (Chiroptera) of the Ujście Warty National Park and the surrounding area

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Abstract: Bat research was carried out in 2012-2013 in the Ujście Warty National Park and in adjacent areas. Bats were caught in chiropterological nets, searched for in winter and summer roosts. Detector listening was carried out and the owls' diet was analyzed for the presence of bats among their prey. In the national park area, 11 species of bats were detected, and together with the Natura 2000 area "Ujście Warty" and the neighbouring areas, a total of 15 species were detected: the Daubenton's bat *Myotis daubentonii*, Natterer's bat *Myotis nattereri*, Brandt's bat *Myotis brandtii*, noctule bat *Nyctalus noctula*, serotine bat *Eptesicus serotinus*, common pipistrelle bat *Pipistrellus pipistrellus*, soprano pipistrelle bat *Pipistrellus pygmaeus*, Nathusius' pipistrelle bat *Pipistrellus nathusii*, brown long-eared bat *Plecotus auritus*, gray long-eared bat *Plecotus austriacus*, western barbastelle bat *Barbastella barbastellus*, greater mouse-eared bat *Myotis myotis*, Bechstein's bat *Myotis bechsteinii*, pond bat *Myotis dasycneme* and the parti-coloured bat *Vespertilio murinus*. The bat fauna of this area is relatively rich compared to other protected areas and presented results constitute an important supplement to the knowledge about the vertebrate fauna of the national park and its vicinity.

Key words: Chiroptera, river valley, flood plains, NW Poland

INTRODUCTION

The Ujście Warty National Park is an area thouroughly analysed ornitologically (Grimmet & Jones 1989, Gromadzki et al. 1994, Ehrnsberger et al. 1999). Studies on mammals pertained mainly to invasive species: the American mink *Neovison vison* and the North American raccoon *Procyon lotor* (Bartoszewicz & Zalewski 2001, 2003, Bartoszewicz 2003, Bartoszewicz et al. 2008, Zalewski et al. 2010, 2011, Okarma et al. 2012, Zalewski & Bartoszewicz 2012, Bartoszewicz & Zalewski 2001, 2003, Bartoszewicz 2003, Bartoszewicz et al. 2008, Zalewski et al. 2010, 2011, Okarma et al. 2012, Zalewski & Bartoszewicz 2012). Species composition of small mammals was also determined based on the analyses of pellets of the birds of prey and owls and excrements of the former (Ruprecht 1993, Indyk et al. 1996, Bartoszewicz 2003, Bartoszewicz & Zalewski 2003). The fauna of shrews and rodents of the park and adjacent areas was presented in the study by Wojtaszyn et al. (2015). There are also published data on collisions of mammals with vehicles on the road running near the park (Bartoszewicz 1997a), and on the occurrence of the lesser white-toothed shrew *Crocidura suaveolens* (Bartoszewicz 1997b). Information on the wild boar *Sus scrofa* population is from the paper by Gaczyński (2011).

The only data on bats in areas neighbouring the national park are from studies of winter roosts situated in Twierdza Kostrzyn (Gólski & Urbańczyk 1992, Dzięciołowska et al. 2013, Dzięciołowski et al. 2021a, 2021b) and from the contributory information on mammals mortality on the road neighbouring the park (Bartoszewicz 1997a).

This study was undertaken to recognise the species composition of bats in the Ujście Warty National Park and in the Ujście Warty Natura 2000 area. The importance of the park and adjacent areas for this animal order was taken under consideration.

STUDY AREA

Study area is situated in the Wielkopolska-Kujawy Lowland, mostly in the Toruń-Eberswald marginal stream valley macroregion and in the Gorzów Basin mesoregion (Kondracki 2001).

