

Adaptive monitoring: using citizen scientists to track wolf populations when winter-track counts become unreliable

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Table S1. Wolf hunting quota (N, individuals) in Lithuania, quota recommended by Nature Research Centre (R) and date (D) of its fulfillment. In the seasons from 2012/2013 till 2017/2018, quotas were set and season was stopped in the administrative districts, not in the whole country.

Year	N	R	D	Source of information
2005/2006	20		Feb 24	www.e-tar.lt/portal/lt/legalAct/TAR.BB55DA44B286 ; www.e-tar.lt/portal/lt/legalAct/TAR.50AE71FEE197
2006/2007	20		Mar 5	www.e-tar.lt/portal/lt/legalAct/TAR.169A042BB188 ; www.e-tar.lt/portal/lt/legalAct/TAR.BD31D8E021D0
2007/2008	20		Jan 10	www.e-tar.lt/portal/lt/legalAct/TAR.C11B0D54D17A ; www.e-tar.lt/portal/lt/legalAct/TAR.49A6E17E00A3
2008/2009	30		Jan 12	www.e-tar.lt/portal/lt/legalAct/TAR.1B98769E238F ; www.e-tar.lt/portal/lt/legalAct/TAR.5F4B030E73F2
2009/2010	40		Jan 11	www.e-tar.lt/portal/lt/legalAct/TAR.169FAC21E6AE ; www.e-tar.lt/portal/lt/legalAct/TAR.D05B0B693A4C
2010/2011	40		Feb 19	www.e-tar.lt/portal/lt/legalAct/TAR.3124AF13DBC1 , www.e-tar.lt/portal/lt/legalAct/TAR.A9A7C28C0958 ; www.e-tar.lt/portal/lt/legalAct/TAR.4D73A03E2E6B
2011/2012	5		Nov 9	www.e-tar.lt/portal/lt/legalAct/TAR.2EF4F6298BB0 ; www.e-tar.lt/portal/lt/legalAct/TAR.3256231AAC80
2012/2013	50		Jan 16	www.e-tar.lt/portal/lt/legalAct/TAR.6FB1DADF7A4A ; www.e-tar.lt/portal/lt/legalAct/TAR.9FC4809EBE5D , www.e-tar.lt/portal/lt/legalAct/TAR.33AE8F464907 , www.e-tar.lt/portal/lt/legalAct/TAR.183D8ADFEBEE
2013/2014	33		Oct 24–Jan 29	www.e-tar.lt/portal/lt/legalAct/TAR.D5AB2076EDCD , www.e-tar.lt/portal/lt/legalAct/TAR.94FD28D2D8BA ; www.e-tar.lt/portal/lt/legalAct/TAR.BC9349CAE0D2 , www.e-tar.lt/portal/lt/legalAct/TAR.29176B7E57B4 , www.e-tar.lt/portal/lt/legalAct/TAR.078BB999F7B9 , www.e-tar.lt/portal/lt/legalAct/TAR.A30F1F46F17A , www.e-tar.lt/portal/lt/legalAct/TAR.8AC5B5CF7FEE , www.e-tar.lt/portal/lt/legalAct/TAR.7110FC6BDBE9 ,

