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ORIGINAL PAPER

MONITORING WOLF POPULATIONS USING HOWLING POINTS COMBINED WITH SIGN SURVEY TRANSECTS

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Abstract
Wolves respond to simulated howling, especially during the mating and breeding seasons. Simulated howling points are, therefore, commonly used by many wolf researchers around the world to estimate pack numbers in a given area. A large amount of information is available on various pack breeding areas in Asturias, the only region in north-western Spain where the Iberian wolf (*Canis lupus signatus*, Cabrera 1907) is not classed as a game species. Wolf research began there in the early 1980s. We present the results of the latest study on population status, conducted between July and November, 2001. Using sampling transects to detect wolf scat and scratch marks and designated howling and observation points, twenty one (21) wolf packs were definitely located, with two others considered "likely". Nineteen (19) packs were detected using howling points (n=314). The results of this study show that simulated howling points and sampling transects are reliable and inexpensive way of detecting wolf packs.

Introduction

A large amount of information is available on the wolf in the Cantabrian Mountains. Several wolf population studies have been conducted since the early 1980s in Asturias [1-13] providing important information on wolf's demography, which is a necessary tool when developing suitable management and conservation [14] actions. A common aim of these studies was to locate wolf packs in order to estimate population size. As a general rule, only the dominant pair in a pack breeds [15] and pup presence is taken as an indicator of the existence of a pack**.**
Although this population estimation method may be the most suitable bearing in mind our available resources, it involves errors as regards effort, surface area, sampling method and prior knowledge [8], as well as in interpreting the results.
Sampling transects and simulated howling are among the most useful methods for locating wolf packs. Many researchers use the former to survey for signs of a species [16-19 among others] and recommend their use in certain situations to determine population changes or seasonal trends [20] eventhough they involve certain restrictions [21]. Transects have been used in many wolf status studies on the Iberian Peninsula [9,22-24 among others]. Species presence can be determined using sampling transects to obtain a relative abundance index and to locate breeding areas during the breeding season. Furthermore, the use of simulated howling to elicit responses during census work and in specific studies is widely reflected in the literature [25-29 among others]. Response to simulated howling is higher in summer and autumn, when packs focus on tending pups in the meeting areas or "rendezvous sites" [27].

This paper aims to assess the usefulness of the combined use of transects and simulated howling as an inexpensive methodology to locate wolf packs and to detect pup presence.

Study period and area

The study was conducted throughout the wolf distribution range in Asturias (6.800 km^2) as defined in the study by Llaneza and Ordiz in 1999 [11] (Fig.1). The study area is in the NW of the Iberian Peninsula, and covers a large part of the Cantabrian Range. Fieldwork was carried out between July and the first half of November 2001, when it is easiest to detect packs in the period from when pups are roughly 1-2 months old until they usually leave the rendezvous sites.

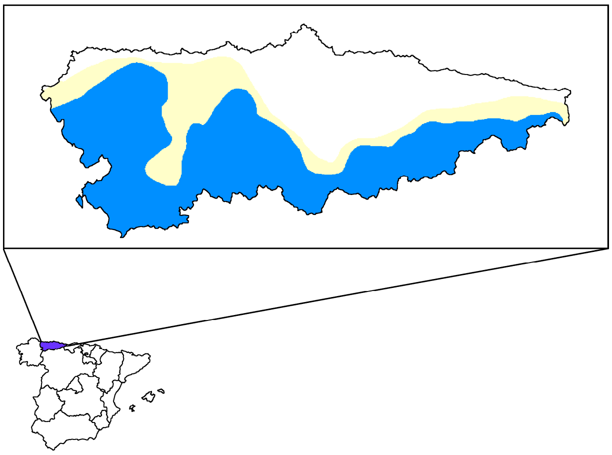


Fig.1. Study area and wolf distribution range in Asturias. Blue: Usual wolf range; Yellow: occasional wolf range.

Material and methods

We used indirect and direct sampling methods. The former involved transects to detect signs of wolf presence in accordance with a selective sampling approach. The latter involved howling and observation points [23] and depended on the results from transects and the information available from previous studies.
Two indirect sampling methods to locate scat and scratch marks were used:
1. Transects on foot. Areas where there was a high probability of locating signs were given priority. Transects with forest trails, firebreaks and trails that at least partly crossed mountain passes, hill ranges or cross-trails were selected.
2. Motorised transects. Transects at suitable sites were covered in 4wd vehicles, particular care being taken when sampling crossroads and hill ranges.
The transects ranged from 1 to 15.4 km (Table 2). We calculated the KAI (Kilometric Abundance Index) to detect places with high sign concentrations. In the breeding season they may indicate the proximity of a litter. We don't use this index like wolves density index.
The direct sampling methods consisted of howling and observation points.
1.- Howling points**:** wolf response was elicited via human imitation of howling. At