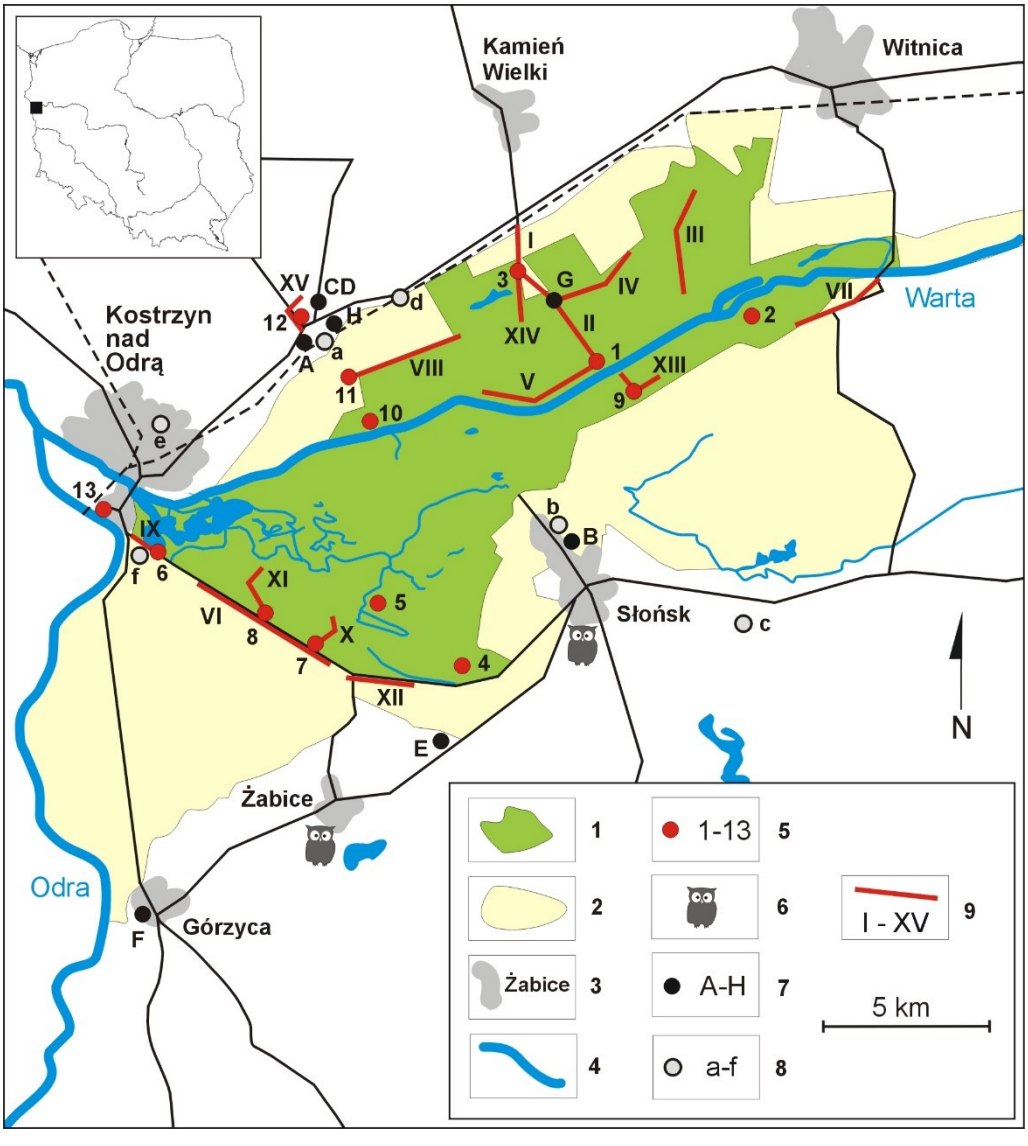

Fig. 1. Study area: 1 – national park, 2 – the buffer zone of the national park, 3 – built-up area, 4 – watercourses and water bodies, 5 – location of the bats mist netting, 6 – location of the collection sites of barn owl pellets, 7 – summer roosts of bats, 8 – winter roosts of bats , 9 – location of the detector listening. Numbering and lettering in the figure as in Table 1–4

The national park is located in the outlet section of the Warta River to the Odra River and occupies an area of 8074 ha (Park Narodowy Ujście Warty 2024), while the Natura 2000 area Ujście Warty PLC 080001 covers an area of 33297 ha (SDF Natura 2000 area Ujście Warty 2001, updated in 2007). Studies were carried out in the floodplain of the Warta at its outlet to the Odra together with the Kostrzyn Retention Reservoir and a fragment of the Odra River valley cut by numerous side streams, ox-bow lakes and reclamation canals (Fig. 1). Frequent and regular floods and long-lasting shallow and large inundations are typical of this area. Meadows, pastures, rushes and willow riparian forests dominate in flooded areas. The highest water level is usually observed in March or April. Annual water table fluctuations reach 3.5 m and daily fluctuations are up to 40 cm. Extensively used meadows and arable lands dominate outside the flood embankments. Patches of xerothermic meadows developed on the edge of the valley (SDF Natura 2000 area Ujście Warty 2013). Forests occupy about 82 ha, which makes slightly more than one percent of the total park area (Park Narodowy Ujście Warty 2024). Our study area coincides with the area of small mammals' inventory made by Wojtaszyn et al. (2015).

Material and Methods

Data on bats in the national park and in the Natura 2000 area of Ujście Warty were collected in the years 2012-2013. Information from sites outside the park and Natura 2000 area but situated in their neighbourhood were also taken into account.

Mist netting

Mist netting was carried out in various habitats and phenological periods. All-night catches were made in 13 sites. Mist netting was performed in both national park (sites 1–11) and in Natura 2000 area in close vicinity of the park (sites 12–13).

Bats were caught in various habitats. Considering specific characteristics of the park, however, sites were selected in view of potential success of catching. Therefore, open areas were wholly passed over and the main focus was on places at least slightly wooded. Nets were set up across tree alleys and in the neighbourhood of wintering site Twierdza Kostrzyn (during swarming and migration of bats to wintering grounds). After determination of species, sex, age, reproduction status and biometric measurements, animals were immediately released to the wild in the place of catching. To confirm the reproduction, special attention was paid on young individuals and on traces that would confirm lactation of the young by females.

Permission no. DLPpn-4102-80/21193/12/RS of May 30th 2012 issued by the Minister of Environment allowed us to catch bats.

