Space, time and movements: how bone refits can be used to reconstruct Neanderthal's occupational models: the case of Abric Romaní (Barcelona, Spain) and Riparo Tagliente (Verona, Italy)

Marta Modolo . Ruth Blasco . Jordi Rosell . Ursula Thun Hohenstein . Maria Chiara Turrini

ABSTRACT

Neanderthal's material remains have been studied from a variety of perspectives with the aim of reconstructing different life-aspects of these human groups. The arrangements of artefacts and features within archaeological sites have often been employed to isolate activity areas and draw inferences about site function. This assumes that objects found in close proximity, were used for the same task and that artefacts were usually discarded where they were used.

In this regard, refitting studies provide useful data in order to achieve some topics like: assemblage formation processes, post-depositional dynamics, settlement patterns, definition and integrity of stratigraphic units. The distribution of the remains and the connection lines documented by refitting, allow to understand the modalities of space-organization, how human groups divide themselves, how they relate to each other and the relationships between the site areas.

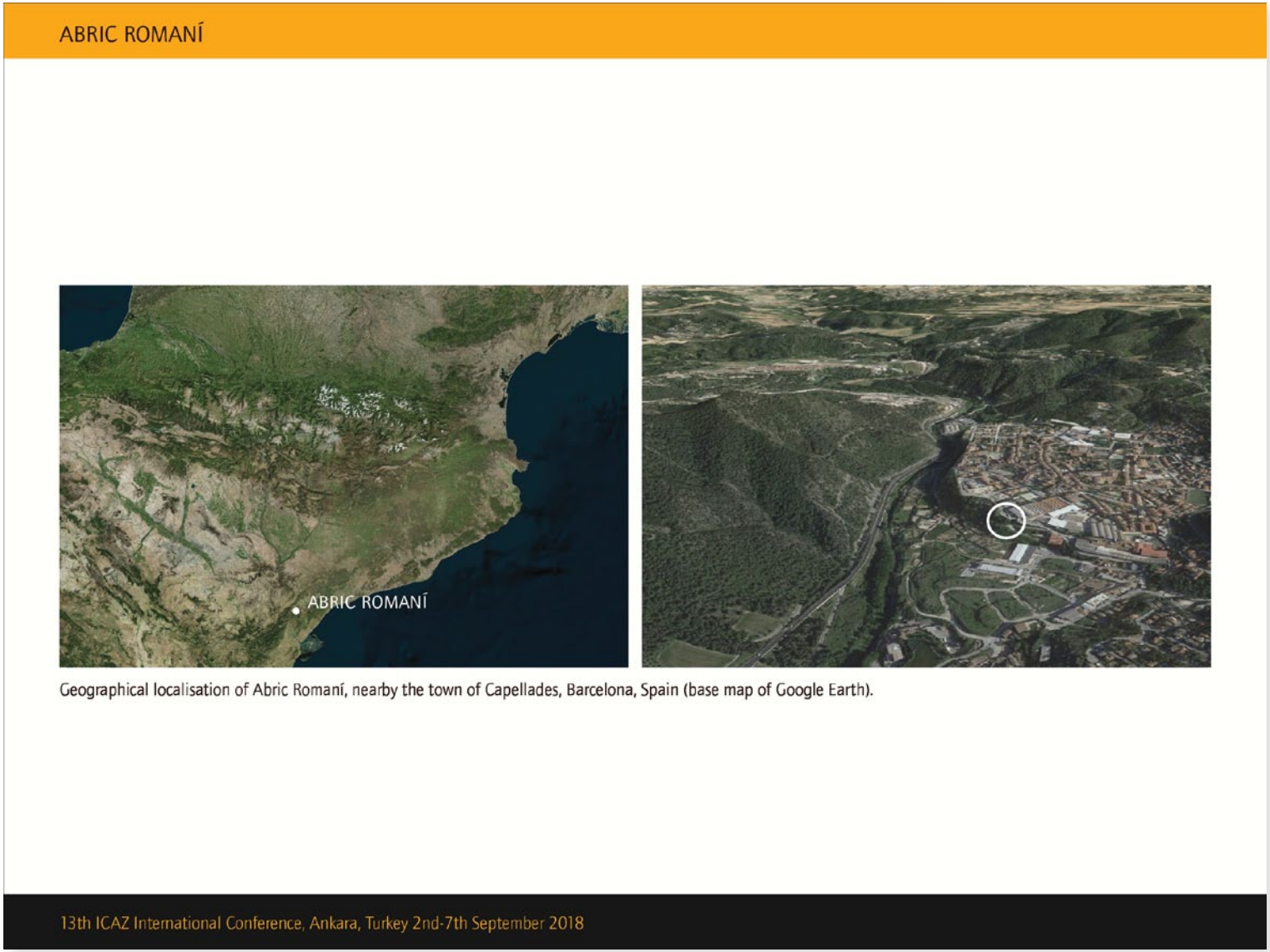
The aim of this paper is to present the application of this methodology in the Middle Palaeolithic levels I and Ja of Abric Romaní (Barcelona, Spain) and level 37 of Riparo Tagliente (Verona, Italy). This approach is correlated with neighbourhood analysis and spatial distributions, allowing to reconstruct both natural and cultural processes involved in this record, in order to explore the anthropogenic use of the site, the differences between occupational patterns, subsistence activities, domestic areas, level of groups sophistication and the length of the occupation(s). Summarizing the collected data, different situations can be noted. Abric Romaní site shows two different occupational models: short-time occupations around small hearths, representing domestic activities in level I and a mixture of short and large occupations in sublevel Ja, with synchronic relationships between activity areas and toss zones. A different situation has been highlighted at Riparo Tagliente where particular formation-site processes, led to the identification of more palimpsests, that consequently have reduced the amount of refits.

The resulting data could be used as a reference to investigate the patterns of occupation and subsistence of Neanderthals in Europe. The interaction of multidisciplinary approaches will improve our understanding of the Neanderthals daily life in a more detailed level.

Keywords: Neanderthal's occupational models, Abric Romaní, Riparo Tagliente, bones refitting, spatial patterns.

This oral communication presented in the session: *Bone refits in faunal analysis: case studies and applications in archaeological assemblages*, explain the results of my PHD thesis titled: *Just two questions: Where & Why? Reconstruction of Neanderthals occupational patterns in the MIS 3.*

Abric Romaní (AR) is a wide rockshelter, located in the North-East of the Iberian Peninsula, 50 Km west of Barcelona. It is placed on the right bank of the Anoia River, at 310m a.s.l., in the town of Capellades.



Geographical localisation of Abric Romaní, nearby the town of Capellades, Barcelona, Spain (base map of Google Earth).

The rockshelter is a part of a travertine cliff (on the left photo) called *Cinglera del Capelló*, which stands at 50m above the actual level of the Anoia River.

ABRIC ROMANÍ

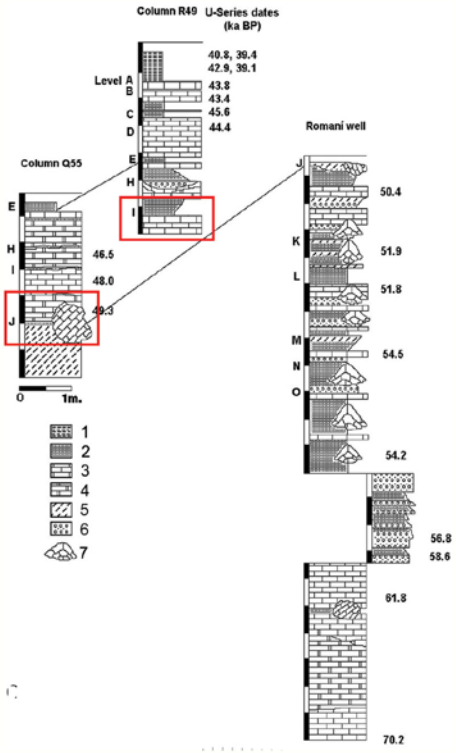
Panoramic view of the *Cinglera del Capelló* (265 m a.s.l.), Capellades (Barcelona), Spain.

Internal view of the rock-shelter during the field excavations, in 2010.

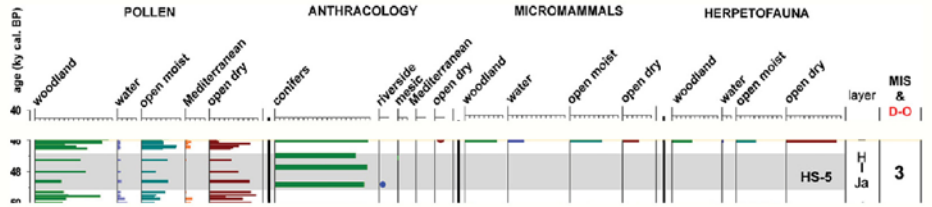
13th ICAZ International Conference, Ankara, Turkey 2nd-7th September 2018

The stratigraphic sequence was formed by 20m of travertine bio-constructions, in which peculiar and rapid formation processes produced archaeological levels of high temporal resolution and created a clear vertical separation of human occupation horizons.
The excavated sequence is approximately 20m thick and covers a timespan ranging from 70 to 40 ka BP. A recent core sample, allowed the identification of at least 30 remaining meters of sediments, enlarging the chronology to 110 ka (Sharp et al. 2016).
All levels, except A are classified in the Middle Palaeolithic techno-complexes. Level I is located in the coldest phase, characterised by continental climatic oscillations with a typical steppe vegetation. Sublevel Ja, situated between the pollen zone 3 and 4 is characterized by a cold environment, with open woodlands side by side with clearings.

ABRIC ROMANÍ > **level *i* and sublevel *ja***



Stratigraphy of Abric Romaní and U-series dates (Romagnoli et al., 2018).
Legend:
- Red sands
- Carbonatic sands
- Filiforme travertines
- Tubulair travertines
- Carbonatic slabs
- Oncolithic gravels
- Travertine blocks



Palaeoecological analyses of level *i* and sublevel *ja* (Abric Romaní). These results are related to MIS (Marine Isotopic Stage), D-O (Dansgaard Oeschger cycles), HS (Heinrich Stadials) and archaeological layers (modified from Burjachs et al., 2012).

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The next site is that of Riparo Tagliente (RT). It is located in the Nord-East of Italy and sets on the Lessini Mounts, on the left side of Valpantena, at 250m a.s.l., near the hamlet of Stallavena di Grezzana, province of Verona (25 km from Lake Garda).

RIPARO TAGLIENTE

Geographical localisation of Riparo Tagliente, in the municipality of Stallavena di Grezzana, Verona, Italy (base map of Google Earth).

Riparo Tagliente stands at the base of the Tregnago Mount, under a rockshelter formed by oolitic limestone. In the past the rockshelter occupied a strategic position, about half way both from the plain and the top of the limestone plateau.
It was discovered in 1958 by Francesco Tagliente, hence the name of the site. In 1967 the excavations were resumed by the University of Ferrara and are still in progress.

