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Composition of twenty Green Frog populations (*Pelophylax*) across Bavaria, Germany

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Abstract. Two species of green frogs exist in the state of Bavaria (Germany), the Marsh Frog (*Pelophylax ridibundus*) and the Pool Frog (*Pelophylax lessonae*). The Edible Frog (*Pelophylax esculentus*) is a hybridogenetic hybrid originally resulting from Marsh Frogs mating with Pool Frogs and therefore sometimes not considered a true species. Its distribution covers large parts of Bavaria, occurring either together with *P. lessonae* in *P. lessonae-P. esculentus*-systems (LE-system) or with *P. ridibundus* in *P. ridibundus-P. esculentus*-systems (RE-system). In order to obtain more precise data on their distribution and population structure, we examined 20 green frog populations in Bavaria, focusing on the possible existence of pure hybrid populations, the occurrence of allochthonous species of green frogs, and the distribution of *P. lessonae*, the most threatened species of green frogs. A total of 200 frogs were sampled, from which 173 could be reliably identified on the basis of their morphology. Species were identified via morphometric measurements and serum albumin PCR. Potentially triploid specimens were identified on the basis of their increased erythrocyte size. Sequencing of mitochondrial ND2 haplotypes allowed identification of allochthonous frogs in three study sites. *P. esculentus* was the most common green frog species at the study sites, representing 47% of the sample size. Four potentially triploid individuals were detected; however, pure triploid hybrid populations could not be confirmed. Allochthonous frogs were identified in three RE-systems. *Pelophylax ridibundus* made up 38% of the reliably identified frogs. The percentage of *P. lessonae* was only 15% of the sampled frogs, possibly due to the decline of suitable habitats and the introduction of allochthonous *P. ridibundus*. In all three taxa, male frogs always dominated in the sex ratio. Out of the 200 observed frogs, 58 were female (29%), 109 were male (54%) and 33 were subadult (17%). This study showed that in 86.5% it was possible to distinguish between the three species by means of morphometric measurements. However, serum albumin PCR did not always correctly identify specimens.

Key words. Amphibia, Anura, Ranidae, *Pelophylax ridibundus, Pelophylax lessonae, Pelophylax esculentus*, allochthonous frogs.

Introduction

Green frogs are amongst the most common amphibians in Bavaria. Two species are present here, the Marsh Frog *Pelophylax ridibundus* (Pallas, 1771) and the Pool Frog *P. lessonae* (Camerano, 1882). The Edible Frog *P. esculentus* (Linnaeus, 1758) is not considered a true species but a hybridogenetic hybrid resulting from Marsh Frogs mating with Pool Frogs. However, for convenience we consider this form as a species in the following, although it is usually claimed to represent a klepton, *P.* kl. *esculentus*. Reproduction in *P. lessonae* and *P. ridibundus* follows Mendelian rules of inheritance whereas *P. esculentus* originates from hybridogenesis: During gametogenesis, one parental genome is deleted completely, so that only one parental set of uncombined chromosomes is transmitted to the next generation (Tunner 1973). Due to the hybridogenetic system, *P. esculentus* can live and reproduce in the presence of only one parental species. Green frog populations can be pooled as population systems according to their genotypic structure and specific reproduction modes. Designation as a single system occurs when the involved species is not limited by primary hybridisation, but can also hybridise hybridogenetically (Plötner 2005). Distinction is thus made between the *P. lessonae-P. esculentus*-system (LE-system) and the *P. ridibundus-P. esculentus*-system (RE-system). Their occurrences depend mainly on ecological predilections of the single parental species. *P. lessonae* is more demanding in this respect, needing sunlit waters with rich vegetation (Zahn 1997). *P. ridibundus* prefers larger water bodies and hibernates in the water, in contrast to *P. lessonae*. *P. esculentus* is more flexible than its parental species and poses fewer demands on its habitat (Plötner 2005). Detailed information on the morphology and ecology of the three green frog forms can be found in Günther (1990) and Plötner (2005). Massive differences

in the genetic structures of different populations are possible in LE-systems, with hybrids making up between 5% and 95% of the population (Berger 1990). RE-systems also feature high structural genetic variability, whereas *P. esculentus* will occur as unisexual individuals in some populations (Plötner 2005). There are also populations consisting of both parental species and the hybrid; however, in these cases it is unclear whether *P. esculentus* stems from hybridogenetic reproduction or primary hybridisation between the parental species (Plötner 2005). Additionally, populations including only hybrids exist, reproducing via triploid individuals (pure hybrid populations). This is possible due to the potential for genetic recombination in triploid individuals that can replace the functional role of the syntopic parental species (Plötner 2005).

Reliable data on the distribution of the individual green frog species as well as the different population systems in Bavaria are scarce (Zahn 1997). This is because green frogs are pooled together as the "green frog complex" in most surveys, avoiding the identification of the individual species. Although distribution maps of Marsh Frog, Pool Frog and Edible Frog in Bavaria do exist (Artenschutzkartierung Bayern, http://www.lars-ev.de/arten/amppe.htm), their data are based only on preliminary identification without substantiation by morphometric measurements or genetic analysis.

In this study, we examined the distribution of the different green frog species as well as the classification of population systems (LE-, RE-systems) at 20 study sites throughout Bavaria. For species identification, morphometric measurements and genetic identification based on serum albumin PCR (following Plötner et al. 2009) were applied. The examination of the distribution of *P. lessonae* was of particular interest, as this species is thought to be declining (Plötner 2005). Another aim of our research was the identification of triploid *P. esculentus*. Pure triploid populations are not yet known from Bavaria (Plötner 2005, Zahn 1997). For the identification of such animals and populations, erythrocyte size was measured (following Uzzell & Berger 1975). Erythrocyte size reflects DNA content and therefore allows the discrimination between diploid and triploid animals. Additionally, the distribution of allochthonous *P. ridibundus* was explored via identification of mitochondrial haplotypes by sequencing the ND2 gene (following Plötner et al. 2008). There is evidence that such allochthonous *P. ridibundus* can have a negative effect on native green frog populations – especially *P. lessonae* (Holsbeek & Jooris 2010). Mazepa & Rachmayuningtyas (2011) detected such allochthonous *P. ridibundus* in the Munich area with the method applied here; however, it remained unknown where else in Bavaria these animals – many of them originating from the Balkans and Greece – occurred (Plötner 2005). Finally the study assessed the condition of the different green frog populations in Bavaria and specifically the threat status of *P. lessonae*. According to Beutler & Rudolph (2003) *P. ridibundus* and *P. esculentus* are not at risk whereas *P. lessonae* is thought to be possibly threatened, but factual data is deficient.

Material and methods

Study area, data collection and morphological species identification

Green frogs live in many different habitat types, including pools, ponds, rivers, ditches, canals, lakes, upland moors, marshes, sand pits and quarries (Günther 1990). With our sampling, we attempted to cover most of the natural geological regions of Bavaria. Twenty green frog populations were examined at 13 locations across Bavaria (Fig. 1, Tab. 1). In Amberg, Altötting, Augsburg, Deggendorf, Nuremberg and Tirschenreuth, two study sites per location were investigated, because we had evidence that these regions were inhabited by LE- and RE-systems and we found suitable habitats for both population systems. This was different in Freilassing, Illertissen, Memmingen, Munich, Oberstreu, Passau and Pfaffenhofen, where we did not find suitable study sites and due to the fact that the Pool Frog and the Marsh Frog do not occur all over Bavaria (Artenschutzkartierung Bayern, http://www.lars-ev.de/arten/amppe.htm). Data collection took place from 2 April to 11 May 2012. Permits for surveying and sampling protected species were granted by the Bavarian administrative districts within the scope of the project "Barcoding Fauna Bavarica" (http://www.faunabavarica.de/). Prior to capturing green frogs, the prospects of an area with water bodies was evaluated by sight. Specimens were collected mainly at night, from dusk until midnight, using a headlamp and a landing net. On average, ten individuals from each site were measured. The following data were recorded: sex (presence of vocal sac), weight [g], snout–vent length (SVL) [mm], tibia length [mm], length of first toe [mm], length of callus internus (c. int. = inner metatarsal tubercle) [mm], form of c. int. (cylindrical, semicircular, esculentus), presence of dorsal stripe, mottling (strong, medium, weak, large or small spots), dorsal colour (green, olive, brown, blue), ventral colour (white, spotted), presence of yellow femur, calling activity, colour of vocal sac (white/ grey) and unusual morphological features were also noted (supplementary table). The weight was taken with a standard kitchen scale (Silver Crest Company, model-no. Z17489) to the nearest gram. The body measurements were taken with digital callipers (HM Müllner Werkzeuge Company, model no. 10109) or analogue callipers from the same company to the nearest 0.1 millimetre. The SVL was measured from the tip of the head to the vent. The first toe was measured from the end of the c. int. to the tip of the toe. It was noted if a frog had a divided dorsal stripe, exhibited a noticeable behaviour, or was otherwise special. The typical form of the c. int. of *P. esculentus* was defined as "esculentus", meaning that it was arched, but never semicircular and its highest point was situated close to the tip of the first toe (Glandt 2011). Species identity was preliminarily fixed according to the morphological appearance of the animal (colour, size etc.). Small individuals (less than 45 mm SVL and 15 g in weight in *P. ridibundus* and 35 mm SVL and 12 g weight in *P. lessonae*) were classified as subadult. From every individual, the tip of the third right finger was taken as a tis-

sue sample for genetic analysis (following Blab 1986). The samples were stored in 96% alcohol. The small amount of blood produced from the amputation was used to make a blood smear on a glass slide for the measurement of erythrocytes in order to identify triploid animals (after Uzzell & Berger 1975). Length and width of ten erythrocytes per animal were measured with a Leica DN RBE microscope using a measuring eyepiece (10×; one scale bar being equivalent to 2.52 µm) and a 40x lens, and the mean values of these ten cells were then calculated. Plötner (2005) specified mean values for diploid frogs to be between 20 and 26 µm in length and between 203 and 308 µm² in surface area. Specimens with an average erythrocyte size ≥ 26.5 µm in length and 308 µm² in area were considered triploid (following Plötner 2005). After all measurements had been taken, the frogs were released at the place of original capture. The concluding species identification was based on the evaluation of the following five morphometric details (following Glandt 2011 and Plötner 2005, Table 2): quotient of SVL/tibia, SVL/c. int., first toe/c. int., tibia/c. int.

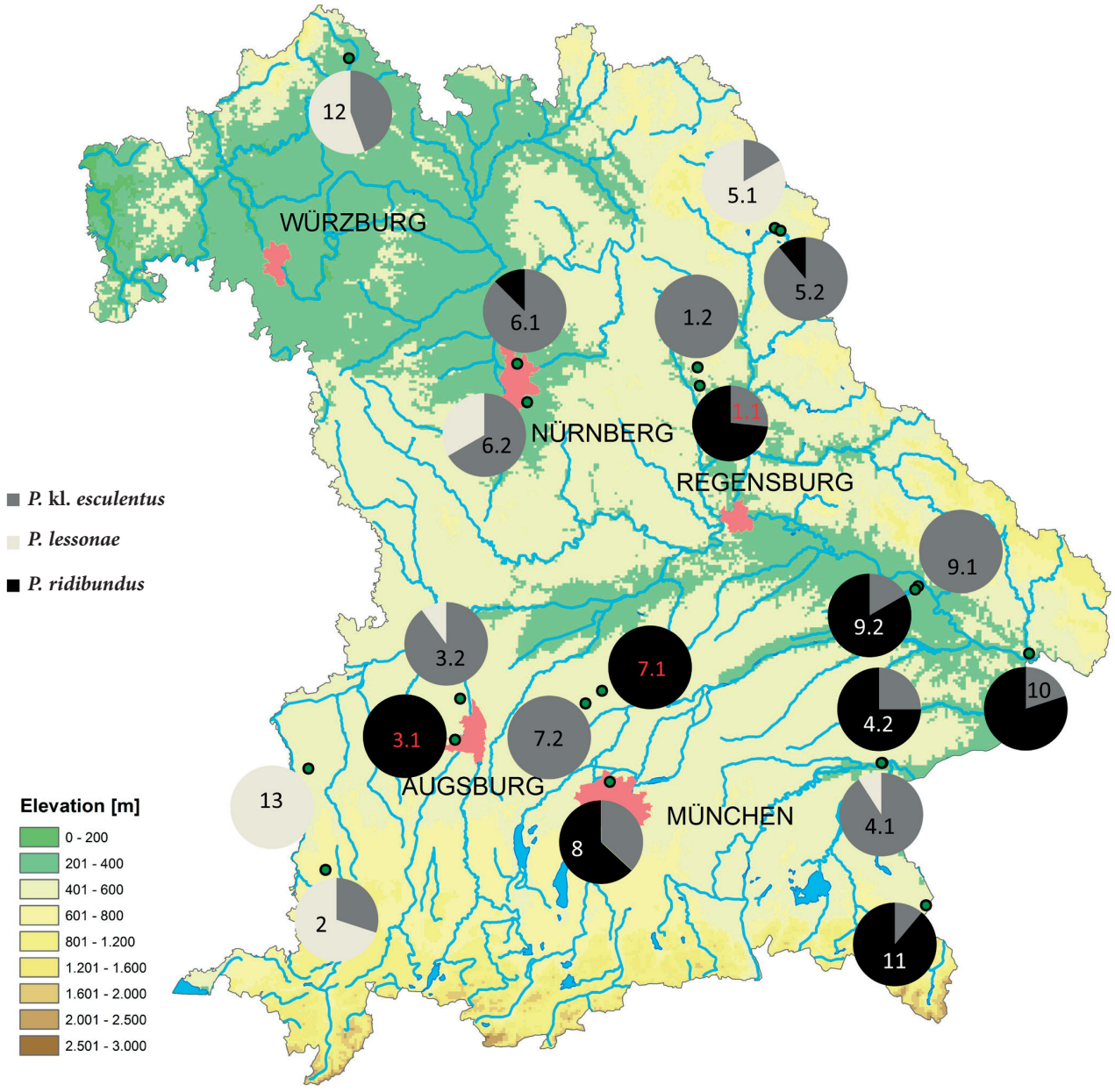

Figure 1. Map of Bavaria created in ArcGIS 10.0 showing the different study sites (nos. 1.1 to 13 inside pie charts) and the composition of each population based on morphological identification. Red numbers indicate populations where allochthonous individuals were found.

