"Demarcating Livestock Routes: A Methodological Proposal for Enhancing Transparency and Legality in Land Management and Linear Infrastructure Development"

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Abstract:

Livestock roads are an essential part of our cultural and natural heritage, and their conservation is crucial for maintaining the balance of the environment and socioeconomic development. However, the lack of demarcation of these routes can lead to conflicts between individuals and the public domain, hindering plans and programs proposed by the administrations.

To address these challenges, the University of Huelva has developed a comprehensive methodology for the demarcation of livestock roads, which responds to criteria of transparency and legality. This methodology includes specific and clear phases, such as the interpretation of sketches, investigation of documentary collections, and topographic survey, leading to the generation of demarcation plans for the cattle tracks.

Moreover, the use of new geographic information technologies allows for a multifunction digital representation of these routes, enabling their cataloging for better conservation and use. With the addition of digitized references from the Cadastre, the exact limits of the cattle tracks can be registered in the Property Registry and the Cadastre, representing them as a parcel.

The innovative use of historical cartography and the latest in information and communication technologies not only allows for the exact demarcation of livestock roads but also provides a glimpse into their past and enables their protection and promotion as cultural and landscape assets.

This methodology is a solid foundation for a comprehensive plan that responds to the demand of the administrations to determine the exact number of cattle tracks and resolve ownership of land between individuals and the public domain. By using this methodology, the demarcation of livestock roads can contribute to the development of linear infrastructure and land management programs, benefiting the environment and socioeconomic development.

Key Policy Highlights:

- Demarcating livestock roads is crucial for maintaining the balance of the environment and socioeconomic development.
- The lack of demarcation of livestock routes can lead to conflicts between individuals and the public domain, hindering plans and programs proposed by administrations.
- The University of Huelva has developed a comprehensive methodology for the demarcation of livestock roads that responds to criteria of transparency and legality, including specific and clear phases such as the interpretation of sketches, investigation of documentary collections, and topographic survey.
- The use of new geographic information technologies allows for a multifunction digital representation of these routes, enabling their cataloging for better conservation and use, as well as their registration in the Property Registry and the Cadastre.
- The innovative use of historical cartography and the latest information and communication technologies not only allows for the exact demarcation of livestock roads but also provides a glimpse into their past and enables their protection and promotion as cultural and landscape assets, contributing to the development of linear infrastructure and land management programs.

Keywords; Livestock Roads, Demarcation, Environmental Evaluation, Geographic Information Technologies, Land Management, Linear Infrastructure, Cattle Tracks, Territorial Balance, Socioeconomic Development

1. Introduction

This article presents a summary of a research study to develop a methodology for the demarcation of livestock roads.

This study is part of a project being carried out by the University of Huelva, in said province, whose main objective is to develop a Strategic Environmental Assessment methodology for railway infrastructure plans and projects, which allows the development of models for the assessment of environmental effects. , territorial, socioeconomic aspects of the possible Huelva (Spain) – Algarve (Portugal) rail connections, as well as carrying out an evaluation of the results obtained, in order to quantify the impacts of said connections on mobility, territorial balance, the environment and socioeconomic development.All this through a Multi-criteria Evaluation in which both environmental and technical aspects will be taken into account and the corridors of maximum aptitude and minimum impact will be obtained through which the railway connection between these two territories should run.

For this, as a starting point, factors of environmental, qualitative and quantitative importance are taken into account, such as the landscape, biodiversity, land use, etc., and especially, it is intended to know the exact route of the livestock routes and the possible conditions that could appear on these roads in the public domain due to the optimal layout of the railway connection, in order to correctly integrate these environmental elements into the linear infrastructure plans, and thus achieve a harmonious articulation of this network of ancestral roads(Vidal-González, 2022).

Livestock roads, assets in the public domain, are economic, historical, social and natural heritage to be preserved(Ruiz & Ruiz, 1986). This large road infrastructure is a huge network of livestock trails of different widths, approximately 125,000 km. in all Spain. What supposes a total extension of 421.00 hectares.

Livestock roads in Spain are classified into four categories (Martin Casas, 2003) according to their width:

- Cañadas: up to 75 meters wide.
- Strings: up to 37.5 meters wide
- Sidewalks: up to 22 meters wide.
- Coladas: any cattle trail of less width than the previous ones.

