

Acoustic monitoring of vocal rutting behaviour in ungulates using automated recording systems

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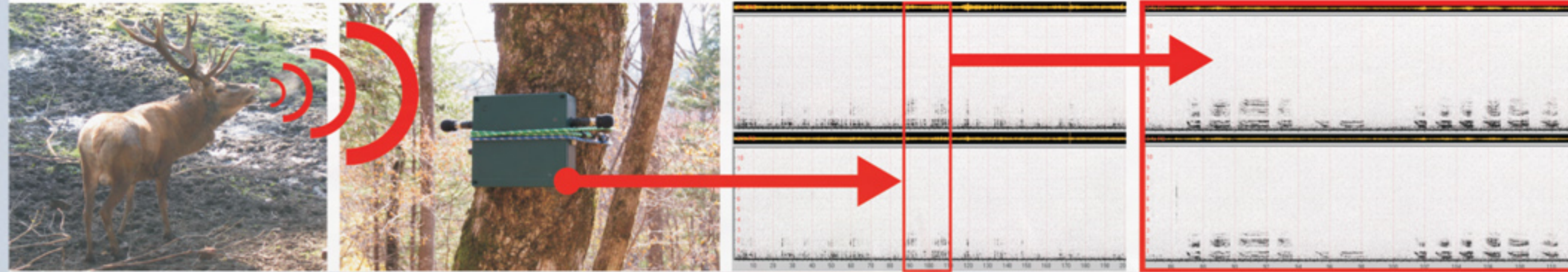


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Aim: In polygynous red deer (*Cervus elaphus*), a prolonged rutting vocal activity represents a prominent part of male reproductive behaviour. We compare male vocal rutting activity in four populations and estimate effects of rut phase, time of day and ambient temperature on vocal activity.

Methods: • September-October 2015-2017

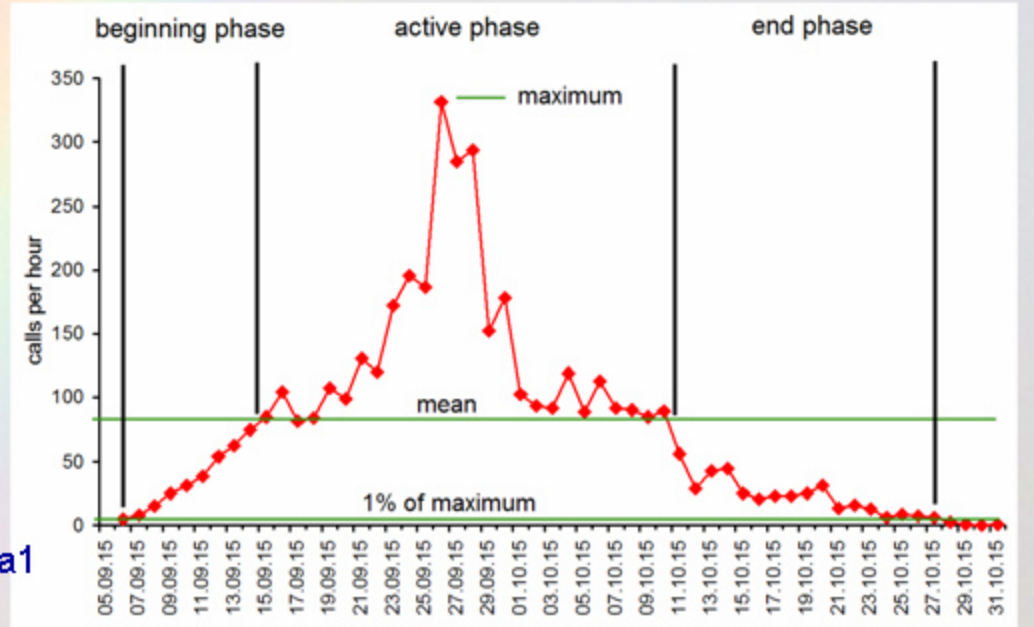
- 8 SongMeter SM2+ automated recorders (two per population, asynchronous recording, between-device distance 300-5000 m)
- 5 min/hour, 24 hours/day, 60-70 days per each device
- Four populations of red deer: European deer *C.e. hippelaphus* (Bryansk, 2016), Siberian wapiti *C.e. sibiricus* (Kostroma, 2015) and two populations of Far-East wapiti *C.e. xanthopygus* (Ussury, 2015; Khabarovsk, 2017)