				www.e-tar.it/portal/lt/legalAct/TAR.5414D013C352 , www.e-tar.it/portal/lt/legalAct/TAR.94FD28D2D8BA , www.e-tar.it/portal/lt/legalAct/TAR.4481F298BC8C , www.e-tar.it/portal/lt/legalAct/TAR.7FBE8309BF90 , www.e-tar.it/portal/lt/legalAct/d2bbd830827411e3a89fd7598ca5c9ab , www.e-tar.it/portal/lt/legalAct/35785a70899111e397b5c02d3197f382
2014/2015	33		Oct 17–Dec 31	www.e-tar.it/portal/lt/legalAct/e887c3f0506811e4a698d921e3e46801 ; www.e-tar.it/portal/lt/legalAct/d233f710567911e4bed793cd2f630bdf , www.e-tar.it/portal/lt/legalAct/b1f18800665f11e4b6b89037654e22b1 , www.e-tar.it/portal/lt/legalAct/a2eab00069a411e4b6b89037654e22b1 , www.e-tar.it/portal/lt/legalAct/b95f3600748311e4a01ea02952726324 , www.e-tar.it/portal/lt/legalAct/719139407af011e48d20daf2927aba7d , www.e-tar.it/portal/lt/legalAct/3c0d03c0803711e4bc68a1493830b8b9 , www.e-tar.it/portal/lt/legalAct/Offa3550803711e4bc68a1493830b8b9 , www.e-tar.it/portal/lt/legalAct/8d190e708a6f11e4a98a9f2247652cf4 , www.e-tar.it/portal/lt/legalAct/9b2e01e0902911e4bb408baba2bddd3 , www.e-tar.it/portal/lt/legalAct/018002f0901f11e4bb408baba2bddd3 . www.e-tar.it/portal/lt/legalAct/ba8da29090cc11e4bb408baba2bddd3
2015/2016	60	60–120	Oct 25–Jan 13	www.e-tar.it/portal/lt/legalAct/618ac9a071ab11e5906bc3a96c765ff4 ; www.e-tar.it/portal/lt/legalAct/1362be40942411e5a6f4e928c954d72b , www.e-tar.it/portal/lt/legalAct/33aa23e094e811e5a6f4e928c954d72b , www.e-tar.it/portal/lt/legalAct/df4c44f0a89111e5be7f7be3f919a1ebe , www.e-tar.it/portal/lt/legalAct/724761f0ae2211e5b12fbb7dc920ee2c , www.e-tar.it/portal/lt/legalAct/0c760960b9f011e5a6588fb85a3cc84b
2016/2017	60		Jan 12	www.e-tar.it/portal/lt/legalAct/5621c9608f9611e6b6098daee0c9a94f ; www.e-tar.it/portal/lt/legalAct/a02fd780d8bc11e68d79c2033f194657
2017/2018	60	120–150	Dec 05–Feb 06	www.e-tar.it/portal/lt/legalAct/97f28e40af3611e7afdadc0e4460de4 ; www.e-tar.it/portal/lt/legalAct/37a9c3b0d9b511e7910a89ac20768b0f , www.e-tar.it/portal/lt/legalAct/b864a950df4d11e7b3f0a470b0373cb2 , www.e-tar.it/portal/lt/legalAct/ede844b0e49d11e7acd7ea182930b17f , www.e-tar.it/portal/lt/legalAct/edc3c6e0ef8c11e78212d364ed0f34b8 , www.e-tar.it/portal/lt/legalAct/67bec4b0facb11e78bcec397524184ce , www.e-tar.it/portal/lt/legalAct/8c1a1320068b11e8b3e7ba9cfff043b1 , www.e-tar.it/portal/lt/legalAct/9785f6600b2311e8a5fc9d9b3a58917b

Table S2. Questionnaire on large carnivores (wolf, lynx, brown bear) registration.

Object of registration	
Date of registration	
Place of registration	
Respondent data	
Remarks	
How to fill a questionnaire	
Object observed	<p>Please indicate species and what was observed (see examples):</p> <ul style="list-style-type: none"> • hunted wolf / lynx carcass, • animals seen (i.e., 2 wolves / lynx with kitten), • photo taken (please attach). <p>Please indicate species and observation details (see examples):</p> <ul style="list-style-type: none"> • dead (hunted) wolf (lynx, etc.), • animal(s) seen (2 wolves; lynx and a cub), • camera record (please attach photo/video), • animals heard (for example, wolf howling), • track found (wolf, lynx, brown bear), • excrements found (wolf, lynx), • domestic animals killed by wolves or lynx, • game animals killed by wolves or lynx.
When observed	Date and time, for example, 2 January 2015, 21.30–22 PM
Where observed	<p>Please indicate exact location using:</p> <ul style="list-style-type: none"> • GPS coordinates • Map (kmz coordinated from Google Earth, or coordinates from maps.It), • If exact location unavailable, please give description enabling to find place on the map (forest and forest square, nearest landmarks and distances).
Respondent data	Name, surname and contact information (phone number and/or e-mail).
Remarks	Please insert additional information here.

First four fields are obligatory.

Anonymous observations will not be registered.

Questionnaires with data should be sent via e- mail linas.balciauskas@gamtostyrimai.lt or linasbal@ekoi.lt,
or using address below:

Nature Research Centre

Akademijos g. 2

08142 Vilnius

Table S3. Representativeness of citizen science data on wolves in Lithuania, 2015–2018, compared to official survey data from 2018. Observations and wolf survey in the territories of cities were not carried out.

