

ARTICLE

RESULTS OF FOURTH OTTER SURVEY IN SPAIN: 2014-2018

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Abstract: In the fourth national otter survey in Spain, 8,024 sampling points were carried out covering the entire Spanish mainland. Sampling unit used was the UTM grid (10x10 km). A total of 4,019 cells were prospected, representing 77.3% of the mainland Spain grids. Inside every grid, we made transects of 600 m distance (n=4,822; 60.1%) and spot-check (n=3,202; 39.9%). An overall value of 5,199 locations sampled with a positive presence of otter was obtained, representing 64.8%. Regarding UTM grids, 2,920 were otter positive, where at least one sampling point was found with valid otter traces or signals, representing 76.4% of the cells sampled. Percentage of the territory of mainland Spain with otter was 59.9%. Overall, the results were more positive in the Spain western half than in the eastern one, and more positive in the Spain northern half than in the southern one. By regions, the maximum percentage of positive sampling points and grids was reached in Galicia (north-western Spain), with 95.4% and 96.8% respectively. On the contrary, the minimum values of positive sampling points and grids were obtained in Valencia (eastern Spain), with 15.0% and 20.7% respectively. In relation to the third survey (2004-2006), otter has continued its spread, more slowly than a decade before, and mainly on Mediterranean basins. The numbers and percentages indicate a similar otter distribution in the 2000s and 2010s decades. In several territories, some cells with otter presence in the third survey were not sampled in the current survey; This fact has reduced the percentages obtained for the presence of otters in Spain.

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INTRODUCTION

Eurasian otter (*Lutra lutra* Linnaeus, 1758) is the species with the widest distribution in the world, and the only one in the subfamily *Lutrinae* present in Europe. Besides Europe, it inhabits northern Africa, Near East and Asia, including East Russia, Korea, Japan, central Asia, China, Taiwan, southern India, Sri Lanka, Malaysia and Sumatra (Wilson and Mittermeier, 2009; Hung and Law, 2016; Duplax and Savage, 2018). In Spain, as in the rest of Europe, the subspecies is *L. l. lutra* (Hung and Law, 2016).

It is an animal perfectly adapted to aquatic life. Its habitat is aquatic ecosystems, from seashore to high mountains. In the Iberian Atlantic Ocean (Galicia, Asturias, south

and south-west of Portugal and south-west of Andalusia) otters also use the sea, in the waters of the estuaries, river mouths and also on the most exposed coast, but they prefer areas with fresh water available, with less exposure to waves and with the presence of a wide area of shallow waters and springs (Clavero et al., 2006; Romero, 2006, 2008, 2018); they are less frequent in Mediterranean marine environments (Ruiz-Olmo, 2014; Saavedra, 2002). The most common natural habitats are rivers, streams, lakes, lagoons, marshes and any place with a permanent presence of water. They can also be found in reservoirs, canals, ditches, cisterns, golf course lakes and in other artificial environments (Ruiz-Olmo and Delibes, 1998; Ruiz-Olmo et al., 2005; Pedroso et al., 2007; Duarte et al., 2011; Pedroso, 2012).

The factors that determine habitat use and selection are the potential availability of food (persistence of water, especially important in Mediterranean environments) and shelter (Prenda et al., 2001; Ruiz-Olmo et al., 2005, 2011; Kruuk, 2006). Otters combine the use of reservoirs, where they can access abundant food, with the use of rivers and streams, where they find shelter (Pedroso et al., 2007).

The otter can live in mountain areas, with maximum height reported in the Pyrenees at around 2,400 m altitude, but its presence is scarce from 1,500 m above sea level; it does not usually reproduce above 800-1,000 m (Ruiz-Olmo, 2007). The presence of the otter at altitude requires the availability of sufficient food, the absence of snow and ice that prevent access to water and prey, and the absence of large barriers such as waterfalls and artificial dams in canyons (Ruiz-Olmo et al., 2005).

In Spain, the otter is included in Annex II (Animal and plant species of community interest for whose conservation it is necessary to designate special conservation areas) of Law 42/2007, of December 13, on Natural Heritage and Biodiversity, which is the transposition to Spain of the Habitats Directive (92/43/EEC of the Council), relating to the conservation of natural habitats and fauna and flora. According to Royal Decree 139/2011, of February 4, for the development of the List of Wild Species under Special Protection Regime and the Spanish Catalogue of Endangered Species, the otter is not included in the Spanish Catalogue of Endangered Species, but it is in the List of Wild Species under Special Protection Regime.

The European otter is included in Appendix I of the CITES treaty and according to the IUCN Red List (2015) it is classified as “Near Threatened NT” (Roos et al., 2015). Due to the recovery of the Iberian population in recent years, the IUCN Category of the otter in Spain has become “Least Concern LC” (Blanco, 2007).

Three previous national otter surveys were carried out in Spain (1980s, 1990s and 2000s decades) (Delibes, 1990; Ruiz-Olmo and Delibes, 1998; López-Martín and Jiménez, 2008).

ANIMALS, MATERIAL AND METHODS

From 2014-2018 we carried out the fourth national otter survey in Spain. We surveyed almost all provinces of peninsular Spain (n=46) on 15 Autonomous Communities and Andorra (Fig. 1); one province was not surveyed, because otter were not found in the three previous Spanish otter surveys (López-Martín and Jiménez, 2008). All Spanish hydrographic basins (Atlantic, Cantabrian and Mediterranean watersheds) were surveyed (Fig. 2). We used, according the recommendation by “*Information System for Otter Survey*”, the square Universal Transverse Mercator UTM (10x10 km) as sampling unity (Reuther et al., 2002). We surveyed 8,024 sampling points on 3,738 cells (Fig. 3), on a total number of 5,319 UTM cells in Spain (70.3% of cells). We surveyed an average of 2.15 points per cell.



Figure 1. Map of Spain, showing the different Regions (Autonomous Communities).

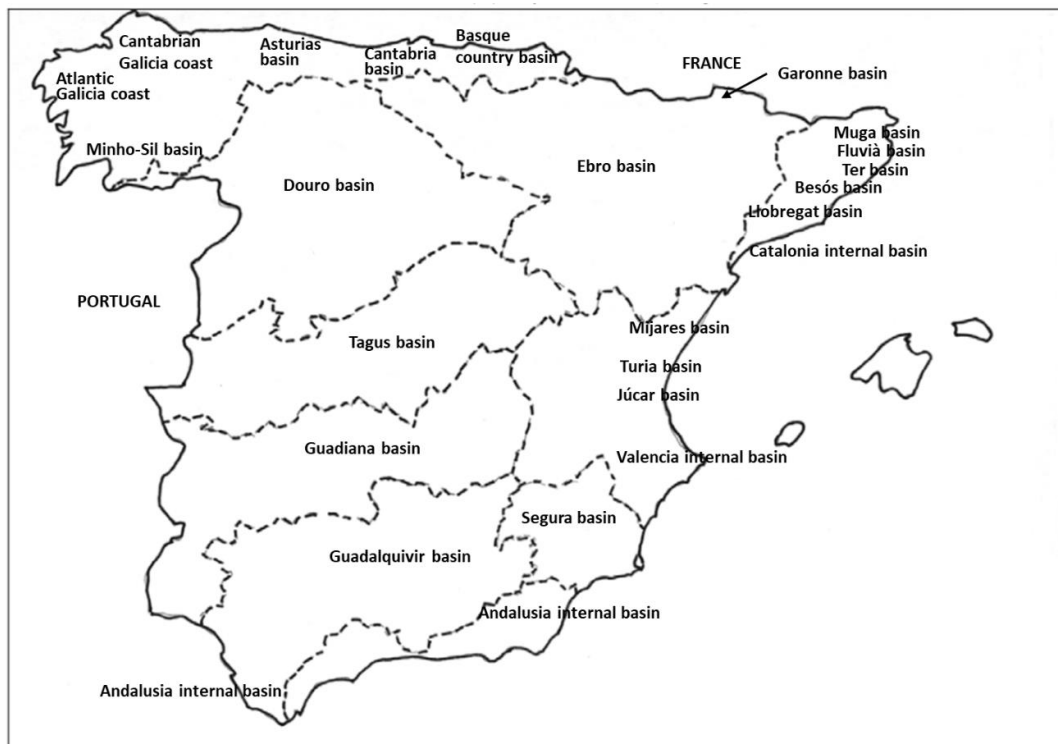


Figure 2. Map of Spain, showing the main hydrographic basins (Cantabrian, Atlantic and Mediterranean watersheds).