Table 1. Overview of the different study sites with latitude, longitude, altitude, total catches, number of frogs per species (*P. esculentus*, *P. lessonae* and *P. ridibundus*, n = 200) and population system (RE-, LE-system). Uncertain individuals are shown in brackets (in the column of the assumed species).

Study site	Location	Lat. [°E]	Long. [°N]	Alt. [m]	total	*P. esc.*	*P. les.*	*P. rid.*	System
1.1	Amberg	11.93909	49.418302	383	15	4	–	11	RE
1.2	Amberg	11.928533	49.474357	458	7	7 (1)	–	–	?
2	Memmingen	10.241702	47.925588	667	12	3	9 (2)	–	LE
3.1	Augsburg	10.84153	48.456288	453	11	–	–	11	?
3.2	Augsburg	10.82092	48.330406	517	10	9	1	–	LE
4.1	Altötting	12.776088	48.263227	361	13	10	3 (2)	–	LE
4.2	Altötting	12.77212	48.263377	345	10	3 (1)	–	7 (1)	RE
5.1	Tirschenreuth	12.293764	49.89914	483	11	2 (1)	9 (4)	–	LE
5.2	Tirschenreuth	12.320386	49.890883	494	10	9 (1)	–	1	RE
6.1	Nuremberg	11.084796	49.481826	311	9	8 (1)	–	1	RE
6.2	Nuremberg	11.132475	49.364817	382	3	2	1	–	LE
7.1	Pfaffenhofen	11.491887	48.484704	444	10	3 (3)	–	7(1)	?
7.2	Pfaffenhofen	11.416752	48.446308	523	10	9 (2)	1 (1)	–	?
8	Munich	11.530735	48.206897	501	19	7	–	12	RE
9.1	Deggendorf	12.948866	48.801189	347	5	5	–	–	?
9.2	Deggendorf	12.935677	48.791374	315	6	1	–	5	RE
10	Passau	13.455192	48.591072	304	10	6 (5)	–	4	RE
11	Freilassing	12.966656	47.826654	422	10	2 (1)	–	8	RE
12	Oberstreu	10.263124	50.405179	319	18	8	10	–	LE
13	Illertissen	10.152558	48.233901	511	1	–	1	–	?

Table 2. Features distinguishing *Pelophylax ridibundus, P. lessonae* and *P. esculentus* (following Glandt 2011, Plötner 2005).

Feature	*P. ridibundus*	*P. lessonae*	*P. esculentus*
SVL/tibia length	≤ 2.0	≥ 2.2	≥ 2.0
SVL/c. int.	17.4–25.4	10.0–14.3	12.0–20.2
First toe/c. int.	>2.3	1.3–1.7	1.7–2.9
Tibia length/c. int.	>8.0	< 7.0	6.5–9.4
Shape of metatarsal tubercle (c. int.)	Flat or only a little arched; cylindrical or triangular	Semicircular	Usually arched, but never semicircular; highest point lies near the tip of the toe (defined as "esculentus")

(Fig. 2, Tab. 3), and the shape of the metatarsal tubercle. Individuals were considered reliably identified if at least four of the five characteristics conformed to a species definition. If only three of the five species characteristics applied to an individual, its identification was considered uncertain. Those frogs were treated as the species with which they shared the most features, but are listed as "uncertain" in the final results and the discussion. The t-test was used to assess significance unless stated otherwise.

Species identification based on genetics

DNA was extracted using the NucleoSpin 96 Tissue kit (Machery-Nagel, Duren, Germany) following the manufacturer's protocol. PCR was conducted following Plötner et al. (2009) with the Primers Alb Ex2-R2 (CTGCCTTTACAATATCGTTTAT) and Alb Ex1-F5 (ATAACAACGAGTCCAGACCAC) amplifying the intron-1 of the serum albumin gene. PCR amplifications were conducted in 25 µl volumes, containing 5.0 µl Mango Taq Buffer (Bioline GmbH, 14943 Luckenwalde, Germany), 1.25 µl $MgCl_2$, 2.0 µl dNTP, 0.5 µl of each primer, 14.5 µl H_2O, 0.25 µl Taq polymerase, and 1.0 µl DNA. The initial denaturation step of 3 min at 94°C was followed by 35 cycles of 30 s at 94°C, 60 s at 52°C, and 60 s at 72°C. The final extension step was 10 min at 72°C. For species identification, the PCR product was not sequenced, but applied directly on an agarose gel (1%) that was run for 30 min at 100 V. Species identification was then made based on band size. According to Hauswaldt et al. (2012) *P. lessonae* shows one small band of approximately 300 bp in length, *P. ridibundus* one large

band of approximately 850 bp in length (with an occasional second band around 700 bp), and *P. esculentus* both the small and the large band.

Identification of mitochondrial haplotypes based on ND2 sequencing

For identification of the mitochondrial haplotype and therefore detection of allochthonous frogs, a PCR with the primers ND2 L2 and ND2 H3 was used for amplification of the mitochondrial ND2 gene (following Plötner et al. 2008). PCR amplifications were conducted using the same recipe as detailed above. The initial denaturation step of 3 min at 94°C was followed by 35 cycles of 30 s at 94°C, 20 s at 62°C and 60 s at 72°C. The final extension step was 10 min at 72°C. PCR products were sequenced using BigDye chemistry (Life Technologies, 92008 Carlsbad, CA, USA). Sequences were cleaned with 2.5 µl Agencourt CleanSEQ (Beckman Coulter Inc., USA; Part No. A29154) and 132 µl ethanol and sequenced on an ABI 3730 capillary sequencer. The ND2 sequences were edited using the software Sequencer 4.9 (Gene Codes Corporation, Ann Arbor, MI, USA). The mitochondrial haplotypes were compared with 20 samples from other parts of Europe from Genbank, and a neighbour joining tree (phylogenetic distance tree) was calculated in MEGA 5.0 (Tamura et al. 2011). The reference sequences were taken from Plötner et al. (2008).

Results

Species identification based on morphology

A total of 200 frogs from 20 different study sites were examined and identified by means of morphological features and morphometric measurements (Tab. 1, Fig. 1). Out of the 200 specimens, 173 (86.5%) could be identified reliably. 27 specimens (13.5%) were considered uncertain and are therefore not included here. Of the 173 reliably identified individuals, 82 were identified as *P. esculentus* (47.4%),

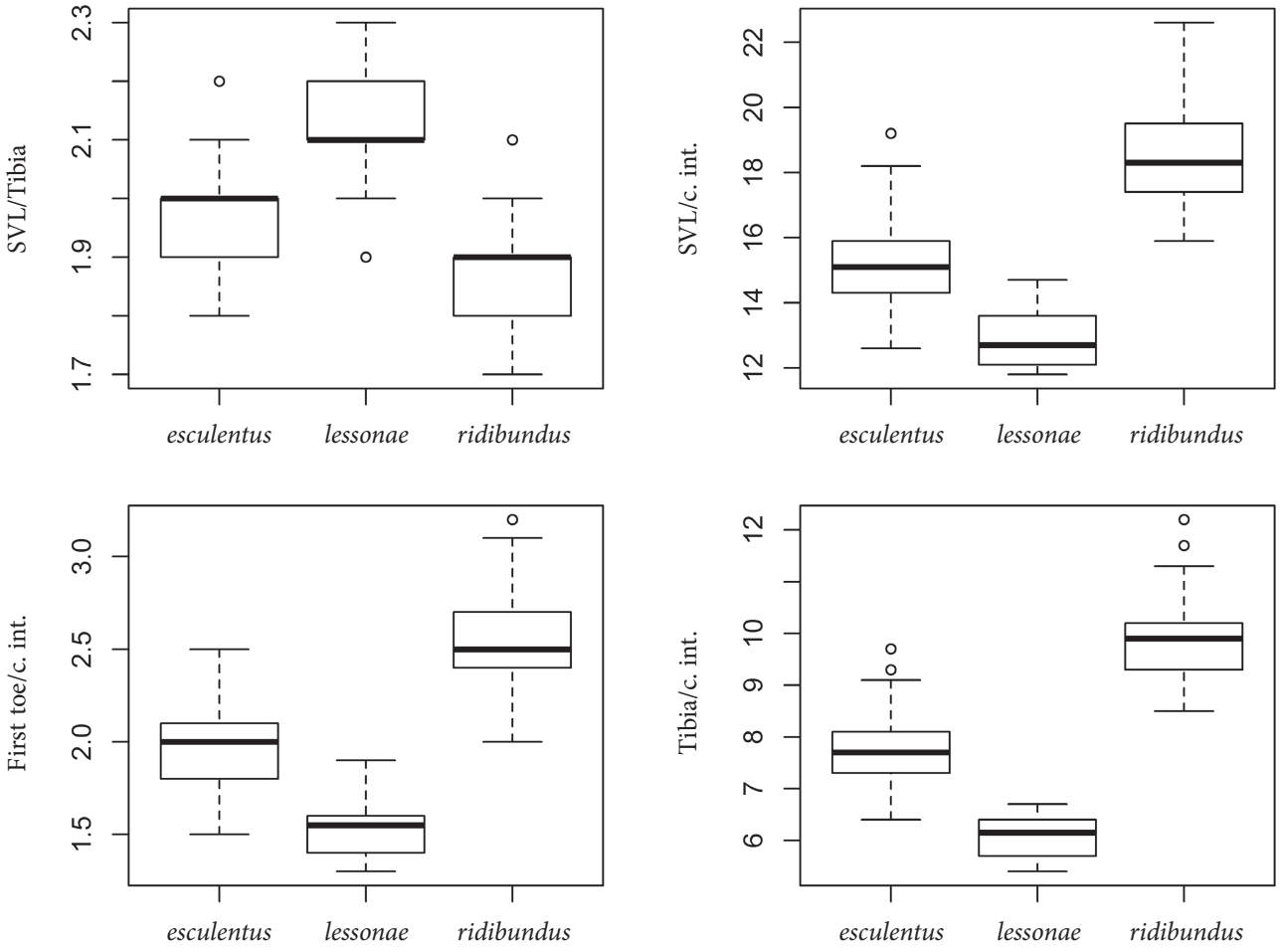

Figure 2. Box plots showing the ratios of SVL/tibia, SVL/c. int., first toe/c. int. and tibia/c. int. in the 173 reliably identified *P. esculentus, P. lessonae* and *P. ridibundus*, showing median, 25th and 75th percentile and 95% confidence interval. All parameters varied significantly among species ($p < 0.01$).

Table 3. Mean and standard error as well as minima and maxima of the ratios of SVL/tibia, SVL/c.int., first toe/c.int. and tibia/c.int. in *P. esculentus, P. lessonae* and *P. ridibundus* (n = 173).

	SVL/Tibia	SVL/c. int.	Toe/cC. int.	Tibia/c. int.
P. esculentus	2.0 ± 0.01	15.1 ± 0.15	2.0 ± 0.02	7.7 ± 0.08
	1.8–2.2	12.0–19.2	1.4–2.5	5.6–9.7
P. lessonae	2.1 ± 0.02	12.9 ± 0.18	1.6 ± 0.03	6.1 ± 0.07
	1.9–2.3	11.8–14.7	1.3–1.9	5.4–6.7
P. ridibundus	1.9 ± 0.01	18.5 ± 0.18	2.5 ±0.03	9.9 ± 0.09
	1.7–2.1	15.9–22.6	2.0–3.2	8.5–12.2

Table 4. Snout–vent lengths (SVL) and weights of *P. esculentus, P. lessonae* and *P. ridibundus* sorted after female, male and subadult (mean, minima and maxima).

	SVL [mm]			weight [g]		
	mean	min	max	mean	min	max
P. kl. *esculentus*						
female	65.0	43.5	86.6	41.9	11.0	93.0
male	66.8	42.9	83.5	40.0	11.0	71.0
subadult	36.0	26.1	43.5	6.2	2.0	12.0
P. lessonae						
female	57.7	47.0	63.1	25.0	14.0	34.0
male	52.3	45.3	59.0	18.3	11.0	26.0
subadult	25.7	22.3	27.5	2.3	1.0	3.0
P. ridibundus						
female	87.6	63.8	108.0	97.3	33.0	175.0
male	83.9	63.5	99.4	85.3	36.0	138.0
subadult	39.8	33.1	48.2	9.7	5.0	17.0

26 as *P. lessonae* (15.0%), and 65 as *P. ridibundus* (37.6%). *Pelophylax esculentus* was present at all locations except Illertissen, although not in every study site. *Pelophylax lessonae* was found in Memmingen, Augsburg, Altötting, Tirschenreuth, Nuremberg, Pfaffenhofen (uncertain), Oberstreu and Illertissen (study sites 2, 3, 4, 5, 6, 7, 12 and 13). *Pelophylax ridibundus* was found in Amberg, Augsburg, Altötting, Tirschenreuth, Nuremberg, Pfaffenhofen, Munich, Deggendorf, Passau and Freilassing (study sites 1, 3, 4, 5, 6, 7, 8, 9, 10 and 11). Population systems were identified based on species composition (Table 1) and revealed eight RE-systems (study sites 1.1, 4.2, 5.2, 6.1, 8, 9.2, 10 and 11) and six LE-systems (study sites 2, 3.2, 4.1, 5.1, 6.2 and 12). In one population (study site 3.1), only *P. ridibundus* was caught, and in two populations only *P. esculentus* (study sites 1.2 and 9.1). At study site 7.1 (Pfaffenhofen), only *P. ridibundus* was reliably identified, although three individuals were identified as uncertain *P. esculentus*. At study site 7.2, only *P. esculentus* was identified reliably; however, one individual was identified as an uncertain *P. lessonae*. In Illertissen, only one *P. lessonae* was collected (Table 1). No population containing all three species was detected. The preliminary species identification in the field based on colouration and the form of the c. int. agreed with that derived from morphometric measurements in most cases (83%). Out of the 200 observed frogs, 58 were female (29%), 109 were male (54%), and 33 were subadult (17%). This result differs from a 1:1 ratio (cumulative binomial distribution, $\alpha < 0.01$). *P. esculentus* (n = 82) had a sex ratio of 30% female (25), 44% male (36) and 26% subadult (21). Of the 26 *P. lessonae*, 7 were female (27%), 16 were male (62%) and 3 were subadult (12%). *P. ridibundus* (n = 65) had a sex ratio of 29% female (20), 66% male (43) and 5% subadult (3). *P. esculentus* had a mean weight of 31.91 ± 2.44 g (mean ± standard error (SE)) and a mean SVL of 58.34 ± 1.80 mm (n = 82). *P. lessonae* weighed 18.27 ± 1.65 g on average and had a mean SVL of 50.68 ± 2.12 mm (n = 26). The mean weight of *P. ridibundus* was 85.28 ± 4.49 g and its mean SVL was 82.92 ± 1.76 mm (n = 65) (see Table 4 for values for males, females and subadults). In the cases where *P. esculentus* cooccurred with *P. lessonae* or *P. ridibundus* (all except study sites 1.2 and 9.1), the size of *P. esculentus* varied depending on the other species in the population. In RE-systems, *P. esculentus* was significantly larger and heavier (42.30 ± 3.64 g, 66.98 ± 2.64 mm) than in LE-Systems (26.46 ± 3.57 g, 53.26 ± 2.56 mm, $p < 0.01$) (Table 1). The size of water bodies in-

habited by LE-systems was in general smaller than those associated with RE-systems (mean size: 2060 m², min: 9 m² and max: 4800 m² vs. mean size: 9183 m², min: 210 m² and max: 50000 m²), but the difference was not statistically significant ($p = 0.27$).