Districts	Citizen science project, 2015-2018			Official data, 2018	Expected wolf number, based on tracks/km
	No of observations	Wolf numbers observed	Individuals per observation	Wolf tracks/km of survey route ¹	
Alytaus	21	32	1.52	0.1693	
Šilalės	15	45	3.00	0.2436	
Biržų.	14	42	3.00	0.3055	
Kupiškio	14	23	1.64	0.2934	
Vilkaviškio	14	16	1.14	0.125	
Anykščių	13	25	1.92	0.0577	
Švenčionių	12	18	1.50	0.1211	
Varėnos	12	23	1.92	0.2926	
Ukmergės	11	22	2.00	0.2628	
Vilniaus	10	16	1.60	0.1054	
Raseinių	9	36	4.00	0.0751	
Rokiškio	9	24	2.67	0.1388	
Tauragės	8	10	1.25	0.2246	
Ignalinos	8	13	1.63	0.058	
Kaišiadorių	7	9	1.29	0.1876	
Joniškio	6	9	1.50	0.1201	
Jurbarko	5	7	1.40	0.0622	
Klaipėdos	5	9	1.80	0.1821	
Šakių	5	18	3.60	0.034	
Trakų	5	17	3.40	0.1869	
Telšių	5	10	2.00	0.0104	
Plungės	4	10	2.50	0.0537	
Marijampolės	4	12	3.00	0.0398	
Utenos	4	10	2.50	0.0987	

Šalčininkų	4	9	2.25	0.18	
Jonavos	4	10	2.50	0.0971	
Radviliškio	4	7	1.75	0.0033	
Širvintų	4	9	2.25	0.2478	
Šiaulių	3	7	2.33	0.1541	
Zarasų	3	5	1.67	0.107	
Molėtų	3	3	1.00	0.0652	
Kėdainių	3	4	1.33	0.0261	
Kelmės	2	6	3.00	0.1033	
Kretingos	2	5	2.50	0.1597	
Kazlų Rūdos	2	2	1.00	0.0389	
Kauno	1	1	1.00	0.0238	
Pakruojo	1	2	2.00	0.076	
Akmenės	1	1	1.00	0.0416	
Panevėžio	1	3	3.00	0.0902	
Prienų	1	1	1.00	0.1601	
Rietavo sav.	1	2	2.00	0.1507	
Šilutės	1	1	1.00	0.0256	
Kalvarijos	1	1	1.00	0	
Elektrėnų	1	1	1.00	0.1667	
Druskininkų	n/d	n/d		0.1042	11
Lazdijų	n/d	n/d		0.1442	14
Mažeikių	n/d	n/d		0.0728	9
Pagėgių	n/d	n/d		0.1367	13
Pasvalio	n/d	n/d		0.1669	15
Skuodo	n/d	n/d		0	0

¹Data from State Service for Protected Areas under the Ministry of Environment.