every howling point, the respective researcher howled at 2-3 min intervals until either there was a response or three to four series had failed to elicit a reply. A single series consisted of 3 to 5 howls, each 5-8 seconds long, separated by a pause of 1-2 seconds, in accordance with Harrington and Mech [27]. Sessions started at sunset and were repeated during the early night-time hours. Howling points were spread over the area at sites that offered good conditions for simulated howling and for receiving responses over the entire area and thought to be a possible breeding area according to the results of the abovementioned indirect methods. Howling sessions took place between August and October as, in the NW of the Iberian Peninsula (unpublished data), this is when pups usually remain at the rendezvous sites and the reply rate reaches a prolonged peak [27]. As wolf packs tend to change rendezvous site location and may not respond, we spent 3 consecutive nights howling over each possible breeding area. When no response was obtained, we sought other information, such as sign concentrations, to assess possible pack presence and breeding (Table 1). No attempts at simulated howling were made on rainy or windy nights as wolf response and howl audibility would have been reduced.

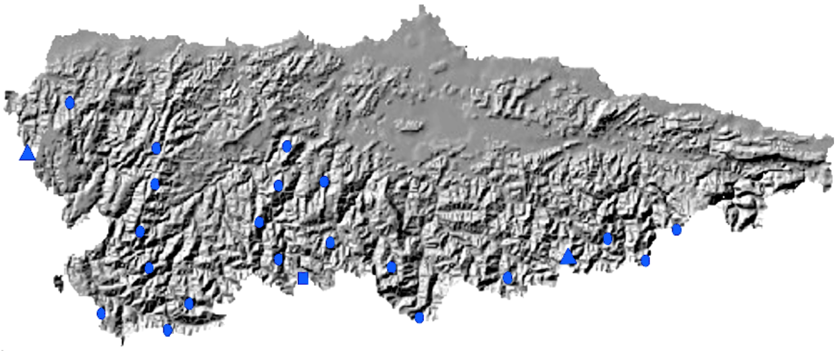
2.- Watching or observation points were mainly selected according to two criteria: a) for having a broad field of view over the supposed breeding area**;** b) places with a narrow field of view were only used when the probability of observing wolves was high (according to data provided by other methods). The latter were only used on a few occasions. Observation points were manned at sunset and sunrise, using 8 x and 10 x binoculars and telescopes with 20-60 x zoom lenses.

Criteria were established using all the information obtained during the fieldwork to determine pack presence and breeding (Table 1). They enabled us to detect packs which did not respond and packs which did not reproduce during the study period. Our wolf population monitoring, based on pack detection, did not permit estimates of the non-breeding fraction of the population.

Table 1. Criteria established to determine pack presence and breeding. KAI: wolf presence signs Kilometric Abundance Index.

<table>
<tr><td rowspan="7">Pack definitely present</td><td rowspan="5">Breeding definite</td><td>Wolf pup replies to simulated howls</td></tr>
<tr><td>Direct observation of pups</td></tr>
<tr><td>High concentration of signs near traditional breeding areas and the pack replies to simulated howls during the breeding season.</td></tr>
<tr><td>Reliable information on pup presence.</td></tr>
<tr><td>Dead pups</td></tr>
<tr><td rowspan="2">Breeding likely</td><td>Concentration of signs in a specific area during the breeding season. KAI > 1[1].</td></tr>
<tr><td>Information about the existence of a pack in the area and evidence of presence in the breeding season.</td></tr>
<tr><td rowspan="2">Pack likely to be present</td><td colspan="2">Information about possible presence of a wolf pack.</td></tr>
<tr><td colspan="2">Concentration of signs in a specific area during the breeding season. KAI<1</td></tr>
</table>

[1]: the KAI value = 1 has been arbitrarily assigned, based on KAI values and reproduction status obtained in previous years.



● Pack definite, breeding definite. ■ Pack definite, breeding likely. ▲ Pack likely.
Fig. 2. Breeding wolf packs located in Asturias.

Table 2. Average KAI (Kilometric abundance index) values for transects assigned to each pack.