Listening with detectors

Listening was undertaken to estimate the distribution of feeding grounds of selected species or groups of bat species in various habitats of the study area. Listening was performed in the years 2012 and 2013 in 19 sites (listening points or transects) in both the park area and its neighbourhood. Listening was carried out along potential routes of daily and seasonal migrations of bats and in feeding grounds situated in: Mościczkowa Droga, Żółta Droga, Kamieńska Grobla, Wał Północny, Droga Krajowa nr 22, Wojskowy Most-Kłopotowo, Grobla przy Olszynkach, Bobrowa Droga, Dąbroszyn Park, Dąbroszyn Wieś, Wał Północny, Dąbroszyńska Droga. Stationary listening was made in the following sites: Chyrzyno – most, Czarnowska Górka, Twierdza Kostrzyn, Kolonia Głuchowo, Strefa, Słowik, przy Czerwonym Kanale. Studies along transects were performed in various phenological seasons. Broad-band ultrasonic detectors were used for listening: Pettersson D 230, D240x and D1000x (Pettersson Elektronik AB, Sweden). Recorded sounds of bats were later analysed. In this study we assumed to determine bats to species. When precise determination was impossible, the sequence of sounds was classified to

genus (*Myotis sp*., *Pipistrellus sp*., *Plecotus sp*.) or to a group of two or more genera (*Eptesicus*/V*espertilio/Nyctalus*). Sounds of unidentified bats were noted separately (Indet). Studies were performed according to standard recommendations on listening and recording of the acoustic activity of bats (Jüdes 1989, Ahlén 1999, Rodriguez et al. 2008, Kepel et al. 2009). Determination was based on available literature data (Skiba 2009, Russ 2012).

Controls in bat roosts

Summer roosts of bats were searched for in attics, behind shutters, in building crevices and in forests (in tree cracks and holes) both in the park and in its surrounding. Winter controls pertained to potential places that might be suitable for bats hibernation (all types of basements). Winter sites of bats situated slightly beyond Natura 2000 area were also considered. Studies were performed with standard methods. Bats were determined without awakening based on external features seen by illuminating animals with electric light.

Analysis of the diet composition of owls

The remains of mammals were prepared from the pellets of the barn owl *Tyto alba* from sites situated near the park. Pellets were collected in churches in Czarnowo, Lemierzyce, Przemysław, Żabice, Słońsk, Pamięcin and in Fort Żabice. Skulls, mandibles and larger skeletal bones were prepared from that material. The key edited by Pucek (1984) and comparative collection were used to determine species. This study presents exclusively data on bats present in analysed material. Data on other groups of animals being prey of owls in study sites were published elsewhere (Wojtaszyn et al. 2015).

RESULTS

Fifteen species of bats were found in the study area including the national park, Natura 2000 area and neighbouring areas. Eleven species: the Daubenton's bat *Myotis daubentonii*, Natterer's bat *Myotis nattereri*, Brandt's bat *Myotis brandtii*, noctule bat *Nyctalus noctula*, serotine bat *Eptesicus serotinus*, common pipistrelle bat *Pipistrellus pipistrellus*, soprano pipistrelle bat *Pipistrellus pygmaeus*, Nathusius' pipistrelle bat *Pipistrellus nathusii*, brown long-eared bat *Plecotus auritus*, gray long-eared bat *Plecotus austriacus* and the western barbastelle bat *Barbastella barbastellus* were noted in the park (Table 1). Thirteen species: the Daubenton's bat,

Table 1. Species composition of bats in the Ujście Warty National Park and in the surrounding. Species from Annex II of the Habitats Directive are listed in bold.

No.	Species	National Park	Natura 2000 and neighbouring areas
1.	*Myotis nattereri*	X	X
2.	*Myotis daubentonii*	X	X
3.	*Nyctalus noctula*	X	X
4.	*Eptesicus serotinus*	X	X
5.	*Plecotus auritus*	X	X
6.	*Plecotus austriacus*	X	X
7.	*Pipistrellus pygmaeus*	X	X
8.	*Pipistrellus nathusii*	X	X
9.	*Pipistrellus pipistrellus*	X	X
10.	*Myotis brandtii*	X	
11.	***Barbastella barbastellus***	X	X
12.	***Myotis dasycneme***		X
13.	***Myotis myotis***		X
14.	***Myotis bechsteinii***		X
15.	*Vespertilio murinus*		X

Natterer's bat, noctule bat, serotine bat, common pipistrelle bat, soprano pipistrelle bat, Nathusius' pipistrelle bat, brown long-eared bat, gray long-eared bat, western barbastelle bat and three species of bats not recorded in the park (the greater mouse-eared bat *Myotis myotis*, Bechstein's bat *Myotis bechsteinii*, and the pond bat *Myotis dasycneme*) were found in Natura 2000 area. The pond bat was found in wintering roost in Twierdza Kostrzyn (Dzięciołowski et al. 2021a). The Brandt's bat caught in the park was not, however, recorded in Natura 2000 area. Remains of the parti-coloured bat *Vespertilio murinus* were found in pellets of the barn owl from the church in Żabice (at the boundary of Natura 2000 area).