The total number of points surveyed was greater than in former surveys (3,966 in 1984-85, 4,049 in 1994-96 and 5,293 in 2004-06) (López-Martín and Jiménez, 2008). The total number of cells UTM (10x10 km) surveyed was higher than in first and second otter surveys (3,061 in 1984-85 and 2,934 in 1994-96) but a little less than in the third

one (4,206 in 2004-06), although in that last survey some squares were counted twice or more times in different territories (López-Martín and Jiménez, 2008).

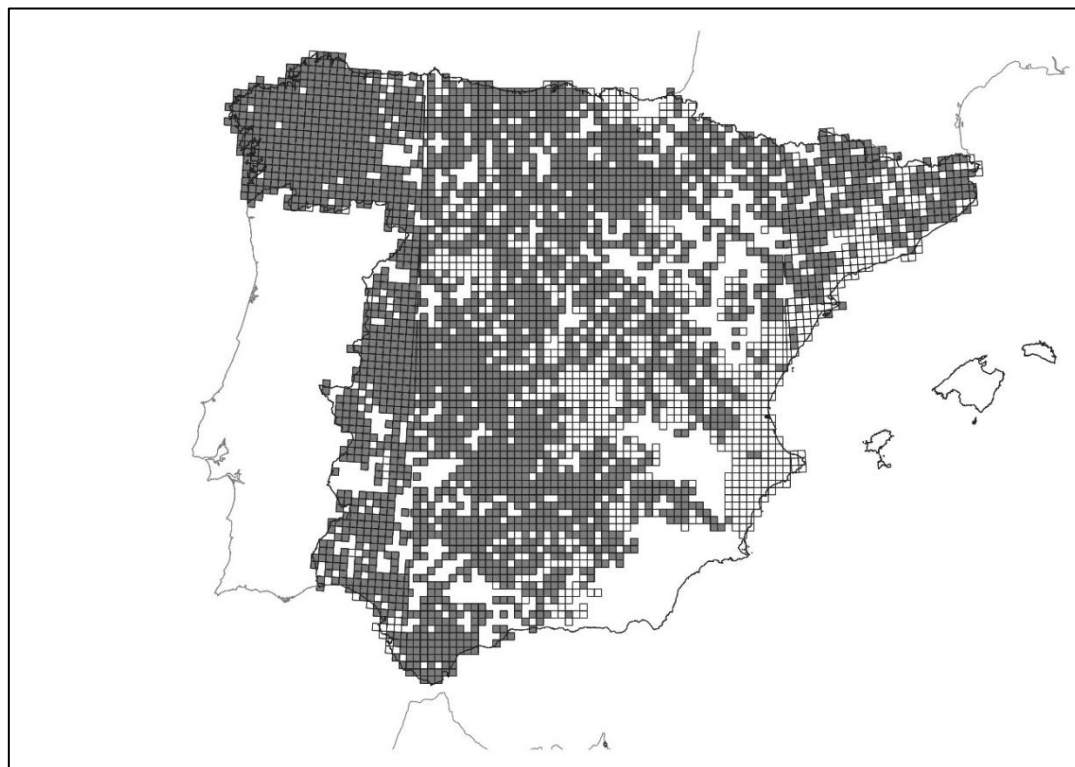


Figure 3. Location of 10x10 km cells surveyed in fourth otter survey (2014-2018) in Spain: otter presence (in black) and no presence (in white).

We carried out two different field surveys. First, and more important, the 600 m itinerary (n=4,822, 60.1%) and second, the spot-check (n=3,202, 39.9%), where a high probability exists to find otter tracks (under bridges, conjunction two rivers, large extensions of mud, etc.) (Chanin, 2003), to complement the first and main prospection. We used the Chi-Square test prove to compare the otter presence among different watersheds and altitudinal bands.

In the fourth Spanish otter survey took part 1,087 collaborators, who surveyed more than 2,280 km of rivers, streams, lakes, pounds, reservoir waters, beaches and coasts.

RESULTS

We found 5,199 points with positive presence of otter (64.8%) (Table 1) and 2,920 UTM (10x10 km) cells were positive (78.1% of surveyed cells) (Fig. 4, Table 2). Respect to total cells in mainland Spain (n=5,319), positive squares with otter presence were 54.9%, what was the percentage of peninsular Spanish territory with presence of otter (Table 2). That result was important to compare the otter occupancy of peninsular Spanish territory with three previous national otter surveys.

Results and Analysis by Territories

In short, results were more positive in the Western and Northern half than in the Eastern and Southern ones. By regions, maximum percentages of positive points and cells were reached in Galicia (north-west), with 94.1% and 96.8%, respectively (Tables

1, 2 and 3). At the opposite end, minimum percentages were reached in Valencian Community (central-east), with 15.0% and 23.2% respectively (Fig. 5).

Table 1. Results (sampling points) of fourth otter survey in Spain, by Regions.

Regions	Sampling Points			N° 600 m itineraries	N° spot check
	N	N Positive	% Positive		
Andalusia	877	687	78.34%	577	300
Aragon	479	373	77.87%	397	82
Asturias	223	141	63.68%	189	34
Cantabria	117	100	85.47%	79	38
Castile La Mancha Mancha	1,266	640	50.55%	759	507
Castile and León	1,714	1,234	72.0%	979	735
Catalonia and Andorra	775	373	48.13%	566	209
Extremadura	635	581	91.51%	201	434
Galicia	387	369	95.35%	309	78
Madrid	171	94	54.97%	124	47
Murcia	67	48	71.64%	62	5
Navarre	208	168	80.77%	98	110
Basque Country	398	183	46.98%	24	374
La Rioja	147	124	84.35%	56	91
Valencia	560	84	15.0%	402	158
SPAIN	8,024	5,199	64.79%	4,822	3,202

