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Selected growth and development traits of the Zebra Finch (*Poephila guttata*) nestlings in amateur breeding

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The following traits of Zebra Finch nestlings were considered: body weight, body length, plumage development stages, wing-formula and length of wing, beak, tail and primary remiges. The study was conducted on 12 nestlings obtained from parents of different colour varieties. Observations were conducted from hatching to week 12 of age, *i.e.* when the nestlings' plumage was already typical of the adult birds. During the research period 47 eggs were obtained, from which 16 nestlings were hatched. The highest number of clutches was noted in the summer and autumn months. The values obtained for zoometric traits, indicate that nestlings maintained in captivity, compared to those living in natural conditions, showed a higher growth rate as well as a quicker plumage development. In a majority of birds the length of the body, wing, primary remiges and beak reached adult dimensions in week 7 of life, while body weight and tail length - in week 8. In turn, on the basis of morphological changes, it proved possible to determine in what order individual traits appear, to determine the sex and age of birds and to determine the plumage type and the wing formula.

KEY WORDS: nestling / plumage / wing formula / Zebra Finch (*Poephila guttata*).

The Zebra Finch (*Poephila guttata, Steganopleura guttata, Amadina castanotis*) belongs to the order *Passeriformes*, suborder *Oscines* and family *Estrildidae*, represented by about 125 species [Keast 1958, Perrins 1993, Jabłoński 1998].

The adult bird of the standard wild type is about 10 cm high and weighs about 11 g [Jabłoński 1998]. Young birds show a grey plumage, black beak and light orange legs with pink claws. During weeks 4-5 of life first appear such typical traits of adults as red stain on the cheeks, throat and fore-neck grey barred with black, and upper tail-coverts black with broad bars of white [Pogodała 1991].

Similarly as most passerinae, the Zebra Finch reaches sexual maturity very early and at the age of 4 months is ready for reproduction [Jabłoński 1998]. The egg-laying ability is very high. The female lays usually four to six white eggs, rarely 12, weighing about 1.09 g each (1.51 cm long and 1.14 cm wide). The incubation lasts 12-16 days [Jabłoński 1998] and the nestlings hatched are about 3 cm long, covered with a pink skin and white down. They are blind with auditory foramens closed, but they do hear from birth and the sounds they make are very quiet and undistinguishable for humans [Ferens and Wojtusiak 1960]. The first three days after hatching decide whether the bird will survive or not. According to Zann [1996], on the day of hatching the nestling's crop is empty as the parents do not feed it until the next day. To draw the attention of their parents the nestlings make movements with their heads and necks simultaneously issuing thin squeaks. A similar role is played by the colouring of the inside of the beak and white-pigmented flange forms, which when touched result in a wide gape opening, due to the Herbst tactile corpuscles there located. All the adaptations listed are known as nestling indicators [Ferens and Wojtusiak 1960].

In Polish publications only general remarks about the breeding of Zebra Finches may be found [Pogodała 1991, Jabłoński 1998]. However, the ontogenesis has been described in detail by numerous foreign authors, e.g. Immelmann [1962] and Zann [1996]. The latter studied not only the development of young, wild Zebra Finches, but also the morphologic changes connected with the correctness and speed in the plumage change of the nestlings. Also, a majority of the growth indicators was recorded for the Zebra Finch living in natural conditions [Rozman *et al.* 2003], as well as in domesticated birds [Sossinka 1970, 1972b, 1980a, Burley 1986c, Boag 1987, Skagen 1988, Lemon 1993]. Work has been conducted on the seasonal changes in body and fat weight in the Zebra Finch from south-east Australia [Rozman *et al.* 2003], while in domesticated birds an analysis was made of the effect of the quality and quantity of diet on the growth rate of most morphological characters [Zann 1996]. Sossinka [1980b] studied also the sexual maturing of the Zebra Finch and observed that most birds reach sexual maturity at the age of 2-2.5 months and that the females mature more slowly than do males. In turn Lemon [1993] recorded the changing energy requirements of nestlings, from the day of hatching until the moment their thermoregulation is stabilized.

