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#### Eliciting stakeholders' preferences towards numerical control of invasive alien mammals: a factorial survey approach with the Eastern cottontail (Sylvilagus floridanus) in Italy.

(Poster)

Jacopo Cerri 🖂 🏛, Giovanni Batisti 🏛, Marco Ferretti 🏛, Sandro Bertolino 🏛, Marco Zaccaroni 🏛

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Management schemes for invasive mammals that may involve direct shooting of animals must possess two fundamental attributes for working: being attractive for voluntary hunters, who often replace professional gamekeepers, and being accepted by the general public, which would otherwise delegitimize agencies. Traditionally, surveys are adopted to elicit the management preferences of these two stakeholders and to inform policy-makers. However, they suffer from social desirability bias and factorial surveys, where respondents evaluate hypothetical scenarios describing alternative management options, are supposed to be a more effective tool. We tested the effectiveness of factorial surveys to measure the preferences of citizens (n=144) and hunters (n=134) towards various control schemes for invasive Eastern cottontails (Sylvilagus floridanus) in Italy. Each factorial survey included a fixed number of management scenarios for cottontails, characterized by a fixed number of dimensions whose levels were assigned at random. Hunters declared whether they would have engaged in the various scenarios, while citizens rated their acceptability. Hunters were more prone to engage in control schemes for cottontails if these included shooting, rather than trapping, and if evidence of cottontail impacts over native wildlife or croplands was provided. Factorial surveys might be an effective tool to elicit their management preference for control schemes for invasive mammals in Europe. On the other hand, the attributes of the management scenarios did not affect their acceptability by citizens. This might underlie the existence of complex factors affecting the evaluation of wildlife management schemes by laymen, like Wildlife Value Orientations or negative emotions towards wildlife killing. Future research, combining qualitative in-depth research, structured questionnaires and experimental stimuli will be needed to provide further insights about them.

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## Eliciting stakeholders' preferences towards numerical control of invasive alien mammals: a factorial survey approach with the Eastern cottontail (Sylvilagus floridanus) in Italy.

Jacopo Cerri<sup>1</sup>, Giovanni Batisti<sup>2</sup>, Marco Ferretti<sup>3</sup>, Marco Zaccaroni<sup>4</sup>, Sandro Bertolino<sup>5</sup>

#### Abstract

Management schemes for invasive mammals that may involve direct shooting of animals must possess two fundamental attributes for working: being attractive for voluntary hunters, who often replace professional gamekeepers, and being accepted by the general public, which would otherwise delegitimize agencies. Traditionally, surveys are adopted to elicit the management preferences of these two stakeholders and to inform policy-makers. However, they suffer from social desirability bias and factorial survey experiments are supposed to be a more effective tool. We tested the effectiveness of factorial surveys to measure the preferences of citizens (n=144) and hunters (n=134) towards various control schemes for invasive Eastern cottontails (Sylvilagus floridanus) in Italy. Each factorial survey included a fixed number of management scenarios for cottontails, characterized by a fixed number of dimensions whose levels were assigned at random. Hunters were asked to declare whether they would have engaged in the various management scenarios, while citizens to rate them as acceptable or not. Hunters were more prone to engage in control schemes for cottontails if these included shooting, rather than trapping, and if evidence of cottontail impacts over native wildlife or croplands was provided. Factorial surveys might be an effective tool to elicit their management preference for control schemes for invasive mammals in Europe. On the other hand, attributes of the management scenarios did not affect their acceptability by citizens. This might underlie the existence of complex factors affecting the evaluation of wildlife management schemes by laymen, like Wildlife Value Orientations or negative emotions towards wildlife killing. Future research, combining qualitative in-depth research, structured questionnaires and experimental stimuli will be needed to provide further insights about them.