Identification of triploid frogs based on erythrocyte measurements

The erythrocytes of 168 frogs were examined. Some samples could not be used due to the poor quality of the blood smear, and for one population (study site 12) we had no permission for finger amputation; those specimens are therefore not included here. Mean sizes did not vary significantly ($p > 0.05$) between *P. esculentus*, *P. lessonae* and *P. ridibundus*. The mean erythrocyte length (± SE) of all examined specimens was 24.06 ± 0.50 µm and the sample set was normally distributed (Fig. 3). Only five specimens had erythrocytes ≥ 26.5 µm in length and were therefore supposed to be triploid (following Plötner 2005). These frogs were collected at study sites 5.2, 6.1, 7.2 and 8. The specimen from study site 8 was identified as *P. ridibundus* according to its morphometric measurements; the others were identified as *P. esculentus*.

Erythrocyte area was also used for the identification of triploid animals. The mean area (± SE) of all samples was 272.02 ± 1.87 µm². The population from study site 5.2 differed significantly from the overall sample set (mean area ± SE: 310.35 ± 7.54 µm²; $p \leq 0.01$), with nine out of ten frogs being triploid at this study site according to erythrocyte area (see discussion).

Species identification based on serum albumin PCR

The results of this analysis differed from the morphometric measurements (Tab. 5). Out of a total of 176 samples that could be analysed, 40 were identified as *P. esculentus* (23%), five as *P. lessonae* (3%), and 131 as *P. ridibundus* (74%). According to this result, *P. ridibundus* was by far the most common green frog species at our study sites in Bavaria at the time of sampling and *P. lessonae* was the rarest (3%). Due to the contradiction between these results and those based on morphology, data based on serum albumin PCR were not used for the final species identification.

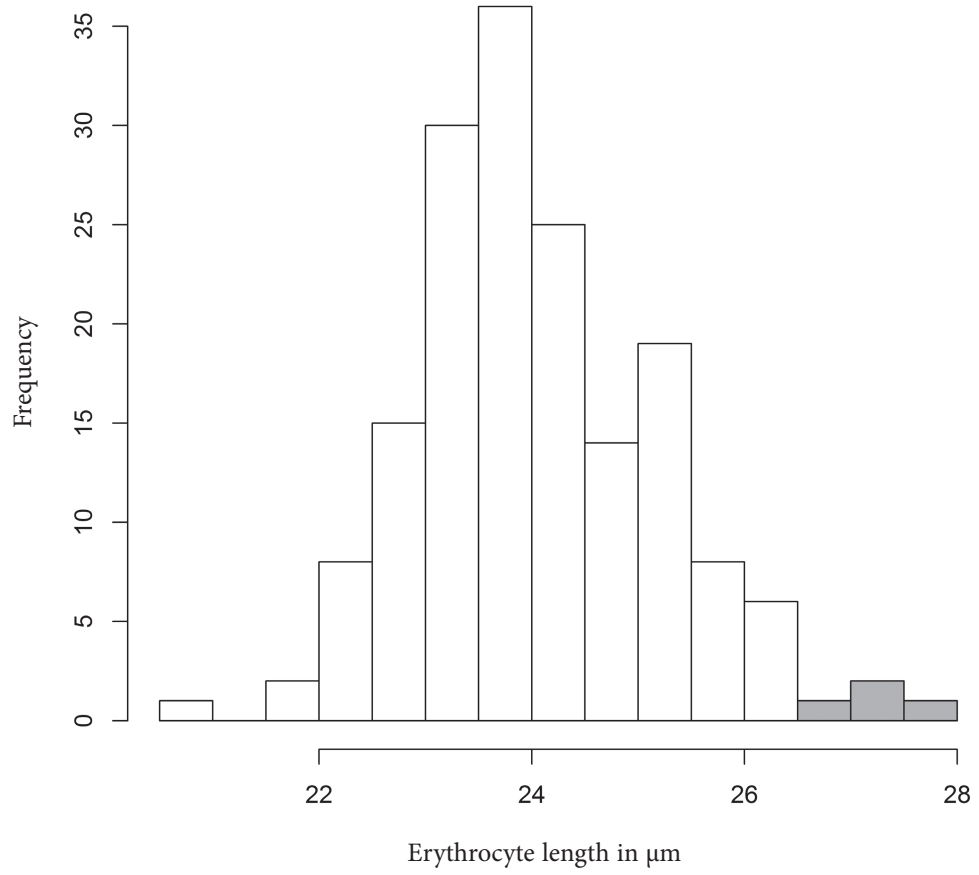

Figure 3. Histogram, showing the frequency of different erythrocyte lengths in the total sample size (n = 168). White bars: presumed diploid individuals, grey bars: presumed triploid individuals (≥ 26.5 µm).

Table 5. Comparison between morphometric and genetic species identification, showing both number and percentage of the same 149 frogs.

species identification					
morphometric	number	%	genetic	number	%
P. esculentus	71	48	*P. esculentus*	36	24
P. lessonae	15	10	*P. lessonae*	4	3
P. ridibundus	63	42	*P. ridibundus*	109	73
total	149	100	total	149	100

Identification of mitochondrial haplotypes and allochthonous frogs based on ND2 sequencing

The mitochondrial haplotypes (about 850 bp per sample) of 176 frogs were identified. In most populations, more than one haplotype was present. Of 71 *P. esculentus*, 69% (n = 49) had *P. lessonae* mitochondrial DNA (mtDNA) and 31% (n = 22) had a *P. ridibundus*-specific haplotype. The majority of individuals with a haplotype characteristic of *P. lessonae* came from LE-systems and most individuals with haplotypes characteristic for *P. ridibundus* came from RE-systems. Exceptions from this were the populations at study sites 4.1, 5.2 and 6.1. Here, of 15 *P. lessonae* (identified by morphological characteristics), 93% had a *P. lessonae* and the remainder a *P. ridibundus* haplotype. Of 63 *P. ridibundus*, 90% had a conspecific haplotype and the remainder a *P. lessonae* haplotype. In 70% of the cases (54% of the *P. esculentus* haplotypes, 87% of the *P. lessonae* haplotypes and 89% of the *P. ridibundus* haplotypes), the sequences were similar to those of Plötner et al. (2008). This allowed the reconstruction of the origins of the individuals and therefore provided evidence of populations with allochthonous frogs (Fig. 4). In three populations (study sites 1.1, 3.1 and 7.1), haplotypes (R10, R13 and R15) were present that were previously found in the Balkans by Plötner et al. (2008). Study site 1.1 was a RE-system, and only *P. ridibundus* was present at study sites 3.1 and 7.1 (study site 7.1 included three uncertain *P. esculentus*). Frogs from study sites 1.2, 3.2 and 6.2 (all *P. lessonae* haplotypes) did not match any of the reference sequences, so that their origins remain unclear. The haplotypes (R17, R18, L3, L6 and L10) of the individuals from all other study sites were found in Northern and Central Europe. Specimens from study site 12 and 13 were not sequenced.

Discussion

Population composition

According to our morphological results, *P. esculentus* is the most common green frog in Bavaria, making up nearly half of all animals (47%, n = 82). This result agrees with the distribution map of the Bayerisches Landesamt für Umwelt (Artenschutzkartierung Bayern, http://www.lars-ev.de/arten/amppe.htm) and the findings of Günther (1990) that *P. esculentus* is the most common form of green frog in many parts of Germany and Central Europe. Zahn (1997) also examined LE-systems in two areas in southeastern Upper Bavaria and found 55 and 73%, respectively, to be *P. esculentus*. 17 out of 20 populations contained *P. esculentus*, often at the highest frequency. A possible explanation for the success of *P. esculentus* is that the intermediate stage between *P. lessonae* and *P. ridibundus* yields ecological advantages for the hybrid. For example, hybrids have a higher tolerance to oxygen shortages, have advantages during food shortages, and are more tolerant to fungicides (Tunner & Nopp 1979). Plénet et al. (1999) found that *P. esculentus* has no advantages under hypoxic conditions, but is intermediate between the parental species (intermediate niche hypothesis). It may be supposed that *P. esculentus* occurs throughout Bavaria, wherever the climate is suitable (i.e., everywhere except for the Alps and parts of the Bavarian Forest) and one of its parental species is present. The question arises as to how the species ratio of single populations stays constant over time. The percentage of *P. esculentus* should be expected to increase when there are more hybrids than *P. lessonae* or *P. ridibundus*, as mating among the former will occur more commonly and should lead to an increased percentage of hybrids. One reason for a constant species ratio might be that juvenile *P. esculentus* tend to disperse to smaller water bodies with less or no vegetation. There, the frogs meet less competition, but achieve no reproductive success due to the absence of a parental species, as *P. lessonae* in particular poses major demands on its habitat (Zahn 1996). Additionally, female mate choice could have an influence on the species ratio, as there is evidence that both hybrid and *P. lessonae* females will preferably choose male *P. lessonae* (Lengagne et al. 2006). This is thought to stabilize the structure and dynamics of LE-systems (Bergen et al. 1997). Another possibility is that the species ratio does not remain constant over time. After an increase of hybrids to some level, there might not be enough individuals of the parental species left to ensure successful reproduction, which would then lead to a decrease in the number of hybrids. In such a case, the species ratio would be fluctuating constantly (Plötner 2005). In our RE-systems, *P. esculentus* was significantly larger and heavier than in our LE-systems ($p < 0.01$). Therefore it appears as though environmental factors and selective forces play an important role in the determination of phenotypes

at a specific locality. The sizes of water bodies inhabited by LE-systems were smaller in comparison to the water body size associated with RE-systems. In RE-systems, larger *P. esculentus* would have a selective advantage, as smaller individuals will not be reproductively successful (Engeler & Reyer 2001). Another reason for the size differences noted might be based on mtDNA. In RE-systems, the haplotype of most of the animals was characteristic of *P. ridibundus*. Exceptions were populations at study sites 5.2 and 6.1. In LE-systems, the haplotype of most of the animals was characteristic of *P. lessonae*. The only exception was the population at study site 4.1. Therefore, mitochondrial DNA could influence the phenotype of *P. esculentus* (Plötner et al. 2008). It is also conceivable that epigenetic factors (also inherited from the female) play a role in the determination of the phenotype at a certain locality (Michimae et al. 2009). In two populations (study sites 1.2 and 9.1), only *P. esculentus* was found. According to the mean SVL and weight, the population at study site 1.2 might involve a RE-system (mean SVL: 60 mm, mean weight: 30 g), and the population at study site 9.1 might involve a LE-system (mean SVL: 47 mm, mean weight: 16 g).

P. ridibundus made up 38% (n = 65) of the total sample size and always occurred together with *P. esculentus* except at two study sites (3.1 and 7.1). At study sites 5.2, 6.1, and 10, *P. ridibundus* was captured in minority (compared with *P. esculentus*); at study sites 1.1, 4.2, 8, 9.2 and 11 it was in majority. There were no female *P. esculentus* found at study