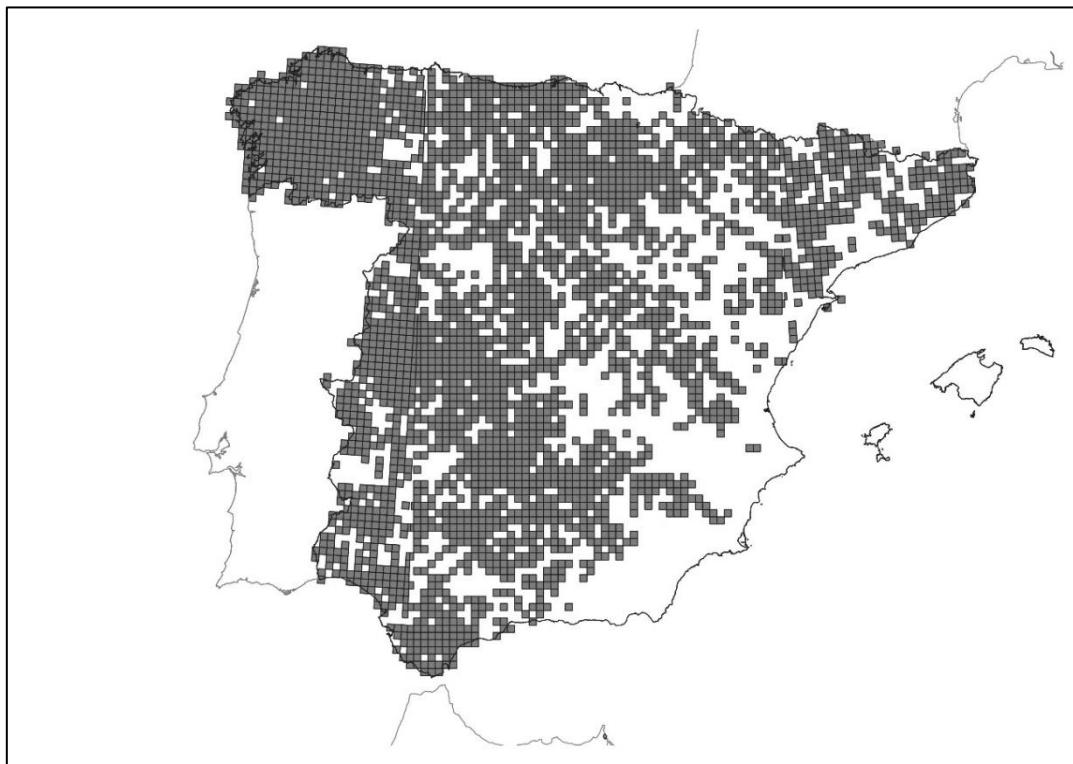


Figure 4. Distribution of otter in Spain: 10x10 km positive squares in fourth otter survey (2014-2018).

Otter presence was detected in all Spanish provinces (n=47), except in one, Almeria, set in the corner south-east of Iberian Peninsula, which not was surveyed (Table 3). The country of Andorra was included inside the Catalonia region because is a continuation of the same hydrographic basin. The number of points and grids, and the sampling area were greater than in previous surveys. Provinces with the lowest otter presence were Alicante (1.5%), Gipuzkoa (13.3%), Murcia (15.5%) and Biscay (22.2%), counted as a percentage of sampling cells with positive presence relative to the total number of sampling cells (Murcia) and with respect to the sampled grids (Alicante, Biscay and Gipuzkoa) (Table 3).

Table 2. Results (UTM 10x10 km cells) of fourth otter survey in Spain, by Regions. N1: Cells with 100 km², N2: Cells with less than 100 km².

Regions	UTM (10x10 km) cells							% Otter Territory
	N1	N2	N Total	N Surveyed ¹	% Surveyed	N Positive	% Positive	
Andalusia	897	42	939	602	64.11%	508	84.39%	54.10%
Aragon	468	32	500	241	48.20%	206	85.48%	41.20%
Asturias	116	12	128	101	78.91%	86	85.15%	67.19%
Cantabria	66	0	66	63	95.45%	56	88.89%	84.85%
Castile La Mancha	835	0	835	709	84.91%	478	67.42%	57.25%
Castile and León	855	55	910	821	90.22%	660	81.09%	76.81%
Catalonia-Andorra	362	0	362	333	91.99%	209	62.76%	57.73%
Extremadura	418	50	468	319	68.16%	315	98.75%	67.31%
Galicia	343	0	343	332	97.79%	322	96.99%	93.88%
Madrid	97	0	97	72	74.23%	56	77.78%	57.73%
Murcia	123	0	123	24	19.51%	18	75.0%	14.63%
Navarre	111	0	111	83	74.77%	71	85.54%	63.96%
Basque country	89	0	89	75	84.27%	43	57.33%	48.31%
La Rioja	61	0	61	58	95.08%	55	94.83%	90.16%
Valencia	268	19	287	276	96.17%	57	20.65%	19.86%
SPAIN²	5,109	210	5,319	4,109²	77.25%	3,140²	76.42%	59.03%
SPAIN³	5,109	210	5,319	3,738³	70.28%	2,920³	78.12%	54.90%

¹Cells shared by two or more provinces without counting more than once.

²Sum of all regions, counting more than once cells shared by two or more regions.

³ Cells shared by two or more regions without counting more than once.

Table 3. Results (summary) of fourth otter survey in Spain (2014-2018) by Provinces and Regions.

Provinces and Totals for Region	Sampling Points			UTM (10x10 km) cells		
	N	Pos ¹	% Pos ¹	N	Pos ¹	% Pos ¹
Almería	0	0	0	0	0	0
Cádiz	125	94	75.20	96	77	80.21
Córdoba	222	152	68.47	141	118	83.69
Granada	88	55	62.50	60	39	65.0
Huelva	135	123	91.11	85	81	95.29
Jaén	144	101	70.14	141	100	70.92
Málaga	51	50	98.04	44	43	97.73
Seville	112	112	100.0	73	73	100.0
Andalusia	877	687	78.06	602	508	84.39
Huesca	226	196	86.73	110	105	95.45
Teruel	125	71	56.80	66	45	68.18
Zaragoza	128	105	82.68	78	67	85.90
Aragon	479	373	77.87	241	206	85.48
Asturias	223	141	63.23	101	86	85.15
Cantabria	117	100	85.47	63	56	88.89
Albacete	97	54	55.67	63	46	73.02
Ciudad Real	294	208	70.75	209	162	77.51
Cuenca	337	143	42.43	160	92	57.50
Guadalajara	161	99	61.49	111	78	70.27
Toledo	377	136	36.07	181	111	61.33
Castile La Mancha	1.266	640	50.55	709	478	74.85
Ávila	216	136	62.96	88	60	68.18
Burgos	219	163	74.43	113	105	92.92
León	237	231	97.47	128	128	100.0
Palencia	167	118	70.66	83	68	81.93
Salamanca	227	195	85.90	96	85	88.54
Segovia	121	67	55.37	74	50	67.57
Soria	130	72	55.38	71	53	74.65
Valladolid	144	77	53.47	70	45	64.29
Zamora	253	175	69.17	124	93	75.0
Castile and León	1.714	1.234	72.0	821	660	80.39
Barcelona	235	89	37.87	79	45	56.96
Girona	110	63	57.27	68	41	60.29
Lleida	175	123	70.29	111	85	76.58
Tarragona	213	62	29.11	85	36	42.35
Andorra	42	36	85.71	8	8	100.0
Catalonia and Andorra	775	373	48.13	333	209	62.76
Badajoz	236	227	96.19	130	122	93.85
Cáceres	399	354	88.72	192	192	100.00
Extremadura	635	581	91.50	319	315	98.75
A Coruña	115	111	96.52	99	93	93.94
Lugo	109	108	99.08	102	101	99.02
Orense	88	81	92.05	75	71	94.67
Pontevedra	75	69	92.00	60	60	100.0

Galicia	387	364	95.35	332	322	96.99
Madrid	171	94	54.97	72	56	77.78
Murcia	67	48	71.64	24	18	75.0
Navarre	208	168	80.77	83	71	85.54
Álava	192	166	86.46	37	35	94.59
Gipuzkoa	158	13	8.23	27	6	22.22
Bizkaia	48	4	8.33	15	2	13.33
Basque country	398	183	45.98	75	43	57.33
La Rioja	147	124	84.35	58	55	94.83
Alicante	123	1	0.81	66	1	1.52
Castellón	140	24	17.14	83	19	22.89
Valencia	297	59	19.87	127	37	29.13
Valencia	560	84	15.0	276	57	20.65
SPAIN	8,024	5,197	64.73	4,109*	3,140*	76.42

¹Pos: positive points.

*With no count more than once the squares shared by two or more Regions (N=3,738; Pos=2,920; %pos=78.12).