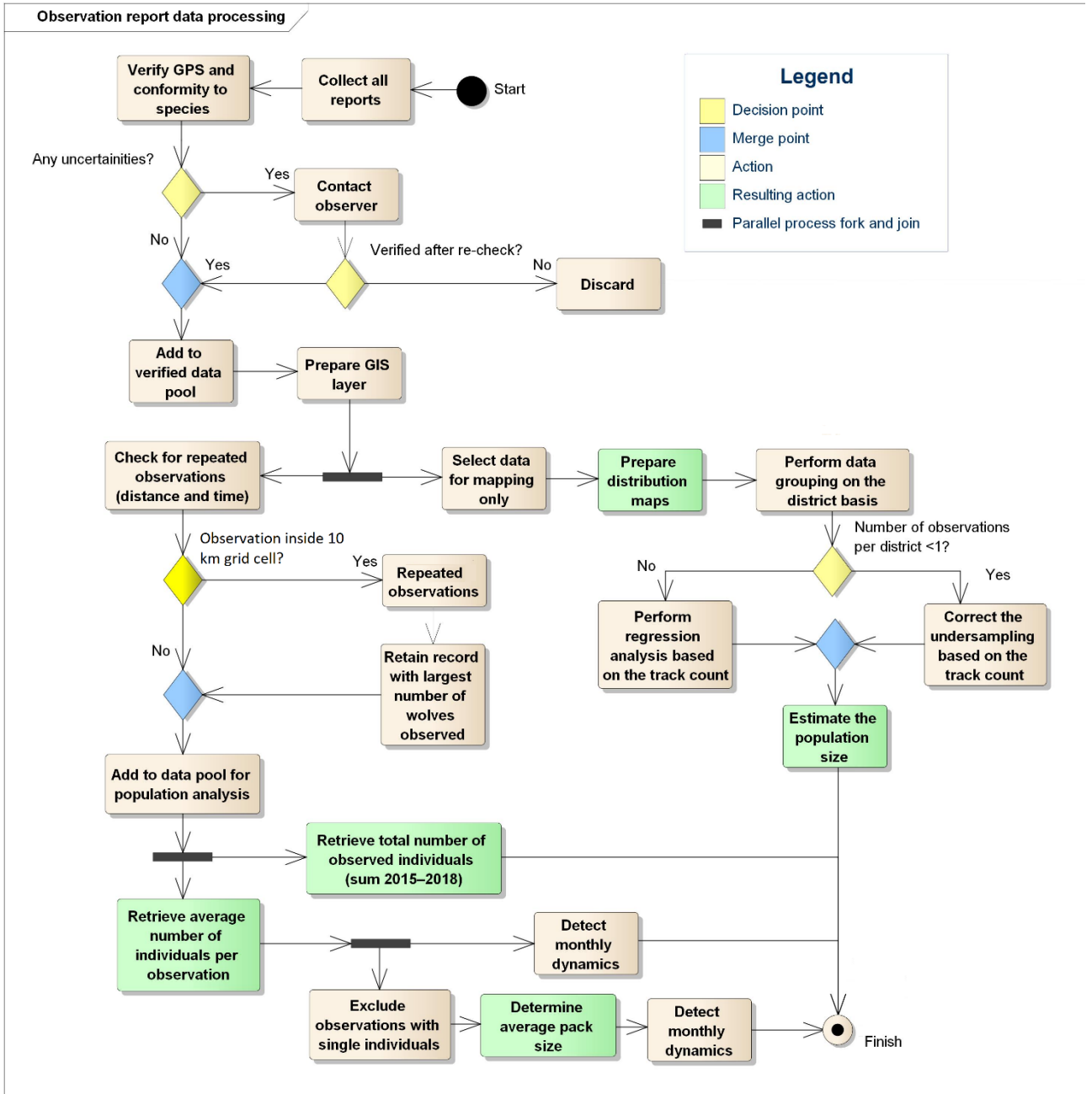


Fig. S1. Decision pathway illustrating how observations by volunteers were processed to describe wolf abundance in Lithuania.

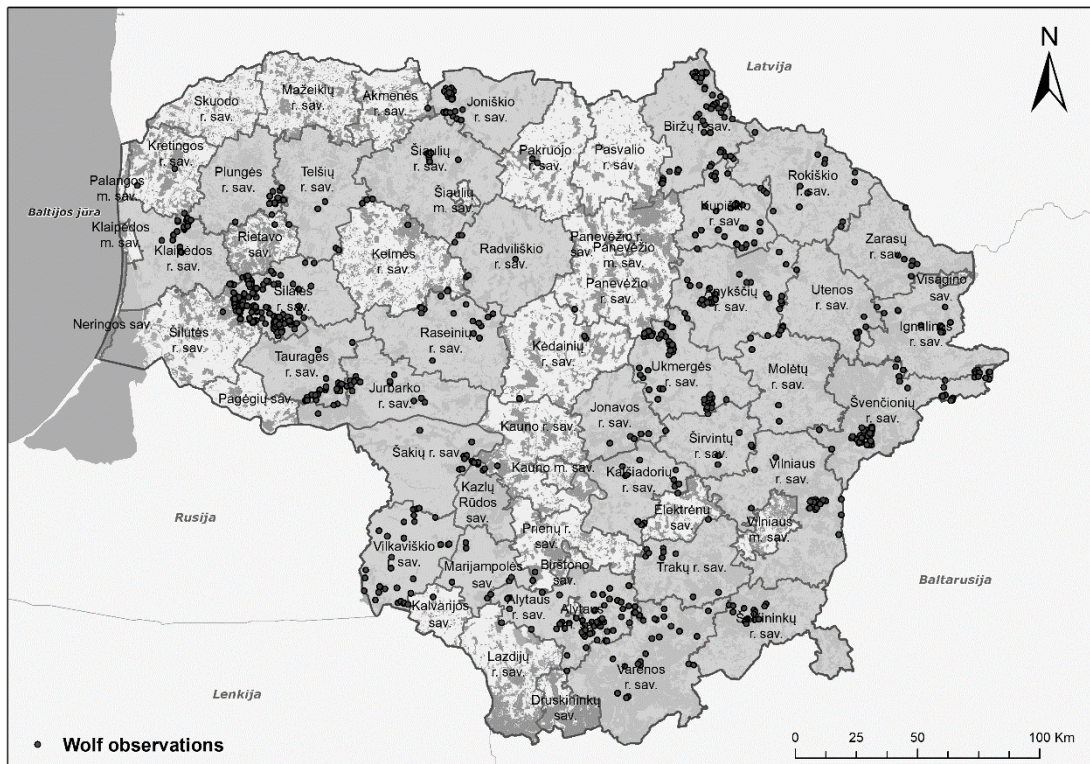


Fig. S2. Representation of wolf observations in 2015–2018 according national municipalities and territories of cities. Light background indicates municipality with insufficient observer coverage (less than 5 reports or no reports at all, see Table S3).