Pack Code	N.T.	A.T.L.V.	Mi.T.L.	Mx.T.L.	A.KAI.V.	Mi.KAI.V.	Mx.KAI.V.
1	6	3.60 ± 0.61	2.00	6.2	0.16 ± 0.05	0	0.29
2	7	4.10 ± 0.28	3.10	5.30	0.77 ± 0.24	0	1.56
3	5	5.44 ± 0.64	3.70	6.80	0.85 ± 0.25	0.27	1.43
4	2	13.35 ± 2.05	11.30	15.40	1.30 ± 1.04	0.26	2.34
5	5	6.20 ± 1.23	2.90	8.90	2.10 ± 0.98	0.11	5.50
6	4	2.57 ± 0.50	1.60	3.90	4.76 ± 1.09	2.48	7.70
7	4	6.42 ± 1.29	4.50	10.20	1.18 ± 0.44	0	2.07
8	1	-	-	4.90	-	-	3.06
9	5	3.70 ± 0.46	2.60	5.10	1.74 ± 0.45	0.53	2.86
10	4	4.87 ± 0.69	3.50	6.50	1.20 ± 0.46	0.55	2.57
11	2	6.15 ± 1.35	4.80	7.50	1.12 ± 0.08	1.04	1.20
12	3	5.67 ± 0.60	4.50	6.50	1.73 ± 0.87	0.33	3.33
13	3	2.83 ± 0.17	2.50	3.00	0.89 ± 0.59	0	2.00
14	3	3.17 ± 0.44	2.50	4.00	1.64 ± 0.94	0	3.25
15	2	3.80 ± 1.20	2.60	5.00	1.49 ± 1.11	0.39	2.60
16	3	6.17 ± 0.44	5.50	7.00	0.62 ± 0.22	0.18	0.86
17	3	2.33 ± 0.33	2.00	3.00	0.78 ± 0.62	0	2.00
18	2	7.00 ± 2.50	4.50	9.50	1.27 ± 1.17	0.11	2.44
19	4	2.90 ± 0.60	1.20	3.90	2.31 ± 1.28	0	5.00
20	3	4.37 ± 2.39	1.00	9.00	1.11 ± 0.95	0	3.00
21	6	2.92 ± 0.35	2.00	4.50	0.33 ± 0.15	0	0.80
22	2	3.00	3.00	3.00	1.67 ± 0.33	1.33	2.00
23	2	2.50	2.50	2.50	1.80 ± 1.80	0	3.60

N.T: Number of transects. **A.T.L.V.**: Average Transect Length Value for each pack. **Mi.T.L.**: Minimum Transect Length. **Mx.T.L.**: Maximum Transect Length. **A.KAI.V.**: Average **KAI** value for each pack. **Mi.KAI.V.:** Minimum KAI value in a transect. **Mx.KAI.V.**: Maximum KAI value in a transect.
Note: Distances are given in kilometres.

Sampling

Six researchers sampled one hundred and twenty one (121) transects (544.5 km) during the fieldwork, involving a total of 314 howling points and 79 observation points.

Results

Twenty three (23) wolf packs were estimated to be in the study area. Twenty one (21) of them were confirmed and 2 considered likely (Fig. 2) in accordance with the established criteria.

According to the results of the transects sampled per pack, an average KAI (Kilometric Abundance Index) value of over 0.5 was found for 91.3 % of packs. Only 2 packs had an average KAI value lower than 0.5 (Table 2). A KAI value of over 1 was recorded for 69.5% of packs, with a maximum for average KAI value for a pack of 4.76 (Pack "6", Table 2).

Eighty three percent (83%) of packs (n=19) were located using howling points, and a further 4% (n=1) via the observation points, but after the study period (Table 3). Between July and early November, there were four sightings from the observation points: one adult and four pups from one pack and at least two pups from another.

Table 3. Results of howling and observation points assigned to each pack.

Pack Code		N	Pos.	Cont.	Adults	pups[1]
1	**How. P.**	28	1	1	2	+
1	**Ob. p.**	4	-	-	-	-
2	**How. P.**	24	-	-	-	-
2	**Ob. p.**	3	-	-	-	-
3	**How. P.**	14	1	-	1-2	+
3	**Ob. p.**	3	-	-	-	-
4	**How. P.**	6	3	3	≥2	+
4	**Ob. p.**	3	3	3	0	≥2
5	**How. P.**	21	0	0	0	+
5	**Ob. p.**	10	0	0	0	2
6	**How. P.**	5	2	2	≥2	+
6	**Ob. p.**	6	1	1	1	4
7	**How. p.**	4	2	2	2-3	+
7	**Ob. p.**	1	-	-	-	-
8	**How. p.**	2	2	2	3	+
8	**Ob. p.**	2	-	-	-	-
9	**How. p.**	10	1	1	2-3	+
9	**Ob. p.**	2	1	1	1	-
10	**How. p.**	27	1	1	1	-
10	**Ob. p.**	4	-	-	-	-

Table 3. (cont.)