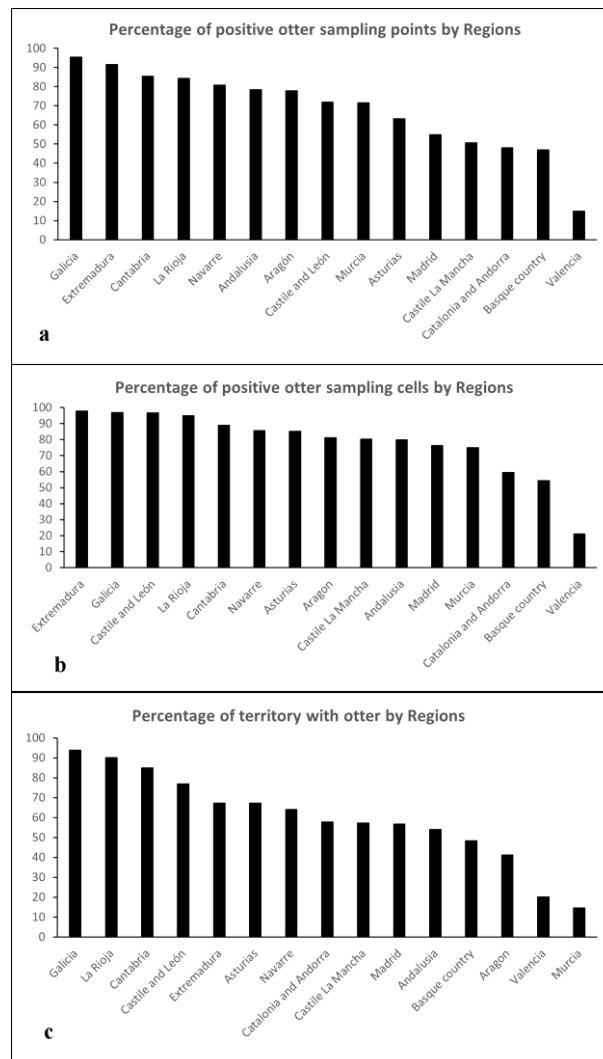


Figure 5. Comparison of three percentages (from higher to lower) of positive otter surveys (a), squares (b) and territory with otter (c), by different Regions in the fourth Spanish otter survey.

The second otter survey takes into account 7.7% (n=4,049) dry stream beds, ravines, streams and small rivers. That value increased significantly in the third survey, up to 11.0% (n=4,692) ($\chi^2=27,96$; $P<0.0001$). In the present survey, we counted 253 points on dry stream beds (3.2%, n=8,028), with a significant decreasing from third survey ($P<0,0001$). We found otter presence in 32 dry streams visited (12.6%).

Results and Analysis by Hydrographic Basins

Otters were present in all hydrographic basins of peninsular Spain (Table 4). Otter distribution was significantly higher in the Atlantic and Cantabrian watersheds (69.7% of positive sampling points, n=5,169 surveyed), and lower in the Mediterranean watershed (55.9% of positive sampling points, n=2,855 surveyed) ($P<0.0001$) (Table 4).

Table 4. Results (summary of sampling points) of fourth otter survey in Spain by watershed and hydrographic basins (2014-2018).

Watershed	Basin	N	Positive	% Positive
Mediterranean	La Muga	12	8	66.67
	Fluvià	25	20	80.00
	Ter	53	32	60.38
	Besós	48	23	47.92
	Llobregat	142	49	34.51
	Catalonia internal basin	156	27	17.31
	Ebro	1,505	1,121	74.49
	Mijares	42	8	19.05
	Turia	104	30	28.85
	Júcar	377	128	33.95
	Valencia internal basin	181	5	2.76
	Segura	147	83	56.46
	Andalusia internal basin	63	61	96.83
	Total	2,855	1,595	55.87
Atlantic	Andalusia internal basin	163	133	81.60
	Guadalquivir	612	458	74.84
	Guadiana	708	532	75.14
	Tagus	1,185	722	60.93
	Douro	1,484	1,079	72.71
	Minho-Sil	191	182	95.29
	Galicia Coast	196	185	94.39
		Total	4,539	3,291
Cantabrian	Galicia Coast	42	39	92.86
	Asturias internal basin	229	148	64.63
	Cantabria internal basin	121	93	76.86
	Basque country internal basin	221	27	12.22
	Garonne	8	5	62.50
	Total	621	312	50.24
Atlantic-Cantabrian	Total	5,160	3,603	69.65

In the Mediterranean watershed, there were strong differences between basins (Fig. 6). From the border with France in the north-east, to the Gibraltar strait, we describe the otter situation. In the rivers of Girona province, in the north-east corner, there was more than 60% otter presence (Muga: 66.7%, Fluvià: 80.0% and Ter: 60.4%), largely because it is the population resulting from a reintroduction carried out in the second half of the 1990s (Saavedra, 2002). The rest of the basins of Catalonia were below 50.0%, with 17.0% in the small rivers of Barcelona and Tarragona provinces, while the large rivers of Barcelona province (Besòs and Llobregat) reached values of 47.9% and 34.5% respectively. The Ebro river basin reached 74.5% presence of otters. The rivers of the Valencian Community were below 30.0% positive samplings, except in Júcar (34.0%), with very low values in the internal basins of that region (2.8%). The Segura river basin presented a percentage of samplings with otters above 56.0%, indicating an excellent recovery, but a very scarce presence in the final stretch, from the city of Murcia. On the other hand, the internal Mediterranean basins of Andalusia (not counting Almería) presented a very high value, 96.8% of otter presence. Otters are present in almost all the Mediterranean rivers in the provinces of Granada, Malaga and Cádiz.

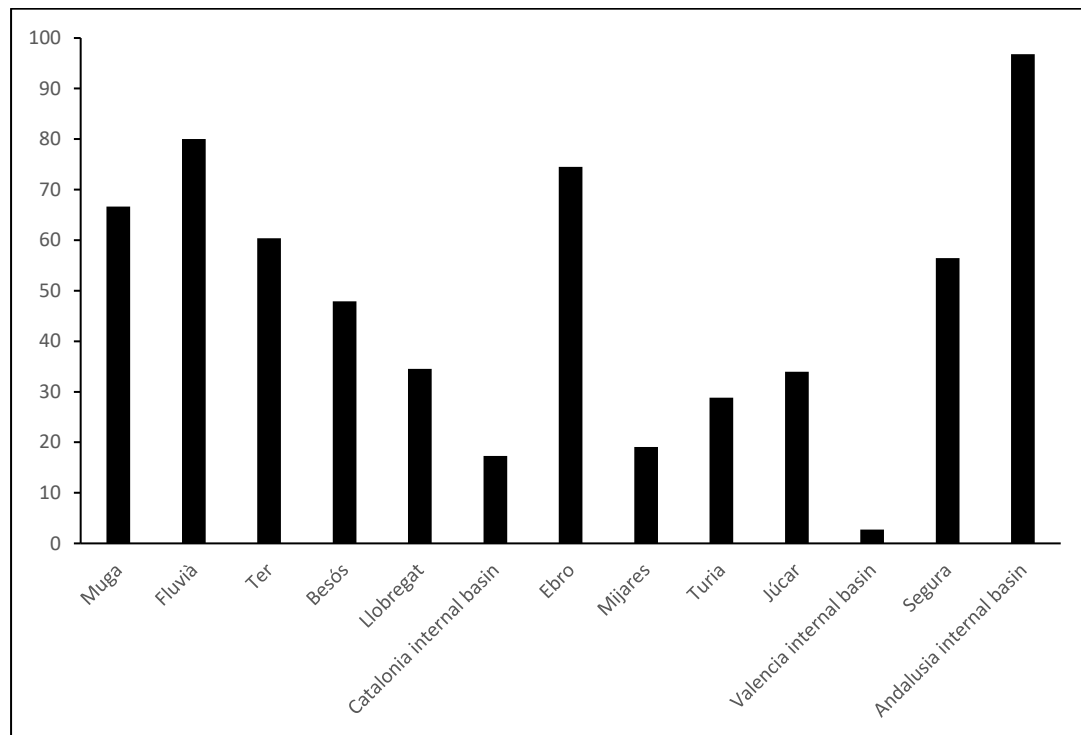


Figure 6. Percentage of positive otter surveys by hydrographical basins in Mediterranean watershed (from north-east to south-west).