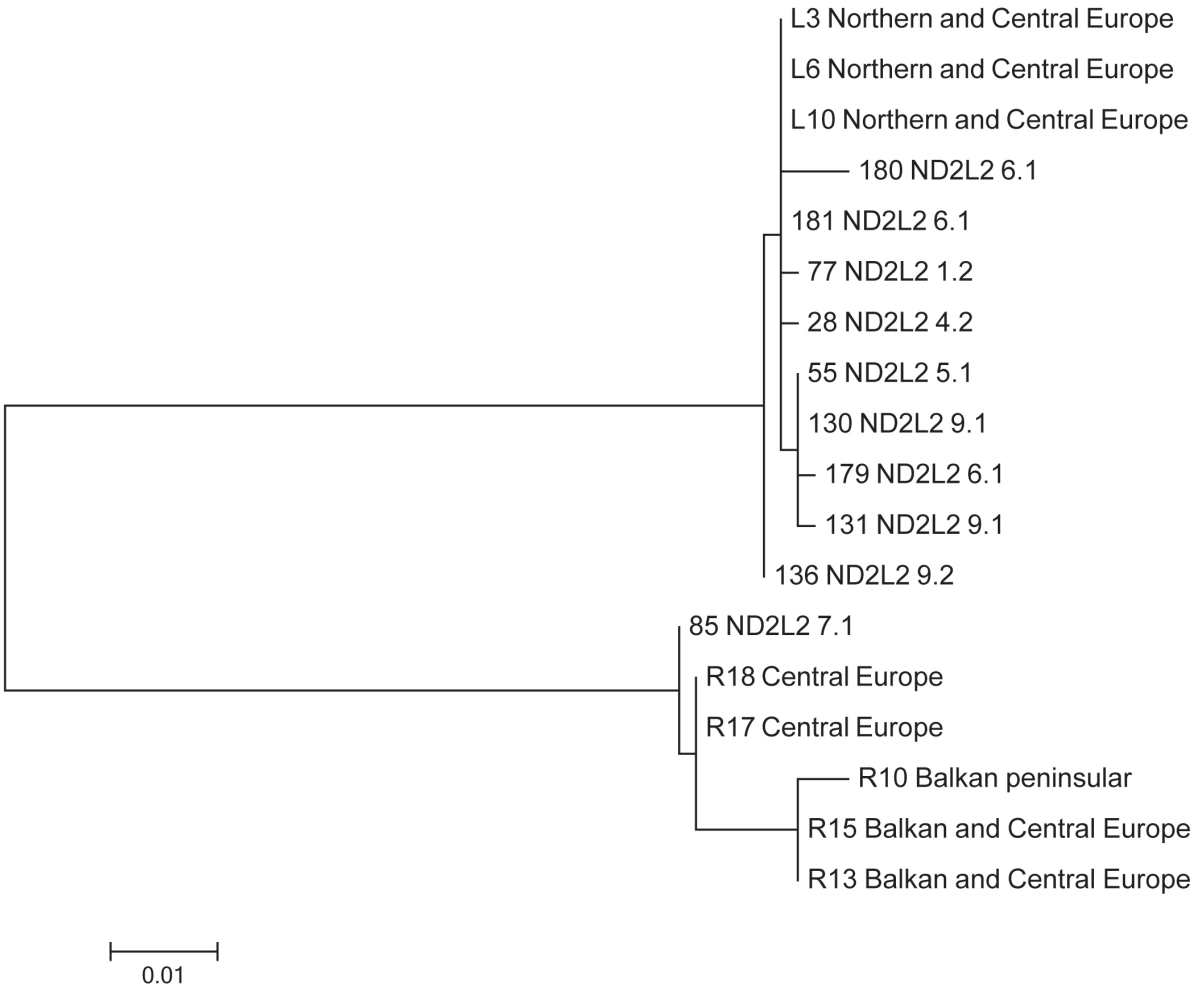

Figure 4. Phylogenetic relationships (maximum likelihood tree, created with MEGA 5.0) of *P. lessonae* and *P. ridibundus* haplotypes. The upper clade shows *P. lessonae* haplotypes; L3, L6 and L10 are reference sequences (from GenBank), which could be assigned to the samples. The other haplotypes represent specimens that could not be matched to any of the reference sequences (the first number is the consecutive number of the specimen; the second is the study site number). The lower clade shows the *P. ridibundus* haplotypes; R10, R13, R15, R17 and R18 are reference sequences (from Genbank)that could be matched to the samples. 85 ND2L2 7.1 is representative of specimens from study site 7.1, which could not be matched to any of the reference sequences.

sites 1.2, 4.1, 8 and 10. This agrees with previous observations that most populations consist of male and female *P. ridibundus* and male *P. esculentus* (Günther 1990). Male *P. esculentus* can only reproduce with female *P. ridibundus*. Most of the male *P. esculentus* produce gametes containing the L-genome, which is responsible for the determination of masculinity. Crossbreeding between male *P. esculentus* and female *P. ridibundus* therefore produces diploid male *P. esculentus* offspring (Günther 1990). However, some male hybrids produce R-gametes. Heterotypical crosses of such individuals lead to mostly female *P. ridibundus* offspring. This means that the clonally inherited genome (of *P. esculentus*) must include factors that determine femininity (Günther & Plötner 1988).

Pelophylax ridibundus was not only found along large rivers, but also in smaller ponds far from rivers (e.g., at study site 7.1) and in the very south of Bavaria (study site 11, Freilassing) where it had not been observed 30 years ago (Schmidtler & Gruber 1980). The latter findings might indicate a range expansion of this species. *P. ridibundus* migrates along rivers and thus extends its range of distribution, as was observed by Schmidtler & Gruber (1980). The extension of its range could also be instrumental to the appearance of allochthonous populations. At site 7.1, frogs had earlier been released by humans (Angela Grau, personal communication, 25 April 2012); other allochthonous individuals were found at study sites 1.1 and 3.1, and Mazepa & Rachmayuningtyas (2011) identified allochthonous populations in and around Munich as well (at different study sites). An extension of the distribution range of *P. ridibundus* has been noted in many parts of Europe, e.g., in the western parts of Germany and in Britain (Plötner 2005, Holsbeek & Jooris 2010).

Pelophylax lessonae was the rarest of the three species at 15% prevalence (n = 26). It was found only at seven sites (Tab. 1), and always together with *P. esculentus* (LE-systems). At site 13, only one *P. lessonae* was collected, but we assume that this study site has a LE-system as well. At study sites 3.2, 4.1 and 6.2, *P. lessonae* was in minority (compared with *P. esculentus*); at study sites 2, 5.1 and 12, it was in majority. The percentage of females among *P. esculentus* was higher than among *P. lessonae* at study sites 2, 3.2, 4.1 and 5.2. This is likely because in such populations the L-genome is deleted during gametogenesis and the R-genome is passed on. The R-genome contains factors responsible for the determination of the female sex. Therefore a cross of a male hybrid with a female Pool Frog will lead exclusively to female offspring (Plötner 2005). Habitat types in which *P. lessonae* was collected included marshes, moors, small ponds and lakes with rich vegetation (study site 12 – a concrete pool – was an exception). We therefore assume that the main distribution range of *P. lessonae* lies in southern Bavaria in the foothills of the Alps where such habitats are still common. In the other parts of Bavaria, its distribution is limited to suitable habitats where no *P. ridibundus* occur. Those habitats, especially marshes, moors and small water bodies, have been in constant decline for many years (e.g., Blab 1993). River regulation, the destruction of reed stocks and eutrophication all have negative influences on green frog populations as well (Plötner 2005). In many regions, the remaining waters are polluted by agricultural wastewaters and residue of pesticides and fertilizers. This has contributed to a general decline of green frogs, possibly due to increased larval mortality, developmental anomalies and fertility disturbances (Günther 1990, Plötner 2005). Often living on land, juvenile frogs face threats from different factors. The uniformity of the modern agricultural landscape, with large open fields and a lack of hedges, groves and other vegetative structures, increases the risk of dehydration. Another hazard is road traffic, especially in populations whose winter and summer habitats are divided by roads with substantial vehicle traffic volumes that result in high mortality during spring and autumn migrations (Plötner 2005). Whether the chytrid fungus (*Batrachochytrium dentrobatidis*) has an influence on the mortality of green frogs is yet to be investigated. Collection and trade have become irrelevant nowadays, as all indigenous amphibians in Bavaria are strictly protected, and their legal protection is adequately enforced. In general, the described hazards apply to all three green frog species. However, it can be assumed that *P. esculentus* and *P. ridibundus* are not threatened in Bavaria. In contrast, *P. lessonae* is obviously rarer and the results of this study provide limited evidence to consider this species as potentially threatened in Bavaria. Its current categorisation in the Red List of Bavaria is D (Data deficient; http://amphibien.bund-naturschutz.de/roteliste1.html). In other parts of Germany, *P. lessonae* is already listed as threatened, e.g., in Brandenburg (Kühnel et al. 2005) and Northrhine-Westfalia (Schlüpmann & Geiger 1999). A potential threat status in Bavaria is also supported by the negative influence of allochthonous *P. ridibundus*, which often uses the same ecological niche and therefore replaces *P. lessonae* (Rey et al. 1985, cited in Holsbeek & Jooris 2010). In future studies, mapping projects and ecological reports, it will be important to distinguish between the three species to obtain a more precise image of the distribution and population structures of green frogs. For improved conservation – of *P. lessonae* in particular, but also for the other green frog species – the conservation of suitable habitats (moors, marshes, ponds with rich vegetation etc.), as well as the renaturation, restoration and the cross-linking of such habitats must have highest priority. Additionally, the introduction of allochthonous green frogs has to be monitored and prevented (Plötner 2005).

13.5% (27) of the individuals could not be identified reliably and were therefore considered uncertain (Fig. 5, Tab. S1 shown in yellow). However, three of five characters were in agreement in all of these frogs and it therefore appears likely that 59% (16) were *P. esculentus*, 33% (9) were *P. lessonae* and 8% (2) were *P. ridibundus*. If these identifications proved to be correct, this would even increase the percentage of *P. esculentus* in the total sample size, confirming the assumption that the hybrid is the most common species in Bavaria. This would also mean that study site 7.1 did not only have *P. esculentus*, but included a LE-system,

and that study site 7.2 did not only have *P. ridibundus*, but included a RE-system. Considering the reliably identified frogs, it seems that the quotient of SVL/tibia is the least reliable character as it is correlated with the other characters in only 62.5%. The form of the c. int. correlated with the other characters in 80.5%, the quotient of SVL/c.int. in 90%, the quotient of first toe/c.int. in 94.5%, and the quotient of tibia/c.int. in 98.5%. When considering the parameters tibia/c. int. and first toe/c. int. (Fig. 5) between the species, the uncertain individuals are mainly represented at the lower and upper boundaries of these ratios.

Based on erythrocyte size, four triploid *P. esculentus* were identified (Fig. 3) at study sites 5.2, 6.1 and 7.2. In two of those, the parameters tibia/c. int. and first toe/c. int. were within the *P. ridibundus* range, one was typical of *P. esculentus* and the other had parameters rather typical of *P. lessonae* (Fig. 5). As far as erythrocyte measurement was concerned, only ten erythrocytes per sample were measured, which may have been too small to produce a reliable result (which might explain the "triploid" *P. ridibundus* from study site 8). Plötner (2005) suggests measuring at least 20 erythrocytes per sample. Most of the frogs at the locations investigated in Bavaria appeared to be diploid with a mean (± SE) erythrocyte length of 24.06 ± 0.50 µm and mean area of 272.03 ± 1.87 µm². 90% of the population samples at study site 5.2 (mean SVL = 61.41 ± 3.30 mm) had significantly larger erythrocytes (mean area = 310.35 ± 7.54 µm²; $p \leq 0.01$) than specimens from other study sites. However, this does not necessarily prove that those frogs were triploid. Schmeller et al. (2001) showed that the SVL, geographic location, organic matter of the substrate, and the relative oxygen content of the water all influence erythrocyte size. Therefore, it is possible that a lack of oxygen in the lakes of study site 5.2 led to increased erythrocyte sizes (oxygen content was not measured). Further molecular work is required to verify whether those frogs were truly triploid, e.g., by means of microsatellite-based genotyping (Christiansen 2005). However, it remains questionable whether erythrocyte measurement is a reliable method for the identification of triploid animals in the first place. Schmeller et al. (2001) and Ogielska et al. (2001) doubt this and assume that only 70 to 80% of triploid individuals can be identified correctly. According to Ogielska et al. (2001), some *P. esculentus* have a variable DNA content with aneuploids and mosaics among them, making it hard to distinguish between diploid and tri-

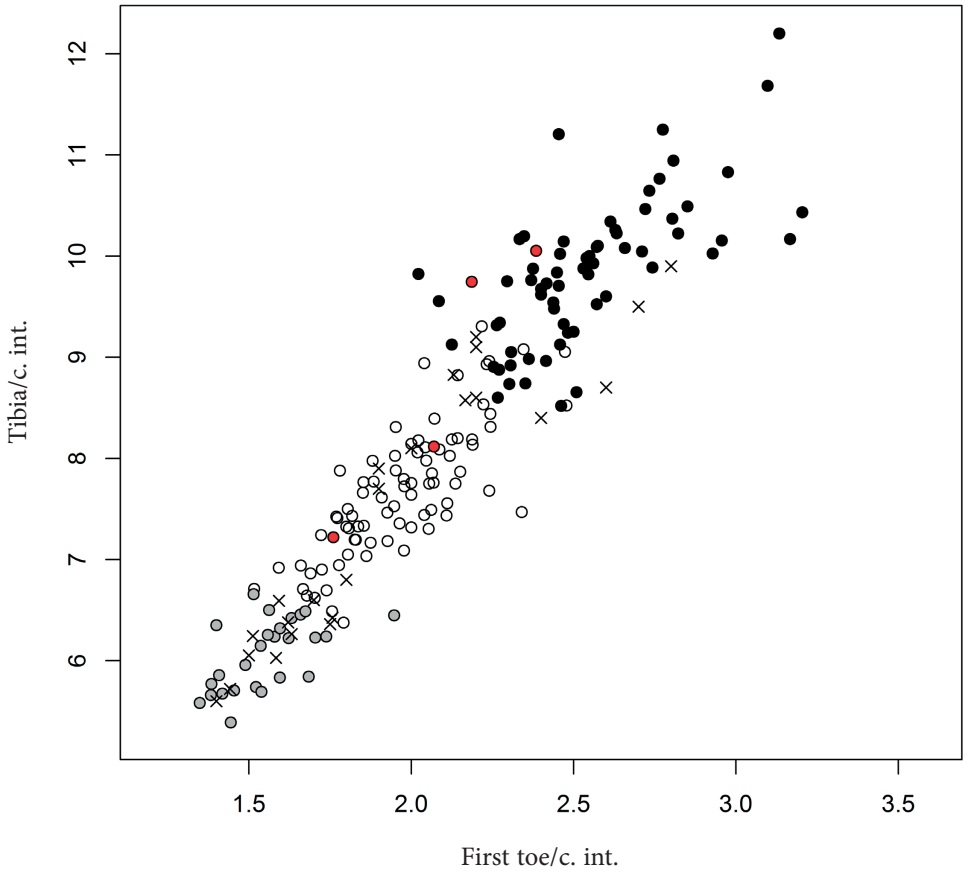

Figure 5. Relation between the parameters tibia/c. int. and first toe/c. int. in all 200 frogs. White: *P. esculentus*, grey: *P. lessonae*, black: *P. ridibundus*, red: presumed triploid *P. esculentus*, x: uncertain individuals.

ploid specimens. At three study sites (1.2, 7.2 and 9.1), only *P. esculentus* was found. No triploid frogs were identified in those populations, making the existence of pure *P. esculentus* populations unlikely. Study site 7.2 included an uncertain *P. lessonae*, making it likely that this site has a LE-system. At study site 1.2, the find of only *P. esculentus* might have been due to it being early in the year (25 April 2012) and still relatively cold, which enabled only the hybrids to be active. Another possibility is that the sample size (seven frogs at study site 1.2 and five at study site 9.1, Tab. 1) was too small. This small sample size could also account for the lack of triploid individuals if they occur at low frequencies. At study site 9.2, *P. esculentus* probably occurs syntopically with *P. lessonae*; at study site 1.2, this is uncertain and it might be a pure hybrid population.