Pack Code		N	Pos.	Cont.	Adults	pups[1]
11	**How. p.**	2	1	1	2-3	+
11	**Ob. p.**	1	-	-	-	-
12	**How. p.**	8	1	2	1	+
12	**Ob. p.**	2	1	1	1	0
13	**How. p.**	3	3	3	3	+
13	**Ob. p.**	1	0	0	0	0
14	**How. p.**	4	1	1	3	+
14	**Ob. p.**	1	0	0	0	0
15	**How. p.**	8	1	1	0	+
15	**Ob. p.**	2	0	0	0	0
16	**How. p.**	3	1	1	0	+
16	**Ob. p.**	3	0	0	0	0
17	**How. p.**	5	1	1	≥2	+
17	**Ob. p.**	2	0	0	0	0
18	**How. p.**	14	1	1	0	+
18	**Ob. p.**	7	0	0	0	0
19	**How. p.**	16	1	1	≥2	+
19	**Ob. p.**	2	0	0	0	0
20	**How. p.**	16	0	0	0	0
20	**Ob. p.**	2	0	0	0	0
21	**How. p.**	18	1	3	1-2	+
21	**Ob. p.**	3	0	0	0	0
22	**How. p.**	2	2	2	2	+
22	**Ob. p.**	2	0	0	0	0
23	**How. p.**	1	1	1	1	+
23	**Ob. p.**	4	0	0	0	0

How.p: Howling points; **Ob.p**: Observation points; **N**: Number; **Pos**: Number of howling or observation points with positive results; **Cont**: Number of contacts with wolf/wolves.
(1): The "+" symbol means that pups responded to simulated howling or that the researcher considers that pups participated in group responses, but is unable to estimate pup numbers.

Discussion

The results indicate that using simulated howling to detect wolf packs can be very effective. Some authors consider this method very useful to estimate the number of packs in small areas [29-31], and especially to confirm information obtained using other methods [23,30,31].

Using howling points together with sampling transects reduces the limitations of simulated howling, as a pack may be present but not reply to simulated howls [27,30]. Signs concentrated in an area may be used to estimate pack presence where there have been no responses to simulated howling. Surveying for signs makes it possible to ascertain changes in pack breeding sites, thus helping to solve, or at least minimise, the problem of pack dynamics highlighted by Blanco and Cortés [30]. The use of simulated howling is not recommended for large areas because of the financial cost and the effort involved [29,30,32]. Nevertheless, the many studies conducted in Asturias have shown that prior information reduces the effort needed to locate breeding sites. If breeding sites are located, which usually results at first in high KAI values, the number of howling points can be reduced, efforts being focused on areas with high sign concentrations.

We are aware that this methodology presents certain problems. Firstly, it is more difficult to locate small packs because of their lower response rate to simulated howling compared with large packs [27]. Secondly, adverse weather conditions reduce the probability of locating packs via simulated howling. Poor knowledge of the area and a lack of prior information should not be obstacles to applying this methodology, but they do considerably increase the effort needed to obtain the sort of results possible if data is abundant and knowledge of the terrain good. Finally, possible echoes and the acoustic structure of wolf choruses [33] make the exclusive use of simulated howling unsuitable for estimating pack size.

Fuller and Sampson [29] tested a survey method proposed by Harrington and Mech [27] for small areas based only on simulated howling**.** Sampling a 1400 km^2 area, they located 5 out of 6 (83.3%) of the wolf packs present in the area using 133 different howling points (26.6 howling points / pack located). They concluded that simulated howling can help in locating wolf packs in relatively small areas, but would be very expensive to detect important changes in the total number of packs in large areas. With prior information, using sampling transects and sampling an area 5 times larger, we located 19 wolf packs (16.5 howling points / pack located) by means of 314 howling sessions. However, we were unable to ascertain the percentage of packs missed. The next step would be to test the method in areas where the number of packs is known in order to gauge its accuracy**.**

Despite these drawbacks, our results and those obtained in previous studies [11,13] suggest that using sampling transects, together with howling points, could be useful for estimating the number of packs in a specific area, and that the size of the area to be sampled and the existence or absence of prior information affect the financial outlay required to obtain reliable results. We propose estimating the number of packs in an area based on howling points combined with sign survey transects during the breeding season, conducting a “saturation census” as proposed by Harrington and Mech [27] in areas where sign concentrations suggest the presence of litters. This greatly reduces the area prospected via simulated howling. In areas with no howling points or wolf response, the criteria established, including all the available information, enable us to estimate pack presence. Further work is needed to estimate the percentage of packs missed.

Studies conducted in other areas of the Iberian Peninsula, e.g. Barrientos [34], have highlighted the effectiveness of observation points in providing information on the minimum number of members in a pack. In our study, they provided little information in this respect. We believe that the reduced effectiveness was due to the orography, vegetation and climate in the Cantabrian Mountains. To obtain large-scale quantitative results in such an area using this method would require enormous effort. Additional methods, such as radiotracking or genetic analysis, would be very advisable.

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