RIPARO TAGLIENTE

Panoramic view of the Tregnago Mount cliff (250 m a.s.l.), Stallavena di Grezzana, Verona, Italy.

External view of the rock-shelter.

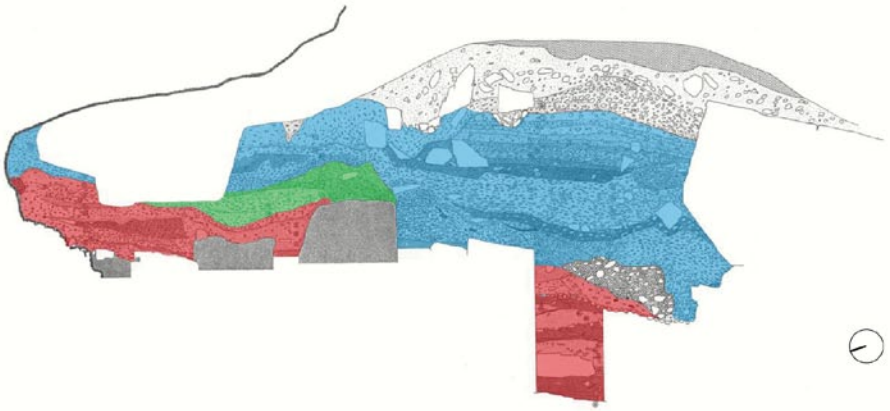
Up to the mid-seventies, research focused on the excavation of a long trench running transversally to the shelter and a smaller one located in the most internal area. This pointed a long stratigraphic series, over 4.60 m. deep, formed by two main deposits separated by a river erosion: a lower deposit with Mousterian and Aurignacian industries and an upper one characterised by Late Epigravettian records.

The mousterian sequence covers a chronology ranging from 60 to 32 years BP, corresponding with the beginning of the Würm glaciation (MIS 3).

The deposits have been studied in two areas: the inner part that corresponds to *sector II* and the outer part that corresponds to *sector I*.

The stratigraphic sequence documents a climatic cycle characterised by the turn over of humid, cold-humid and cold-dry weather conditions.

RIPARO TAGLIENTE



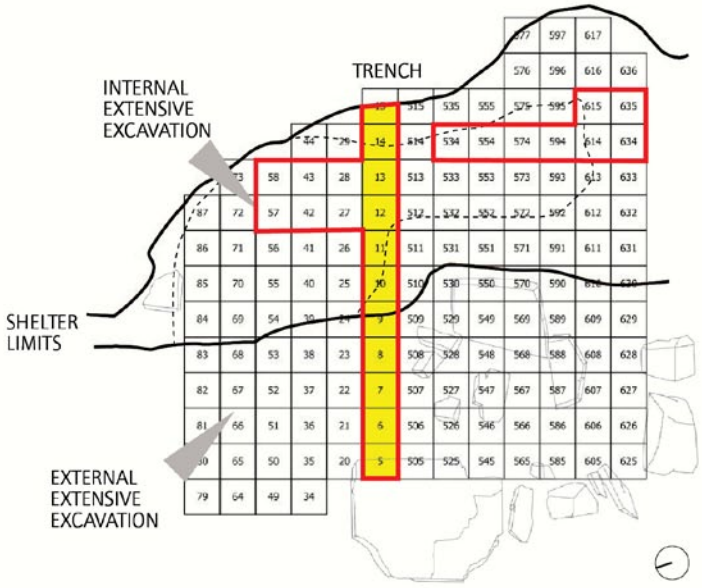
Stratigraphic sequence of Riparo Tagliente. Section between the squares 5/15 and 505/51. The colours are associated with the layer's dating: 43-31 Mousterian (red); 25c-25 Aurignacian (green); 18-4 Epigravettian (blue). - Scale 1:50

OUTER SURVEY (SQ7)	INNER SURVEY (SQ.614-615-634-635)	CUT
40	40	
40α	40α	
40ß	40ß	
40γ	40γ	
40δ	41α	
40ε	41ß	40
40ζ	41γ	
40η	41ε	
40θ	41ζ	
40ι	41η	
40κ	41θ	
40λ	42	
41	43	41
42α	44	
42ß	45	42
42γ	46	

Diagram provided for levels from 40 to 42, showing the related numbers of the outer and inner survey (Thun Hohenstein, 2001).

This is the planimetry of the site. Squares affected by the excavation of Mousterian levels have been marked. in red. Squares from 5 to 14 represent the trench and the *sector I*, whereas the inner part represent the *sector II*. Level 37 was divided into 3 cuts: 37, 37a and 37b. The choice was dictated by the increase of sediment's thickness, towards the outside part of the shelter. Anyway, the analysis of faunal refits have been carried out taken into account the level 37 as a whole.
The photo on the right side shows the stratigraphic section of the outer sector that belongs to the Mousterian deposits.

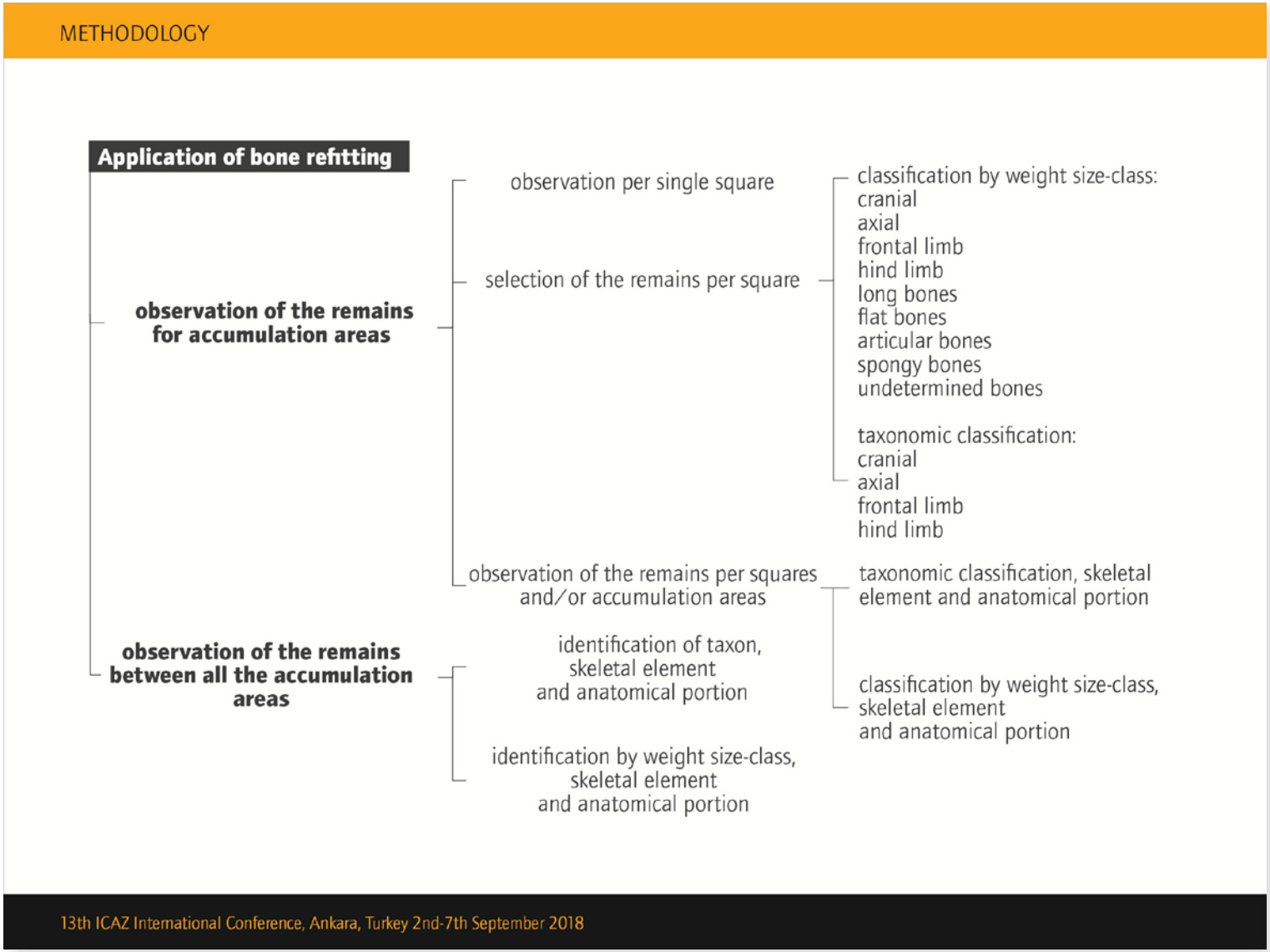
RIPARO TAGLIENTE > **level *37***



Total planimetry of the site. In red are marked the squares affected by the excavation of the Mousterian levels. The dotted line show the limits of the Middle Age interventions. - Scale 1:100

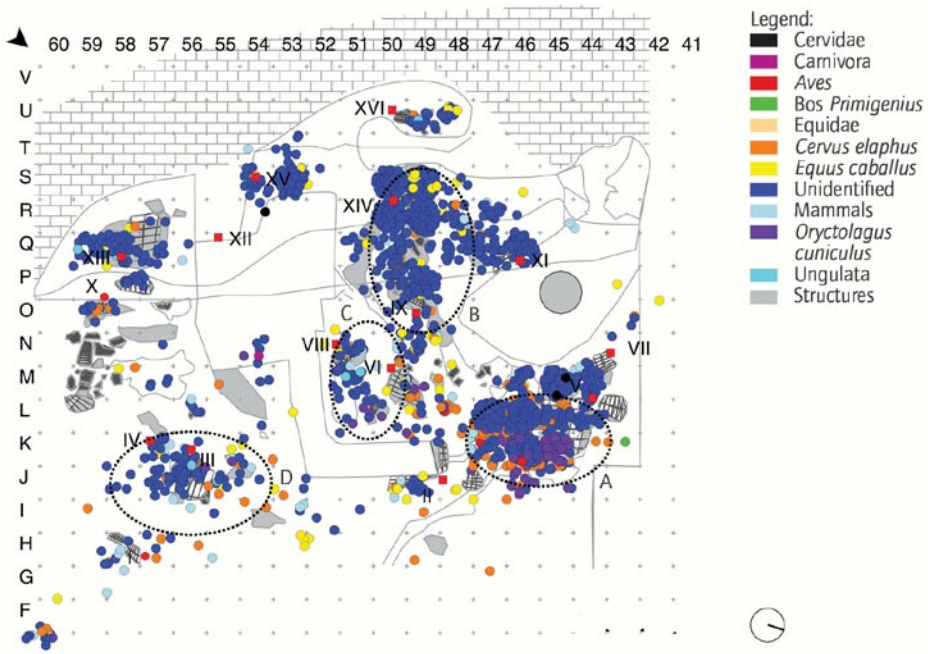
Stratigraphic section of the outer sector (Mousterian).