The Andalusian Autonomous Community has more than 30,000 km., which occupy more than 110,000 km. Livestock trails are considered authentic ecological corridors, essential for migration, geographic distribution, genetic exchange of wild species and for constituting an instrument that favors man's contact with nature(Tipping, 2018). In this community, the cattle trails are regulated by Decree 155/1998, of July 21, which approves the regulations for cattle trails of the Andalusian Autonomous Community.

The livestock trails take on even more importance after the Lille Declaration, for a European green network, in September 2000, which reflects the decision to develop, on the part of the European countries and regions, with the support of the European Union and the European Association of Greenways (AEWA), a "European Green Network" that satisfies the great demand for equipment for the development of non-motorized displacements(*Association Européenne Des Voies Vertes*, 2000), the practice of active leisure activities in contact with nature in complete safety and that contributes to the development sustainable tourism that renews the local socioeconomic fabric, improves the preservation and diversification of the landscape, especially in urban environments, and revalues the cultural and historical values of the municipalities it crosses;all focused on improving the quality of life in rural and peri-urban areas(GONZÁLEZ ALGARRA, 2001).

Inspired by this declaration, the Rever Med Project (European Green Network of the Mediterranean Framework) arises, whose objective is the design of an authentic European Green Network of more than 10,000 km in the Western Mediterranean Arc, extended to Portugal and Italian Adriatic regions. , extended to inland regions, also included in the Western Mediterranean Area(Ioannis & Doukas, n.d.) and a total of 27 public administrations and 4 technical partners, belonging to the countries of Spain, Portugal, France and Italy, participate in the development of this Project. Spain corresponds to 4,765 km, which constitutes 44% of the total, with the Autonomous Community of Andalusia being the region with the greatest potential(Pardoel, 2020).

The objective of REVERMED (*Association Européenne Des Voies Vertes*, 2000)is to have both continuous long-distance itineraries and a local network for non-motorized travel and leisure at the local level, complemented by a series of services that guarantee their interest, maintenance and safety.

The REVERMED Project is part of the Community Initiative for Transnational Cooperation Interreg III B MEDOC (Western Mediterranean Area), following the model already started in Northern Europe, known as REVER AMNO, approved by the European Commission within the Interreg II framework. C. This first project covers the North-West Metropolitan Areas made up of Ireland, the United Kingdom, Belgium, Luxembourg, Northern France, the Netherlands and Germany, with the Walloon region (Belgium) assuming leadership.

The creation of a Green Network has a positive impact on social, economic and environmental aspects that can materialize in the following benefits (HERRERO TEJEDOR, 2005):

- Satisfy the social demand for open spaces for outdoor leisure and sports, in contact with nature.
- Promote other forms of non-motorized travel by stimulating intermodal transport.
- Establish a new relationship between the countryside and the city by introducing environmental connotations in the design of cities.
- Recovery, maintenance and enhancement of assets in the public domain and/or natural and cultural heritage.
- Sustainable development supported by ecotourism and creation of services.
- Diversify the tourist offer favoring the flow of saturated areas (eg coastal) to others little exploited (eg inland).
- Revitalization and socioeconomic diversification of rural, peri-urban or degraded areas in general.
- Creation of green corridors that link unique natural spaces and especially those included in the Natura 2000 Network.
- Constitute an ideal support for environmental education.
- Promote biodiversity. Many sections of the Network will meet the conditions to be considered authentic ecological corridors.

In order to achieve this plan, it is necessary to have the ancestral livestock routes that, since the time of the Honest Council of La Mesta in the ancient kingdoms of Castile and Aragon, have been traveled by cattle and that are currently, in many cases, invaded by buildings, cuts in the layout and other impediments that make them impassable (Torres García et al., 2020). That is why the need for these routes to be expedited and for this the demarcation of the same is mandatory.

The demarcation of a cattle route is the act by which the coordinates of the limits of the route are legally defined and consequently, the practicable width for the application of the restoration models of each type of use. The demarcation of cattle trails has important legal, economic, political, social and environmental repercussions.

Currently there are no general instructions for the demarcations of the cattle routes, so that the methodology used for this purpose is left to the judgment of the administrations

that carry it out, or rather to the judgment of the technician who directs the demarcation projects.

In order to carry out an adequate management of the cattle routes, it is necessary to have the corresponding demarcation files approved. And this is so because, in addition to the fact that the approval of the demarcation file reinforces the legal certainty of the neighboring interested parties, who in this way can know precisely the limit of the land that the Administration considers public property, because various jurisprudence has understood that it is not A disciplinary file can be resolved for an improper occupation of a property in the public livestock domain if the demarcation is not previously approved(PRIETO MORIN, 2005).