Results of mist netting

Nine species of bats: the Daubenton's bat, Natterer's bat, Brandt's bat, noctule bat, common pipistrelle bat, soprano pipistrelle bat, Nathusius' pipistrelle bat, brown long-eared bat and gray long-eared bat were caught in nets in the park. Two next species were caught near the national park in a park in Dąbroszyn within Natura 2000 area (the western barbastelle bat) and in the inlet to wintering site in Twierdza Kostrzyn (the Bechstein's bat) Table 2.

Table 2. Results of bats' mist netting in particular localities. Following the name of the site, the catching dates and location according to the Atlas of mammals of Poland (2024) are given. The numbers (1-12) refer to the positions shown in Figure 1. *Sites outside the national park (within the boundaries of the Natura 2000 area). Acronyms used: Mdau – Daubenton's bat *Myotis daubentonii*, Mbra – Brandt's bat *Myotis brandtii*, Mnat – Natterer's bat *Myotis nattereri*, Mbch – Bechstein's bat *Myotis bechsteinii*, Nnoc – noctule bat *Nyctalus noctula*, Ppip – common pipistrelle bat *Pipistrelus pipistrellus*, Pnat – Nathusius' pipistrelle bat *Pipistrellus nathusii*, Ppyg – soprano pipistrelle bat *Pipistrellus pygmaeus*, Paur – brown long-eared bat *Plecotus auritus*, Paus – gray long-eared bat *Plecotus austriacus*, Bbar – western barbastelle bat *Barbastella barbastellus.*

Place of catching /location acc. to Atlas of mammals of Poland	Data	Mdau	Mbra	Mnat	Mbch	Nnoc	Ppip	Pnat	Ppyg	Paur	Paus	Bbar	Total
Niwka (02Hb) (1)	2 Jul 2012	3											3
Niwka (02Hb) (1)	24 Aug 2012	1											1
Parking Grusza –Kłopotowo Most (02Hc) (2)	3 Jul 2012								1	2			3
Olszynki – northern polder (02Hb) (3)	24 Aug 2012			1		1		1					3
Olszynki przy Górkach – southern polder (02He) (4)	25 Aug 2012			1		1	1	4		3	1		11
Olszynki przy Górkach– southern polder (02He) (4)	31 Jul 2013					1				1			2
Topolowa Droga (02He) (5)	25 Aug 2012	1	1			1	1	2	2				8
Chyrzyno (02Hd) (6)	28 Jun 2013	1											1
Strefa (02He) (7)	28 Jun 2013	2											2
Słowik (02He) (8)	28 Jun 2013									1			1
Wojskowy Most (02Hb) (9)	29 Jun 2013	1		1				1		1			4
Śluza (02Hb) (10)	28 Aug 2013	1						1					2
Dąbroszyńska Droga – Bobrowa Droga – canal (02Hb) (11)	29 Aug 2013		1										1
Dąbroszyn park – western part (02Hb) (12)*	3 .May 2012							1	1				2
Dąbroszyn park – eastern part (02Hb) (12)*	4 May 2012								2				2
Dąbroszyn park – road (02Hb) (12)*	22 Aug 2013	1		1								1	3
Twierdza Kostrzyn – Bastion Król (02Hd) (13) *	12 Oct 2012 13 Oct 2012	1		18	1								20
Total		12	2	22	1	4	2	10	6	8	1	1	69

Results of controlling roosts in the summer time

A group (probably of reproductive character) of the Nathusius' pipistrelles bat was found in the elements of tourism infrastructure (observation platform) of the national park (Table 3). In Natura 2000 area – in a park in Dobroszyn, reproductive colonies of the common and soprano pipistrelles were noted (Table 3). Reproductive colonies of the greater mouse-eared bat (33 females) were found in churches in Dąbroszyn (Natura 2000 area) and in the church in Słońsk – a colony of the same species composed of maximum 15 individuals. Moreover, the colonies of the brown long-eared bat were noted in churches in Czarnowo and Górzyca – still farther from the park's boundaries. The roost of a single individual of the Nathusius' pipistrelle bat was found behind the shutter of a residential building in Dąbroszyn (Table 3).

Table 3. Summer roosts of bats in the national park and in adjacent areas. Location according to the Atlas of mammals of Poland (2024). The letters (A-H) refer to the positions shown in Figure 1. *Sites outside the National Park (within the boundaries of the Natura 2000 area). Acronyms used: Mmyo – greater mouse-eared bat *Myotis myotis*, Ppip – common pipistrelle bat *Pipistrelus pipistrellus*, Ppyg – soprano pipistrelle bat *Pipistrellus pygmaeus*, Pnat – Nathusius' pipistrelle bat *Pipistrellus nathusii*, Paur – brown long-eared bat *Plecotus auritus.*

Site/Location acc. to The atlas of mammals of Poland	Date	Mmyo	Ppip	Ppyg	Pnat	Paur
Dąbroszyn – church* (02 Hb) (A)	29 Jun 2013	33				
Słońsk – church*(02 He) (B)	28 Jun 2013	15				
Dąbroszyn Park – old oak by the road – tree hole*(02 Hb) (C)	3 May 2012		15			
Dąbroszyn Park – garden house „Świątynia Cecylii"* (02 Hb) (D)	4 May 2012			8		
Czarnów – church* (02 He) (E)	3Jul 2012					5
Górzyca – church* (02Hg) (F)	29 Jun 2013					3
Observation platform at the crossroad of Żółta Droga and Kamieńska Grobla (02 Hb) (G)	29 Aug 2013				4	
Dąbroszyn 48 – residential building * (02 Hb) (H)	29 Jun 2013				1	