The Atlantic basins, as expected, offered the highest values, with an average 72.5% of otter presence (Fig. 7). From Gibraltar strait to the border with France, northward and then eastward, we describe the otter situation. The Galician coastal basins and the river system of Minho-Sil stood out with 94.4% and 95.3%, respectively. The basin with the lowest percentage of positives was the Tagus River, with only 60.9%. The basins of the Guadalquivir, Guadiana and Douro rivers presented positive sampling percentages above 70.0%. These percentages would probably have been higher if the provinces of Seville (Guadalquivir), Badajoz (Guadiana), Valladolid and León (Douro) could have been sampled more completely. As in the Mediterranean

basin, the internal Andalusian ones of the Atlantic also presented a significant otter presence, with 81.6% (provinces of Cádiz and Huelva).

In the Cantabrian basin, there is a decrease in the presence of otters from west to east, with maximum values of 92.9% in the Galician coastal rivers and minimum values of 12.2% in the Basque country rivers (Fig. 7), next to France. The internal basins of Asturias and Cantabria presented 64.6% and 74.9% of positive samplings, respectively. In addition, in Garonne basin, at its headwaters in the Aran Valley (Catalonia), with a 62.5% positive presence of otters found.

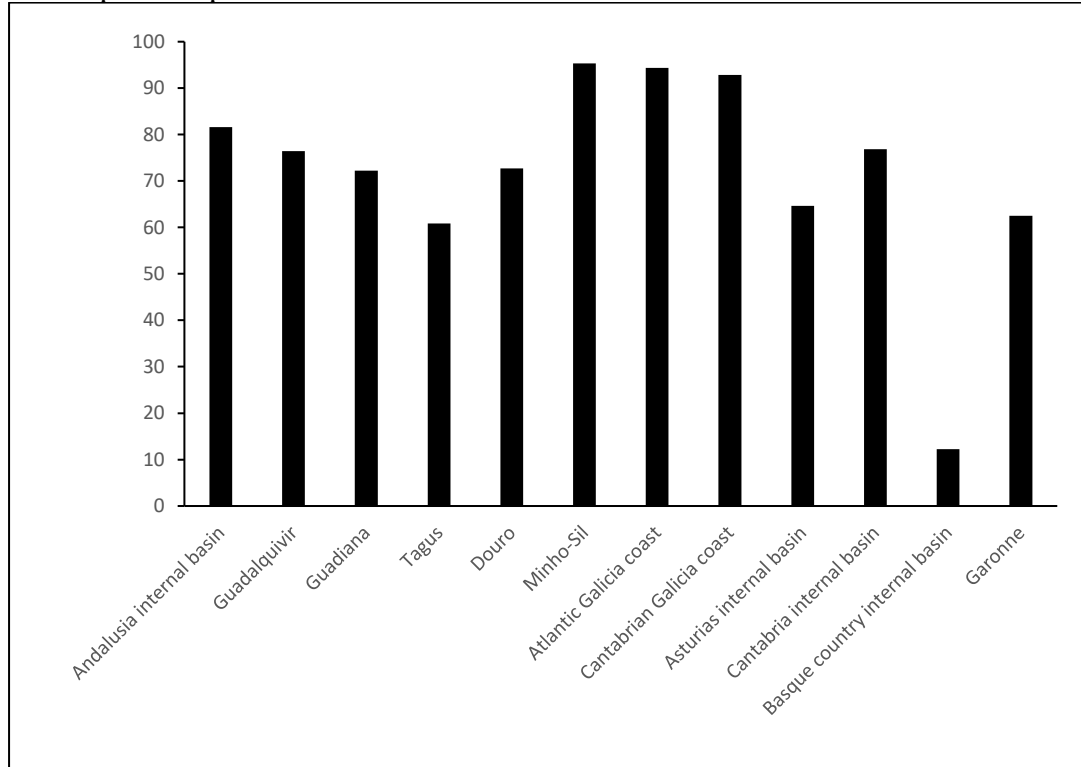


Figure 7. Percentage of positive otter surveys by hydrographic basins in Atlantic and Cantabrian watersheds (from south-west to north).

Results and Analysis by Waterbody Typology

In flowing waters (lotic ecosystems, as rivers, streams, channels, irrigation canals, ravines, etc.), the number of surveyed cells was 7,213, with 4,578 positive for otter (63.5%). There were important differences among Cantabrian (49.9%), Atlantic (71.2%) and Mediterranean (55.0%) watersheds (Fig. 8).

In static waters (lentic ecosystems, such as reservoir waters with fixed and variable level, lakes, pounds, pools, lagoons, marshes, etc.), the number of surveyed points was 645, with 508 positive ones in otter (78.7%). Comparing surveys of otter presence, there were also important differences among Cantabrian (n=7; 42.9%), Atlantic (79.7%) and Mediterranean (77.6%) watersheds.

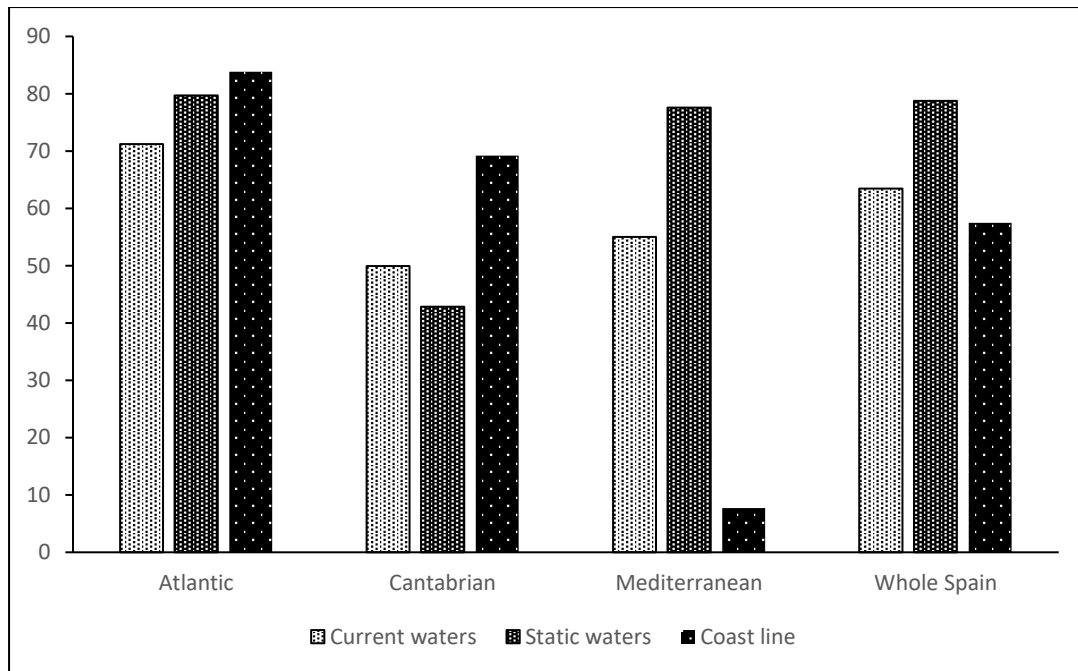


Figure 8. Percentage of positive otter surveys by typology of waterbodies (current, static and coasts) in the three watershed and the whole Spain.