In total, registered 33801 rutting calls (Kostroma 17955; Ussury 926; Bryansk 12223; Khabarovsk 2697 calls)

Results: Subdividing rut to phases

- Maximum and mean call number were calculated for the entire rut period.
- Rut onset and completions were selected as days when call number/hour reached 1% of the maximum.
- Beginning phase was set between onset day and day with mean call number/hour.
- Active phase was set between two days with mean call number/hour.
- End phase was set from day with mean call number/hour to the completion day.



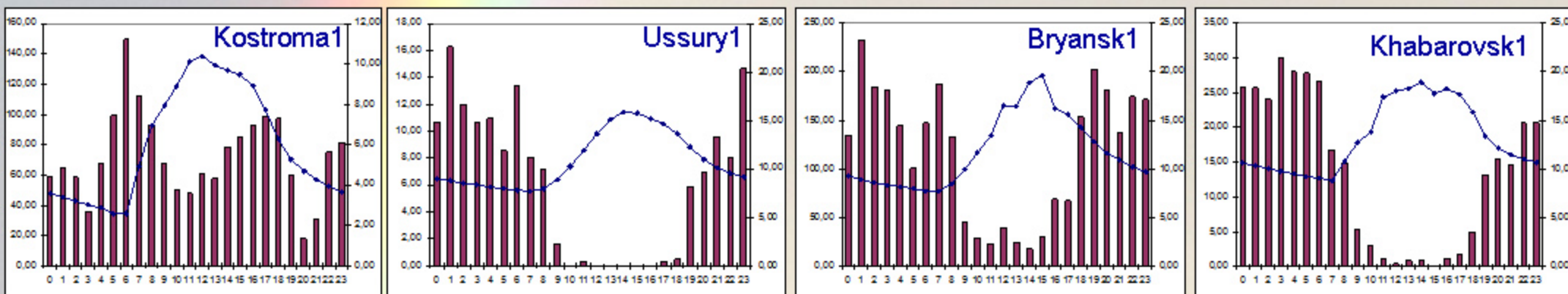
Rut parameters

Four populations, two Song Meter devices (1 & 2) per population

	Kostroma 2015		Ussury 2015		Bryansk 2016		Khabarovsk 2017	
	1	2	1	2	1	2	1	2
Rut duration (days)	52	52	45	43	35	39	53	51
Beginning phase (days)	9	10	17	14	13	9	9	8
Active phase (days)	26	24	12	12	18	20	24	22
End phase (days)	17	18	16	17	4	10	20	21
Maximum (calls/hour)	331	351	46	19	512	271	54	33.5
Mean (calls/hour)	82.1	90.3	6.8	3.7	117.4	50.9	14.5	11.4

- Vocal activity (calls/hour) was highest in Kostroma and Bryansk, intermediate in Khabarovsk and weakest in Ussury.
- Rut duration was longest in Kostroma and Khabarovsk, intermediate in Ussury and shortest in Bryansk.
- The active phase was longest in Kostroma and Khabarovsk, intermediate in Bryansk and shortest in Ussury.
- Devices within locality displayed different numbers of calls/hour, but similar dynamics of vocal activity.

Time of day graphs of the vocal activity (calls/hour) against the mean hourly ambient temperature



- Decrease of vocal activity (calls/hour) was observed in all populations for the exclusion of Kostroma in the light time of day, between 09:00 and 17:00-18:00.
- The maximum vocal activity was observed in all populations for the exclusion of Kostroma between 01:00 and 03:00.
- Two additional peaks of vocal activity were also observed at sunrise (06:00-07:00 for Kostroma, Ussury and Bryansk) and at sunset (17:00-18:00 for Kostroma and 19:00-21:00 for Ussury, Bryansk and Khabarovsk).