Faunal materials of AR and RT were analysed in previous studies. I have re-examined the samples at zooarchaeological and taphonomic level, in order to gather useful information for the refitting programme, following the terminology used by Todd (1983, 1987) and Lyman (1994, 2006, 2008). With this scheme it can be checked out the methodological protocol used (Fernández-Laso, 2010). According to this, both mechanical and anatomical refits have been observed. The location of the remains plus the distance and their taphonomic modifications, particularly those anthropic have been taken into account. I have analysed all bones larger then 3cm in level I and sublevel Ja of AR, whereas for level 37 of RT a more accurate analysis has been adopted, selecting even fragments less than 3cm. This choice was made due to the high-degree of fragmentation and different excavation protocols that didn't allow a recovery by means of 3D coordinates. For both sites spongy bones were not included, since they are difficult to conjoin. All bones with fresh and dry breakage were taped together with patafix glue-pads sticks to allow the study of fractures.



The result of level I was published in 2017 (Modolo and Rosell, 2017) but I would like to give some data to better understand the results. Level I yielded 1.833 bones, 19.7% of which was anatomically and taxonomically identified. Red deer is the most represented *taxa* (46.7%), followed by horses and few aurochs remains. Carnivores are very scarce.
Post-depositional damages didn't play an important role: roots and chemical corrosions, mainly related to plants activities are the most common interventions, followed by weathering, concretion and water action.
The map represents the whole faunal assemblage, according to the total NISP. Remains are concentrated in 4 accumulation zones (A,B,C,D) identified by micro-stratigraphic analysis. The high percentage of unidentified fragments, like diaphysis, flakes, spongy and dental fragments, covers the maximum extension in all these zones.
36 refits were conjoined, involving 84 fragments: 28 composed of 2 remains, 5 of 3, 2 of 4 and 1 of 5. Taxonomic identification was possible on the majority of the remains.

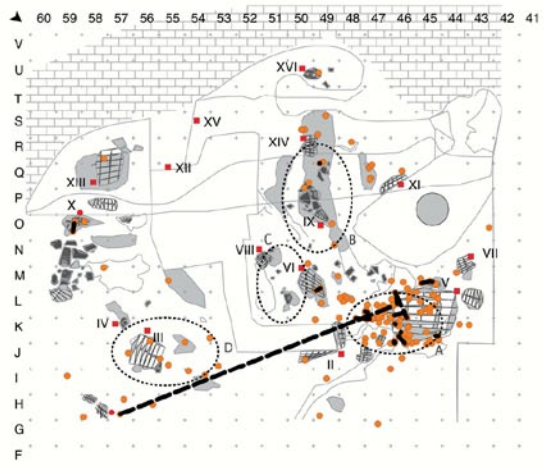
RESULTS > **Abric Romaní** > LEVEL *i*



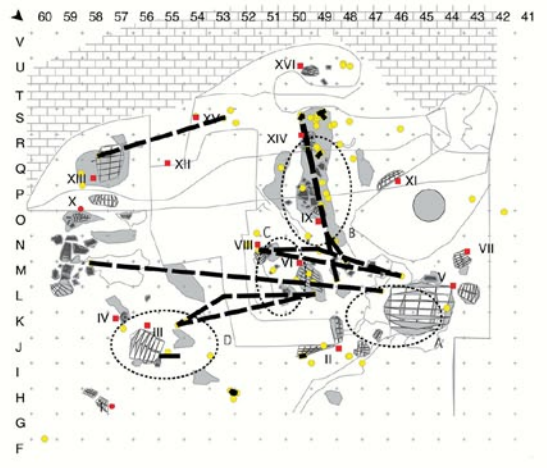
Gis spatial distribution of the whole faunal assemblage (Tot. NISP). - Scale 1:100

The map on the left shows the connection lines established for red deer. On a total of 34 fragments, 4 anatomical and 10 mechanical refits with anthropic breakage were identified (remains refers to femur, 2 humeri, 2 tibias, 2 metacarpals and 3 metatarsals). They are distributed in all the accumulation zones, especially in A, near a hearth located in secondary platform. Connection lines are at a short distance, except one (humerus) over long (11m). II remains are associated with hearths. Concerning horses 32 bone fragments were refitted. The most common elements belong to *cranium:* 9 sets of connections were identified on isolated teeth and 3 on maxillary fragments with teeth. Only one fragment of femur with anthropic marks was refitted. The frequency-distribution is wider than cervids and primarily long-distance connections were documented with a maximum distance of 11.4m (premolars teeth). Only 3 remains were documented in zone A, while the majority appeared in B,C and D.

RESULTS > **Abric Romaní** > LEVEL *i*



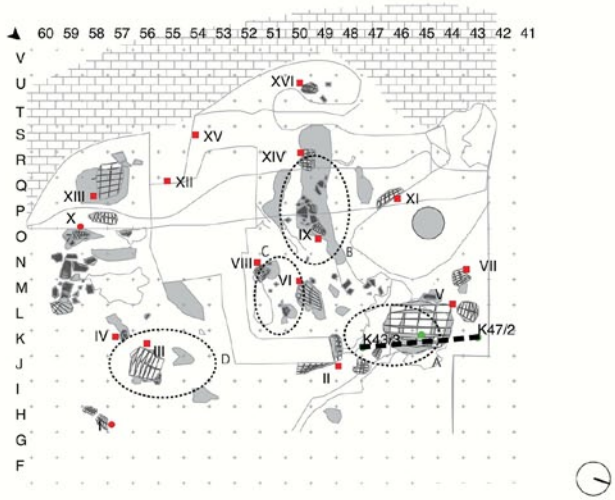
Gis spatial distribution of *Cervus elaphus* with faunal refits connections. - Scale 1:150



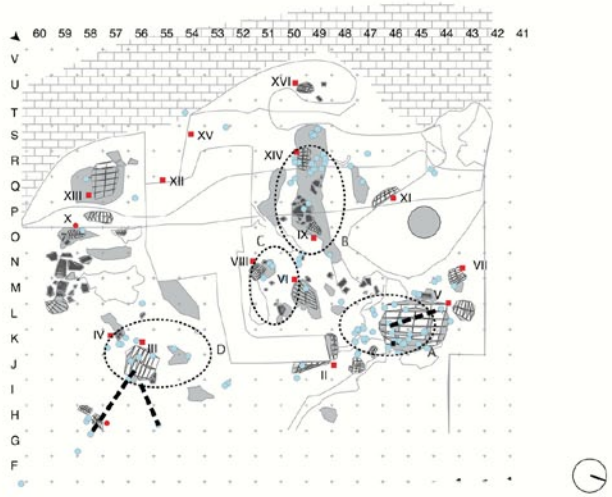
Gis spatial distribution of *Equus ferus* with faunal refits connections. - Scale 1:150

The map on the left side shows a scarse presence and distribution of *Bos primigenius* elements. This lead to the identification of a single refit on tibia shaft with intentional breakage, impact point and cortical scars.
The map on the right shows the remains of weight-sized mammals. They are distributed in all areas especially A and B. All refits are composed by limb bones: 2 were documented on medium-sized and one on medium-big sized.

RESULTS > **Abric Romaní** > LEVEL *i*



Gis spatial distribution of *Bos primigenius* with faunal refits connections. - Scale 1:150



Gis spatial distribution of mammal-sized remains with refits connections. - Scale 1:150

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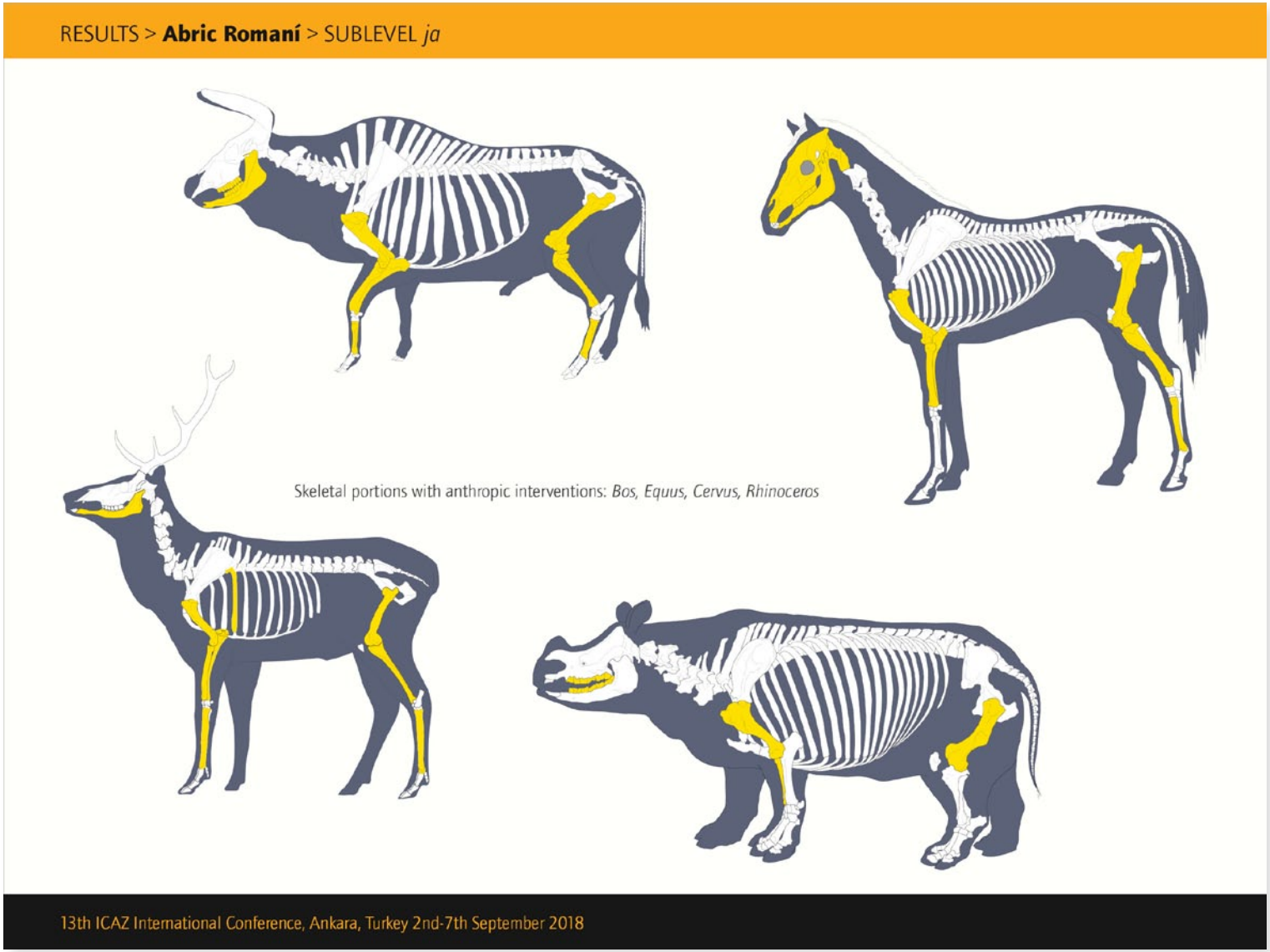
In this photo there are some examples of mechanical refitted bones (level l):
- A, B, C belong to red deer and concern two metatarsus and one femur;
- D belongs to a diaphyseal fragment of medium-sized mammal;
- E is a tibia of *Bos primigenius;*
- F is a femur of *Equus* with anthropic breakage and percussion cone.