Although otters are more frequent in continental aquatic environments, it occupies the coastline, even using the sea. A total of 120 points was surveyed in littoral areas and coasts, with 57.5% positive ($n=69$). The positive percentage was 81.5% ($n=81$ surveys) in Atlantic-Cantabrian watersheds and was 7.7% ($n=39$ surveys) in the Mediterranean one ($P<0,0001$).

Along the Mediterranean the otter is present in the marshes “Aiguamolls de l’Empordà” (Girona), in the final stretches of Besós and Llobregat rivers (Barcelona), in the Ebro delta, in the final stretches of Mijares (Castellón), Segura (Alicante) rivers and all rivers of Málaga and Cádiz provinces. On the Atlantic coast of Andalusia, otters are found in the marshes that form the Guadalete (Cádiz), Guadalquivir (Seville), Tinto, Odiel and Guadiana (Huelva) mouths.

On the Galician coast, otters were detected in 49 of 53 coastal samplings (92.5%). In Asturias, otter sign was found just once, in the Eo estuary. In Cantabria, otter sign was found in five points of the Pombo and Oyambre wetlands and the Agoños estuary. With only two coastal records in Basque country, otter sign was found in the Mundaka estuary and the mouth of Plentzia river.

Results and Analysis by Altitude

The highest altitude where otter sign was found, sover 2,000 meters above sea level, were in the Pyrenees (Lleida and Andorra) and the Cantabrian Mountains (Palencia). In Catalonia, otter presence was detected at 2,220 m, inside “Aigüestortes and Sant Maurici Lake National Park”; in Andorra at 2,070 m and in two Palencia lakes at 2,045 and 2,020 m.

The altitude distribution of otter presence is differs by watershed and altitudinal band. Most percentages of positive sign were between 200 and 400 m altitude (79.0%) and between 400 and 600 m (71.2%). The minimum value was more than 1.800 m (36.4%). The rest of altitudinal bands comprise values between 50 and 65% of positive points (Table 5, Fig. 9). When the altitudinal range of the otter is compared with the presence of otters (percentage of positive samplings) in the three watersheds (Atlantic,

Cantabrian and Mediterranean) there were some remarkable differences. In the first three altitudinal bands (from 0 to 599 m) the differences between the three watersheds were significant ($P < 0.0001$ and $P = 0.0168$), with a higher percentage of positive samplings on the Atlantic one (Table 5, Fig. 10). Percentages of sampling points with otters on the Mediterranean watershed are lower in the 0-199 m range and increase considerably between 200 and 599 m. Between 600 and 799 m there were no altitudinal differences between the three watersheds, although the highest percentages of otter presence occurred in the Cantabrian one. Between 800 and 1,199 m, there were statistical differences again ($P = 0.0082$ and $P < 0.001$); Cantabrian watershed presented the highest percentages of positive samplings and the Mediterranean the lowest ones. Between 1,200 and 1,399 m, the maximums occurred on the Atlantic watershed, but without being a significant difference. Differences were not found between 1,400 and 1,599 m, but highest percentages of otter presence were found on the Mediterranean watershed. Above 1,600 m of altitude there were not enough samples to compare the three watersheds.

Table 5. Comparison of percentage of positive surveys along altitude range (200 meters) among three watersheds (Atlantic, Cantabrian and Mediterranean) and whole Spain.

Altitude range (m)	Watershed			Whole Spain	P (χ^2 , 2 d.f.)
	Atlantic	Cantabrian	Mediterranean		
0-199	86.33%	45.64%	39.38%	57.15%	< 0.0001*
200-399	89.19%	54.05%	69.76%	79.0%	< 0.0001*
400-599	76.26%	51.35%	67.51%	71.18%	0.0168*
600-799	62.67%	72.09%	58.94%	61.99%	0.4923
800-999	61.65%	70.59%	46.7%	29.27%	0.0072*
1,000-1,199	71.34%	71.43%	36.67%	41.95%	< 0.0001*
1,200-1,399	64.95%	38.89%	42.47%	57.54%	0.0544
1,400-1,599	62.3%	50.0%	78.38%	68.0%	0.6147
1,600-1,799	66.67%	0.0%	55.56%	60.0%	-
>1,800	33.33%	0.0%	62.5%	36.36%	-

*Statistically significant

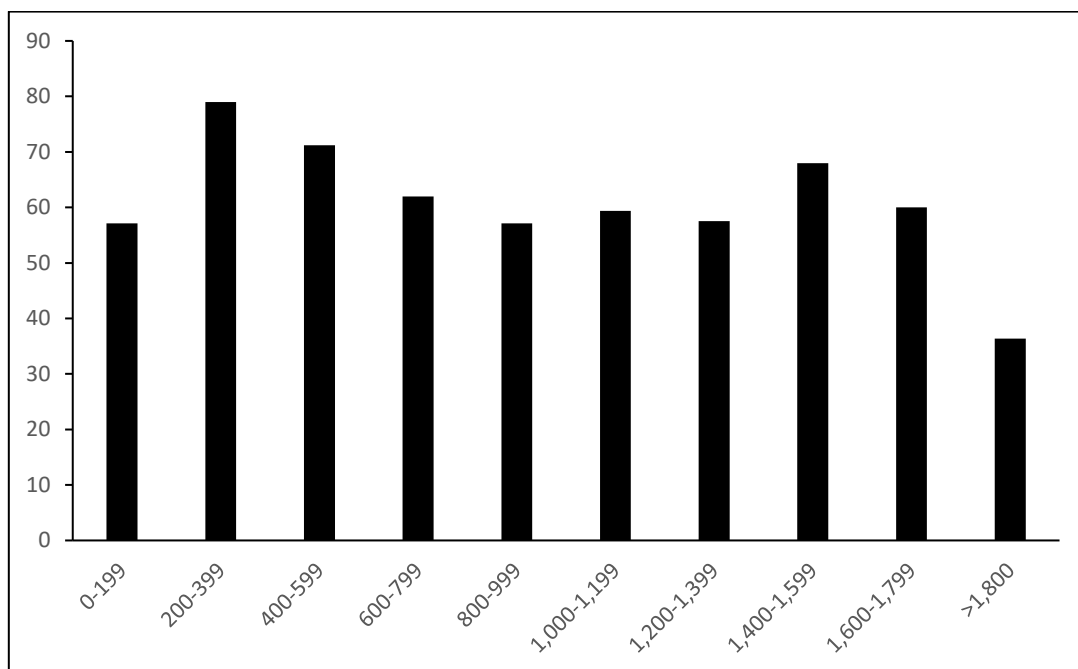


Figure 9. Percentage of positive otter surveys in Spain along altitudinal bands of 200 m.