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A factorial survey (Auspurg & Hinz, 2014) with scenarios describing some hypothetical control schemes for cottontails was administered to a sample of hunters (n=144), and to one of



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residents (n=134), in the province of Pistoia (Italy). Scenarios were created by randomly combining features that were deemed to be important for hunters engagement and for public acceptance. Hunters evaluated the entire factorial of scenarios, while citizens evaluated a D-efficient sample, as the overall number of potential scenarios was too high. Each hunter evaluated 6 scenarios, and residents evaluated 4 scenarios. For each scenario, hunters indicated whether they would have engaged as volunteers, while citizens indicated whether the scenario was acceptable or not. The effect of the various characteristics of control schemes over participation or acceptability was modeled with a MCMC Bayesian multilevel logistic regression with a random intercept, an inverse Wishart prior for the (co)variances and a normal prior for the fixed effects (Hadfield, 2017). Model selection was carried out by comparing nested models through the Deviance Information Criterion (DIC) and the MCMC converged after 13.000 iterations.



			CILZCUS	
	Impact of introduced cottontails:	Cottontails have no impact on the environment or human activities (baseline). Cottontails negatively affect populations of native game species. Cottontails cause damage croplands. Cottontails transmit diseases to humans.	Contraction of the second seco	<b>EXAMPLE A</b>
	Method adopted to remove cottontails:	Cottontails are trapped and euthanized (baseline). Cottontails are shot with a firegun.		
	Duration of the control plan:	The control plan lasts 1 year (baseline). The control plan lasts 3 years. The control plan lasts 5 years.	Contraction of the second seco	Contraction of the second seco
	Aim of the control plan:	At the end of the control plan, cottontail population has been mildly reduced (baseline). At the end of the control plan, cottontail population has been strongly reduced. At the end of the control plan, cottontail population has been eradicated.	Contraction of the second seco	Contraction of the second seco
I ANK VI	Scale of the control plan:	Control operations are carried out in the whole province of Pistoia (baseline). Control operations are carried out over a sub-provincial hunting district. Control operations are carried out in a municipality. Control operations are carried out at a single hotspot.		Contraction of the second seco
V- V-	Control effort:	Control operations are carried out once per month (baseline). Control operations are carried out every 14 days. Control operations are carried out every week. Control operations are carried out every 3 days.		Contraction of the second seco
	Operator:	Operations are implemented by voluntary hunters (baseline) / wildlife professionals.		
		Citizens do not receive (baseline) / receive preliminary information about the		



Preliminary communication campaigns: Chizens do not receive (baseline) / receive preliminary information about the control plan.

#### Results

Among citizens, the acceptability of management schemes for cottontails increased strongly for those schemes including preliminary communication campaigns to inform citizens. The other variables were retained in the final model, on the basis of the DIC, but did not have a clear impact. For example, the duration of the scheme, its management goal, the location of control operations, the subject carrying them out and the method adopted had a 95% Confidence Interval that was centered around zero. On the other hand, hunters declared to be more prone to engage in control schemes for cottontails if they were allowed to shoot, rather than to trap them, and when cottontails were found to have some sort of impact. Notably, when cottontails were found to harm native game species, the willingness to engage in control operations was at its highest. Hunters were slightly less prone to control cottontails when these damaged crops or transmitted disease to humans. The effort required by control operations, the duration of the control scheme and its scale, were retained in the best candidate model, but have no strong effect over hunter participation.

## Citizens: fixed effects

#### Model information:

Iterations = 3001:12991 Thinning interval = 10	G-structure: Respondent's identity	post.mean 27206	l-95%CI 5070	u-95%CI 46291	eff.samp 45,5
DIC = 10.32	R-structure: observational	post.mean	l-95%CI	u-95%CI	eff.samp
Sample size = $1000$	units	50457	13375	79725	23,74

#### Fixed effects:

	post.mean	l-95%CI	u-95%CI	eff.samp	pMCMC	
Intercept	-159.72	-268.45	-62.62	90.36	< 0.001	***
Method adopted: shooting	-27.41	-85.45	26.90	568.29	0.32	n.s.
Duration of the control plan: 3 years	-17.28	-81.11	49.64	524.89	0.61	n.s.
Duration of the control plan: 5 years	18.74	-50.45	89.48	370.02	0.62	n.s.
Aim of the control plan: strong reduction	54.08	-19.13	120.47	469.97	0.12	n.s.
Aim of the control plan: eradication	-1.64	-69.09	75.82	630.82	0.98	n.s.
Preliminary communication campaigns	50.72	0.40	105.99	256.71	0.04	*
Context: urban areas	-32.03	-91.60	22.91	461.65	0.29	n.s.
Operator: wildlife professionals	29.62	-22.57	88.40	498.25	0.29	n.s.