I will describe now some data obtained from the study of sublevel Ja. A total of 6.378 remains were recovered. Despite the number of *taxa* is higher than in level I, red deer and horses are still predominant. Other ungulates such as rhinoceros, aurochs and chamois are sporadically represented, as well as some carnivore remains.

The high degree of human impact is attested by numbers: 60% of bones are smaller than 3cm, only 984 remains were determined at taxonomic level and 58.4% were classified according to weight-sized categories.

In this slide I propose some skeletal representation of the most important *taxa,* showing anatomical parts affected by anthropic interventions (cut-marks and intentional breakage).

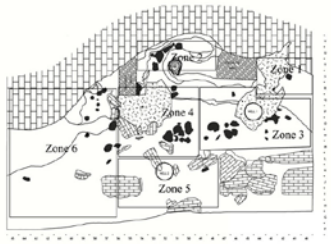


Now I present the results obtained by the refitting programme. At the bottom I provided a map about the division of sublevel Ja surface, according to that established by Vaquero and colleagues in different publications. We have six zones that don't have any behavioural meaning but have only been used to present spatial data, in order to standardise faunal and lithic informations about refits.

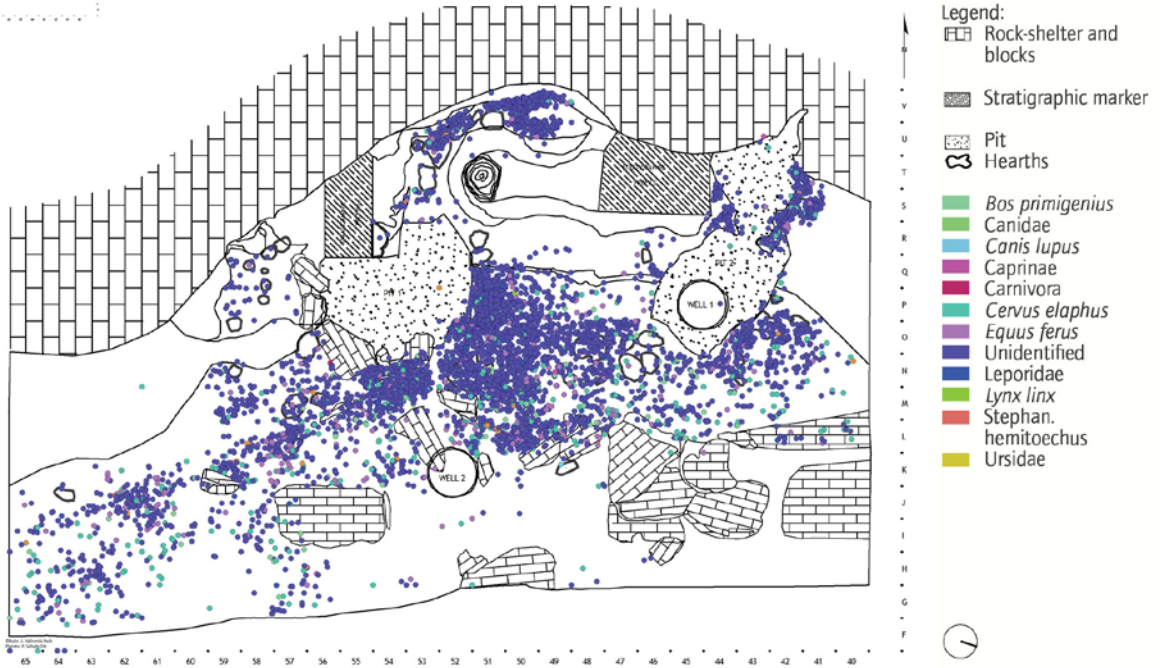
In this first distribution it is possible to see the whole faunal assemblage. All the remains are distributed over the total surface of Ja, but there are some unequivocal and important accumulations in the central and inner part of the shelter.

After a carefully re-examination of the material, 129 (4.5% of the total NISP) new bone refits were documented, involving 301 fragments (99 of 2, 18 of 3, 11 of 4 and 1 of 5 remains).

RESULTS > **Abric Romaní** > SUBLEVEL *ja*



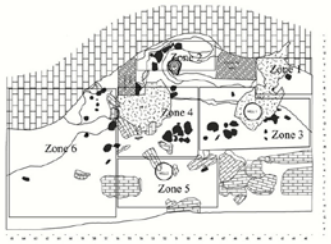
Sublevel *ja*: identified zones to represent the spatial data. - Scale 1:300



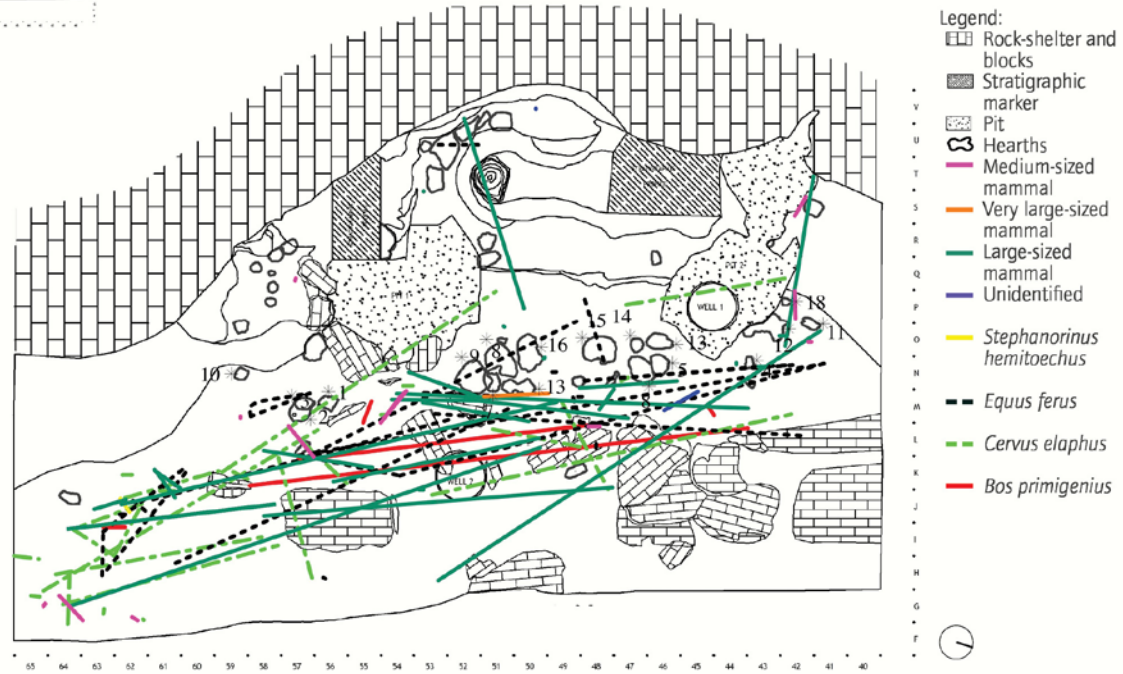
Gis spatial distribution of the whole faunal assemblage (tot. NISP). - Scale 1:100

Connection lines amount to 172, with 96 established among *taxa*.
Both anatomical and mechanical refits were documented, spreaded out over the entire surface. Anyway, they are proportionally more frequent in zone 3, 4 and 6. Both short and long distance connections have been documented, just to a maximum of 16.45m.
Red deer has the largest number of refits: 34 affecting 77 elements.
Connection lines are on short and long distance, ranging from 3cm to 10m.
Zone 1 and 2 yielded very few remains and no refits had been documented.
Two refits on long distance connect zone 3 to 5. Zone 4 (the central) shows a good concentration of remains with intra-zone connections. Zone 6 (the exterior) has documented 2 short and 6 long connections.
Within the category of medium-sized mammals, only short connections were documented (between 2cm and 2m), except one over long distance, found in zone 4 and interesting one burned fragment. All refits involve diaphysis's fragments and one a fragment of flat bone. The distribution of the connections interest all zones, short of 2.

RESULTS > **Abric Romaní** > SUBLEVEL *ja*



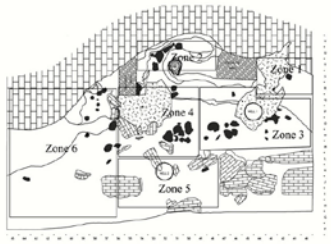
Sublevel *ja*: identified zones to represent the spatial data. - Scale 1:300



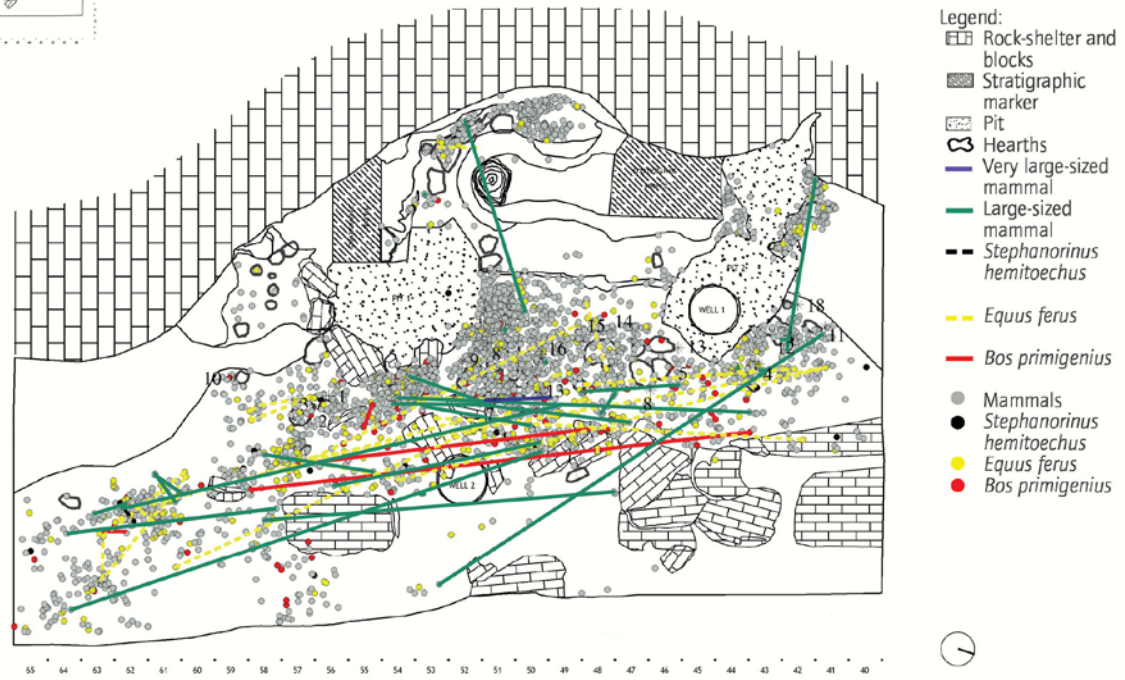
Gis spatial distribution of the whole faunal assemblage (Tot. NISP). The lines show the connection established on the basis of faunal refits. - Scale 1:100

The map includes large and very large mammals, both identified and classified according to the weight-sized.
Horse remains and the established connection lines are common in all zones except 1.
Aurochs documented anthropic refits on short distance in zone 3, 4 and 6 and extra-zonal connections between zone 3 and 6.
As for Rhinoceros only one refit located in zone 6 (humerus) drawn a short connection line.
The category of large-sized mammals reflect a different situation. Long (14) and short (12) connections are almost the same in number, with distances ranging from 1cm to 16m. As for the other described *taxa*, zones 1 and 2 are poorly represented. In zones 3 and 5, intra-zonal refits were identified, whereas zones 3 and 4 are connected by some long distance refits (3 to 11m).
Some long connections relate zones 4 and 5 to the external one (6).
Among very-large sized mammals only one refit on short distance have been detected in zone 4.