The objective of this study consists of framing some technical guidelines aimed at requiring, by the competent Administration, compliance with the conditions set out in general instructions, with the preparation of studies, in the technical procedures for the demarcation of livestock tracks. technicians that perfectly justify a consistent demarcation line, pursuing that the sentences against the demarcations handed down are favorable to the Administration, avoiding having to process the demarcation files again.

On the other hand, it is intended to take advantage of the use of new geographic information technologies in order to obtain a multifunction digital representation of the livestock routes that allow their cataloging for better conservation and use of this heritage.

2. Methodology

The methodology followed for the procedures of the technical part of the demarcation work, both in the office and in the field, is explained below.

2.1 Interpretation of description and classification sketches

This meticulous work begins with the work in the office interpreting the textual description of the cattle trail that appears in the Huelva cattle trail classification project, the province in which the Strategic Environmental Assessment is being carried out.

In this Classification project the information of its extension, width, code, orientation and numbering with respect to the classification for each municipal term appears, in addition a description of the layout of the road is made in which they are considered: places, place names, accidents of the land (streams, etc.), properties (according to the allocation in the cadastre of the time), infrastructures (houses, farms, farmhouses, water troughs, etc.), orientations, paths, crossings, turns, conditions, intrusions, etc.

The classifications vary in their content depending on the time in which they were carried out, in some they are spoken only in reference to place names, trails and known places,

in others they are also considered properties of properties with the names of the owners of yesteryear, in the most recent even includes a descriptive sketch or even a list of UTM coordinates that is associated with places of interest or the axis of the road (although the latter is not legally defined until the demarcation).

2.2 Investigation of documentary funds

2.2.1. Collection of documentary collections

In order to obtain the possible documentary and administrative background generated over time by the existence of the livestock route whose demarcation is going to be made, all the Archives and Documentary Funds must be consulted, in which there may be descriptive or representative mention of the cattle track. These documentary funds work in the following competent bodies:

1) From the National Geographic Institute in the Department of Documentation and Archive:
   - The Planimetric Sketch of the area that was carried out by the Law of August 24, 1896 for the Rectification of the Evaluatory Cards.
   - National Topographic Plan, sheets 1:25,000.
   - National Topographic Historical Plan (General Directorate of the Geographic and Cadastral Institute), sheet 1:50,000
   - Documentary sources of CAMINERÍA HISPANIC
   - Historical Plans.
2) From the General Directorate of Cadastre of the Ministry of Finance, in its Provincial Territorial Management Office
   - Current cadastral plan
   - Cadastral Historical Plan (from 1940-1960)
   - old cadastral records(MINISTRY OF FINANCE (Spain), 2002)
   - Current cadastral certificates.
3) From the Ministry of the Environment
   - Documentary Fund of Livestock Routes of the General Directorate of Nature Conservation of the Ministry of the Environment (formerly ICONA).
   - Demarcations of cattle roads made in the past (1934).
   - Classifications made in the past.

4) From the National Historical Archive

- Documentary background. Mesta section.

5) Of the Provincial and Municipal Archives, in addition to the archives of Provincial Councils
   - files

6) From the Ministry of the Environment of the Junta de Andalucía, both in the Central Services and in the Provincial Delegations
   - Projects for the classification of the cattle routes of the municipal terms (with their sketches).
   - All documentation and reports made for each livestock route.
   - ACERVO data information.
   - Documentation regarding the Recovery Plan for Livestock Trails in Andalusia.

7) Other Departments of the Ministry of the Environment
   - Topographic surveys or boundaries of the mountains.
   - Riverbed plans in the public hydraulic domain
   - Land maritime public domain plans
   - Map of Protected Natural Areas
   - vegetation planes
   - Flora and Fauna Plans
   - Floor Plans
   - Etc.

8) From the Ministry of Culture of the Junta de Andalucía
   - Plan of Archaeological Sites and assets of the historical heritage of the Andalusian Autonomous Community.