The growth of young birds examined biometrically, renders it possible to define the age of nestlings of a given species with considerable precision, irrespectively of the nest and conditions from which they originate [Juillard 1978]. The methods of determining the age of nestlings were described for individual species [e.g. Kania 1983, 1988, Eriksson *et al.* 1984] and groups of species with a similar growth rate, e.g. *Passeriformes* birds – Malĉevskij [1959], Bieme [1972] – cited after Kania [2001].

Zebra Finches have emerged as one of the top few avian species used as models for biomedical research. The great news of the U.S. National Human Genome Research Institute (NHGRI) is proposal for construction of a BAC library of the genome of the Zebra Finch (*Taeniopygia guttata*). The access to the Zebra Finch genome would reveal the strength and power of comparative genomics. Specifically, the possibility to align and compare the Zebra Finch and chicken genomes will allow the identification of genetic characteristics underlying traits common to different birds but also to uncover the genetic background to traits that differ among birds. A full genome sequences would allow us to immediately pinpoint genes underlying variation in phenotypes such as bill colour, plumage traits, song differences between species and, indeed, speciation itself [Arnold and Clayton 2005].

Despite numerous elaborations still no answers have been found to several more detailed, though important questions, referring to the growth and development of the Zebra Finch nestlings. Obtaining those answers would help avoid errors in breeding and thus obtain birds of a higher quality. For this reason, the principal goal of the present work was to elaborate a model for the growth and development of the Australian Zebra Finch nestlings, which would include among much else morphological changes, sex and age distribution and zoometric traits such as live body weight, length of body, and length of wing, primary remiges, tail and beak.

Material and methods

The studies were conducted on 12 out of 16 nestlings, that survived after hatching from eggs laid in five nests of the Zebra Finch from a private amateur aviary. A nest consisted of a pair of adult unrelated birds of standard size (10 cm in body length and 2.5 cm in height) and in several colour varieties: fawn, standard grey and penguin. The colour of the parents and crossing results are presented in Table 1.

Table 1. Results of mating the Zebra Finch

Nest number	Number of nestling	Colour varieties			
		parents		nestlings	
		male	female	male	female
I	1	standard	fawn	fawn	
I	2				fawn
II	3	penguin	standard	standard	
II	4				fawn
III	5	standard	penguin		fawn
III	6				fawn
III	7				fawn
IV	8	standard	fawn	standard	
IV	9				fawn
IV	10			standard	
IV	11				fawn
V	12	standard	standard	standard	

Observation of nestlings was conducted between 27 March 2002 and 18 February 2003. For the first four weeks, when the greatest number of conformation changes occurred the observations were conducted daily. Next, every 5 days until week 12 of life, *i.e.* until the birds show an adult plumage.

The measurements were made under home conditions at the same time of day. All birds were maintained in a room in which the temperature, humidity and light depended to a considerable degree of the weather conditions. The exceptions were March, April, October and November, when the temperature was maintained at about 22°C (room temperature). Beside changes in the macroclimate during spring, summer and autumn records were made of the number of eggs laid and nestlings hatched in subsequent hatchings (Tab. 2).

Table 2. The relation between the number of clutches, eggs and nestlings and the weather parametres during three seasons of the year

Year 2002		Number of			Mean range (min.-max.)			
season	month	clutch	eggs	nestlings	temp. (c°)	relative humidity (%)	precipitation (mm)	day length (h, min)
Spring	March April May	1	5	2	17.0-22*	62-68	18.3-33.2	12.52-16.42
Summer	June July August	4	17	5	17.8-21.6	66-71	18.7-31.8	15.41-17.42
Autumn	September October November	5	25	9	13.0-22*	75-86	22.9-92.9	9.48-13.40

*Temperature inside the room.

Hatching was performed in bamboo type nests in cages meeting the requirements for size and equipment. The birds were fed a ready-made feed for exotic birds (composed of millet, canary seed, linseed, hempseed and the like) and a prepared every day egg mixture, necessary during the hatching period.