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#### Model information:

	Iterations = 3001:12991	G-structure: Respondent's identity		post.mea 34081	an ]-95% 118	60791 %CI u-95%C	CI eff.sar 4 15	np
	$\frac{1}{10000000000000000000000000000000000$	Datmatura	abaamational	nost me	an 1050	ACI 11 05%	 N effsar	nn
DIC = 21.50		units		18029	591	9 $32447$	51 - 611.521	11p )2
	Sample size = 1000			10020	001			_
	Fixed effects:							
			post.mean	l-95%CI	u-95%CI	eff.samp	pMCMC	
	Intercept		-171.68	-264.12	-36.83	6.68	< 0.001	***
	Impact: native game species		77.77	12.46	135.13	16.56	0.004	**
	Impact: crop damaging		65.37	5.22	118.78	26.67	0.010	*
	Impact: disease transmission		48.95	4.11	101.49	24.54	0.026	*
	Method adopted: shooting		82.48	20.85	127.26	12.79	< 0.001	***
	Control effort: every 14 days		4.02	-49.79	48.13	107.73	0.858	n.s.
	Control effort: every 7days		-21.60	-70.33	26.81	110.52	0.342	n.s.
	Control effort: every 3 days		-1.66	-47.42	45.19	196.08	0.934	n.s.
	Duration of the control plan: 3	years	25 39	-11 81	66 69	167 32	0 198	ns

Duration of the control plan: 5 years	-26.96	-72.48	10.95	154.78	0.166	n.s.
Scale of the control plan: district	2.38	-45.43	50.10	133.65	0.896	n.s.
Scale of the control plan: municipality	15.53	-29.24	69.63	99.31	0.496	n.s.
Scale of the control plan: hotspot	17.51	-35.52	68.68	61.94	0.458	n.s.

#### Discussion and conclusions

Our research shows how wildlife managers could adopt factorial surveys to integrate stakeholders' preferences in the design of control schemes for invasive alien mammals. Due to their random allocation of hypothetical scenarios to respondents, factorial surveys have a high internal validity and they should be used in place of conventional questionnaires. Under a practical viewpoint, our study indicates that voluntary hunters are more prone to participate to those control initiatives that do not compromise their leisure experience. Therefore, as trapping is necessary to completely eradicate invasive mammals, voluntary hunters cannot entirely replace wildlife professionals. Information about invasive species and their impacts is also necessary, to promote hunter engagement in control initiatives and to raise the acceptability of management interventions among the general public. Finally, our study also indicates that the attributes of management schemes for invasive species do not strongly affect their acceptability by citizens. This might underlie the existence of deeper level of conflict about wildlife management, deriving from Wildlife Value Orientations or negative emotional arousal connected with lethal control of wildlife. We encourage future qualitative and experimental studies addressing these issues, as they could be crucial to design more accepted management initiatives for invasive alien mammals.

#### Authors:

- 1 Istituto di Management, Scuola Superiore Sant' Anna, Piazza Martiri della Libertà, 33, 56127, Pisa, Italy. email: j.cerri@santannapisa.it;
- 2 Scuola di Agraria, Università degli Studi di Firenze, Piazzale delle Cascine, 18, 50144, Firenze, Italy;
- 3 Regione Toscana, Corso Gramsci, 110, 51100, Pistoia, Italy;
- 4 Dipartimento di Biologia, Università degli Studi di Firenze, Via Madonna del Piano, 6, 50019, Sesto Fiorentino, Italy;

5 - Dipartimento di Scienze della Vita e Biologia dei Sistemi, Università degli Studi di Torino, Via Accademia Albertina, 13, 10123, Torino, Italy.

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