9) From the Ministry of Public Works and Transport
   - Road infrastructure plans (roads and railways)

10) From the Ministry of Housing
   - Plans of areas declared urban and developable.
   - Plans of the Subsidiary Regulations of the Municipalities
   - Plans of the General and Partial Plans of the PGOU

11) of the municipalities
   - Plans of the Subsidiary Regulations of the Municipalities
   - Plans of the General and Partial Plans of the PGOU

12) From the Cartographic Institute of Andalusia

- Aerial photographs of the area.
- Orthophotographs of the area, including:
    - From the year 1956/57 (American flight)
    - from the year 1977
    - from the year 1984
    - from the year 1998
    - from the year 2001
    - from the year 2004
    - from the year 2005
- Navigation charts.
- Historical Plans
- Infrastructure Plans

13) From the Geographical Center of the Spanish Army

- Plans of the Spanish Army
- Map of Andalusia 1:50,000 1940-1944 of the General Staff of the German Army

14) From the Land Registry.

- Simple notes of the adjoining and affected parcels
- Registry Files

2.2.2. *Descriptive and cartographic analysis procedure*

Once the content of the description and its attached sketch have been studied, a process of analysis of the elements that appear in it is carried out, so that, using all the documentary information sources obtained, the limits of the road are investigated. , using a feedback method in which the textual description of the classification is based on, in successive steps, inferring the georeferenced layout in the most up-to-date orthophotography of the cattle trail.

It is also possible that there is a section in which during the administrative process, as a consequence of the allegations presented, it is considered necessary to carry out a study to reinforce or propose a modification of the proposed demarcation. In this case, it will be necessary to carefully study the allegations and studies presented by those affected, analyzing what they are based on when questioning the demarcation.

It is a matter of identifying all the data previously described in the different analysis cartographies, which in turn can provide some data or element that can serve as an indication or confirm the layout.

It is essential to search the plans for evidence of the route of the path that we will recognize as a livestock route, and for this reason the more cartography is used, from different sources and times, the more details of the route are obtained.

The use of Spatial Data Infrastructure technologies makes it possible to reference the elements of the route of the livestock route in adapted and visualizable cartography (orthophotos and digital plans) with Geographic Information Systems (GIS) computer programs(Plaza et al., 2023).

To be able to work with this technology, it is necessary to have cartographic material ortho-referenced to a given coordinate system and Datum, such as orthophotographs and ortho-referenced maps of the mentioned sources, in RASTER or VECTORIAL.

In the case of old cartography, which is not in orthoreferenced format, in addition to the fact that the scale may not be exact, and may even be referred to in Castilian rods instead of meters, a digitization and superimposition process must be carried out by geocoding,using for this the GIS (Arc-Gis) and programs for the generation of plans (Autocad).

On the other hand, the study of place names and names that appear on the plans is of special interest, serving as clues for the analysis of the layout.

In image 1 you can see an example of geocoded superimposition of the 1896 planimetric sketch plane on an aerial orthophotograph from 2001.

Image 1. Cañada Real de Niebla in Paterna del Campo (Huelva)

Superimposition by Geocoding of the 1896 planimetric sketch of the Cadastral Geographic Institute on the orthophotography of theyear 2001 of the ICA (Cartographic Institute of Andalusia)

In this example, we can see the place names from the 1896 sketch, which we tried to contrast with those that appeared in other cartographies from different periods, seeking to specify the area of analysis.

An analysis of the layout can be made over time by viewing the plans and their descriptive content in chronological order. The layout over time of the Cañada Real de Niebla in Paterna del Campo can be seen in the different images shown below (Images 2, 3, 4, 5, 6, 7 and 8). It can be observed at this point how the nature of the land has changed, appearing new uses of the land, private occupations, infrastructures, new constructions, while other elements disappear.

Image 2. Same stretch of La Cañada in 1:50,000 cartography from the National Geographic Institute (IGN) from the year 1938

Image 3. Same section in cartography of the IGN, 1:50,000 of the year 1948

Image 4. Same section as the previous illustration but with baselines of the cattle track on orthophoto from 1956 of the American flight.

Image 5. Same section on the 1:50,000 map of the 1976 IGN
Image 6. Same section in superimposed aerial photography from 1977
Image 7. Same section in map 1:50,000 of the IGN of 2003
Image 8. Same section Google Earth satellite photography

In this sense, experience shows that the best references available are photographs, both aerial and on the ground. These provide essential information (when analyzed in all their chronological series) for the search for indications of the route of the livestock route, such as roads, open fields (in the case of resting troughs), respected unbuilt areas, etc.