The following six parametres (traits) were recorded for each nestling: live body weight, body length, maximum wing length, length of primary remiges, length of tail and beak. The traits were measured according to classical methods described by Busse [1990], using electronic weighing scales, ruler and slide calliper.

Simultaneously with the recording of zoometric traits changes in morphology were observed (Tab. 4).

In order to describe the plumage (characteristic for the given age group) and determine the moulting time the tips of remiges and rectrices were colour marked. With the loss of feathers it was possible to observe lacks in coloured markings. The identification of individual plumage was based on the detailed description of changes in feathers presented by Busse [1990] for *Passeriformes*.

Table 3. Feather development stages in *passerinae* nestlings [Kania 2001]

Subject of control (1)	Features of the stage (2)	Stage (3)
Body feathers of nestling dorsal side (remiges and rectrices excluded, femoral tract included)	Dark papillae of the upper body feathers invisible (papillae of the remiges can be seen as deep, dark spots)	A
	Papillae of the upper body feathers visible as dark dots or strokes under skin surface. Pins (excluding ones of the remiges and rectrices) do not protrude out of skin.	B
	At least some pins of the body feathers protrude out of skin (at the beginning they can be seen as delicate pricks, easy to overlook in bad lighting). All pins of remiges without visible vanes (bushes) but can be open.	C
Remiges without dwarf outer primary and three inner secondaries ('tertials')	At least some remiges with visible vanes but no remiges with vanes equal or longer than ¼ remex*	D
	Vanes of at least some remiges equal or longer than ¼ remex, but no remiges with vanes equal or longer than ½ of remex*	E
	Vanes of some but not all remiges equal or longer than ½ of remex*	F
	Vanes of all remiges equal or longer than ½ of remex*	G

*Length of remex at the time of observation (not length of full-grown remex) from the surface of the skin to the top of the feather.

During the daily control of young Zebra Finches and using as a model the plumage development stages elaborated by Kania [2001] for *Passeriformes* (Tab. 3) subsequent stages of plumage development in nestlings were identified (Tab. 5).

The plumage development was analysed on the basis of the growth of primary and secondary remiges and the ratio between the vane length and the part of feather visible above the skin surface. Letters were used (from A to G) to indicate the degree of plumage development [Kania 2001]. As the variation within groups of the growth rate of nestlings meant that individual trait values corresponded usually to more than one one-day age class, every day of life was assigned a modal trait value. In this way an exemplary model of plumage development was obtained for the species considered (in Table 5 shown in italics).

Table 4. A comparison of literature data on the development of domesticated Zebra Finches (a and b) with those obtained in the present study.

Trait or symptom examined	Time of occurrence (day/week) reference a	reference b	this study
	day		
1. Nestlings are covered with pink skin and white down	1	1	1
2. The external auditory foramens are closed	–*	–*	1
3. The nestlings squeak, wings become darker, beak is a light-corn in colour	3	3	3-4
4. The germs of primary remiges appear, a day later the germs of secondary remiges	–*	–*	6-7
5. Auditory foramens are open	–*	–*	7
6. The young are almost continuously warmed by the parents, latter their thermoregulation stabilizes	–*	to 6-8	–*
7. The eyes begin to open (at this moment their heads are turned towards the entrance to the nest)	8	8	7-10
8. The tail rectrices appear	9	9	8
9. The vanes become visible on:			
remiges	–*	–*	9
rectrices	–*	–*	12
10. The colour of the beak turns black	10-12	to 14	to 14
11. A teardrop appears under the eye and upper tail-coverts black with broad bars of white (traits characteristic for both sexes)	–*	–*	16
12. No flight reflex.	–*	to 15-18	to 17-20
13. The young left the nest in complete plumage.	21	21	19
	week		
14. The birds are themselves (they eat on their own), the colour of the beak changes to orange. It is possible to determine the sex as the plumage takes on traits typical of adult birds – males show orange markings on the cheeks, throat and fore-neck grey barred with black, and chestnut, while spotted feathers on the sides of the body.	–*	5	4-5
15. Young males try to sing	–*	–*	5
16. No white-pigmented flange forms outside around the beak angle	–*	–*	8
17. Plumage described as juvenal	8	–*	7-8
18. The beak turns red.	9-10	9-10	9-10
19. The birds show an adult plumage.	–*	12-14	12-14

a – Immelmann [1982]; b – Jabłoński [1998].
*not studied.