Results of controlling roosts in winter

No underground objects that might serve as wintering sites for bats were found in the national park. Such sites were found in the neighbourhood including the cellar of alcohol distillery in Dąbroszyn, cellars of the palace in Słońsk, former factory of ammunition in Słońsk, the culvert under railways in Dąbroszyn and in former brewery in Kostrzyn (Table 4). Important wintering site of these mammals known as „Twierdza Kostrzyn" is in the close vicinity of the national park. Data on this site were published by Dzięciołowski et al. (2021a, 2021b).

Table 4. Species and numbers of bats recorded in hibernacula in the study area in 2012–2013. Location according to the Atlas of mammals of Poland (2024). The letters (a-f) refer to the positions shown in Figure 1. * – Facilities located outside the national park and Natura 2000 area. Acronyms used: Mmyo – greater mouse-eared bat *Myotis myotis*, Mdau – Daubenton's bat *Myotis daubentonii*, Mnat – Natterer's bat *Myotis nattereri*, Paur – brown long-eared bat *Plecotus auritus*, Bbar – western barbastelle bat *Barbastella barbastellus*, Nnoc – noctule bat *Nyctalus noctula.*

Obiect	Data	Mmyo	Mdau	Mnat	Paur	Bbar	Nnoc	Total
Dąbroszyn – cellar of the alcohol distillery (02 Hb) (a)	6 Jan 2012			4		1		5
Słońsk – palace (02 He) (b)	1 Feb 2012	1						1
Słońsk – former ammunition factory* (02 He) (c)	1 Feb 2012	2	3	7	4	2		18
Dąbroszyn – culvert under railway (02 Hb) (d)	1 Feb 2012			1				1
Kostrzyn – former brewery* (02Ha) (e)	1 Feb 2012		3	16				19
Chyrzyno (02 He) (f)	15 Jan 2013						1	1

Results of listening

Numerous noctule bats, serotine bats and two species of pipistrelle (the common and Nathusius' pipistrelle bat) were recorded in most listening sites in the national park. The soprano pipistrelle bat was noted in three sites and the western barbastelle bat – in one. In nine sites, bats of the genus *Myotis* were recorded while those of the genus *Plecotus* were noted in seven sites. Data on the occurrence of these species and genera along particular transects and in sites are given in Table 5.

Table 5. Species and groups of species found during listening in the national park and in adjacent areas. Location according to the Atlas of mammals of Poland (2024). The numbers (I–XV) refer to the positions shown in Figure 1. *Sites outside the national park (within the boundaries of the Natura 2000 area). Acronyms used: Nnoc – noctule bat *Nyctalus noctula*, Eser – serotine bat *Eptesicus serotinus*, EVN – *Eptesicus/Vespertilio/Nyctalus*, Ppip – common pipistrelle bat *Pipistrellus pipistrellus*, Ppyg – soprano pipistrelle bat *Pipistrellus pygmaeus*, Pnat – Nathusius' pipistrelle bat *Pipistrellus nathusii*, Pip sp. – *Pipistrellus sp.*, Myo sp. – *Myotis sp.*, Bbar – western barbastelle bat *Barbastella barbastellus*, Plec sp. – *Plecotus sp.*

Species/ Location acc. to the Atlas of mammals of Poland	Nnoc	Eser	EVN	Ppip	Ppyg	Pnat	Pip sp.	Myo sp.	Bbar	Plec sp.
Kamieńska Grobla (02Hb) (I)	X			X			X			
Kamieńska Grobla (02Hb) (II)	X	X	X	X		X	X	X		
Mościczkowa Droga (02Hb/02Hc) (III)	X	X	X			X	X			
Żółta Droga (02Hb) (IV)	X			X		X				
Wał Północny (02Hb) (V)	X		X	X		X	X	X		X
Droga Krajowa nr 22 (02He) (VI)	X	X	X	X		X	X	X		X
Wał Wschodni (02Hc/Hb) (VII)	X	X	X	X	X	X	X	X		
Bobrowa Droga (02Hb) (VIII)	X	X	X	X	X	X		X	X	X
Chyrzyno (02He) (IX)	X			X		X	X	X		X
Strefa (02He) (X)	X			X						X
Słowik (02He) (XI)	X			X						
Czerwony Kanał (02Hb) (XII)	X					X		X		
Wojskowy Most (02Hb) (XIII)	X			X	X	X		X		X
Olszynki/Grobla przy Olszynkach (02Hb) (XIV)	X		X	X		X		X		X
Dąbroszyn* (02Hb) (XV)	X			X		X	X	X		

Social signals of the Nathusius' pipistrelles were recorded along the Wał Północny, Wał Wschodni and by the country road Kostrzyn – Słońsk. This may evidence the presence of mating groups in tree holes or crevices.