RESULTS > **Abric Romaní** > SUBLEVEL *ja*

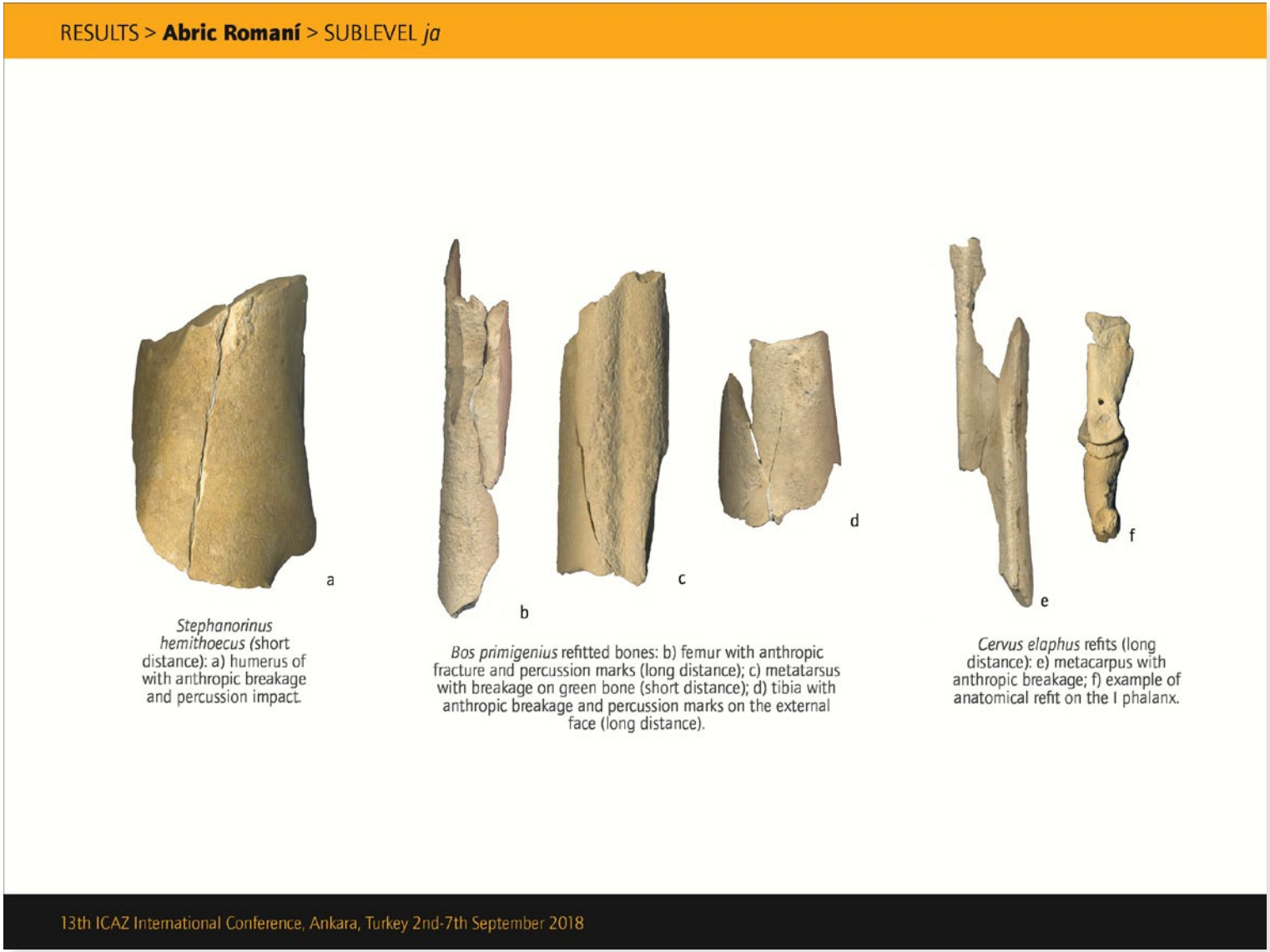


Sublevel *ja*: identified zones to represent the spatial data. - Scale 1:300



Gis spatial distribution of *Bos primigenius*, *Equus ferus*, *Stephanorinus hemitoechus*, very large and large mammals, with connection lines established on the basis of faunal refits. - Scale 1:100

This photo shows some of the refitted bones, documented in sublevel Ja:
- A belongs to a humerus of rhinoceros, identified on short-distance;
- B, C and D represent bovid remains. B and D are on long distance whereas C on short;
- E, F are red deer fragments and both were conjoined on long distance.



- A, B, C are refitted bones documented on *Equus*. All of them were located at long distance;
- D, E are two examples of long distance refitted bones, on weight-sized mammals fragments.

RESULTS > **Abric Romaní** > SUBLEVEL *ja*

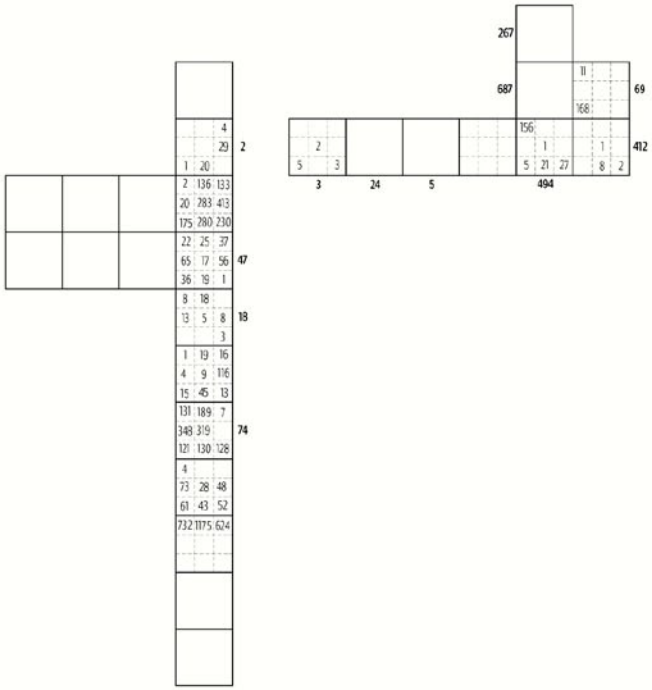
Equus ferus refits (long distance): a) radio/ulna with anthropic breakage and two percussion impacts; b) metapodial with green breakage; c) radio/ulna with anthropic fracture and two impact points.

Weight-sized mammals (long distance): d) and e) diaphyseal fragments with intentional fractures. The second have been broken on fresh.

Now I start with results obtained in level 37 of Riparo Tagliente.
The photo on the left shows the external sector of mousterian deposits, with the trench and behind the inner part of the shelter (*sector II*).
The planimetry on the left side shows the density of bone remains within each square. The numbers within 1sqm identify the number of remains collected for each quadrant of 33x33cm. The numbers placed outside refers to bone remains collected in the square of 1sqm without a clear identification by means of quadrants.

RESULTS > **Riparo Tagliente** > LEVEL *37*

Mousterian deposit of the outer sector



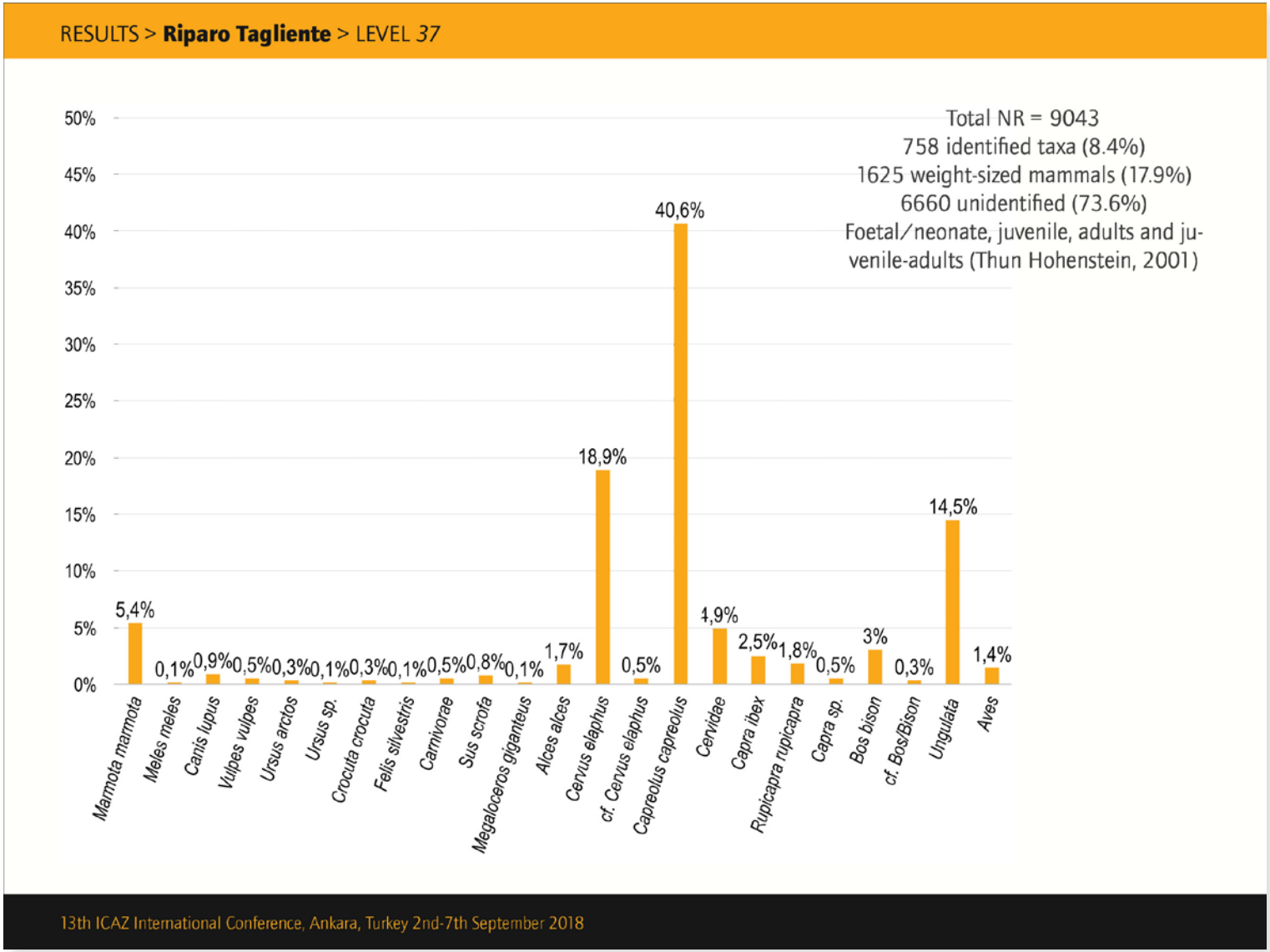
Planimetry of level 37: density/square meter.