When all the nestlings (16 birds of different sex and age) reached a maximum wing length a quantitative wing formula was elaborated, containing the measurements of the distance between the tips of primary remiges (2 to 8) and the wing end (Tab. 6).

As a majority of Zebra Finch nestlings were moulting before measuring, the remiges were examined and those forming the end of the wing, in relation to which the remaining remiges were measured were wrote the formula down. A formula registration was presented in a worded form (what is known as dictated formulas) and

Table 5. Plumage development stages in the domesticated Zebra Finch, determined daily in 5 nests. Day one of life = day of hatching

Nest number*	Nestling number**	Hatching date	Day of life																				
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
I	1	17.05.02	A	A	A	A	B	B	C	C	C	D	D	D	D	E	E	F	F	G	G		
I	2	17.05.02	A	A	A	B	B	C	C	C	D	D	D	D	E	E	F	F	G	G			
II	3	04.06.02	A	A	A	B	B	C	C	C	D	D	D	E	E	E	F	G	G	G			
II	4	05.06.02	A	A	A	B	B	C	C	C	D	D	D	E	E	E	F	F	F	G	G		
III	5	04.06.02	A	A	A	B	B	C	C	C	D	D	D	E	E	F	F	G	G				
III	6	29.10.02	A	A	A	B	B	B	C	C	C	D	D	D	E	E	F	F	G	G			
III	7	29.10.02	A	A	A	B	B	C	C	C	D	D	D	E	E	F	F	G	G				
IV	8	03.11.02	**A**	**A**	**A**	**A**	**A**	**A**	**B**	**B**	**B**	**B**	**C**	**C**	**C**	**D**	**E**	**E**	**F**	**F**	**F**	**G**	**G**
IV	9	26.11.02	A	A	A	B	B	C	C	C	D	D	D	D	D	E	E	F	F	G	G		
IV	10	26.11.02	A	A	A	B	B	C	C	C	D	D	D	D	E	E	F	F	G				
IV	11	27.11.02	A	A	A	B	B	B	C	C	C	D	D	D	D	E	F	F	F	G	G		
V	12	28.11.02	A	A	A	B	B	C	C	C	C	C	D	D	D	E	E	F	F	G	G		
Modal value[4]		Stage	*A*	*A*	*A*	*B*	*B*	*C*	*C*	*C*	*D*	*D*	*D*	*D*	*E*	*E*	*F*	*F*	*F/G*	*G*	*G*		
		(%)	100	100	100	83	92	67	92	92	58	83	92	58	58	75	67	67	50	67	42		

*Nest number, indicating also the nestling's parents.
**Four nestlings were rejected as they died during the first 10 days of life.
Bold letters – nestling with a clearly lower plumage development.
[4]Modal value – the most often repeating value.

Table 6. A quantitative wing formula of a zebra finch

Bird's number*	1	2	3	5	6	7	9	10	11	12	a	b	c	d	E	f		
Sex	♂	♀	♂	♀	♀	♀	♀	♂	♀	♂	♂	♀	♂	♂	♀	♂		
Maximum wing length	5.7	5.7	5.7	5.8	5.7	5.5	5.6	5.7	5.6	5.6	5.5	5.8	5.6	5.7	5.4	5.7	Modal value[5]	
Mean wing length	5.6																	
Remige number	Distance between wing tip and tips of remiges (mm)**																(mm)	(%)
2	3	1	2	1	1	1	1	u	1	1	3	1	1	1	2	u	1 (b)	62
3	0	0	u	1	1	0	0	0	u	0	0	0	0	0	0	4	0 (a)	69
4	0	1	0	0	0	0	0	u	0	u	u	u	1	0	0	0	0 (a)	62
5	1	3	1	3	1	2	3	1	1	3	1	1	2	1	1	4	1 (c)	56
6	4	7	4	5	3	4	4	4	3	4	3	3	4	3	2	6	4 (c)	44
7	7	8	7	7	7	7	6	5	6	6	5	6	7	7	5	8	7 (c)	44
8	9	10	9	9	9	9	8	7	8	u	8	8	10	9	8	9	9 (c)	44

*Marked with numbers – young birds with a maximum wing length.
Marked with letters – parental birds.
* * u – damaged remiges
(a) – wing tip, (b) – distal remige, (c) – proximal remiges
[5]Modal value – the most often repeating value.