Table 6. Bat species detected using various research methods (records of all species in the Park and in the vicinity)

No.	Species	Listening	Mist netting	Summer roosts	Wintering grounds	Owls' pellets
1.	*Myotis myotis*			X	X	X
2.	*Myotis bechsteinii*		X		X	
3.	*Myotis nattereri*		X		X	
4.	*Myotis daubentonii*	X	X		X	
5.	*Myotis brandti*		X		X	
6.	*Myotis dasycneme*				X	
7.	*Nyctalus noctula*	X	X		X	
8.	*Pipistrellus pygmaeus*	X	X	X		
9.	*Pipistrellus pipistrellus*	X	X	X		
10.	*Pipistrellus nathusi*	X	X	X		
11.	*Eptesicus serotinus*	X			X	
12.	*Plecotus auritus*		X	X	X	
13.	*Plecotus austriacus*		X		X	
14.	*Barbastella barbastellus*	X	X		X	
15.	*Vespertilio murinus*					X

Bats in the diet of the barn owl *Tyto alba*

In total, 1069 vertebrate prey items were found in pellets of the barn owl *Tyto alba*. Among prepared remains of bats, the presence of the parti-coloured bat *Vespertilio murinus* was confirmed in the diet of owls from churches in Żabice and that of the greater mouse-eared bat *Myotis myotis* in the diet of owls from churches in Słońsk (Table 6). Bats' remains were not found in pellets of owls from: Czarnów, Lemierzyce, Przemysław, Pamięcin and Fort Żabice.

Overview of recorded species

Myotis daubentonii (Kuhl, 1817) – Daubenton's bat

This species is numerous in the national park. It was caught in nets in five sites within the park: in Niwka, Topolowa Droga, Strefa, Wojskowy Most and Śluza. Lactating females and young individuals were caught, which means that breeding colonies were present in the park or in its close vicinity. Most recorded echolocation signals attributed to the genus *Myotis* probably belonged just to this species. Based on the way of flight, feeding and listening, individuals of this species were found feeding in the following listening points: Chyrzyno, by Czerwony Kanał, Wojskowy Most and in the transect Wał Północny (Table 6). One sexually active male was caught in Natura 2000 area (park in Dąbroszyn) and another one – in Twierdza Kostrzyn during the autumn swarming. The species was also recorded in winter roosts situated in the former brewery in Kostrzyn and in the inactive ammunition factory near Słońsk (Table 6).

Myotis brandtii (Eversmann, 1845) – Brandt's bat

Found in only one site in the national park. An adult female without evidence of lactating was caught in nets by Topolowa Droga (Table 6).

Myotis nattereri (Kuhl, 1817) – Natterer's bat

Caught in nets in three sites: Olszynki, Lasek przy Górkach and Wojskowy Most. In one of them a female showed traces of lactating which suggests that a reproductive colony was situated in the park or in its surrounding. The species was also caught in the park in Dąbroszyn and near Twierdza Kostrzyn during swarming. In winter, individuals of this species were observed in several sites: in former brewery in Kostrzyn, alcohol distillery in Dąbroszyn, in culvert under railway in Dąbroszyn and in former ammunition factory near Słońsk (Table 6).

Myotis myotis (Borkhausen, 1797) – greater mouse-eared bat

Colonies of this species were noted near the national park: in the attic of church in Dąbroszyn (Natura 2000 area) and in church in Słońsk. The skull of one individual of this species was prepared from pellets of the barn owl collected in the latter locality. One individual was found in the cellar of ruined palace in Słońsk (Table 6).

Myotis bechsteinii (Kuhl, 1817) – Bechstein's bat

One sexually active male was caught at the inlet to Bastion Król in Twierdza Kostrzyn during the autumn swarming (Table 6).

Myotis dasycneme (Boie, 1825) – *pond bat*

Pond bat was found only during the hibernation period in the Twierdza Kostrzyn (Dzięciołowski et al. 2021a).

Nyctalus noctula (Schreber, 1774) – noctule bat

Noctules were caught in nets in three sites: Olszynki, Lasek przy Górkach and Topolowa Droga. The species was represented in great numbers during listening in almost all study sites.

In winter (15.01.2013) the presence of the noctule bat was noted in the immediate vicinity of the national park. One individual awoken from hibernation lived inside the park's seat in Chyrzyno (personal info and photo - Szymon Śródecki) (Table 6).

***Pipistrellus pipistrellus* (Schreber, 1774) – common pipistrelle bat**

The common pipistrelle was caught in nets in two sites: Lasek przy Górkach and Topolowa Droga. It was also noted in great numbers during listenings. A colony (probably mating) of this species was found in the tree hole of oak in park in Dąbroszyn within Natura 2000 area (Table 6).