Together with this cartographic analysis, all the textual information must be considered, in which many details can be found that indicate something about the route of the livestock route to be demarcated. This textual information can come from the following:

1. The reports made in the Department over the years regarding occupations, authorizations for longitudinal fencing to the road, route modifications, road conditioning authorizations, complaints made, etc.
2. Documentation of the Ministry of Public Works regarding road works or expropriations carried out in the past.
3. Historical archives of the Mesta and/or General Association of Cattlemen.
4. Minutes of the topographic surveys carried out in the limits of the municipal term in the 80s and 90s of the 19th century.
5. Description of the adjoining properties in the old cadastral and registry files.

It is about defining the probable line of demarcation. Once the section of livestock track has been defined and the administrative and technical background has been analyzed, a probable delimitation of the limits of the livestock public domain will be drawn on the aerial photographs and other plans.

The areas that, a priori, seem most problematic, will be identified on these photographs, in order to focus on them more exhaustively when going to

field.

It may be the case that there is no clear identification of the route because the elements that appear in the description are not well defined. In this case, you can resort to historical cartographies that can serve as support, clarifying the investigation. To obtain more data on the same section of the Cañada Real from Torre del Campo to Cazalilla (Jaén) at different times (Images 9, 10 and 11), historical cartography of the area is used.

Image 9. Cañada Real from Torre del Campo to Cazalilla (Jaén), orthophoto from 2002

Image 10. Same section in the "Geographical Map of the Kingdom of Jaén" from 1787.

Image 11. Same section in the "Map of the Kingdom of Jaén" from 1727.

At this point, it can be said that there is a basic cartography for the livestock route that is being studied, which includes:

- Actual state
- historical state
- descriptive details
- other analysis references.

2.3 Restitution of base cartography

In the previous point, there would be a referencing of the general layout of the study section, for which a restitution of the details of the terrain will be carried out by a photogrammetric survey of a strip of land 150 meters wide along the layout of the road to be demarcated, the central reference being the axis of the cattle track itself, with the double objective of identifying the details in the field and representing these details in the final plans as well as many others that will be seen.

Before carrying out the comprehensive topographic study of the route of the livestock route, this phase is addressed, in which the photogrammetric technique used is based on orthophotographs carried out in Andalusia by the Andalusian Cartographic Institute and which we have in different series by time of realization, although the one that interests us to use is the most recent, either the one obtained from a regional project embodied in a 1:10,000 mosaic with a level of detail with a geometric resolution of 0.5 meters, or an existing local project carried out in a special flight with even higher level of detail resolution.

About four years ago, for this study, a specific flight was carried out with airplanes, but currently all of Andalusia is orthophotographed, which does not make it necessary to carry out a specific flight for the study of a cattle track.

These orthophotographs in digital format are processed on the platform in a digital photogrammetric station validated in all its characteristics and algorithms, trying to develop a cartography that will be reliable as long as the quality protocols for these cases are met, and specifically the Aviation Standards. Civil and the Higher Cartographic Council.

The restitution (Image 12) is carried out adjusting model by model in order to be able to work by means of aerial triangulation (aerotriangulation) using the AeroSys 3.0 tool.

With this methodology, optimal precision of the square mean errors is guaranteed in each and every one of the points obtained in the field, obtaining a restitution scale of 1-2:000 in order to be able to compare with the cartography obtained from the topographic survey of the road and the cartography of the current digital cadastre(LERMA GARCÍA, 2000).

The following are restored in the 150-meter strip: the cattle track (what remains as a road), other roads, plot boundaries, any type of construction, trees and scrub, hydrography, power lines, etc., that is, all the planimetry inside the trace.

Subsequently, the digital model of the terrain made in different series by the Andalusian Cartographic Institute and/or National Geographic Institute is coupled, which covers the entire Andalusian territory in different series made.

The results (Image 13) that are going to be obtained have a dimension and scope that will allow a series of conclusions that can be decisive in the study of the demarcation of the road, although it is possible that the digital restitution does not represent all the details of the terrain because the orthophotography is not very recent and something has changed in the terrain, for which we proceed in a subsequent step to another in situ restitution as will be seen later.

Image 12. Photogrammetric restitution of the Vereda del Carril de los Coches in Niebla (Huelva)

Image 13. Same section with background of orthophotography from 2002 in black and white, which includes the baselines.

2.4 Material reconnaissance in the field

By means of a meticulous recognition of the current state of the livestock route to be demarcated, according to the documentary collection compiled and the base cartography created in the office, its route and those defining points that can be used for the correct location of the strip of land recognized as a route are identified. livestock.