Table 7. Wing formula

(a)	(b)					
3 4	1					
	1	4	7	9		

(c)

(a) – wing tip
(b) – distal remige
(c) – proximal remiges

in a table for selection and further elaboration of the material (Tab. 7). Column (a) presents the numbers of the longest remiges while the remaining columns (b and c) the distances between them.

Results and discussion

During the period of observations 47 eggs were obtained from which 16 nestlings were hatched (fawn and standard grey). The observations indicate that such low (34%) hatching results could be caused by incorrect environmental conditions (too low temperature or humidity) or by a low hatching ability of the given pair. The number of eggs in a clutch ranged from 3 to 6, while the number of nestlings from 1 to 2.

Under natural conditions the hatching season of the Zebra Finch comes during the greatest praecipitation – in Australia during the spring and autumn [Immelmann 1982]. In Poland, in year 2002 the greatest precipitation was observed during the summer and autumn (56 mm) with an optimum temperature of about 19^{o}C and relative humidity of about 75% (Tab. 2).

There seems to be a relation between the number of hatchings and the weather conditions during the summer and autumn. Each time it rained outside the birds bathed in an artificial pool and the subsequent hatching indicators were higher. For this reason the results presented in Table 2 could confirm the relation between the precipitation and hatching (similarly as in the case of Australian Zebra Finch). It was also observed that the length of the day had no significant effect on hatching.

Considerable variation was observed in daily body weight gain (figures not tabulated). The mean weight of nestlings on the day of hatching amounted to 0.89 g. Over the first two days of life the increase in body weight was the lowest because, according to Zann [1996] the parents do not feed their young at that time as they still use nutrients from their yolk sack. Between day 3 and 14 of life the body weight increase was very intensive (mean daily weight gain reached 0.83 g) and on day 14 amounted to a mean of 10.80 g (5 times the weight on day 3). Subsequently, the growth rate decreased. This could result from the energy requirement decreasing with the growth of the plumage when the thermoregulation of the Zebra Finch stabilized (the parents spent less time to feed and to warm their young up). Feathers are most important to minimize the energy cost of temperature regulation. During the fourth week of age a majority of birds reached a body weight of an adult individual, *i.e*. about 13 g. After day 29 of life considerable differences in body weight were observed (figures not tabulated) arising from the nestlings' self-feeding. Zann [1996] reports that the nestlings of domesticated zebra finch weigh on the average about 0.6-0.9 g. on the day of hatching. During the first 10 days the birds gain about 0.66 g per day. On day 7 of life they weigh 4.6 g., on day 12 – 8.0 g, and 9-10 g after reaching the full plumage growth. In the present study the growth rate obtained until day 7 of life (figures not tabulated) was comparable with that cited in literature [Immelmann 1982, Zann 1996, Jabłoński 1998], but subsequently it was about 1 g higher.

On the day of hatching the body length of the nestlings (figures not tabulated) reached a mean of 2.8 cm and the subsequent increase was regular. On week 9 of life the birds were 10.4 cm. long what is close to the maximum length reaching 11.0 cm.

On the day of hatching the mean length of the nestlings' wings amounted to 4 mm (figures not tabulated) Initially the growth rate was very slow as the daily increase in length amounted to only 1 mm. On day 6 of life the length of the wings increased much faster, what may be related to the appearance of primary remiges. On day 9 of life the increase in wing length was even greater, as it was four times that observed at the beginning. This in turn was caused by the vanes, growing from feather shafts. Young zebra finches at the age of 21 days were already in full plumage, but a wing size characteristic for adult birds was not reached until day 54.