***Pipistrellus nathusii* Nathusius' (Keyserling et Blasius, 1839) – pipistrelle bat**

Representatives of this species were caught in nets in five sites within the national park: Olszynki, Lasek przy Górkach, Topolowa Droga, Wojskowy Most and Śluza. Captured individuals included lactating females, young individuals and sexually active males, which means the presence of reproductive colonies and mating grounds in the national park and in the surrounding. A group of most probably mating character was found behind the information board at the cross-road of Żółta Droga and Kamieńska Grobla. Social activity of this species suggesting the presence of mating groups was also noted during listening along the three studied transects. Roosts are most probably in tree holes and in spaces under protruding bark of old drying trees in the national park (Table 6).

***Pipistrellus pygmaeus* (Leach, 1825) – soprano pipistrelle bat**

Representatives of this species were caught in two sites within the national park: Parking Grusza and Topolowa Droga. Lactating female and this year's young evidence the presence of a colony in the national park or in its surrounding. The activity of the soprano pipistrelle was recorded on Wojskowy Most and Wał Wschodni and along transect from Bobrowa Droga to Kamieńska Grobla. The species was caught in Natura 2000 area in a park in Dąbroszyn. Reproductive colony of this species was noted just there in a garden house called „Świątynia Cecylii" (Table 6).

***Plecotus auritus* (Linnaeus, 1758) – brown long-eared bat**

One lactating female was caught in Lasek przy Górkach, which suggests the presence of reproductive colony nearby (Table 6).

***Plecotus austriacus* (Fischer, 1829) – gray long-eared bat**

One lactating female was caught in Lasek przy Górkach, which suggests the presence of reproductive colony nearby (Table 6).

***Eptesicus serotinus* (Schreber, 1774) – serotine bat**

Serotine bats were noted through listening along many transects and listening points (Table 6).

***Barbastella barbastellus* (Schreber, 1774) – western barbastelle bat**

The species was found in the national park based on the analysis of echolocation signals. Acoustic activity of the western barbastelle was found on one transect near Bobrowa Droga. A single individual was caught in chiropterological nets in a park in Dąbroszyn outside the national park. The species was also found in winter in cellars of the alcohol distillery in Dąbroszyn and in objects of the former ammunition factory in Słońsk (Table 6).

***Vespertilio murinus* Linnaeus, 1758 – parti-coloured bat**

Remains of one individual of this species were found in pellet of the barn owl living in the tower of a church in Żabice (Table 6).

DISCUSSION

Data on bats in the Ujście Warty National Park have not been published so far. Available information from the surrounding of the park pertained to mammals wintering in Twierdza Kostrzyn (Gólski & Urbańczyk 1992, Dzięciołowska et al. 2013, Dzięciołowski et al. 2021a, 2021b). Except wintering, there was also a remark about three dead Daubenton's bats (victims of collision with vehicles) on the road from Słońsk to Kostrzyn, at the boundary of national park (Bartoszewicz 1997a).

In the study area, eleven species of bats were recorded in the national park itself but when the surrounding of the park (Natura 2000 area) is included, the number of bat species increases to fourteen. Moreover, Dzięciołowski et al. (2021a) published data on wintering sites in Twierdza Kostrzyn in the vicinity of the national park (where they found e.g. the pond bat *Myotis dasycneme*). Taking all this into account, one may conclude that bat fauna in the national park and its surrounding is composed of fifteen species.

Bat fauna of the northern part of Poland is poorer than that of southern Poland (Sachanowicz et al. 2006). Having in mind almost treeless character of the national park and comparing it with other protected areas in northern Poland one may state that bat fauna of the Ujście Warty National Park is relatively rich. For example, during studies in the years 2004–2008 in the Wigry National Park, twelve species of bats were found (Kmiecik et al. 2010). Supplementary studies to the plan of nature protection allowed increasing this number to 14 species (Gromadzki et al. 2013). In landscape parks of the northern part of Poland, nine species were noted in the Landscape Park „Mierzeja Wiślana", seven species in Kaszuby Landscape Park, eight species in Wdzydze Landscape Park and nine species in each of the Landscape Parks Dolina Słupi, Nadmorski and Trójmiejski (Ciechanowski et al. 2008). In the years 2002–2006, fourteen species of bats were found in the Landscape Park Puszcza Zielonka (Łochyński & Grzywiński 2009). Moreover, parks listed above have more wooded areas which facilitate the species richness of this group of animals. The Ujście Warty National Park is, however, almost treeless area. Analysed areas of similar character but situated in eastern Poland are in the Biebrza River National Park. Twelve species of bats were found in the Biebrza River Valley and in neighbouring areas (Lesiński 2001).

It is possible that more bat species exist in the Ujście Warty National Park and its surrounding. The presence of the Leisler's bat *Nyctalus leisleri* is possible since one may expect individuals of this species at least migrating along the valleys of the Warta and Odra rivers. It is, however, a rare species. Its existence in Puszcza Darżlubska was confirmed not earlier than after four years of extensive studies (Ciechanowski 2003). The presence of the northern bat *Eptesicus nilssonii* is possible since sites of this species are known from northern part of Poland (Ciechanowski & Szkudlarek 2003, Ciechanowski 2013). It is also conceivable that individuals of the whiskered bat hibernate in winter in small numbers in Twierdza Kostrzyn. In that case, however, they are determined as a group of species *Myotis mystacinus/brandtii.*