This is the first time that refits have been applied on this site. On the total of 9.043 fragments only 8.4% were identified, 17.9% classified according to weight-sized mammals and 73.6% unidentified. The high rate of anthropic exploitation, burning damage and post-depositional modifications revealed that 68.4% are smaller than 2cm.

The predominant *taxa* are deers and roe deers, followed by bovids, ibex, chamois, elk, wild boar and megaceros. Few carnivore remains inform us about the presence of these animals in the shelter (wolf, fox, brown bear, hyena, badger, wild cat). Among the lagomorphs the presence of hare was attested and among rodents abundantly present is the marmot. Some remains of birds have been also documented.

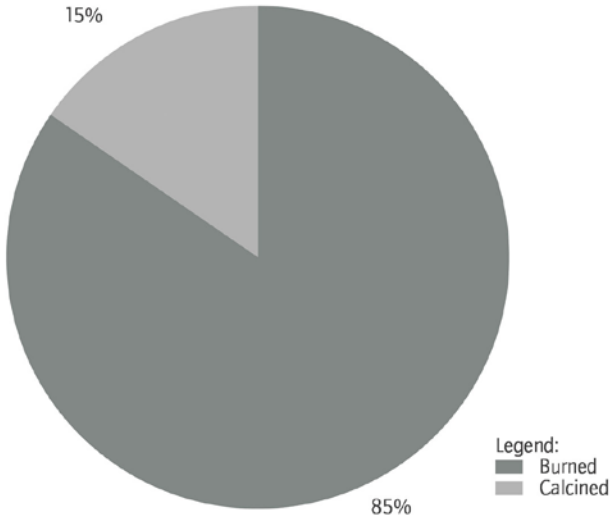
Among weight-sized mammals, the cathegory of medium-large is the most represented with the greatest anatomic integrity. Follow medium, large and small classes.

Predominants are long bones, followed by cranial elements and scarce remains of the axial skeleton.



Despite the absence of documented combustion structures, burned bones are common reaching 33.1% of the total. All degrees of combustion were documented although a clear prevalence of stages 2 and 3. This suggests the existence of fireplaces, perhaps in the inner areas of the shelter.
Regarding post-depositional modifications, several interventions caused damages on bone surfaces. Alterations are mainly attributable to manganese oxides, roots and concretion. Following weathering, water activity, exfoliation, erosion, fractures caused by sediment pressure, trampling and corrosion.
Only one intervention of rodent has been attested on a 1 phalanx of roe deer. Carnivore activity let us to propose more considerations: 90 remains attest carnivore marks on ungulates, carnivores and marmots elements.

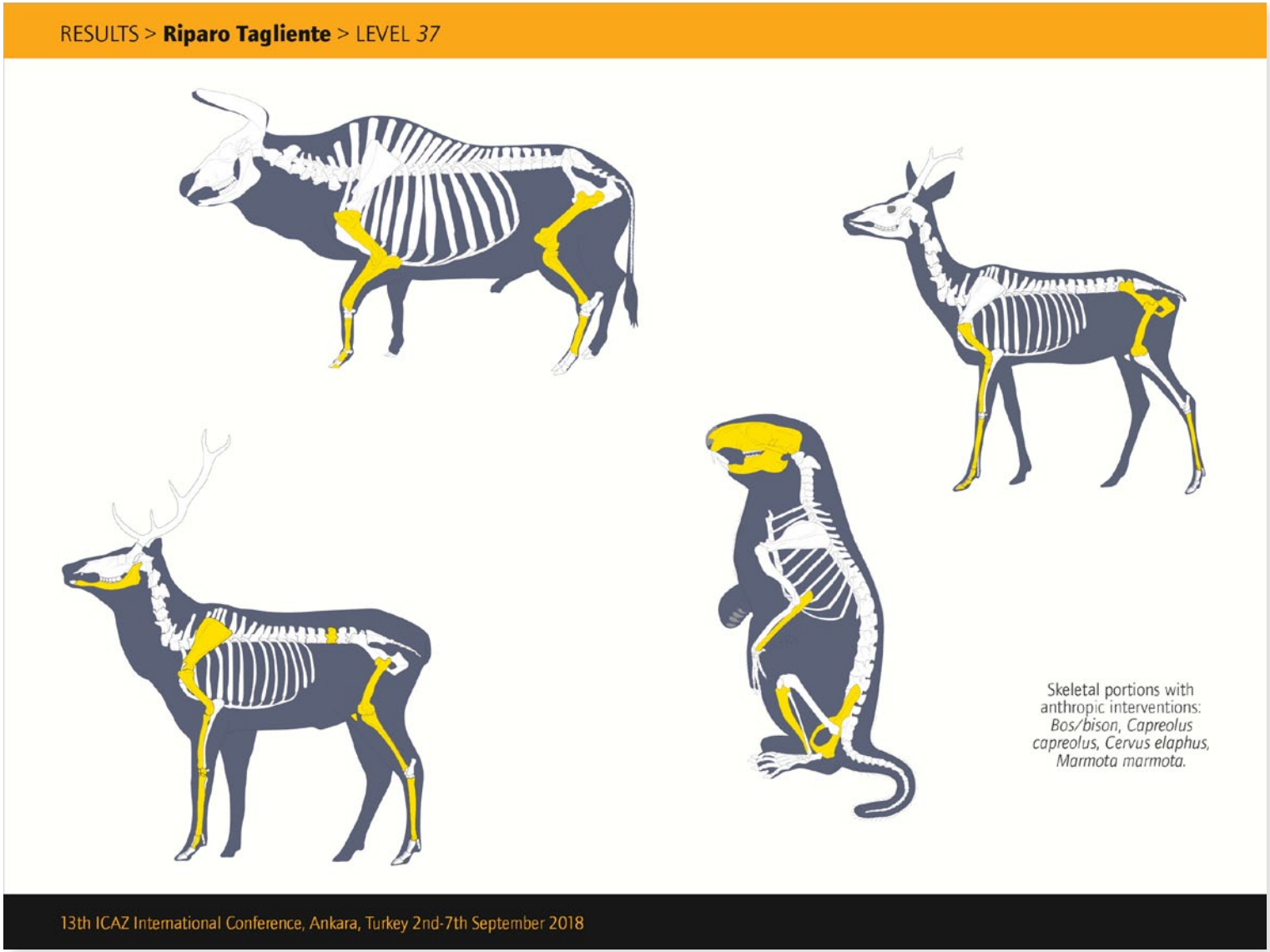
RESULTS > **Riparo Tagliente** > LEVEL *37*



Burned remains: 2528
Calcined remains: 462
TOT. burned remains: 2990 (33.1%)

Postdepositional agents	Total	%
Manganese oxides	5337	59,00%
Corrosion	24	0.3%
Erosion	68	0.7%
Fluitation	291	3.2%
Roots-etching	3393	37.5%
Weathering	917	10.1%
Esfoliation	90	1,00%
Sediment pressure	51	0.6%
Trampling	46	0.5%
Concretion	2205	24.4%

Evidence of anthropic modifications were observed on all ungulates (except megaceros and goat), carnivores, marmots and birds.
Evidences range from bone breakage to percussion, cut-marks, cortical and medullary extractions as well as retouchers.
Among the most represented *taxa*, as you can see from the skeletal portions, mainly the appendicular skeleton is interested by human intervention, whereas for red deer and marmots also the cranial one is represented.



In level 37, 65 bone refits involving 164 remains were documented (1.8% of the total), involving 99 connection lines (49 refits of 2 fragments, 1 of 3, 3 of 4, 1 of 5, 1 of 8 and 1 of 11).

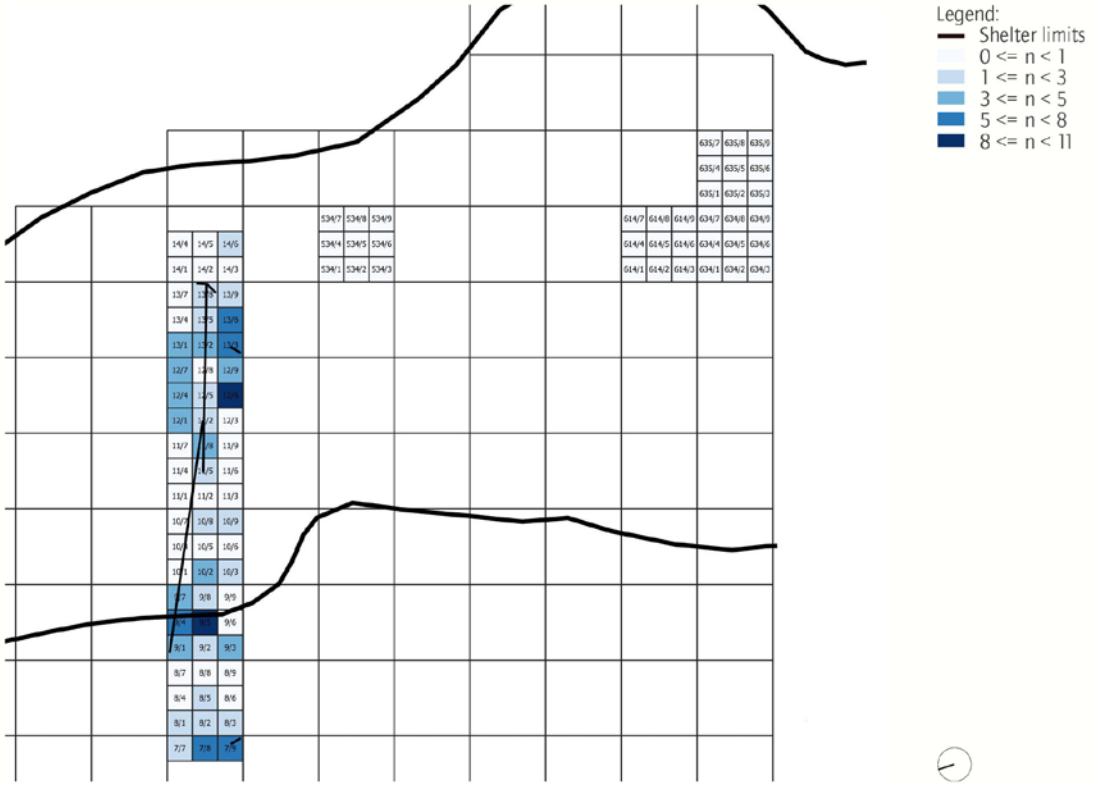
The *taxa* interested by refits are only red deer, elk and roe deer.