The development of primary remiges (Tab. 5) was very similar to that of the wing. Thin hairs preceded the first pins which broke through the skin on day 6 of life. Until day 10 of life the length of the remiges increased by 7 mm. From day 9, when the feather vanes started to show, the nestlings demonstrated a more intensive growth of remiges – on day 18 the remiges were 3.5 cm long and two weeks later already 4.7 cm. According to Zann [1996] the remiges of wild Zebra Finches grow daily 3 mm between day 6 and 10 of life and next, till day 18, also about 3 mm/day. The first vanes appear about day 11 of life. The results obtained indicate that in the case of the Zebra Finches living in captivity the growth of remiges is much faster than in those living at large. It seems that the latter birds may be more affected by unfavourable environmental conditions (e.g. lack of feed) which may limit the growth of remiges. One should also consider the fact that the wild Zebra Finches are differently determined genetically than are the domesticated birds. Similar differences were observed in the growth of rectrices (Tab. 4) – in birds leaving the nest their length reached 3.8 cm.

During the 12 weeks of measurements also the beak length of nestlings was recorded On the day of hatching the beak of a majority of nestlings was about 2.8 mm long. The beak of an adult Zebra Finch measured on the average about 1 cm, while the maximum length recorded was 1.07 cm (figures not tabulated).

With the growth of nestlings also morphological changes were detected in order to determine the way of feathering of the Zebra Finch, as well as the sequence and order in which various traits appear indicating the bird's age and sex. On the day of hatching the nestlings had tufts of down feathers on the head, back, shoulders and thighs. First, thin hairs appeared in place of primary and secondary remiges, next the final feathers (pins with appearing vanes) and then covering feathers which appeared simultaneously with the thin hairs of rectrice feathers. With the progressing feathering the down feathers were replaced by covering feathers. On individual parts of the body feathers appeared in the following order: wing, back, spine, chest, and belly, rectrices on the tail, thigh, head, and neck. Within each of these areas the order in which the feathers appeared was more or less fixed.

No differences were observed in the feathering rate between the two colour types observed. After about two weeks both standard and fawn nestlings showed grey or fawn feathers, respectively, without any markings of another colour. During the following week the birds were not yet in full plumage, in particular the bottom part of the wings, belly and chest were not fully covered by feathers. The upper tail-coverts black with broad bars of white, characteristic of the juvenile plumage, remained visible. With the progressing growth the colour of the feathers became clearer and in nestling of a given colour type different shades of grey and fawn could be observed. During the fourth week of life the stripes on the tail disappeared what may indicate a change from juvenile to a mixed immature plumage which, according to Busse [1990] appears in the *Passeriformes* after the partial juvenile plumage. During the fifth week the tails of nestlings again showed white-and-black stripes and dimorphic differences between males and females also became visible. The final plumage, described as adultus, the Zebra Finch attained during week 12 of life when after the remige feathering in week 8 the feathers became closer, with a more pronounced pigmentation and less delicate than during the juvenile stage. The developmental stages observed in the young domesticated Zebra Finches were in accordance with the descriptions found in literature [Immelmann 1982, Jabłoński 1998], what was shown in Table 4.

Similarity between the results obtained in the present study and those reported in the literature indicate a proper growth and development of the group of birds examined. In turn, changes earlier not described and presented here in Table 4, mark the time in which the given trait appears. Moreover, on the basis of most of the traits analysed it is possible to determine the sex and age of nestlings.The error should not exceed 1 week.