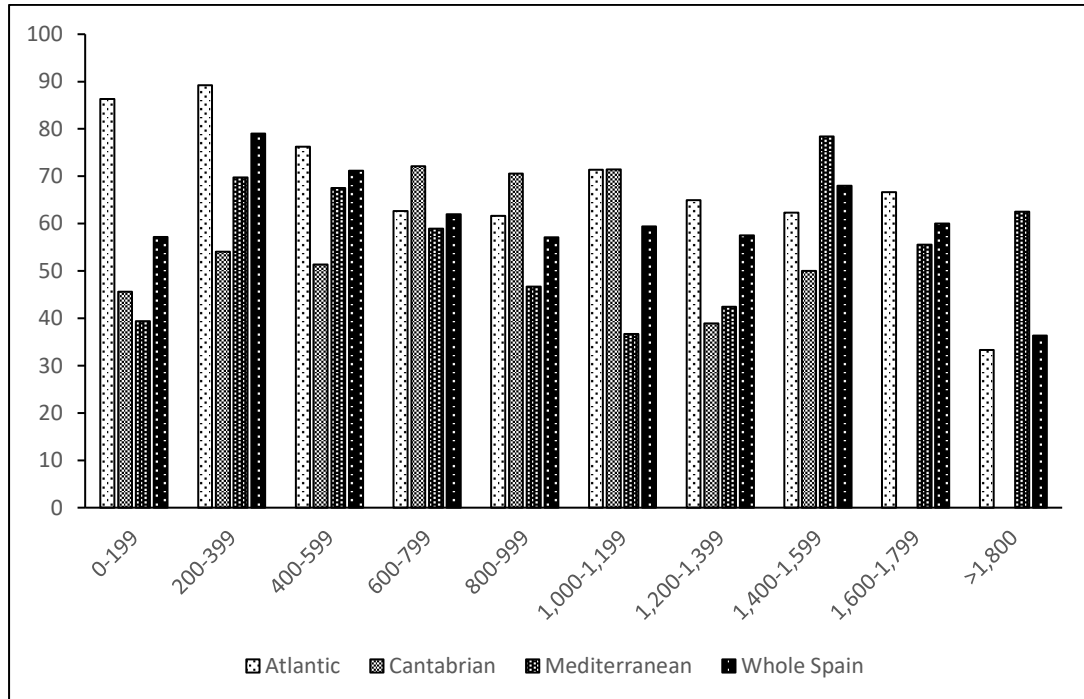


Figure 10. Comparison of percentage of positive surveys by altitude bands of 200 m among three watersheds (Atlantic, Cantabrian and Mediterranean) and the whole Spain.

DISCUSSION

Otter Surveys

Since the 1980s, four national otter surveys have been carried out in Spain, each around the middle of decades (1980s, 1990s, 2000s and 2010s) (Delibes, 1990; Ruiz-Olmo and Delibes, 1998; López-Martín and Jiménez, 2008; Palazón, 2021). In some regions, such as Catalonia, Navarre and Valencia, intermediate surveys (Urrea and Castien, 2021; Palazón, 2017a; Jiménez and Crespo, 2021) have been carried out. The general trend of the species has been to recover from a critical situation that reached its lowest peak in the 1980s (Delibes, 1990). With the beginning of the new century, the Eurasian otter began to recover in a stable way in a lot of territories where it had disappeared, from its mountain refuges to lower areas. This fourth survey has confirmed the expansion of the species, both in distribution and population growth, which was detected in the third national survey (Jiménez, 2005; López-Martín and Jiménez, 2008; Jiménez et al. 2009).

Few European countries have carried out four or more national otter surveys like Spain. A special case is Great Britain (Wales, England, Scotland, Northern Ireland and the Republic of Ireland) where surveys have been carried out since the late 1970s and early 80s (Strachan, 2015; Crawford, 2003, 2010; Findlay et al., 2015; Reid et al. 2013a, 2013b). Also in some Central European countries, surveys have been carried out over decades; examples are Denmark and Austria (Therkildsen et al., 2020; Kranz and Polednik, 2020) from the 1980s to the present.

Historic threats to Otters in Spain

The causes that led to the near disappearance of otters in many Spanish regions were very diverse. First was the direct persecution of the species; trappers almost wiped out the entire population of some rivers (Ruiz-Olmo, 2014). For instance, of 88 cases of otters killed between 1970 and 1985, 72.7% were killed directly, by shooting or

trapping (Jiménez and Delibes, 1990). The large dams built in Spain throughout the 20th century fragmented the otter's habitat, since some were and are strong obstacles, very difficult to overcome (Jiménez et al., 2008). These large infrastructures force the otters into open urban stretches, crossing roads, swimming in hydroelectric canals, etc., increasing mortality due to predation, or due to being run over in traffic. In addition, large dams decrease the connectivity of the otter population between upstream and downstream, and that of the potential prey (fish) populations from downstream to upstream. Finally, water pollution by phytosanitary and industrial products affected the reproduction and growth of some animals (Ruiz-Olmo et al., 2000).

Recovery of Otters in Spain

The turning point for otter populations recovery was also diverse. Firstly, the total absence of direct persecution. There are no longer any “illegal” trappers (poaching) dedicated to this “trade”, because the otter has been a strictly protected species in Spain since 1973 (Delibes, 1990). For example, of 81 otters killed between 1997 and 2008, none were killed by direct action or human persecution (Jiménez et al., 2009). In addition, the proliferation of Special Conservation Areas (ZEC in Spanish), established according to the EU Habitat and Birds Directive (Natura 2000 network) in the last 20 years in many stretches of rivers, lakes and marshes, have contributed to otter conservation.

Secondly, progressive reduction in the level of contamination of most Spanish riverbeds, mainly due to the start-up of treatment plants and the decrease in phytosanitary products (reduction of organochlorines and PCBs) used in agriculture and residual products (heavy metals) used in industry. The elimination of these bio-accumulative products was very important. The decrease in pollution has also favored the increase in the otter's potential prey, such as fish, and an increase in the biological diversity that inhabits aquatic ecosystems.

The conservation, and in some cases, the improvement of riparian vegetation, especially due to the abandonment and reduction of rural life, have assisted the otter increase. As river habitat has recovered, the otter has been gaining ground and colonizing new stretches of rivers. The proliferation of the red swamp crayfish (*Procambarus clarkii*) and the signal crayfish (*Pacifastacus leniusculus*), especially in Mediterranean rivers, acts as a supplementary source of food for otters, especially in times of scarcity as occur in Mediterranean regions in summer. Red swamp crayfish have spread throughout Spain since the early 1980s, followed later by the signal crayfish. In the Segura basin, the otter has gone from consuming native species of fish to preying on non-native species in just 20 years (Dettori et al., 2022). In Asturias rivers, otter preyed on exotic fish such as mountain trout (*Salvelinus fontinalis*), river bream (*Chondrostoma polylepis*), minnow (*Phoxinus phoxinus*) and rainbow trout (*Oncorhynchus mykiss*) (Palazon, 2021).

The presence of shelter (habitat) and food (fish and crabs) has been and is essential for the recovery of Spanish otter populations. The future of the otter in Spain is favorable. Advances are already known, after this study, in some Mediterranean rivers, reaching the sea and the coast (Jiménez and Crespo, 2021; Palazón, 2021; Ruiz-Olmo, 2014) in Valencia and Catalonia. For instance, the Galicia coast is ideal for otters because of the numerous short rivers with abundant flow, and the topography of the coastline due to the typical Galician estuaries.

Current Threats to Otters in Spain

There are still problems that threaten watercourses and other aquatic areas, such as agricultural intensification, increase of intensive livestock, growth of cities, and the presence of more and more non-native species, especially fish and plants in aquatic systems (Jiménez et al., 2008). The scarcity of water in some river courses in the south and east of Spain is due to periodic episodes of drought and the increasing demands for water by the agricultural (irrigation) and livestock sectors, and human consumption. Water pollution continues, despite the numerous treatment plants that exist throughout Spain. Many of these have become obsolete and they use outdated technology. There are no resources to renew them or for their good maintenance and they allow many pollutants to pass into the rivers. In recent years, chemical pollution from agricultural sources (intensive irrigation) and livestock (macro farms with their nitrogen purines) has increased.

