

VOCAL DEVELOPMENT VIA VOICE BREAKING IN THE RED-CROWNED CRANE GRUS JAPONENSIS

Anna V. Klenova¹, Ilya A. Volodin^{1,2}, Elena V. Volodina², Kirill A. Postelnykh³

¹ Lomonosov Moscow State University, Russia, klenova2002@mail.ru;

² Scientific Research Dept., Moscow Zoo, Russia volodinsvoc@gmail.com;

³ Oka Biosphere State Nature Reserve, Russia kirill_cbc@mail.ru



Introduction

Voice breaking is a process associated with puberty of human males and attends adolescence also in some birds. This phenomenon is well studied in humans, but still is poor studied in birds.

Purpose of this work is to study:

- when cranes start and complete voice breaking
- what voice shifts occurring along voice breaking
- relation of voice breaking with sex, date of birth and body weight.

Methods

Subjects: 61 red-crowned cranes.

Site of work: Oka Crane Breeding Centre (Ryazan region, Russia).

Call samples: 1) 1132 chirps and 811 trills for analysis of acoustic characteristics throughout the ontogenesis.
2) 24000 calls for analysis of onset, completion and the duration of voice breaking.

Body weight: independent sample of 11 red-crowned cranes.

Dates: 2003-2008.

Software: Avisoft SASLab Pro v. 4.3.

1. Acoustic characteristics of calls throughout ontogenesis.

During voice breaking, chirps and trills of both sexes contained two independent fundamental frequencies: the upper one (f_0), that was a retained juvenile frequency, and the lower one (g_0), that was a newly appeared adult frequency. Before voice breaking, calls contained the high frequency singly, while after voice breaking the low frequency singly. The f_0 and g_0 didn't overlap in frequency and were kept sustainable all over ontogenesis.

Figure 1. Spectrograms of chirps and trills recorded from red-crowned cranes throughout ontogenesis.

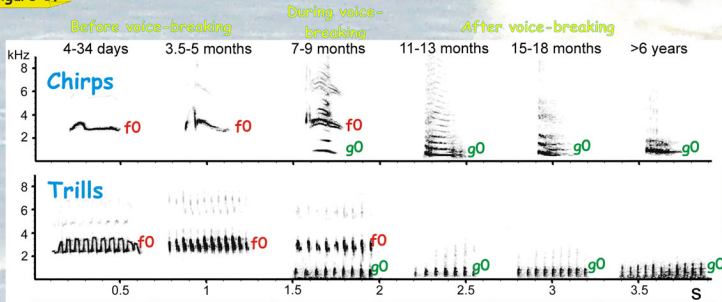


Figure 2. Spectrograms, power spectra and waveforms of chirps during voice breaking. A - two-frequency chirp with the long f_0 and a newly appeared short g_0 , one after another; B - two-frequency chirp with the f_0 and g_0 occurring simultaneously, that resulted in the appearance of linear combinatory frequency bands; C - two-frequency chirp with the short f_0 and the long g_0 , one after another. Arrows indicate parts of the calls from which the power spectra and waveforms were created.

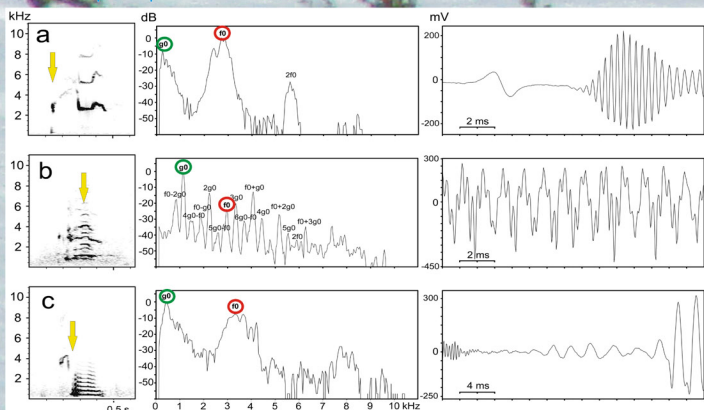


Table 1. Means±SD (min-max) of time and frequency parameters of chirps and trills of 61 studied red-crowned cranes at six ages and one-way ANOVA results for comparison between the ages.

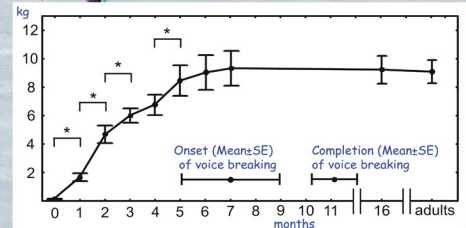
Vocal parameter	Ages / (n birds - n chirps) - (n birds - n trills)						ANOVA results
	4-34 days / (10-200) - (10-200)	3.5-5 months / (10-200) - (10-183)	7-9 months / (10-200) - (7-78)	11-13months / (7-140) - (7-104)	15-18months / (10-192) - (6-98)	over 6 years / (10-200) - (8-148)	
	high-frequency call		two-frequency call	low-frequency call			
Chirps							
Duration (ms)	334±43 (277-417)	341±51 (252-406)	245±58 (171-359)	161±35 (108-203)	144±25 (107-185)	125±23 (101-164)	F _{5,51} =52.7 p<0.001
f ₀ peak (kHz)	2.98±0.34 (2.38-3.62)	3.16±0.27 (2.70-3.51)	2.99±0.37 (2.50-3.64)				F _{2,27} =0.9 p=0.42
g ₀ peak (kHz)			0.76±0.10 (0.61-0.92)	0.64±0.12 (0.47-0.78)	0.60±0.12 (0.42-0.77)	0.71±0.11 (0.49-0.84)	F _{2,33} =3.9 p=0.018
Trills							
Duration (ms)	420±90 (294-615)	433±105 (338-619)	401±32 (357-442)	486±97 (367-640)	425±31 (381-474)	466±12 (338-653)	F _{5,51} =1.5 p=0.222
f ₀ peak (kHz)	2.78±0.19 (2.39-3.05)	3.24±0.35 (2.60-3.62)	2.96±0.37 (2.60-3.71)				F _{2,24} =5.1 p=0.015
g ₀ peak (kHz)		0.55±0.08 (0.47-0.67)	0.54±0.12 (0.35-0.69)	0.67±0.03 (0.63-0.70)	0.60±0.15 (0.41-0.83)	0.60±0.15 (0.41-0.83)	F _{3,32} =2.1 p=0.127

2. Onset, completion and duration of voice breaking.

Between individuals, the age of **onset** of voice breaking ranged from ages 3.5 to 11 months (Means±SD = 7.1±2), the age of **completion** ranged from ages 8.7 to 13.5 months (11.6±1) and the **duration** ranged from ages 1-8.5 months (4.6±2.1) between individuals. The onset of voice breaking coincided with achieving the adult body weight, while factors influencing on its completion were not evident with our data set. We didn't find any effect of sex on date of birth on the onset and completion of voice breaking (GLM, p>0.07 for all comparisons).

Figure 3.

Changing of body mass with age. Points - Means, whiskers - SE, * - significant differences (post-hoc Tukey test, p<0.05) between body mass in different ages.



Discussion.

Besides red-crowned crane jump-like vocal development was reported for some other bird species from different orders, but voice-breaking through two-frequency call stage wasn't still known for any of them.

Is this phenomenon unique for cranes?

Thank you for your interest!