Comparison of morphological and genetic species identification

The results from species identification via serum albumin PCR diverged considerably from those based on morphometric measurements. Genetic and morphological species identification only agreed in 64% of the cases. According to the serum albumin PCR, *P. lessonae* would be very rare in Bavaria, accounting only for five identified specimens out of 176. *P. ridibundus* would by far be the dominating species with 74% (n = 131). This result, however, is doubtful when comparing it to the morphometric results. ND2 sequencing also suggested that serum albumin PCR is unreliable, because numerous *P. lessonae* (identified based on morphometric measurements) had a haplotype characteristic for *P. lessonae*, but were identified as *P. ridibundus* according to the serum albumin PCR. On the other hand, many *P. ridibundus* (identification based on serum albumin PCR) that were morphologically identified as *P. esculentus*, had a haplotype characteristic of *P. lessonae*. This discrepancy might be explained by occasional genetic introgression, but is very unlikely to occur to such an extent. The agarose gel displayed clear bands, suggesting that methodical errors are unlikely to explain these results. Hauswaldt et al. (2012) developed a method similar to that applied here (based on Plötner et al. 2009), but had no problems with species misidentification. Plötner (pers. comm., 22 April 2012) would not exclude the possibility that some *P. lessonae* might not have the small band of 300 bp in length, but a large one instead. This would mean that such specimens were misidentified as *P. ridibundus*. Hauswaldt (pers. comm., 22 April 2012) suggested the possibility that the primers did not work well for the amplification of the small band. Therefore it might be possible that frogs identified as *P. ridibundus* were actually *P. esculentus* and thus could explain the high percentage of *P. ridibundus* and the low percentage of *P. lessonae*. To further address this problem, the genetic species identification would have to be repeated with another method (e.g., Hauswaldt et al. 2012). If another species identification based on genetic features should confirm these results, the morphological results would be invalidated. Kierzkowski et al. (2011) compared morphometric and genetic data from 174 frogs and found that 91% of the diploid specimens were identified correctly by means of morphometric identification (quotients from first toe/c. int., tibia/c. int. and femur/tibia, Fig. 2). Only 84% of LLR and 54% of RRL genotypes were correctly identified by means of morphometric identification. Identifying LLR and RRL genotypes by means of morphometric measurements does not work well for populations in Central Europe according to Plötner et al. (1994, cited in Hauswaldt et al. 2012). Therefore it is possible that several frogs were identified incorrectly by means of morphological characteristics, and maybe some triploid hybrids were not identified as such either.

Genetic introgression and effects of allochthonous frogs on indigenous populations

The mitochondrial haplotype of most of the examined frogs supported our morphological results. *P. ridibundus* possessed mtDNA that was characteristic of *P. lessonae* in 10% of cases and a conspecific haplotype in the other 90%. A similar result was previously obtained by Plötner et al. (2008) and Holsbeek & Jooris (2010) and can be explained by genetic introgression, or interspecific transfer of DNA. In this case, mtDNA is transferred from *P. lessonae* to *P. ridibundus* via one of two different scenarios: If two *P. esculentus* – carrying *P. lessonae* mtDNA – mate, *P. ridibundus* can result. However, this is unlikely because this offspring does not normally survive due to the accumulation of lethal factors (Berger 1967). More likely is that a female *P. esculentus* carrying *P. lessonae* mtDNA mating with a male *P. ridibundus* will yield *P. ridibundus* carrying *P. lessonae* mtDNA (Holsbeek & Jooris 2010). Plötner et al. (2008) assumes that both *P. esculentus* and *P. ridibundus* have advantages when carrying *P. lessonae* mtDNA. This might especially be the case in connection with the O_2/CO_2 metabolism, as animals possessing mtDNA from *P. lessonae* might be less sensitive to hypoxic conditions (Plötner 2001). The finding that 7% of *P. lessonae* contained mtDNA from *P. ridibundus* must be treated with caution. A phenomenon like this has not been observed before (Plötner et al. 2008), but it is nevertheless conceivable. It is possible that those individuals were *P. esculentus*, which cannot unfortunately be verified due to the uncertainties associated with genetic species identification (the values of the morphometric measurements were typical of *P. lessonae*). The haplotypes of individuals from study sites 2, 4.1, 4.2, 5.1, 5.2, 7.2, 8, 9.2, 10 and 11 were also found in northern and central Europe. It is therefore likely that these populations were autochthonous. In populations at study sites 1.2, 3.2, 6.1, 6.2 and 9.1, the haplotypes could not be matched with reference sequences. Thus, no statement about the origin of the individuals can be made here. The sequences could not be matched perhaps due to natural mutations or simply because they have not previously been collected and sequenced. In the population at site 8, no evidence for allo-

chthonous frogs was found, contrasting with the results obtained by Mazepa & Rachmayuningtyas (2011), who mainly found allochthonous *P. ridibundus* in the Munich area (80%). However, a different site was investigated in our study. In three populations (study sites 1.1, 3.1 and 7.1), haplotypes (R10, R13 and R15) were present that had previously been found in the Balkan peninsula by Plötner et al. (2008). It is therefore likely that those populations (study sites 1.1 and 7.1 were RE-systems, and only *P. ridibundus* was found at study site 3.1) included allochthonous individuals (Fig. 4). An explanation for allochthonous frogs in Bavaria is human-mediated translocation, either inadvertently (e.g., through fish stocking) or intentionally for garden ponds (Plötner 2005). The introduction of allochthonous *P. ridibundus* into indigenous LE-systems may have had extensive effects. *P. ridibundus* will mate with both *P. esculentus* and *P. lessonae*, as their mating season overlaps (Pagano et al. 2001, cited in Holsbeek & Joris 2010). Mating among *P. ridibundus* produces *P. ridibundus* offspring as does mating between *P. ridibundus* and *P. escuentus*. Mating between allochthonous *P. ridibundus* and *P. lessonae* lead to hybrid offspring, which are genetically different from the autochthonous *P. esculentus*. Therefore crosses between autochthonous and allochthonous *P. esculentus* may lead to fertile, viable *P. ridibundus* (Holsbeek & Jooris 2010). Overall, this would lead to an increased presence of *P. ridibundus*, because all mating within *P. ridibundus* and *P. esculentus* will produce *P. ridibundus*. *P. lessonae* would decrease in numbers, because only mating inter se will produce *P. lessonae* offspring (Holsbeek & Jooris 2010). Additionally, competition with the larger *P. ridibundus* has a negative influence on the success of *P. lessonae*. In the end, this might lead to a pure allochthonous *P. ridibundus* population or a RE-system (Holsbeek & Jooris 2010). The probability that *P. lessonae* will be replaced in such a scenario is high. *P. ridibundus* from southern Europe lacks the capacity of inducing genome elimination (Plötner 2005), which leads – if introduced – to a reduced presence of *P. esculentus* and *P. lessonae* as a result of their wasted reproductive efforts. The risk of losing autochthonous LE-systems is a real threat, as has been proven by examples from Switzerland where LE-systems have been replaced by allochthonous *P. ridibundus* (Rey et al. 1985, cited in Holsbeek & Jooris 2010).

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Online Supplementary Material

Martin Mayer, Oliver Hawlitschek, Andreas Zahn & Frank Glaw: Composition of twenty Green Frog populations (*Pelophylax*) across Bavaria, Germany. - Salamandra, **49**(1): 31–44.

2 Supplementary tables

Table 1: Results of species and mitochondrial haplotype identification, erythrocyte, weight and SVL measurements.

color code:

reliable identification

uncertain identification

consecutive Nr.	habitat nr.	date	species (first estimation)	**species (final identification)**	species (based on Albumin PCR)	mitochondrial ND2 haplotype	ND2 haplotype no.	origin (based on Genbank)	erythrocyte length [µm]	sex	weight [g]	SVL [mm]
1	1.1	02.04.2012	*P.* kl. *esculentus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R10	Balkan peninsular	24,7	f	54	73,6
2	1.1	02.04.2012	*P. ridibundus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R10	Balkan peninsular	25,45	m	62	81,8
3	1.1	02.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R10	Balkan peninsular	25,33	m	80	85,1
4	1.1	02.04.2012	*P.* kl. *esculentus*	***P. ridibundus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe	-	f	48	63,8
5	1.1	02.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R10	Balkan peninsular	23,69	m	113	91,7
6	1.1	02.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R10	Balkan peninsular	22,55	m	53	72,4
7	1.1	02.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R10	Balkan peninsular	25,07	m	41	67,9
8	1.1	02.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R10	Balkan peninsular	24,57	f	33	67,8
9	1.1	02.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R10	Balkan peninsular	23,69	subadult	12	43,5
10	1.1	02.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe	22,93	subadult	6	37,7
11	1.1	06.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R10	Balkan peninsular	23,81	m	72	78,6
12	1.1	06.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R10	Balkan peninsular	23,94	f	74	81,5
13	1.1	06.04.2012	*P.* kl. *esculentus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R10	Balkan peninsular	24,7	m	48	68,8
14	1.1	06.04.2012	*P.kl. esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe	23,94	m	47	69
15	1.1	06.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	lessonae	-	-	23,44	m	40	69,3
16	13	13.04.2012	*P. kl. esculentus*	***P. lessonae***					25,2	f	14	47
17	3.1	19.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R13/ R15	Balkan and Central Europe	22,68	f	112	97,7
18	3.1	19.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe	25,07	m	85	91,8
19	3.1	19.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe	23,31	f	117	94,7
20	3.1	19.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R13/ R15	Balkan and Central Europe	24,19	m	102	89,7
21	3.1	19.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe	22,18	f	143	98,1
22	3.1	19.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R13/ R15	Balkan and Central Europe	21,92	f	120	96
23	3.1	19.04.2012	*P.* kl. *esculentus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe	24,44	m	97	90,6
24	3.1	19.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R13/ R15	Balkan and Central Europe	25,2	m	89	85,7
25	3.1	19.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe	23,44	f	74	86,3
26	3.1	19.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe	23,44	m	69	80,4
27	3.1	19.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R13/ R15	Balkan and Central Europe	24,19	m	96	88,6
28	4.2	20.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	lessonae	-	-	23,44	f	260	114,5
29	4.1	20.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	ridibundus	R17/ R18	Central Europe	-	m	38	70
30	4.1	20.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe	-	f	15	45
31	4.1	20.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	L3/ L6/ L10	Central and northern Europe	-	f	21	54,4
32	4.1	20.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe	24,57	f	11	43,5
33	4.1	20.04.2012	*P.* kl. *esculentus*	***P. lessonae***	*P.* kl. *esculentus*	ridibundus	R17/ R18	Central Europe	22,68	subadult	8	37,5
34	4.1	20.04.2012	*P. lessonae*	***P. lessonae***	*P.* kl. *esculentus*	ridibundus	R17/ R18	Central Europe	26,08	m	16	47,7
35	4.1	20.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	ridibundus	R17/ R18	Central Europe	-	subadult	7	38,6
36	4.1	20.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	ridibundus	R17/ R18	Central Europe	23,94	subadult	11	41,3
37	4.1	20.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	ridibundus	R17/ R18	Central Europe	-	subadult	5	34,7
38	4.1	20.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	ridibundus	R17/ R18	Central Europe	-	subadult	7	38,5
39	4.1	20.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	ridibundus	R17/ R18	Central Europe	-	subadult	4	33,2
40	4.1	20.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	L3/ L6/ L10	Central and northern Europe	24,82	subadult	3	29,1
41	4.1	20.04.2012	*P.* kl. *esculentus*	***P. lessonae***	*P.* kl. *esculentus*	ridibundus	R17/ R18	Central Europe	-	subadult	2	24,6
42	4.2	20.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe	22,23	m	103	88,2
43	4.2	20.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe	25,58	m	98	89,2
44	4.2	20.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe	26,21	m	99	88
45	4.2	20.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe	23,81	f	175	108
46	4.2	20.04.2012	*P. ridibundus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe	23,44	m	79	76,9
47	4.2	20.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe	24,44	m	82	80,3