There also continues to be destruction and fragmentation of habitat, especially due to the large infrastructure projects and emergency measures applied by the water management administrations after periodic floods, mainly in Mediterranean rivers, but also in Cantabrian rivers. The presence of construction channels (houses and farms) and crop fields in flood zones creates strong social pressure to “clean dirty rivers”, dredging the beds to make them deeper, cutting or cleaning riparian vegetation, including large trees, building retaining walls or breakwaters, etc. All these actions should be very prompt, only where truly necessary, and very short lived. The natural course of the life of a river, with its periodic floods, make these remedies totally inefficient in the face of the next swelling of the river and the subsequent flood of mainland. More long-term planning and fewer automated responses are needed.

Linked to global warming, water demand for human supply and new irrigation is increasing, leaving water levels very close to the limit. Today, less water passes through Spanish rivers than 30 years ago (Palazón, 2021). This factor will be aggravated in the future, and more efficient water consumption should be promoted to reduce demand and guarantee a minimum ecological flow.

The otter has always shared its habitat with other native mammals, but always as the “apex-predator” of continental aquatic ecosystems. Currently it must also share with the European mink (*Mustela lutreola*) (since 1950s), American mink (*Neovison vison*), the coypu (*Myoscastor coipu*) and the beaver (*Castor fiber*) (Ruiz-Olmo, 2014; Palazon, 2017b; Palazón and Meleró, 2014, 2017; Palazón et al., 2021).

On the banks of the rivers there are poplar plantations, mainly to produce paper. During the felling of these crops, the last 10 meters closest to the riverbed must be protected. Plantations with native species, typical of river groves, with a width sufficient to act as biological corridors, should be encouraged. The presence of natural islands is very important as areas of reproduction, refuge, and protection against human presence.

Road traffic is one of the most important current causes of otter mortality. In Catalonia alone, between 2008 and 2016, 42 otters were run over (Palazon, 2017a, 2021). The improvement of highways, greater density of traffic, modern, fast vehicles, more straight sections where speed limits are exceeded, and roads that run parallel to the riverbeds and that cross several times produce more points or “black sections” where otters and other semi-aquatic mammals are run over. The authorities are trying to correct these problems, but there are very few actions carried out in Spain to prevent otter mortalities.

In recent years there has been greater concern amongst citizens for the conservation of habitats and species. There is greater environmental awareness, surely

due to a better dissemination of knowledge, and a closer awareness of natural values, to which global warming and the scarcity of water resources have contributed. The otter has an increasing number of allies who will monitor its presence and take care of the improvement of its habitat.

Otters have been able to occupy areas with a high degree of artificiality, ignoring the proliferation of human presence in the riverbeds or riparian environments. Special cases are the presence of otters in the Manzanares river, in the city of Madrid, and in the Llobregat and Besós rivers, both in the city of Barcelona; both cities are made up of metropolitan areas where more than three million people live (Palazón, 2021).

Since the Third Survey, otters have continued to expand, more slowly, and mainly in Mediterranean areas (López-Martín and Jiménez, 2008). The numbers and percentages indicate a similar distribution of otters to that in the 2000s, but we believe that it is because in some territories a significant number of grids which showed positive presence of otter in the third survey were not sampled in this survey.

CONCLUSIONS

Otter expansion continues throughout the decade of the 2010, mainly in the direction of the Mediterranean Sea, occupying dry areas with temporal water bodies and where the food is more difficult to get, and occupying areas near to great towns and cities. Otters have yet to arrived on the Mediterranean coast, though the species reached the Atlantic and Cantabrian seashores ten years earlier. Otters are more and more abundant in Spain; the increase of visual observations and road casualties are a consequence of that. Because of this, some regional administrations are considering lowering legal protection of otter. Otter studies in the future should be focused on coexistence between otters, and human and their activities, especially in zones with great industrial activity and high human density.

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We all want to regret the death of Rafael Romero in October 2022, a great lover of otters.

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RÉSUMÉ

RÉSULTATS DE LA QUATRIÈME CAMPAGNE DE PROJECTION SUR LA LOUTRE EURASIENNE (*Lutra lutra*) EN ESPAGNE : 2014-2018

Lors de la quatrième enquête nationale sur la loutre en Espagne, 8.024 points d'échantillonnage ont été réalisés sur l'ensemble du territoire espagnol. L'unité d'échantillonnage utilisée était la grille UTM avec des carrés de 10x10 km. Au total, 4.019 carrés ont été prospectés, représentant 77,3 % du réseau de l'Espagne continentale. À l'intérieur de chaque carré, nous avons fait des transects de 600 m de long (n = 4.822 ; 60,1 %) et des vérifications ponctuelles (n = 3.202 ; 39,9 %). Sur l'ensemble des sites échantillonnés soit 5.199, nous avons obtenu des indices de présence positifs dans 64,8 % des cas. En ce qui concerne les carrés UTM, 2.920 étaient positifs pour la loutre, avec au moins un point d'échantillonnage comportant des traces

ou des indices de présence de loutre validés, ce qui représente 76,4 % des carrés échantillonnés. Le pourcentage de présence de la loutre sur le territoire de l'Espagne continentale était de 59,9%. Dans l'ensemble, les résultats ont été davantage positifs dans l'ouest de l'Espagne que dans l'est, et davantage positifs dans le nord que dans le sud de l'Espagne. Par région, le pourcentage maximum de points et de carrés d'échantillonnage positifs a été atteint en Galice (nord-ouest de l'Espagne), avec respectivement 95,4 % et 96,8 %. Au contraire, les valeurs minimales des points d'échantillonnage positifs et des carrés ont été obtenues à Valence (est de l'Espagne), avec respectivement 15,0 % et 20,7 %. Par rapport à la troisième campagne de prospection (2004-2006), la loutre a poursuivi son expansion, mais plus lentement que la décennie précédente, et principalement dans le bassin méditerranéen. Les nombres et les pourcentages indiquent une répartition similaire des loutres dans les décennies 2000 et 2010. Dans plusieurs régions, certains carrés UTM positifs lors la troisième campagne, n'ont pas été prospectés dans le présent relevé; Ce fait a pour conséquence de réduire les pourcentages de présence de la loutre en Espagne.

RESUMEN

RESULTADOS DE LA CUARTA ENCUESTA DE NUTRIA EUROASIÁTICA (Lutra lutra) EN ESPAÑA: 2014-2018

En el cuarto sondeo nacional de nutria en España se realizaron 8.024 puntos de muestreo cubriendo la casi totalidad del territorio español peninsular. Se utilizó como unidad de muestreo la cuadrícula UTM (10x10 km), con un total de 4.019 cuadrículas prospectadas, representando el 77,3% del territorio español. En cada cuadrícula, se realizaron itinerarios de 600 m de distancia (n = 4.822; 60,1%) y puntos "spot-check" (n = 3.202; 39,9%). De todos los puntos muestreados, 5.199 fueron positivos en nutria, representando el 64,8%. De todas las cuadrículas muestreadas, 2.920 fueron positivas, con al menos una localidad con indicios o señales de nutria, representando el 76,4%. Las cuadrículas con nutria fueron el 59,9% de territorio peninsular español. A nivel general, los resultados fueron más positivos en la mitad oeste de España que en la este, más positivos en la mitad norte que en la sur. Por regiones, los máximos porcentajes de puntos y cuadrículas positivas se alcanzaron en Galicia (noroeste de España), con 95,4% y 96,8%, respectivamente. En el lado contrario, los mínimos valores se obtuvieron en la Comunidad Valenciana (este de España) con 15,0% y 20,7%, respectivamente. En comparación con el tercer sondeo, la nutria ha continuado expandiéndose, a un ritmo más lento, principalmente por las cuencas mediterráneas. Los números y los porcentajes indicaron una similar distribución de la nutria en las décadas 2000s y 2010s. En varios territorios, algunas cuadrículas con presencia de nutria en el tercer sondeo no fueron muestreadas en el actual sondeo; este hecho ha hecho disminuir los porcentajes obtenidos de presencia de nutria en España.