This procedure consists of the in situ georeferencing of the elements considered in the previously generated base cartography.

It is especially helpful, in certain cases, the testimony of agents in the area or local people who may know or have been able to know in the past the route of the road, who remember the areas where cattle pass or who identify trails and places by the same toponymy.

It is important to try to identify all the elements that appear in the photogrammetric restitution of the area, because otherwise (either because some element no longer exists from the moment the orthophoto was taken, be it construction, wall, trees, etc. ,) a restitution must be made in situ, using a monofrequency GPS and describing the elements that did not appear or disappeared in the main photogrammetric restitution.

Finally, a real restitution of the route of the road will be obtained.

It is at this point that it is about reaching a criterion to determine certain reference points on the ground as well as establishing the one that will be taken as the central axis of the livestock route, for the subsequent topographic survey.

With the information obtained in the field together with that obtained in the cartographic analysis of the documentary collections, the base cartography is complemented.

2.5 Topographic Survey

The planimetry of a sufficient strip of land is carried out for the subsequent location of the baselines that define the cattle track to be demarcated, based on its legal width.

For this, the most up-to-date orthophotography available is taken, in this case the Andalusian Cartographic Institute, specifically the one from 2007, which is made at a scale of 1:10,000 and with a geometric resolution of 0.5.

A 1/8,000 scale photogrammetric flight could also be used, from which a topographic field support is made with 4 points per pair, placing stakeout bases along the entire trace for later purposes. baseline situation work.

Both for the support process and for the determination of the coordinates of the placed vertices, the high-precision GPS methodology will be used, guaranteeing visibility between the placed vertices.

With the support that is made, we proceed to the restitution of all the identifiable and necessary points to obtain the real parcel where the road runs.

Once the orthophotography has been obtained, all the significant territorial elements and those that allow the subsequent location of the strip of land considered a livestock route are represented by digitalization, as well as the infrastructures that affect it in their exact position and true form (electrical, telephone, , roads, paths, pipes, etc.), in addition to dumps, buildings, cisterns, ravines, etc.

We proceed to take into account the restitution carried out in the office and also in the field, placing all those details that, due to not having been identified in the photogrammetric restitution phase or being hidden in the frames, it has been necessary to reflect according to the requested scale. .

Next, we proceed to the graphical representation of all the observed points.

In this survey of the baselines of the cattle route, all the digital layers of cartographies of conditions that the route has are digitized, such as consolidated urbanized areas, protected natural spaces, public road domain, public hydraulic or maritime terrestrial domain, mountains, etc. .

Image 14. Representation of the baselines of the "Vereda del Camino de los Huertos" in Isla Cristina (Huelva) on an orthophoto from 1956

Image 15. Orthophoto from 2002, with superimposed layers that represent:

- *Mayado celeste: Natural Area "Marshes of Isla Cristina"*
- *Brown Mayado: Public forest of the Junta de Andalucía "Dunas de Isla Cristina" with ref.: 10.016.*
- *Yellow line: Demarcation of the Maritime Terrestrial Public Domain. (DPMT)*
- *Red line: DPMT protection easement area.*
- *Green line: Base lines of the limits of the Vereda del Camino de los Huertos*.

It can be seen in Image 15 how, apart from what is apparently logical, the livestock route does not fit the current road that did not exist in the 50s, as seen in Image 14, in which Base lines of the "Vereda del Camino de los Huertos" in Isla Cristina (Huelva) on orthophoto from 1956.

This case would be that of an overlap of public domains between public forest and cattle trail, in addition to overlapping of forests and maritime terrestrial public domain, that is,

for the characterization of that specific surface, a demanial mutation of one of the figures of protection in favor of the other through an administrative procedure of prevalence of public use.

Image 16. Orthophotograph of the year 2002 with the baselines of the cattle tracks that intersect: Vereda de Pozo del Camino a Lepe (West and north), Vereda del Camino de la Playa (south). Contains the layer of the general urban plan of the urban nucleus of La Redondela (green mayado)

For all this procedure, only digital technology is used, there is no survey by itinerary or radiation with tachymeter and level, all that is used are Geographic Information Systems with maps and orthophotographies georeferenced with databases, so that the work is It is done almost entirely in the cabinet, and the level of precision is much higher. In Image 16, the orthophotography of the year 2002 is presented with the baselines of the cattle tracks that intersect: Vereda de Pozo del Camino a Lepe (West and north), Vereda del Camino de la Playa (south).It is observed how, through the use of GIS, the baselines of this can be marked on the orthophotography of a section of cattle track.