48	4.2	20.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		23,69	m	102	91,5
49	4.2	20.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,56	m	46	71,1
50	4.2	20.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	ridibundus	R17/ R18	Central Europe		24,07	m	43	70,5
51	5.1	23.04.2012	*P. lessonae*	***P. lessonae***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		25,33	f	15	50,8
52	5.1	23.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		24,32	m	11	42,9
53	5.1	23.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		23,56	m	13	46,8
54	5.1	23.04.2012	*P.* kl. *esculentus*	***P. lessonae***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		23,06	f	21	49,6
55	5.1	23.04.2012	*P. lessonae*	***P. lessonae***	*P. ridibundus*	lessonae	-	-		23,81	f	11	42,9
56	5.1	23.04.2012	*P.* kl. *esculentus*	***P. lessonae***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		23,31	m	15	44,3
57	5.1	23.04.2012	*P. lessonae*	***P. lessonae***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		24,70	m	12	45,3
58	5.1	23.04.2012	*P. lessonae*	***P. lessonae***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		24,07	m	12	46,5
59	5.1	23.04.2012	*P. lessonae*	***P. lessonae***	*P.* kl. *esculentus*	lessonae	L3/ L6/ L10	Central and northern Europe		22,47	subadult	3	27,3
60	5.1	23.04.2012	*P. lessonae*	***P. lessonae***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		23,18	subadult	3	27,5
61	5.1	23.04.2012	*P. lessonae*	***P. lessonae***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe	-		subadult	1	22,3
62	5.2	23.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		25,58	f	36	66,7
63	5.2	23.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		25,45	f	47	69,4
64	5.2	23.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		25,45	f	41	65,5
65	5.2	23.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		25,07	f	41	68,8
66	5.2	23.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		26,96	f	52	72,8
67	5.2	23.04.2012	*P.* kl. *esculentus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		25,45	f	42	69,2
68	5.2	23.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		24,95	m	26	57,2
69	5.2	23.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		22,68	m	17	53
70	5.2	23.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		25,83	m	23	50,7
71	5.2	23.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		25,2	subadult	9	40,8
72	6.1	24.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		27,59	f	51	70,9
73	6.1	24.04.2012	*P.* kl. *esculentus*	***P. ridibundus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe	-		subadult	5	33,1
74	1.2	25.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	-	-		24,32	f	32	60,7
75	1.2	25.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		24,19	f	47	68,4
76	1.2	25.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		23,44	f	23	53,3
77	1.2	25.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		24,19	m	34	62,1
78	1.2	25.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	-	-		25,58	f	22	56,9
79	1.2	25.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		26,21	m	24	56
80	1.2	25.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***					-		f	34	60,3
81	7.1	25.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	-	-		23,44	m	86	83,5
82	7.1	25.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	-	-		23,94	m	57	71,2
83	7.1	25.04.2012	*P. ridibundus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	-	-	-		m	35	65,1
84	7.1	25.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	-	-		23,69	m	56	80,2
85	7.1	25.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	-	-		23,94	f	63	71,7
86	7.1	25.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	-	-		25,33	m	67	78,4
87	7.1	25.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	-	-		22,81	f	85	89,8
88	7.1	25.04.2012	*P.* kl. *esculentus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R13/ R15	Balkan and Central Europe		24,57	f	55	72,2
89	7.1	25.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	-	-		24,57	m	61	75,3
90	7.1	25.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R13/ R15	Balkan and Central Europe		24,82	m	40	64,2
91	7.2	26.04.2012	*P. lessonae*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		27,22	m	44	67,2
92	7.2	26.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		23,81	m	36	64,9
93	7.2	26.04.2012	*P. lessonae*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		23,44	subadult	8	42,1
94	7.2	26.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	L3/ L6/ L10	Central and northern Europe		24,44	subadult	9	40
95	7.2	26.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		23,69	subadult	8	39,7
96	7.2	26.04.2012	*P. lessonae*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	-	-		23,56	subadult	9	38,8
97	7.2	26.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		24,07	subadult	7	38,8
98	7.2	26.04.2012	*P. lessonae*	***P. lessonae***	*P. ridibundus*	lessonae	-	-		23,81	subadult	6	37,2
99	7.2	26.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		24,19	subadult	4	30,9
100	7.2	26.04.2012	*P. lessonae*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		23,94	subadult	2	26,1
101	3.2	27.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	-	-		23,44	m	36	64,1
102	3.2	27.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		23,69	f	58	73,8
103	3.2	27.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		23,56	f	39	64,3
104	3.2	27.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	-	-		24,19	m	16	50,1
105	3.2	27.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	-	-		22,81	m	31	62,1

106	3.2		27.04.2012	*P. lessonae*	***P. lessonae***	*P. lessonae*	lessonae	-	-		26,08	m	18	52,8
107	3.2		27.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		24,44	f	21	53,4
108	3.2		27.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	-	-		23,94	m	24	58,2
109	3.2		27.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		23,94	m	21	55,2
110	3.2		27.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	-	-		23,31	subadult	3	30
111		8	30.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		27,09	m	97	90
112		8	30.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		22,81	m	116	90,1
113		8	30.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	ridibundus	R17/ R18	Central Europe		24,82	m	68	81,5
114		8	30.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	ridibundus	R17/ R18	Central Europe		25,96	m	71	83,5
115		8	30.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		25,07	m	95	86,5
116		8	30.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,81	m	105	91,7
117		8	30.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		25,45	m	123	91
118		8	30.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	ridibundus	R17/ R18	Central Europe		25,58	m	68	80,7
119		8	30.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	ridibundus	R17/ R18	Central Europe		24,07	m	47	68,9
120		8	30.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		24,7	m	138	96,5
121		8	30.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,69	f	63	76,1
122		8	30.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		25,58	m	92	87,5
123		8	30.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,18	m	115	92,8
124		8	30.04.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe	-		m	127	95,6
125		8	30.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	ridibundus	R17/ R18	Central Europe		23,44	m	42	69,3
126		8	30.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***						23,81	m	67	79,2
127		8	30.04.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***						24,19	m	53	74
128		8	30.04.2012	*P. ridibundus*	***P. ridibundus***						22,55	m	123	89,9
129		8	30.04.2012	*P. ridibundus*	***P. ridibundus***						23,94	f	170	102,8
130	9.1		01.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		23,44	m	40	64,9
131	9.1		01.05.2012	*P. lessonae*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		22,18	f	21	56,3
132	9.1		01.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,18	subadult	7	39,3
133	9.1		01.05.2012	*P. lessonae*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		23,31	subadult	6	38,5
134	9.1		01.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		22,3	subadult	7	35,9
135	9.2		01.05.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,18	m	81	81,3
136	9.2		01.05.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	lessonae	-	-		22,43	f	159	102,2
137	9.2		01.05.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		25,07	m	79	86,5
138	9.2		01.05.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		24,44	m	86	84,4
139	9.2		01.05.2012	*P.* kl. *esculentus*	***P. ridibundus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		22,93	m	78	84
140	9.2		01.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,94	f	12	45,1
141		10	02.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,1	m	52	70,9
142		10	02.05.2012	*P. ridibundus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		21,8	m	67	76,3
143		10	02.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,56	m	46	67,3
144		10	02.05.2012	*P.* kl. *esculentus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		24,1	m	55	73,8
145		10	02.05.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		22,43	m	36	63,5
146		10	02.05.2012	*P. ridibundus*	***P.* ridibundus**	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,1	subadult	17	48,2
147		10	02.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		24,44	subadult	10	41,6
148		10	02.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,69	subadult	9	38,7
149		10	02.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,69	subadult	4	30,3
150		10	02.05.2012	*P.* kl. *esculentus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,1	subadult	7	38
151		11	03.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		24,17	m	104	89,3
152		11	03.05.2012	*P.* kl. *esculentus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,31	f	77	89,2
153		11	03.05.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,44	m	100	88,8
154		11	03.05.2012	*P.* kl. *esculentus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		24,32	f	118	102,2
155		11	03.05.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,56	f	97	92,2
156		11	03.05.2012	*P. ridibundus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,81	m	116	99,4
157		11	03.05.2012	*P.* kl. *esculentus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		25,2	m	71	82,3
158		11	03.05.2012	*P.* kl. *esculentus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		25,83	m	37	64,3
159		11	03.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		23,44	f	78	86,6
160		11	03.05.2012	*P.* kl. *esculentus*	***P. ridibundus***	*P. ridibundus*	ridibundus	R17/ R18	Central Europe		22,93	f	117	90,9
161		2	04.05.2012	*P.* kl. *esculentus*	***P. lessonae***	*P.* kl. *esculentus*	lessonae	L3/ L6/ L10	Central and northern Europe		24,44	f	26	59,2
162		2	04.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	L3/ L6/ L10	Central and northern Europe		22,55	f	56	73,8
163		2	04.05.2012	*P. lessonae*	***P. lessonae***	*P.* kl. *esculentus*	lessonae	L3/ L6/ L10	Central and northern Europe		23,18	m	15	48,8

164	2	04.05.2012	*P. lessonae*	***P. lessonae***	*P. lessonae*	lessonae	L3/ L6/ L10	Central and northern Europe		23,56	m	14	45,9
165	2	04.05.2012	*P. lessonae*	***P. lessonae***	*P.* kl. *esculentus*	lessonae	L3/ L6/ L10	Central and northern Europe		23,18	m	14	45,9
166	2	04.05.2012	*P. lessonae*	***P. lessonae***	*P. lessonae*	lessonae	L3/ L6/ L10	Central and northern Europe		22,68	m	13	48,2
167	2	04.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	L3/ L6/ L10	Central and northern Europe		20,92	m	17	51,2
168	2	04.05.2012	*P.* kl. *esculentus*	***P. lessonae***	*P.* kl. *esculentus*	lessonae	L3/ L6/ L10	Central and northern Europe		24,01	m	16	54,7
169	2	04.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	L3/ L6/ L10	Central and northern Europe		22,93	f	40	70
170	2	04.05.2012	*P. lessonae*	***P. lessonae***	*P. lessonae*	lessonae	L3/ L6/ L10	Central and northern Europe		23,69	m	20	51,5
171	2	04.05.2012	*P.* kl. *esculentus*	***P. lessonae***	*P.* kl. *esculentus*	lessonae	L3/ L6/ L10	Central and northern Europe		26,21	m	19	52,8
172	2	04.05.2012	*P. lessonae*	***P. lessonae***	*P. lessonae*	lessonae	L3/ L6/ L10	Central and northern Europe		23,31	m	11	46,2
173	6.1	10.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	-	-		26,46	f	91	82,5
174	6.2	10.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		25,2	f	66	80,1
175	6.2	10.05.2012	*P. lessonae*	***P. lessonae***	*P.* kl. *esculentus*	lessonae	-	-		24,07	m	19	53,3
176	6.2	10.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		22,43	subadult	2	26,7
177	6.1	10.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	-	-		24,7	m	43	74,5
178	6.1	10.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		23,94	m	47	75,5
179	6.1	10.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	-	-		25,2	m	41	70,4
180	6.1	10.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P. ridibundus*	lessonae	-	-		22,81	m	47	74,1
181	6.1	10.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	-	-		23,18	m	43	74,7
182	6.1	10.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***	*P.* kl. *esculentus*	lessonae	-	-		24,57	m	53	73,4
183	12	11.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***					-		m	43	71,1
184	12	11.05.2012	*P.* kl. *esculentus*	***P. lessonae***					-		f	27	61,4
185	12	11.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***					-		m	37	60,2
186	12	11.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***					-		m	36	63,4
187	12	11.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***					-		m	39	65,5
188	12	11.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***					-		f	93	83,2
189	12	11.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***					-		m	30	61,7
190	12	11.05.2012	*P. lessonae*	***P. lessonae***					-		m	24	58,5
191	12	11.05.2012	*P. lessonae*	***P. lessonae***					-		f	28	61,5
192	12	11.05.2012	*P. lessonae*	***P. lessonae***					-		m	22	57,7
193	12	11.05.2012	*P. lessonae*	***P. lessonae***					-		f	34	63,1
194	12	11.05.2012	*P. lessonae*	***P. lessonae***					-		f	25	57,8
195	12	11.05.2012	*P. lessonae*	***P. lessonae***					-		m	24	58,8
196	12	11.05.2012	*P. lessonae*	***P. lessonae***					-		f	32	62,3
197	12	11.05.2012	*P. lessonae*	***P. lessonae***					-		m	26	57,9
198	12	11.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***					-		m	29	59,5
199	12	11.05.2012	*P. lessonae*	***P. lessonae***					-		m	23	59
200	12	11.05.2012	*P.* kl. *esculentus*	***P.* kl. *esculentus***					-		f	50	69,7

Table 2: Results of morphological measurements and additional identification features.

color code for identification features:

feature characteristic for final identification

consecutive Nr.	species (final identification)	1. tibia [mm]	2. tibia [mm]	C. int. [mm]	first toe [mm]	SVL/ tibia	SVL/ C. int.	first toe/ C. int.	tibia/ C. int.	form C. int.	dorsal stripe	dorsal color	ventral color	yellow femur	calling activity	color vocal sack
1	*P. ridibundus*	40,4	40,7	4	10,3	1,8	18,4	2,6	10,1	esculentus	n	green-brownish	very little black spots	n	-	-
2	*P. kl. esculentus*	41,7	41,4	5,3	11,4	2,0	15,4	2,2	7,9	cylindrical	y	brown	weak spotted	n	y	grey
3	*P. ridibundus*	44,3	44,3	5,2	12,8	1,9	16,4	2,5	8,5	cylindrical	y	brown	grey spots (medium)	n	n	grey
4	*P. ridibundus*	36,6	36,6	3	9,4	1,7	21,3	3,1	12,2	cylindrical	y	olive	many small grey spots	n	-	-
5	*P. ridibundus*	49,3	49,3	4,7	13,4	1,9	19,5	2,9	10,5	cylindrical	n	olive	big grey spots	n	n	grey
6	*P. ridibundus*	38,7	38,7	4,5	10,2	1,9	16,1	2,3	8,6	cylindrical	y	olive	many small grey spots	n	y	grey
7	*P. ridibundus*	37	36,9	4	10	1,8	17,0	2,5	9,3	cylindrical	y	brown	dark spots	n	y	grey
8	*P. ridibundus*	35,9	36,3	3,5	9,2	1,9	19,4	2,6	10,3	cylindrical	n	greenish	grey spots	n	-	-
9	*P. kl. esculentus*	23,6	23,7	2,6	6,1	1,8	16,7	2,3	9,1	esculentus	y	brown	very few spots	n	n	-
10	*P. kl. esculentus*	19,2	19,6	2,5	5,6	2,0	15,1	2,2	7,7	cylindrical	y	green	grey spots	n	n	-
11	*P. ridibundus*	42,1	42,3	4,2	12,3	1,9	18,7	2,9	10,0	cylindrical	y	brown	little dark spots	n	n	grey
12	*P. ridibundus*	42,7	42,3	4,4	10,8	1,9	18,5	2,5	9,7	cylindrical	n	brown	little dark spots	n	n	grey
13	*P. ridibundus*	38,3	38,4	3,8	10,1	1,8	18,1	2,7	10,1	cylindrical	y	green	few dark spots	n	n	grey
14	*P. kl. esculentus*	37,3	37,2	4,6	9,4	1,8	15,0	2,0	8,1	esculentus	y	green	very few spots	y	n	grey
15	*P. ridibundus*	36,6	36,7	3,6	11,4	1,9	19,3	3,2	10,2	cylindrical	y	olive	some dark spots	n	n	grey
16	*P. lessonae*	20,8	20,9	3,2	5	2,3	14,7	1,6	6,5	semicircle	y	green	little grey spots	y	n	-
17	*P. ridibundus*	48,4	48,9	4,9	12,4	2,0	19,9	2,5	9,9	cylindrical	y	brown	spotted	n	-	-
18	*P. ridibundus*	47,7	47,8	4,6	12,9	1,9	20,0	2,8	10,4	cylindrical	y	brown	spotted	n	n	grey
19	*P. ridibundus*	46,7	47,2	4,6	13,6	2,0	20,6	3,0	10,2	esculentus	y	brown	spotted	n	n	-
20	*P. ridibundus*	44,9	44,6	4,6	10,9	2,0	19,5	2,4	9,8	cylindrical	n	brown	spotted	n	n	grey
21	*P. ridibundus*	51	50,2	5,1	13	1,9	19,2	2,5	10,0	cylindrical	y	brown	spotted	n	n	-
22	*P. ridibundus*	47,6	47,5	5,5	13,8	2,0	17,5	2,5	8,7	cylindrical	y	brown	spotted	n	n	-
23	*P. ridibundus*	48	47,9	5	13	1,9	18,1	2,6	9,6	esculentus	y	green (bronzefarben	some spots	n	n	grey
24	*P. ridibundus*	44,4	44	4,1	12,2	1,9	20,9	3,0	10,8	cylindrical	y	brown	spotted	n	n	grey
25	*P. ridibundus*	46	45,9	4,5	12,7	1,9	19,2	2,8	10,2	cylindrical	y	brown	spotted	n	n	-
26	*P. ridibundus*	42,6	42,6	4,8	10,9	1,9	16,8	2,3	8,9	cylindrical	y	green	spotted	n	n	grey
27	*P. ridibundus*	45,5	46,3	4,4	11,5	1,9	20,1	2,6	10,3	cylindrical	y	brown	spotted	n	n	grey
28	*P. ridibundus*	60,9	60,7	6,9	14,7	1,9	16,6	2,1	8,8	cylindrical	y	brown	weak spotted	n	n	-
29	*P. kl. esculentus*	34,1	34,7	4,4	9,4	2,1	15,9	2,1	7,8	esculentus	y	green	spotted	n	n	grey
30	*P. kl. esculentus*	24,7	24,3	2,8	6	1,8	16,1	2,1	8,8	esculentus	n	green	some spots	n	n	-
31	*P. kl. esculentus*	26,6	26,4	4,1	7,2	2,0	13,3	1,8	6,5	in between	y	green	white	n	n	-
32	*P. kl. esculentus*	23,5	23,2	2,8	5,8	1,9	15,5	2,1	8,4	esculentus	y	green	some spots	n	n	-
33	*P. lessonae*	17,8	17,8	2,7	4,3	2,1	13,9	1,6	6,6	esculentus	y	green	white	n	n	-
34	*P. lessonae*	24,4	24,2	3,8	6,2	2,0	12,6	1,6	6,4	semicircle	y	green	white	n	n	-
35	*P. kl. esculentus*	19,1	19,1	2,5	5	2,0	15,4	2,0	7,6	esculentus	y	green	some spots	n	n	-
36	*P. kl. esculentus*	22,5	22,3	2,9	6	1,8	14,2	2,1	7,8	esculentus	y	green	spotted	n	n	-
37	*P. kl. esculentus*	16,3	17,3	2,2	3,9	2,1	15,8	1,8	7,4	esculentus	y	green	spotted	n	n	-
38	*P. kl. esculentus*	18,6	18,7	2,8	4,7	2,1	13,8	1,7	6,6	esculentus	y	green	some spots	n	n	-
39	*P. kl. esculentus*	15,3	15	2,4	4,3	2,2	13,8	1,8	6,4	esculentus	y	green	some spots	n	n	-
40	*P. kl. esculentus*	13,6	13,1	1,8	3,8	2,1	16,2	2,1	7,6	esculentus	y	green	some spots	n	n	-
41	*P. lessonae*	11,9	11,7	1,9	3,1	2,1	12,9	1,6	6,3	esculentus	y	green	some spots	n	n	-
42	*P. ridibundus*	46,3	47	5,3	12,2	1,9	16,6	2,3	8,7	cylindrical	n	green	spotted	n	y	grey
43	*P. ridibundus*	47,4	46,8	5	12,2	1,9	17,8	2,4	9,5	cylindrical	n	green	spotted	n	y	grey
44	*P. ridibundus*	47,2	47,4	5,4	12,7	1,9	16,3	2,4	8,7	cylindrical	y	green	spotted	n	y	grey
45	*P. ridibundus*	56,1	54,8	6,3	14,2	1,9	17,1	2,3	8,9	cylindrical	n	brown	spotted	n	n	-
46	*P. kl. esculentus*	43,2	43,1	5,5	10,3	1,8	14,0	1,9	7,9	cylindrical	n	brown	spotted	n	y	grey
47	*P. ridibundus*	43,7	43,3	4,9	11,3	1,8	16,4	2,3	8,9	cylindrical	n	brown	spotted	n	y	grey

48	*P. ridibundus*	47,9	49	4,5	12,3	1,9	20,3	2,7	10,6	esculentus	n	green	spotted	n	y	grey
49	*P. kl. esculentus*	38,4	38,3	4,5	10	1,9	15,8	2,2	8,5	esculentus	n	green	some spots	n	y	grey
50	*P. kl. esculentus*	35,1	31,5	4,7	11	2,0	15,0	2,3	7,5	esculentus	y	green	very few spots	n	y	grey
51	*P. lessonae*	24	23,7	4,3	5,8	2,1	11,8	1,3	5,6	semicircle	y	green-brownish	some spots	y	n	-
52	*P. kl. esculentus*	20,8	20,7	3,1	4,7	2,1	13,8	1,5	6,7	esculentus	y	brownish	spotted	y	n	?
53	*P. kl. esculentus*	21,8	22,1	3,9	5,5	2,1	12,0	1,4	5,6	esculentus	y	brownish	some spots	y	n	?
54	*P. lessonae*	24,6	24,9	4,3	6,2	2,0	11,5	1,4	5,7	esculentus	y	green	strong spotted	y	n	-
55	*P. lessonae*	21,2	21,1	3,3	5,8	2,0	13,0	1,8	6,4	semicircle	y	green	some spots	y	n	-
56	*P. lessonae*	21,7	21,8	3,6	5,7	2,0	12,3	1,6	6,0	esculentus	y	green	strong spotted	y	n	?
57	*P. lessonae*	22,2	22,2	3,8	6,4	2,0	11,9	1,7	5,8	semicircle	y	green	almost white	y	n	?
58	*P. lessonae*	23	23	3,8	5,7	2,0	12,2	1,5	6,1	esculentus	y	green	white	y	n	?
59	*P. lessonae*	12,7	12,6	2	2,8	2,1	13,7	1,4	6,4	semicircle	y	green	white	n	n	-
60	*P. lessonae*	13,2	13	2,3	3,5	2,1	12,0	1,5	5,7	semicircle	y	green	white	n	n	-
61	*P. lessonae*	9,7	9,6	1,8	2,6	2,3	12,4	1,4	5,4	semicircle	y	green	white	n	n	-
62	*P. kl. esculentus*	32,3	32,3	4,1	7,3	2,1	16,3	1,8	7,9	in between	y	brown	some spots	n	n	-
63	*P. kl. esculentus*	34,5	34,5	4,6	8,3	2,0	15,1	1,8	7,5	esculentus	y	green	some spots	n	n	-
64	*P. kl. esculentus*	33,7	33,9	4,2	8,9	1,9	15,6	2,1	8,0	esculentus	y	green-brownish	some spots	n	n	-
65	*P. kl. esculentus*	33,1	33,5	4,2	8,2	2,1	16,4	2,0	7,9	esculentus	y	green	bright spots	n	n	-
66	*P. kl. esculentus*	34,9	35,2	4,3	8,9	2,1	16,9	2,1	8,1	esculentus	y	green-brownish	some spots	n	n	-
67	*P. ridibundus*	36,6	36,9	3,4	9,4	1,9	20,4	2,8	10,8	cylindrical	y	green	spotted	n	n	-
68	*P. kl. esculentus*	30	30,2	4,1	8,2	1,9	14,0	2,0	7,3	esculentus	y	green	very few spots	n	n	?
69	*P. kl. esculentus*	24,5	24,7	3,7	6,3	2,2	14,3	1,7	6,6	esculentus	y	brown	spotted	n	n	?
70	*P. kl. esculentus*	26,6	26,9	3,9	7,1	1,9	13,0	1,8	6,8	in between	y	green	spotted	n	n	?
71	*P. kl. esculentus*	19,6	19,7	2,3	5,7	2,1	17,7	2,5	8,5	esculentus	y	green	almost white	n	n	-
72	*P. kl. esculentus*	39,2	39,1	3,9	9,3	1,8	18,2	2,4	10,1	cylindrical	y	olive	spotted	n	n	-
73	*P. ridibundus*	17,7	17,8	1,9	4,3	1,9	17,4	2,3	9,3	esculentus	y	brown	some spots	n	n	-
74	*P. kl. esculentus*	31,8	32,2	4,1	8,2	1,9	14,8	2,0	7,8	esculentus	y	green	bright spots	n	n	-
75	*P. kl. esculentus*	33,9	34,1	4,9	7,8	2,0	14,0	1,6	6,9	esculentus	y	green	spotted	n	n	-
76	*P. kl. esculentus*	29,5	30	4,1	7,5	1,8	13,0	1,8	7,2	esculentus	y	green	almost white	n	n	-
77	*P. kl. esculentus*	33	33,2	5	8,7	1,9	12,4	1,7	6,6	semicircle	y	green	bright spots	y	n	grey
78	*P. kl. esculentus*	28,9	29	4,1	7,4	2,0	13,9	1,8	7,0	esculentus	y	green	bright spots	n	n	-
79	*P. kl. esculentus*	29,3	29,1	4	7,2	1,9	14,0	1,8	7,3	esculentus	y	green	bright spots	y	n	grey
80	*P. kl. esculentus*	32,2	31,9	4,8	8	1,9	12,6	1,7	6,7	esculentus	y	green	bright spots	n	n	-
81	*P. ridibundus*	43,8	44,2	4,8	10,2	1,9	17,4	2,1	9,1	cylindrical	y	green	spotted	n	n	grey
82	*P. ridibundus*	40,7	40,4	4,1	10,5	1,7	17,4	2,6	9,9	cylindrical	y	olive	spotted	n	n	grey
83	*P. kl. esculentus*	35,8	35,4	3,9	8,5	1,8	16,7	2,2	9,2	cylindrical	n	olive	some spots	n	n	grey
84	*P. ridibundus*	44,2	43,5	4,5	9,1	1,8	17,8	2,0	9,8	cylindrical	y	brown	some spots	n	n	grey
85	*P. kl. esculentus*	38,7	39,1	4,8	9,4	1,9	14,9	2,0	8,1	cylindrical	n	green	some spots	n	n	-
86	*P. ridibundus*	43,8	43,1	4,8	11,8	1,8	16,3	2,5	9,1	cylindrical	n	olive	spotted	n	n	grey
87	*P. ridibundus*	46,3	47,2	5,4	11,7	1,9	16,6	2,2	8,6	cylindrical	n	olive	very strong spotted	n	n	-
88	*P. ridibundus*	38,7	38,9	4	9,6	1,9	18,1	2,4	9,7	esculentus	y	brown	bright spots	n	n	-
89	*P. ridibundus*	41,1	41,1	4,4	10	1,8	17,1	2,3	9,3	cylindrical	y	brown	spotted	n	n	grey
90	*P. kl. esculentus*	36,6	36,1	3,7	10,5	1,8	17,4	2,8	9,9	cylindrical	n	green	almost white	n	n	grey
91	*P. kl. esculentus*	36,1	35,8	5	8,8	1,9	13,4	1,8	7,2	semicircle	y	green	white	y	n	?
92	*P. kl. esculentus*	32,7	32,3	4,4	8	2,0	14,8	1,8	7,4	esculentus	y	green	some spots	n	n	?
93	*P. kl. esculentus*	20,4	20,8	2,9	5,4	2,1	14,5	1,9	7,0	semicircle	y	green	white	y	n	-
94	*P. kl. esculentus*	20,6	20,3	2,8	5,5	1,9	14,3	2,0	7,4	esculentus	y	green	almost white	y	n	-
95	*P. kl. esculentus*	19,9	19,9	2,9	4,9	2,0	13,7	1,7	6,9	esculentus	y	green	white	n	n	-
96	*P. kl. esculentus*	20,1	20,3	2,6	4,9	1,9	14,9	1,9	7,7	semicircle	y	green	white	y	n	-
97	*P. kl. esculentus*	19	18	2,6	4,7	2,0	14,9	1,8	7,3	esculentus	n	green	white	n	n	-
98	*P. lessonae*	18,5	17,5	2,9	4,7	2,0	12,8	1,6	6,4	esculentus	y	green	white	y	n	-
99	*P. kl. esculentus*	15,4	15,1	2,3	4	2,0	13,4	1,7	6,7	esculentus	y	green	some spots	n	n	-
100	*P. kl. esculentus*	13,1	12,9	1,6	3,4	2,0	16,3	2,1	8,2	semicircle	y	green	white	n	n	-
101	*P. kl. esculentus*	34,3	34	4,4	8,7	1,9	14,6	2,0	7,8	esculentus	y	green	bright spots	y	y	grey
102	*P. kl. esculentus*	38,6	38,3	5,2	9,2	1,9	14,2	1,8	7,4	esculentus	y	green	spotted	y	n	-
103	*P. kl. esculentus*	34,3	33,5	4,3	8,8	1,9	15,0	2,0	8,0	esculentus	y	green	spotted	y	n	-
104	*P. kl. esculentus*	25	24,9	3,6	6,4	2,0	13,9	1,8	6,9	esculentus	y	brown	spotted	y	n	grey
105	*P. kl. esculentus*	31,9	32,1	4,5	8,9	1,9	13,8	2,0	7,1	esculentus	y	green	spotted	n	y	grey