Good results are provided by anthropic modifications on refitted bones, since 95.7% of the remains show evidence of human intervention.

Now, in collaboration with Dr. Turrini M.C. (UniFe) a new phase of data re-analysis is under way. We are drawing new maps to better interpret our results, therefore I will be able to give only some data.

The map on the right shows the distribution and connection lines established among red deer. Six anthropic refits (metatarsal and tibia) were identified. Two long distance connections concern tibia's fragments, in which anthropic modifications, roots, manganese and water abrasion were documented. Seven metatarsal fragments were refitted over short distance and in two refits, water and trampling were documented.

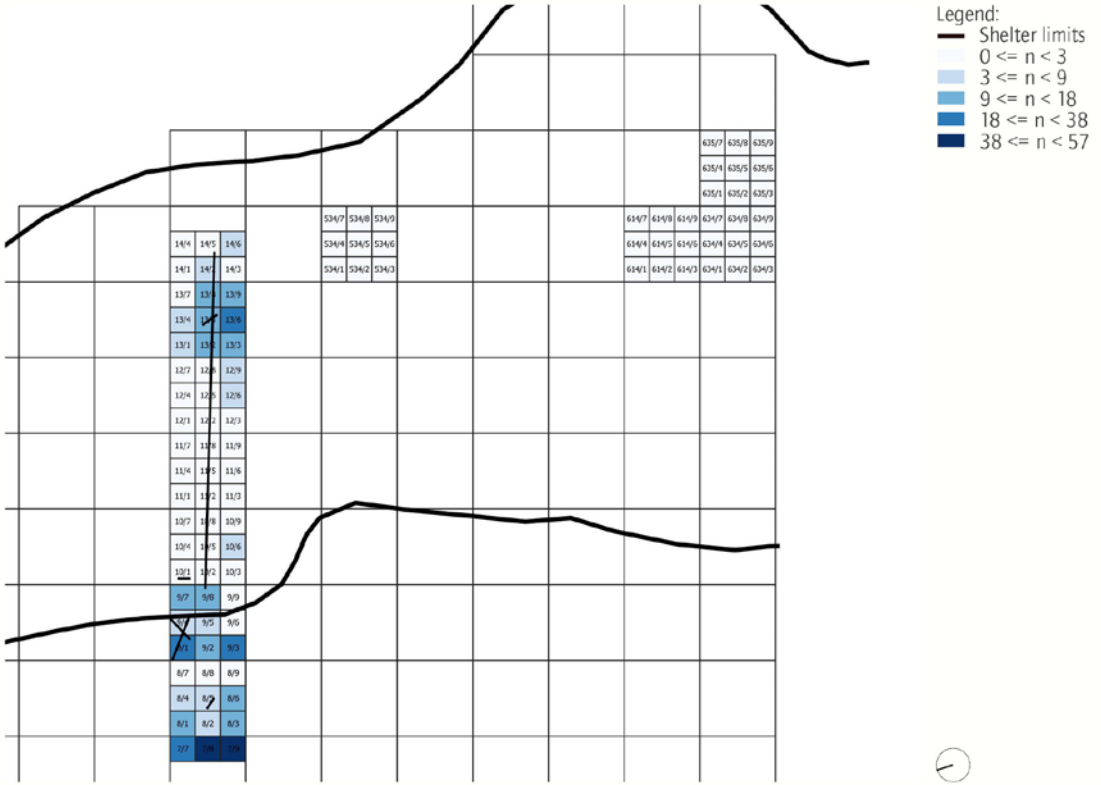
RESULTS > **Riparo Tagliente** > LEVEL *37*



Gis spatial distribution of *Cervus elaphus* (Tot. NISP). The lines show the connection established on the basis of faunal refits. - Scale 1:50

According to weight-sized mammals, 40 refits were attributed to this category (16 refits on big-sized, 13 on medium-big-sized, 7 on medium-sized, 1 on small-sized).
The map on the right shows the distributions and connection lines documented among big-sized mammals. 16 refits in which 6 anthropic and 10 of post-depositional nature were identified. Only short distance connections, except one over long, were detected.
All the remains show a very intensive post-depositional activity, related to plants, water abrasion, manganese oxides and weathering.

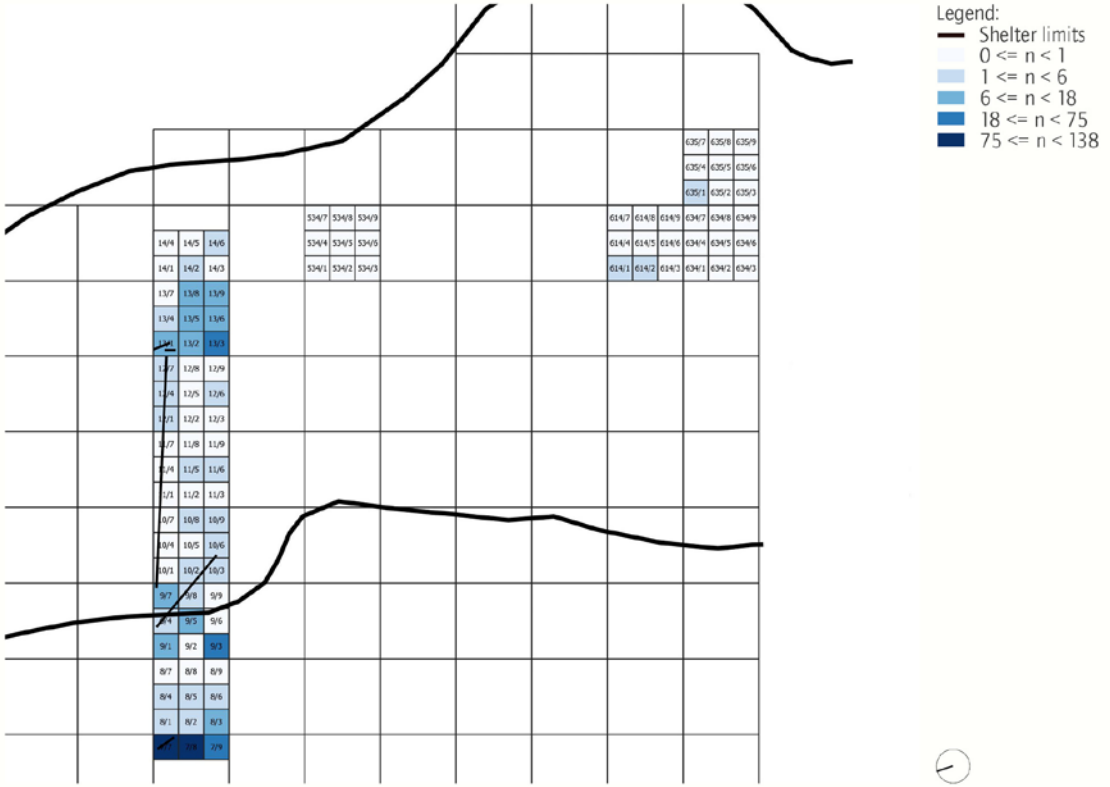
RESULTS > **Riparo Tagliente** > LEVEL *37*



Gis spatial distribution of big-sized mammals (Tot. NISP). The lines show the connection established on the basis of faunal refits. - Scale 1:50

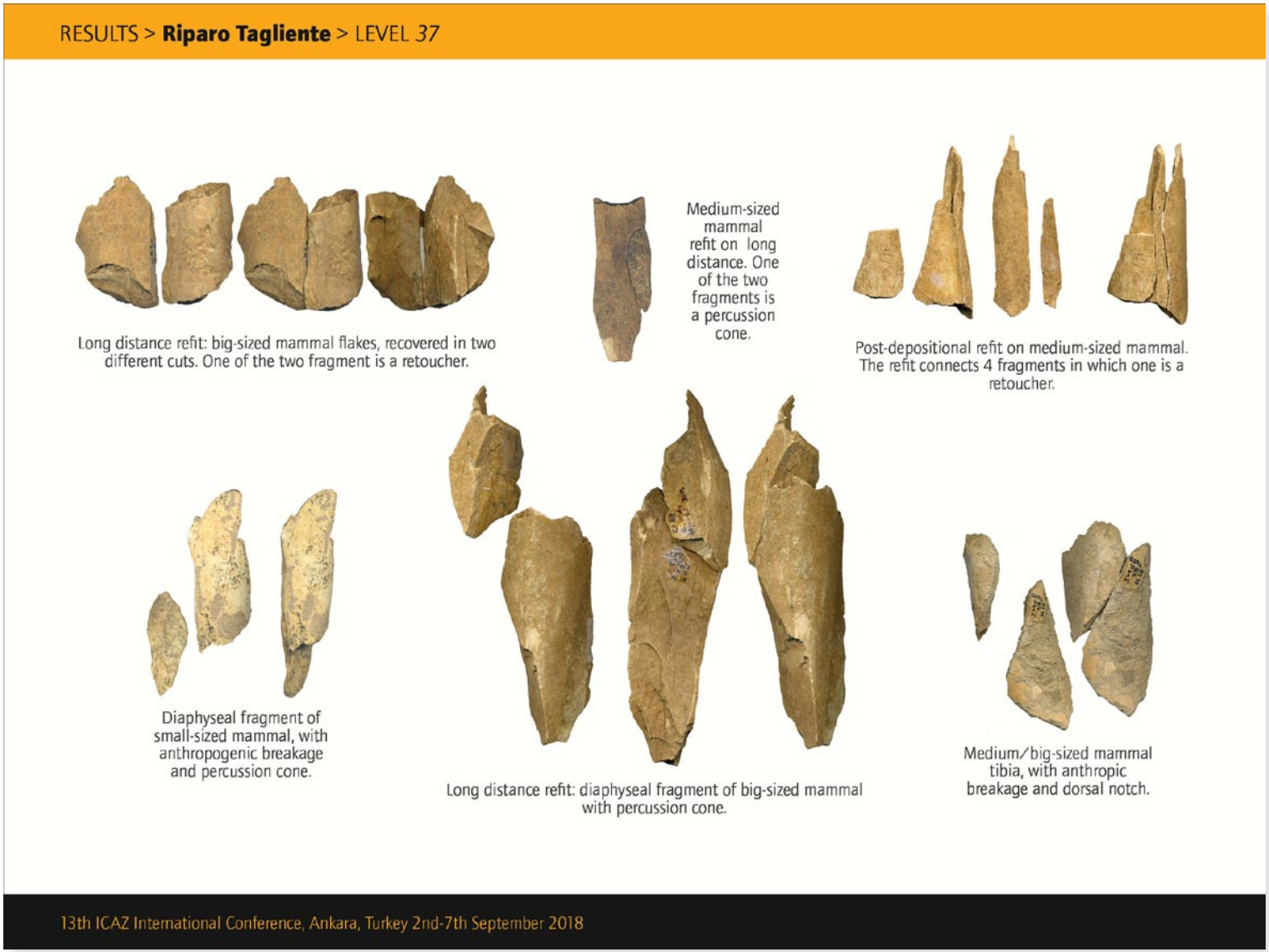
We reconstructed the same situation for big-medium sized mammals: 6 post-depositional refits and one anthropic on short-distance.