2.6 Generation of demarcation plans of the livestock route

On the topographic survey carried out with the restitutions of the strip of land in plans at a scale of 1/2,000, the following are represented:

- the baselines of the road
- those boundaries of plots that, not being located in the field, do appear in the cadastral plans of the virtual cadastre of the Ministry of Finance.
- overlaps with highways, roads, hydraulic public domain, maritime terrestrial public domain, roads, ETC.
- the areas to be disaffected because they are urban according to Law 17/1999, of December 28, which approves Fiscal and Administrative measures. (BOJA no. 152, of 12.31.99)

It reflects, in addition to the situation of the baselines with their defining points, the toponymy of the area and the correlative adjoining properties to the cattle track, the necessary descriptive references, the location of the provisional staking and possible intrusions and occupations detected for their subsequent superficiation.

In a demarcation plan (Image 17) the following details would appear represented (apart from the layers mentioned above and the restorations):

- baselines with coordinates in ZONE 30 (fuchsia)

- Unaffected areas to the demarcation (red dotted)
- Cadastre parcel (orange dashed line)
- Borders (in square with polygon and cadastral parcel)
- Intrusions (in numbered circle)

Image 17. Lava flow from the Arroyo del Tejar (Huelva) (irregular-width cattle track); the greyish surfaces correspond to the superimposed layer of the unaffected urban area of the public domain where a section appears in a dotted line that is unaffected.

Finally, we have a plan represented in orthophoto of the route of the livestock route, based on the description and sketches of the Classification Project, with all the details of the survey, and prepared to carry out the act of demarcation in the field, considering that it may undergo changes after the allegations in the survey or in the period of public exposure, without forgetting the possible changes that could arise after a favorable appeal.

2.7 property investigation

Once the livestock route has been recognized and the baselines that define it based on the topographic survey carried out have been established, the ownership of the adjoining parcels is studied, creating an alphanumeric database of owners. To do this, consult:

- The files of the Territorial Management of the Cadastre of the province
- The files of the competent Property Registry,

This procedure begins with the study of the current cartography of the cadastre (which has already been carried out in previous points) attending to the holders that appear in the cadastral certificates issued by the Territorial Cadastre Management

Cadastral information is useful as long as it is graphic and descriptive. The cadastre, since ancient times, tries to map the different plots that form a mosaic, relating them to the cadastral files where the owner appears, although this document does not certify the ownership of the plot, since legal accreditation is only Gives the registry deeds of the plot and/or the deeds of sale.

It may even be the case that someone still appears as the owner in the current cadastre but after selling the property and not having notified the successor owner, the plot appears in the cadastre under the title of the first.

To ensure the property data, the property registry is always investigated, where it is tried to contrast the cadastral data (Image 18 and 19) with the registry (which do not have cartographic representation of the land), not always without problems, since The only way to know the limits of a plot, as well as the cattle tracks, is through a demarcation, as

provided by the Civil Code (articles 384 to 387, both inclusive) and the Civil Procedure Law (old, from 1881 and new , 2000).

These data obtained in the property investigation are contrasted with the ownership data of the old cadastre with its cartography in case of allegation in order to see the boundaries that appear in the descriptions of the classifications of the cattle routes.

Image 18. View of cadastral plots adjacent to the Vereda de Hinojos (Huelva), Virtual Cadastre, Ministry of Finance.

Image 19. Same parcels (some segregated) in the cadastral plan of the Cadastral Geographic Institute of 1945.

2.8 Obtaining proposed boundary plans

Once the formal act of demarcation has been carried out, and the base lines of the cattle tracks have been established on the ground, the final demarcation plan will be prepared. For this, and in the first place, those possible modifications of baselines that during said act and prior allegation, have been accepted by the Representative of the Administration will be carried out. Subsequently, by correlative identification to the right and left of the axis of the roads, the adjoining plots with their number referred to the cadastre (both plot, sub-plot and polygon) will be represented, as well as correlative numbering of the intrusions that affect them. The urban centers through which the roads cross will also be represented, as well as the buildings that could be affected by their passage.