The pond bat was not found in the national park although natural habitats of the park seem suitable for this species associated with waters. None of the recorded sequence of signals attributed to the genus *Myotis* could be unanimously classified as produced by just this species. The pond bat is rare in Poland as it is in most European countries (Ciechanowski et al. 2007, Hutson et al. 2008). Most probably, the species appears in the national park since its presence was noted in the Natura 2000 area in objects of Twierdza Kostrzyn (Dzięciołowski et al. 2021a). The pond bat is certainly not numerous there. In studies carried out in the 1990's it was not found in Twierdza Kostrzyn (Gólski & Urbańczyk 1992) and in inventories performed since the year 2000 it was noted only several times (Dzięciołowski et al. 2021a). The presence of the pond bat may be suggested by its presence in areas of similar character situated relatively closely to the

study area - in the national park of the lower Odra River (Nationalpark Unteres Odertal) in Germany (Horn 2012).

Live catching the lactating female of the gray long-eared bat (evidence of the existence of reproductive colony nearby) is interesting due to the presence of this species at the edge of its range (Wojtaszyn et al. 2014). However, findings of this species in areas far north (Ciechanowski et al. 2005, 2011) may suggest that the gray long-eared bat extends its range. Particularly valuable is the presence of the Bechstein's bat caught at the boundary of the national park in Twierdza Kostrzyn and wintering there in the undergrounds (Dzięciołowski et al. 2021a). This species is rarely and not numerously noted throughout the country (Sachanowicz et al. 2006).

The presence of the noctule bat during hibernation in the building of national park's administration deserves attention because not until recently information about its wintering in Poland has become more and more numerous (Łupicki et al. 2007, Lesiński & Janus 2020).

Spring floodings in the Warta River valley are probably rich feeding grounds for bats. Listenings showed that these grounds were used by numerous noctule bats, serotine bats, pipistrelles and bats of the genera *Myotis* and *Plecotus*. The presence of so rich feeding grounds facilitates the formation and functioning of reproductive colonies (in the national park or in immediate vicinity). Colonies of greater mouse-eared bats, brown long-eared bats, common and soprano pipistrelle bats were found when searching for roosts. During mist netting, reproduction was confirmed by catching lactating females or young individuals of: the Daubenton's bat, Natterer's bat, Nathusius' pipistrelle bat, soprano pipistrelle bat, gray long-eared bat and brown long-eared bat.

The complex of important in the country scale wintering sites of bats is situated near the national park in Twierdza Kostrzyn. The number of bats wintering in Twierdza Kostrzyn exceeds 500 individuals. In the years 2000-2020, at least eleven species of these mammals were found in the objects of Twierdza Kostrzyn (Dzięciołowski et al. 2021a). So important wintering sites present close to the national park certainly affect species richness of bats in the park.

Despite short study period (years 2012–2013) it seems, that obtained results constitute an important supplement to the knowledge about vertebrate fauna of the Ujście Warty National Park.

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STRESZCZENIE

[**Nietoperze (Chiroptera) Parku Narodowego Ujście Warty i terenów przyległych**]

Badania nietoperzy prowadzono w latach 2012–2013 na terenie Parku Narodowego Ujście Warty (PNUW) oraz obszarach przyległych. Odławiano nietoperze w sieci chiropterologiczne, poszukiwano nietoperzy w kryjówkach zimowych i letnich, prowadzono nasłuchy detektorowe oraz analizowano dietę sów pod kątem występowania, wśród ich ofiar, nietoperzy. Na obszarze PNUW wykazano 11 gatunków nietoperzy, a biorąc pod uwagę obszar Natura 2000 „Ujście Warty" i tereny sąsiadujące wykazano łącznie 15 gatunków: nocka rudego *Myotis daubentonii*, nocka Natterera *Myotis nattereri*, nocka Brandta *Myotis brandtii*, nocka dużego *Myotis myotis*, nocka Bechsteina *Myotis bechsteinii*, nocka łydkowłosego *Myotis dasycneme,* borowca wielkiego *Nyctalus noctula*, mroczka późnego *Eptesicus serotinus*, karlika malutkiego *Pipistrellus pipistrellus*, karlika drobnego *Pipistrellus pygmaeus*, karlika większego *Pipistrellus nathusii*, gacka brunatnego *Plecotus auritus,* gacka szarego *Plecotus austriacus*, mopka zachodniego *Barbastella barbastellus* oraz mroczka posrebrzanego *Vespertilio murinus*. W wyniku odłowów w sieci stwierdzono 11 gatunków (Tab. 2). Odnaleziono kryjówki letnie pięciu gatunków, w tym dwie kolonie rozrodcze nocka dużego (Tab. 3). Sześć gatunków stwierdzono w zimowiskach (Tab. 4), a w wypluwkach sów stwierdzono dwa gatunki (Tab. 6). Fauna tego obszaru, w porównaniu z innymi terenami chronionymi w Polsce północnej i zachodniej, biorąc pod uwagę niemal zupełnie bezleśny charakter parku, jest stosunkowo bogata. Uzyskane wyniki stanowią ważne uzupełnienie wiedzy na temat fauny kręgowców Parku Narodowego i jego sąsiedztwa.

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