106	*P. lessonae*	24,4	24,6	4,3	6,1	2,2	12,3	1,4	5,7	semicircle	y	lemongreen	white	y	y	white
107	*P.* kl. *esculentus*	27,6	27,8	4	6,9	1,9	13,4	1,7	6,9	esculentus	y	green	bright spots	n	n	-
108	*P.* kl. *esculentus*	30,1	28,9	3,7	8,1	1,9	15,7	2,2	8,1	esculentus	y	green	spotted	n	y	grey
109	*P.* kl. *esculentus*	28,7	28,7	3,5	7,5	1,9	15,8	2,1	8,2	esculentus	y	green-brownish	some spots	n	y	grey
110	*P.* kl. *esculentus*	14,3	14,6	1,9	3,7	2,1	15,8	1,9	7,5	esculentus	y	green	white	n	n	-
111	*P. ridibundus*	45	45	4,3	11,7	2,0	20,9	2,7	10,5	cylindrical	n	olive	spotted	n	y	grey
112	*P. ridibundus*	48,2	49,3	4,9	12	1,9	18,4	2,4	9,8	cylindrical	n	brown	spotted	n	y	grey
113	*P.* kl. *esculentus*	40,9	39,8	5,6	11,5	2,0	14,6	2,1	7,3	esculentus	y	green	spotted	n	y	light grey
114	*P.* kl. *esculentus*	39,5	39,2	5,5	10,6	2,1	15,2	1,9	7,2	esculentus	y	green	some spots	n	y	light grey
115	*P. ridibundus*	47,4	49,1	4,8	11,4	1,8	18,0	2,4	9,9	cylindrical	y	olive-green	spotted	n	y	grey
116	*P. ridibundus*	49,3	48,1	4,4	10,8	1,9	20,8	2,5	11,2	undefined	y	olive to brown	spotted	n	y	grey
117	*P. ridibundus*	48,8	49,7	4,8	11,2	1,9	19,0	2,3	10,2	cylindrical	y	olive-green	spotted	n	y	grey
118	*P.* kl. *esculentus*	41,1	40,8	5,1	10,3	2,0	15,8	2,0	8,1	esculentus	y	green	spotted	y	y	light grey
119	*P.* kl. *esculentus*	34,2	35,3	4,6	9,7	2,0	15,0	2,1	7,4	esculentus	y	green	spotted	y	y	light grey
120	*P. ridibundus*	49,9	50,3	5	12,7	1,9	19,3	2,5	10,0	cylindrical	n	brown	spotted	n	y	grey
121	*P. ridibundus*	45	44	4	11,1	1,7	19,0	2,8	11,3	kurz, aber cyli	y	brown	spotted	n	n	-
122	*P. ridibundus*	45,8	45,6	4,8	11,7	1,9	18,2	2,4	9,5	kurz, mit Erhe	y	brown	spotted	n	y	grey
123	*P. ridibundus*	47,9	47,5	4,1	12,7	1,9	22,6	3,1	11,7	cylindrical	n	olive	spotted	n	y	grey
124	*P. ridibundus*	48,1	48,1	4,8	11,8	2,0	19,9	2,5	10,0	cylindrical	y	olive-green	spotted	n	y	grey
125	*P.* kl. *esculentus*	34,7	34,8	5	8,3	2,0	13,9	1,7	6,9	esculentus	y	green	some spots	y	y	white
126	*P.* kl. *esculentus*	40,3	41,1	5,5	10,1	2,0	14,4	1,8	7,3	esculentus	y	green	spotted	y	y	light grey
127	*P.* kl. *esculentus*	36,7	36,3	4,9	10,1	2,0	15,1	2,1	7,5	esculentus	y	green	spotted	n	y	almost whit
128	*P. ridibundus*	49,7	49,3	4,9	12,1	1,8	18,3	2,5	10,1	cylindrical	y	brown	spotted	n	y	grey
129	*P. ridibundus*	56,9	56,7	5,2	14,6	1,8	19,8	2,8	10,9	cylindrical	n	olive-brown	spotted	n	n	-
130	*P.* kl. *esculentus*	34,9	34,6	4,2	8,2	1,9	15,5	2,0	8,3	esculentus	y	green	some spots	y	y	light grey
131	*P.* kl. *esculentus*	27,9	27,9	3,6	7,4	2,0	15,6	2,1	7,8	semicircle	y	green	white	y	n	-
132	*P.* kl. *esculentus*	21,4	21,3	2,3	5,1	1,8	17,1	2,2	9,3	esculentus	n	brown	some spots	n	n	-
133	*P.* kl. *esculentus*	18,6	18,8	2,3	4,8	2,1	16,7	2,1	8,1	semicircle	y	green	white	y	n	-
134	*P.* kl. *esculentus*	18,6	18,9	2,5	5,1	1,9	14,4	2,0	7,4	esculentus	y	green	some spots	y	n	-
135	*P. ridibundus*	46,9	47	4,6	10,8	1,7	17,7	2,3	10,2	cylindrical	y	olive	spotted	n	n	grey
136	*P. ridibundus*	56,5	54,7	5,6	14,4	1,8	18,3	2,6	10,1	cylindrical	n	brown	spotted	n	n	-
137	*P. ridibundus*	45,9	45,4	4,4	14,1	1,9	19,7	3,2	10,4	cylindrical	n	brown	spotted	n	y	grey
138	*P. ridibundus*	47,5	46,2	5,3	12,8	1,8	15,9	2,4	9,0	cylindrical	y	brown	spotted	n	y	grey
139	*P. ridibundus*	45,2	44,7	4,5	12,2	1,9	18,7	2,7	10,0	cylindrical	y	olive-green	some spots	n	y	light grey
140	*P.* kl. *esculentus*	22,4	22,2	2,5	5,6	2,0	18,0	2,2	9,0	esculentus	y	green	white	y	n	-
141	*P.* kl. *esculentus*	40	39,8	4,2	11,2	1,8	16,9	2,7	9,5	cylindrical	n	green	white	n	y	light grey
142	*P.* kl. *esculentus*	43	42,9	5,3	10,8	1,8	14,4	2,0	8,1	cylindrical	y	brown	spotted	n	y	grey
143	*P.* kl. *esculentus*	38,6	38,2	4,5	9,9	1,7	15,0	2,2	8,6	cylindrical	n	olive-green	some spots	n	n	light grey
144	*P. ridibundus*	42,9	41,8	4,4	10,1	1,7	16,8	2,3	9,8	cylindrical	n	green-olive	some spots	n	n	grey
145	*P. ridibundus*	34,6	34,6	3,5	9,6	1,8	18,1	2,7	9,9	cylindrical	n	brown	some spots	n	n	grey
146	*P.* ridibundus	26,8	26,7	2,9	7,2	1,8	16,6	2,5	9,2	cylindrical	n	brown	some spots	n	n	-
147	*P.* kl. *esculentus*	22,7	22,2	2,6	6,7	1,8	16,0	2,6	8,7	in between	n	green	white	n	n	-
148	*P.* kl. *esculentus*	21,1	21,5	2,5	6	1,8	15,5	2,4	8,4	cylindrical	n	olive	almost white	n	n	-
149	*P.* kl. *esculentus*	17,2	17,6	1,9	4,7	1,8	15,9	2,5	9,1	esculentus	y	green	white	n	n	-
150	*P. ridibundus*	20	20,2	2,1	5,4	1,9	18,1	2,6	9,5	cylindrical	n	olive	white	n	n	-
151	*P.* kl. *esculentus*	49,9	49,1	5,5	12,2	1,8	16,2	2,2	9,1	cylindrical	n	green	strong spotted	n	y	light grey
152	*P. ridibundus*	43,2	43,2	4,4	11,2	2,1	20,3	2,5	9,8	cylindrical	n	green	some spots	n	n	-
153	*P. ridibundus*	46,7	45,7	4,8	11,6	1,9	18,5	2,4	9,7	cylindrical	n	brown	spotted	n	y	grey
154	*P. ridibundus*	52,1	52,7	5,8	13,7	2,0	17,6	2,4	9,0	cylindrical	y	green	some spots	n	n	-
155	*P. ridibundus*	45,7	45,2	4,9	12,1	2,0	18,8	2,5	9,3	cylindrical	n	brown	spotted	n	n	-
156	*P. ridibundus*	50,1	49,8	4,9	12,9	2,0	20,3	2,6	10,2	cylindrical	n	olive	spotted	n	y	grey
157	*P. ridibundus*	44,9	44,9	4,7	9,8	1,8	17,5	2,1	9,6	cylindrical	n	green	strong spotted	n	y	grey
158	*P. ridibundus*	35,3	35,1	3,9	9	1,8	16,5	2,3	9,1	cylindrical	y	green	some spots	n	n	light grey
159	*P.* kl. *esculentus*	44,7	44,9	5	10,2	1,9	17,3	2,0	8,9	esculentus	n	green	spotted	n	n	-
160	*P. ridibundus*	52,9	52,6	5,5	13,2	1,7	16,5	2,4	9,6	cylindrical	n	green	spotted	n	n	-
161	*P. lessonae*	25,6	25,6	4,1	6,2	2,3	14,4	1,5	6,2	esculentus	y	green	spotted	y	n	-
162	*P.* kl. *esculentus*	36	36	4,7	8,7	2,1	15,7	1,9	7,7	esculentus	y	green	some spots	y	n	-
163	*P. lessonae*	23,3	23,8	3,5	5,3	2,1	13,9	1,5	6,7	semicircle	y	lemongreen	white	y	y	white

164	*P. lessonae*	22,2	21,4	3,9	6	2,1	11,8	1,5	5,7	semicircle	y	green	white	y	y	white
165	*P. lessonae*	23,7	23,5	3,8	6	1,9	12,1	1,6	6,2	semicircle	y	lemongreen	white	y	y	white
166	*P. lessonae*	22,9	22,6	3,6	6,3	2,1	13,4	1,8	6,4	semicircle	y	grasgreen	white	y	y	white
167	*P. kl. esculentus*	26,4	26,5	3,4	6,3	1,9	15,1	1,9	7,8	esculentus	y	green	some spots	y	y	light grey
168	*P. lessonae*	25,2	25,3	4,1	6,3	2,2	13,3	1,5	6,1	semicircle	y	green	some spots	y	y	light grey
169	*P. kl. esculentus*	33,5	33,8	4,4	8,4	2,1	15,9	1,9	7,6	esculentus	y	green	light spotted	y	n	-
170	*P. lessonae*	24,5	24,3	4,2	6,7	2,1	12,3	1,6	5,8	semicircle	y	lemongreen	white	y	y	white
171	*P. lessonae*	24,5	24,9	3,8	7,4	2,2	13,9	1,9	6,4	semicircle	y	green	spotted	y	y	white
172	*P. lessonae*	22,5	22,3	3,9	5,4	2,1	11,8	1,4	5,8	semicircle	y	lemongreen	white	y	y	white
173	*P. kl. esculentus*	41,9	41,3	4,3	9,4	2,0	19,2	2,2	9,7	esculentus	y	green	spotted	n	n	-
174	*P. kl. esculentus*	39,1	38,1	5,4	9,3	2,0	14,8	1,7	7,2	esculentus	y	green	light spotted	y	n	-
175	*P. lessonae*	25,1	25	4,4	6,4	2,1	12,1	1,5	5,7	semicircle	n	green	some spots	y	y	white
176	*P. kl. esculentus*	13,1	13,3	1,6	3,5	2,0	16,7	2,2	8,2	esculentus	y	green	white	n	n	-
177	*P. kl. esculentus*	34,6	33,7	4,1	9,2	2,2	18,2	2,2	8,4	esculentus	y	green	light spotted	n	y	light grey
178	*P. kl. esculentus*	38,4	38,3	4,3	9,6	2,0	17,6	2,2	8,9	esculentus	y	green	light spotted	n	y	light grey
179	*P. kl. esculentus*	36,3	36,6	4,7	9,3	1,9	15,0	2,0	7,7	esculentus	y	green	spotted	y	y	light grey
180	*P. kl. esculentus*	37,4	37,6	4,5	10,1	2,0	16,5	2,2	8,3	cylindrical	y	olive	spotted	n	y	light grey
181	*P. kl. esculentus*	34,4	33,8	4,8	9	2,2	15,6	1,9	7,2	esculentus	y	green	light spotted	n	y	light grey
182	*P. kl. esculentus*	36,9	36,9	4,7	9,7	2,0	15,6	2,1	7,9	esculentus	y	green	spotted	y	y	light grey
183	*P. kl. esculentus*	36,8	37,3	4,5	9,1	1,9	15,8	2,0	8,2	esculentus	y	green	light spotted	y	n	light grey
184	*P. lessonae*	28,4	28,6	4,4	7,3	2,2	14,0	1,7	6,5	semicircle	y	green	spotted	y	n	-
185	*P. kl. esculentus*	33,5	33,4	4,2	7,9	1,8	14,3	1,9	8,0	esculentus	y	green	light spotted	y	n	light grey
186	*P. kl. esculentus*	33,1	32,3	4,6	8,4	1,9	13,8	1,8	7,2	esculentus	y	green	spotted	y	n	light grey
187	*P. kl. esculentus*	35,2	34,8	4,8	8,9	1,9	13,6	1,9	7,3	esculentus	y	green	light spotted	y	n	light grey
188	*P. kl. esculentus*	40,4	40,2	5,2	9,8	2,1	16,0	1,9	7,8	esculentus	y	green	almost white	y	n	-
189	*P. kl. esculentus*	32,1	31,7	4	7,8	1,9	15,4	2,0	8,0	esculentus	y	green	light spotted	y	n	light grey
190	*P. lessonae*	27,9	27,3	4,3	7,2	2,1	13,6	1,7	6,5	semicircle	y	green	light spotted	y	n	white
191	*P. lessonae*	26,2	26	4,2	7,3	2,3	14,6	1,7	6,2	semicircle	y	green	light spotted	y	n	-
192	*P. lessonae*	28	27,4	4,5	7,3	2,1	12,8	1,6	6,2	semicircle	y	green	light spotted	y	n	white
193	*P. lessonae*	29,7	29,2	4,7	7,5	2,1	13,4	1,6	6,3	semicircle	y	green	light spotted	y	n	-
194	*P. lessonae*	26,9	27,3	4,3	6,7	2,1	13,4	1,6	6,3	semicircle	y	green	light spotted	y	n	-
195	*P. lessonae*	27,4	27,2	4,4	7,5	2,1	13,4	1,7	6,2	semicircle	y	green	light spotted	y	n	white
196	*P. lessonae*	28	28,3	4,7	7	2,2	13,3	1,5	6,0	semicircle	y	green	light spotted	y	n	-
197	*P. lessonae*	28,7	28,9	4,9	6,9	2,0	11,8	1,4	5,9	semicircle	y	green	white	y	n	white
198	*P. kl. esculentus*	30,6	30,9	4,1	7,9	1,9	14,5	1,9	7,5	esculentus	y	green	light spotted	y	n	light grey
199	*P. lessonae*	26,6	27,6	4,7	6,5	2,2	12,6	1,4	5,7	semicircle	y	green	white	y	n	white
200	*P. kl. esculentus*	34,2	34,4	4,2	8,4	2,0	16,6	2,0	8,1	esculentus	y	green	light spotted	y	n	-