To be able to determine the age of nestlings more precisely and in a shorter time interval (before day 19 of life) Table 5 presents the stages of plumage development. The stages made it also possible to evaluate the rate of feathering for individual birds. An examplary model of plumage development (letters in italics), elaborated on the basis of stages, indicates that stages A and C usually lasted three days, stages B and E – two days, stage D – four days and stages F and G – two-three days. In practice this means that on day four of life a majority of birds had visible pins of cover feathers in the form of deep pricks. On day six the pins of some cover feathers broke through the skin, while the pins of remiges were visible but had no vanes, which were visible on the remiges on day nine – on at least 0.25 of the feather length. Already on day 12 of life the vanes were equal to or longer than 0.25, but still shorter than 0.5 of the feather length. On day 15 from some sheaths the vanes appeared on 0.5 or more than 0.5 of the feather length. On day 17 all vanes were half the length of the feather. Differences between nestlings in the appearance of a given trait were minimum and thus age estimation was possible with a precision of 2-3 days (four days in the case of stage D). In a majority of birds the plumage development occurred with a similar rapidity. The only exception was nestling no. 8 from nest IV (Tab. 5), which showed a clearly slower feather development. This may have been caused by the fact that the parents stopped feeding it – birds from this nest started sitting on eggs from the next clutch and stopped showing interest in the young, which died soon after feathering.

The wing formula (Tab. 6) showed not only the arrangement of remiges in Zebra Finch but also allowed for the registration of the occurrence of feathering in the species. After measuring the distance between the tips of primary remiges and wing tip a considerable variation was observed in the value of the formula obtained for individual birds (Tab. 6). The nestlings with this value for remiges 2 and 5 exceeding 1 mm and for remiges 3 and 4 (forming the wing tip) exceeding zero, were most probably undergoing a complete feathering or passing its final stage. The smaller was the difference between the value of the measured remige and the modal value for the given remige the closer was the given bird to gaining the final plumage. Basing on the formula elaborated (Tab. 7) it was stated that the Zebra Finches as a rule showed one distal remige, marked as no. 2, two longest remiges, marked as nos. 3 and 4 and four proximal remiges, marked as 5, 6, 7 and 8. Whereas writing of formula presented in Table 7 run the following: three to four, one-one, four, seven, nine. Three to four, or otherwise 3=4 means that the wing peak was formed by remiges 3 and 4, being of equal length. One-one means, that the distal and proximal remiges are equal while four, seven, nine means that the measurements obtained for proximal remiges did not correspond to any distal remiges.

The wing length analysed here was similar in the parental birds and nestlings had no significant effect on the value of the formula. Busse [1986] suggests that the value of the formula is closely related to the wing length and that data from the measurements of the quantitative wing formula may constitute a basis for studies on the adaptive value of the wing shape, differences between populations, and sexual and age dimorphism, studied in the present work as one of the elements of the growth and development of young, domesticated Zebra Finches.

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Wybrane cechy wzrostu i rozwoju młodych zeberek australijskich w hodowli amatorskiej

S t r e s z c z e n i e

Celem pracy było ustalenie wzorca wzrostu i rozwoju piskląt zeberki australijskiej (*Poephila guttata*) w hodowli amatorskiej. Określono masę i długość ciała, stadia rozwoju upierzenia i formułę skrzydła oraz długość skrzydła, dzioba, ogona i lotek I rzędu. Badania przeprowadzono na 12 pisklętach będących potomstwem ptaków o różnych odmianach barwnych. Obserwacje trwały od wyklucia do 12 tygodnia życia, w którym ptaki osiągnęły upierzenie dorosłego osobnika. W okresie badań uzyskano 47 jaj, z których wykluło się 16 piskląt (4 osobniki padły). Największą liczbę lęgów stwierdzono latem i jesienią. Wyniki pomiarów cech zoometrycznych, po odniesieniu do danych z piśmiennictwa wskazują, iż pisklęta żyjące w niewoli w porównaniu z żyjącymi dziko charakteryzowały się lepszymi przyrostami masy ciała oraz szybszym wzrostem piór. W przypadku większości osobników długość ciała, skrzydła, lotek I rzędu i dzioba osiągały wielkości charakterystyczne dla ptaków dorosłych już w siódmym tygodniu życia, podczas gdy masę ciała i długość ogona w tygodniu ósmym. Na podstawie zmian morfologicznych możliwe było ustalenie porządku pojawiania się różnych cech, oznaczenie płci i wieku ptaków, określenie szat oraz formuły skrzydła.