For all these maps, we used a classification based on quantiles: the limits of the classes are the values relating to 20, 40, 60, 80 and 100% of the number of sub-squares.

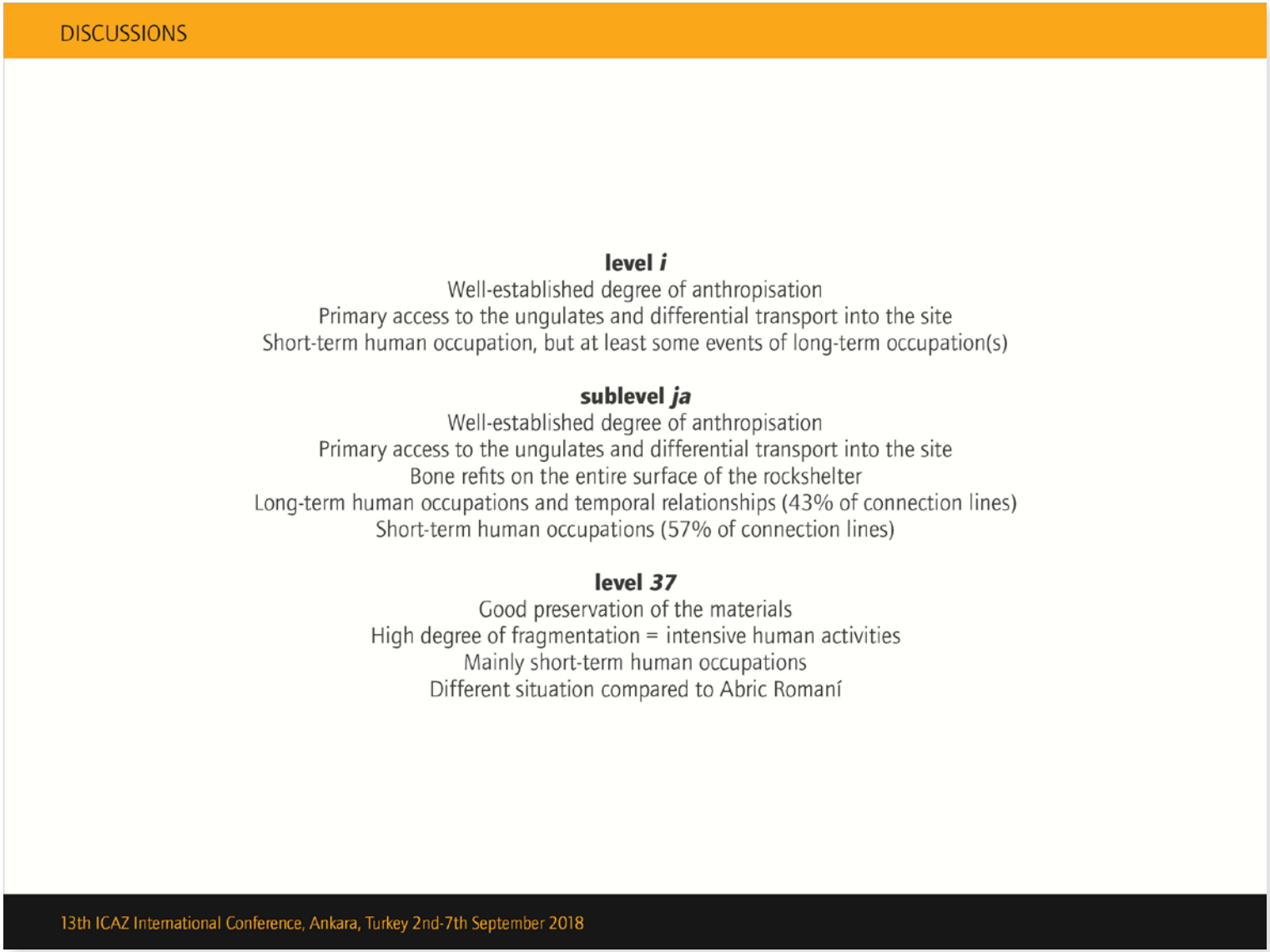


Gis spatial distribution of medium-big sized mammals (Tot. NISP). The lines show the connection established on the basis of faunal refits. - Scale 1:50

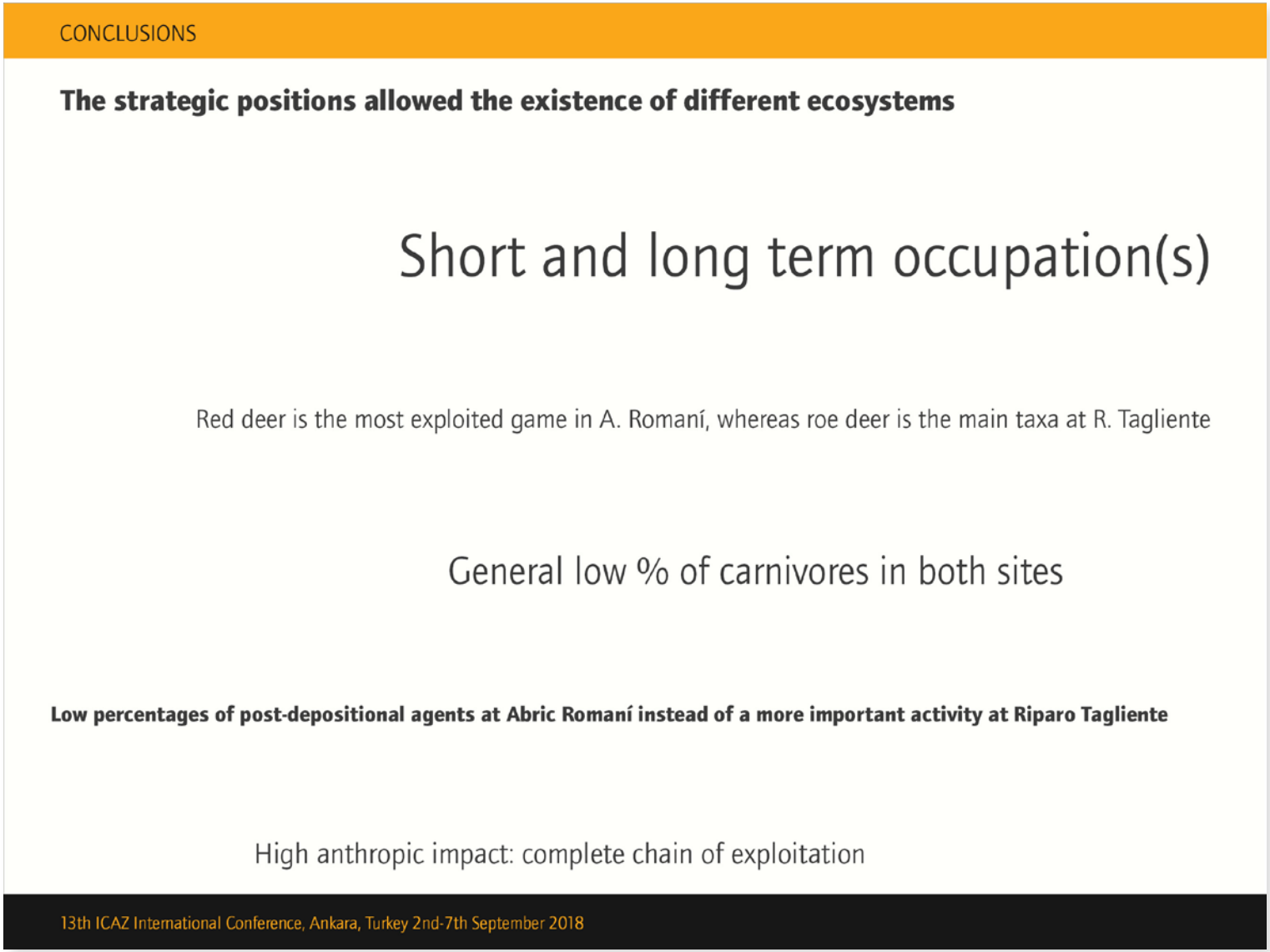
In the photo, some examples of refitted bones documented on weight-sized mammals are reported. All of them are interested by anthropic marks.
I would like to stress the first and the third one because they are both retoucher.



Level I testifies a well-established degree of anthropisation. The new connection lines established could be interpreted in the framework of short-term occupation(s), but at least one occupational event of higher intensity may have be occurred thanks to the presence of some long distance refits identified among equids.
In sublevel Ja all remains are distributed over the entire surface. A total of 53 long and 73 short connections have been found, leading to the interpretation of both synchronic and diachronic events.
Level 37 of RT is characterised by an intensive and continuos human occupation(s). The short and long connections suggest that level 37 is a complicated palimpsest. Generally, refits are located in the trench area except one coming from the innner sector.
The strong attested presence of post-depositional agents may have affected more than one occasion the bones and have produced some movements after human leaving. Therefore we can not say that all elements are *in situ*.



In conclusion we can say that refitting is a powerful tool that enhances the quality and strength of archaeological studies.
The Abric Romaní can be considered a "site model" for the application of this methodology thanks to the good preservation of the materials, the excavation on a large surface and the high temporal resolution of the levels.
Riparo Tagliente had shown a different situation. It is a very complicated site for the interpretations of this issue, but thanks to the application of this methodology, very interesting data has emerged.



Thank you for your attention!

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AUTHORS

Marta Modolo[a,b]
Ruth Blasco[c]
Jordi Rosell[a,b]
Ursula Thun Hohenstein[d]
Maria Chiara Turrini[d]

[a] Àrea de Prehistòria, Universitat Rovira i Virgili (URV), Avinguda de Catalunya 35, 43002 Tarragona, Spain.

[b] IPHES, Institut Català de Paleoecologia Humana i Evolució Social, Zona Educacional 4, Campus Sescelades URV (Edifici W3), 43007 Tarragona, Spain.

[c] CENIEH, Centro Nacional de Investigación sobre la Evolución Humana, Paseo Sierra de Atapuerca 3, 09002 Burgos, Spain.

[d] Dipartimento di Studi umanistici, Sezione di Scienze preistoriche e antropologiche, Corso Ercole d'Este 32, 44100 Ferrara, Italia.