Once the final demarcation plans have been drawn up, each of the existing intrusions and occupations will be surfaced, if any, identifying each of them and their nature, as well as indicating the type of enclosure and its length. All the data referring to intrusions and occupations will be dumped on the Alphanumeric Database of Owners, giving rise to the generation of the Adjacent and Intrusions lists as well as the Occupations lists.

Regardless of the possible intrusions made on the cattle track, the necessary information will be collected from each and every one of the adjoining properties for the registry modification if necessary.

2.9 Geotagging of the singular points of the livestock route

During the shoring procedure, photographs of singular points will be taken and a video of the route of the livestock route in both directions of the section can also be recorded.

With the photographs taken in the act of demarcation (Images 20 and 21) we proceed to geotag them in the proposed digital demarcation plan, as well as the digital video made,

so that once the plans have been implemented in a cartography (such as Google-earth itself) by clicking with the cursor on the points indicated on the maps you can see the photograph of the area in question and by clicking on the beginning of the road you can see the video of the route (either in mpeg format or others).

Image 20. Photo taken at the end of a stretch between pair num. 94, on the border of Santa Ana la Real and Almonaster la Real (Huelva)

Image 21. Taken between par 59 and 60 in a westerly direction, view of the Descansadero-Abrevadero de la Guerrera with the well and the pillar.

2.10 Study of the allegations presented and modification of the Proposals.

Once the demarcation file view process has been completed and the possible allegations to the Demarcation Proposals have been presented, they will be studied and analyzed to then carry out the pertinent technical-legal study. Once they are issued, they will be submitted for appropriate consideration, returning to the initial process, thus providing feedback to the analysis. Below, you can see (Image 22, 23, 24 and 25) the baselines of the Vereda del Carril de los Coches cattle track in Niebla superimposed on a georeferenced cartographic series for analysis in allegations, it includes:

- *Image 22. Base lines on planimetric sketch 1869.*
- *Image 23. Base lines on old cadastre from 1942.*
- *Image 24. Base lines on Orthophotography from 1956.*
- *Image 25. Base lines on orthophotography from 2005.*

The changes that could arise as a consequence of the estimated allegations will be incorporated into the graphic and alphanumeric documentation that make up the initial Boundaries Proposals.

3. Conclusions

With this method, the demarcations of the cattle tracks are achieved following specific and clear phases, since the demarcations must respond to criteria of transparency and legality since they are delicate administrative procedures that resolve the ownership of land between individuals and the public domain.

The different technical aspects that are studied in the present work can be the basis of a solid comprehensive plan that responds to the demand of the administrations to determine exactly by demarcating the number of cattle tracks that, in a high percentage, are today without delimit with the serious problems of occupations of the public domain by

individuals. In addition, these undemarcated cattle roads can operationally hinder the plans and programs that the administrations propose in the different areas that involve land management or linear infrastructure development.

To carry out the demarcation, work forms or models corresponding to each type of section studied are described, which respond to differentiated landscape typologies and conditions different from the public domain.

When digitized references from the Cadastre or similar organizations are added, the divergence that occurs when they overlap with the new representations that we obtain from the explained process can be observed. In the case of direct data collection on the limit lines and their subsequent representation, perfect synchrony is observed, hardly any divergence, while, in the case of the implementation with the aforementioned bases and the following comparison with the new cartography made from of the photogrammetric process, the divergence is exaggerated in some areas.

With Information and Knowledge technologies, it is possible to make cartography formats compatible, being able to register in the Property Registry and the Cadastre the exact limits of the cattle tracks, so that it is represented as a parcel.

The use of all kinds of historical cartography by georeferencing, geocoding or simply by its interpretation manages to increase the degree of precision when it comes to discerning the original layout of the route of the livestock route (Image 26), while allowing greater knowledge of its original nature, in addition to, once implemented in the GIS, it allows its visualization with the limits of the road represented, which gives it a possibility of cultural, didactic use, useful for subsequent historical-social and even archaeological investigations.

Image 26. Path of the Summits. Moguer. (Huelva) (Orthophoto of 2006 and map of the National Geographic Institute of 1930)

The classic procedure is innovated while the latest in information and communication technologies are used so that not only can the limits of the public domain be known exactly, but also its past can be known, singular points can be visualized with just click on an icon within the digital image or even watch a video of its journey, all with the multiple possibilities it provides for its management as a public asset, its protection and respect as a natural asset and its promotion as a cultural and landscape asset in the different frameworks: local, provincial, regional, national and community, serving for the programming of trails and routes, even for plans at a European level such as the Revermed Plan itself.

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