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Session 5. Conservation of relict and mature forests

LANBIOEVA methodology as a tool for the conservation, management and planning of vegetation landscapes. The example of *Quercus petraea* forest in the North of the Iberian Peninsula

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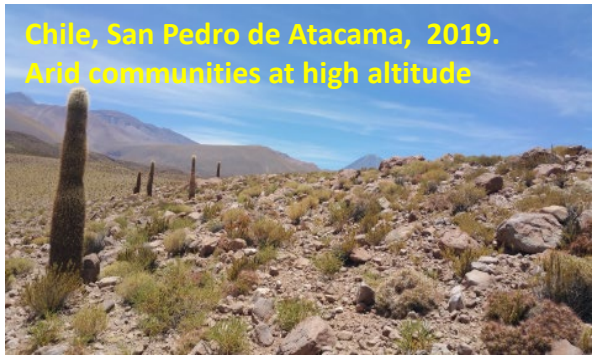
Introduction

- I present the methodology –LANBIOEVA- (Landscape Biogeographical Evaluation), a tool for the analysis, diagnosis and management of biotic units and landscapes.
- This methodology started in 1998, and since then it has been incorporating different parameters that improve its application in decision-making on habitats' management (Lozano et al., 2020)[1].
- It includes a phytosociological sampling from which a multifactorial evaluation is carried out at the level of two independent, but interrelated concepts: Conservation Interest (INCON) and Conservation Priority (PRICON).
- As an example, I will present the results of the application of LANBIOEVA to the sessile oak (*Quercus petraea*) formations of the north of the Iberian Peninsula.

[1]Lozano-Valencia, P.J., Varela, R., Latasa, I., Lozano-Fernández, A. & Meaza, G. (2020) Biogeographical valuation of global plant landscapes using "lanbioeva" (landscape biogeographical evaluation) methodology. In Iternational Geographical Union, *Spain, bridge between* continents. Spanish contribution to 34th International Geographical Congress, Istanbul 2020. Pp: 174-187.


Croatia, Krk National Park, 2019.
Mediterranean communities


Chile, San Pedro de Atacama, 2019.
Arid communities at high altitude


Spain, Astigarraga, 2016.
Green hedges separating fields


Spain, Ciudad Real, 2018.
Quercus rotundifolia Dehesas


Montenegro, 2010.
Cupressus sempervirens forest


France, Lower Navarra, 2015.
Quercus rubra reforestation


Brazil, Northeast región, 2015.
Caatinga formations


Spain, Larra-Belagoa Natural Park,
Navarrese Pyrenees, 2017.
Pinus sylvestris and
montane beech forests


Chile, 5th region, 2014.
Palm Groves of *Jubaea chilensis*


Spain, Navarra, Irati Forest, 2007.
Beech-spruce formations


Spain, Navarra, Bardenas, 2016.
Semi-arid communities


Spain, Navarra,
Larra-Belagoa Natural Park, 2004.
Black pine forest (*Pinus uncinata*)

LANBIOEVA methodology: Phytosociological sampling (1st phase)

- A minimum number of disseminated samples (relevés) is considered based on stratified characteristics selected randomly by GIS:
  a) The larger the area the larger the number of samples to take.
  b) The larger the variance, the larger the number of samples.
  c) If after one sample the next two show less than 5 % in new plants, the number of samples is considered sufficient.
- A sampling of 10% of the total surface of the vegetation patch in 400 m^2 grids (20x20 m^2) randomly considering its centre, edges and intermediate areas (Figure 1).
  - The samples are representative of all ecogeographic categories by integrating altitude, inclination, orientation, lithology and soil.

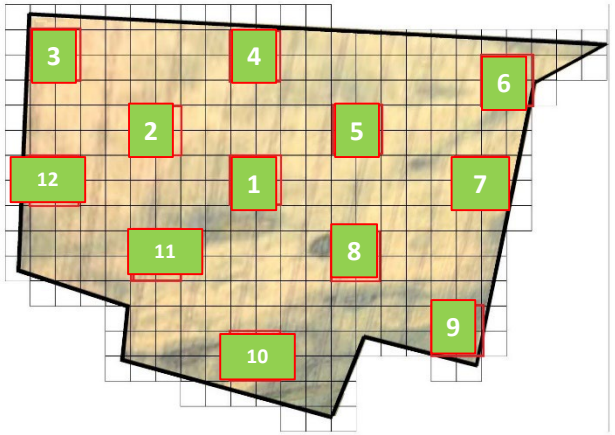


Figure 1. Example of sampling procedure. Squares of 400 m^2 are established, the first being in the centre of the area to be sampled. (Modified from Wulfsohn (2010)[1])

- For each sample the first step is to obtain general data regarding location and identification:
  - Coordinates (geographic and UTM, toponyms, etc.), geographic and environmental facets and patterns (topographical, lithological, geomorphological, soil and aquatic characteristics), photograph of the site, etc. (Table 1).

Table 1. Information from one of the samples carried out in Garralda (Navarra)

FICHA BIOGEOGRÁFICA INVENTARIO PARA VALORACIÓN DE LA VEGETACIÓN
Nº OLA1 /FECHA: 30/05/2019. WAYPOINT: INV Wylli y Peio FOTOS: Guille y Peio
Comunidad: Robledal de roble albar Dinámica: Progresiva
Superficie estudiada: 400 m2 Altitud: 732 M
Lugar: Robledal de Olarrizko-Arizabal (Garralda-Navarra).
Situación topográfica: Ladera media
Exposición: este Inclinación:25º
30TWN-638.786,47/4.752.734,53 42º 54´ 53"/1º 17´ 59"
Litología: Areniscas rojas del Butdsastein.
Suelo: Pardo forestal
pH: 5 Escorrentía: Subsuperficial
Notas: Nos encontramos al lado de un enorme canchal de bloques métricos. El robledal aparece orlando a ambos ñlados, ahora estamos a la izquierda pero al borde. El boj sólo se dispone precisamente al borde, en la frontera entre el canchal libre de vegetación y el cubierto, con un poco más de suelo.

- Subsequently, coverage data for the vascular, fungal, lichen and muscinal flora taxa are compiled.
  - For the vascular flora, the phytosociological-sigmatistic scale (abundance-dominance values) is used (Table 2) for the four strata in height into which it is divided (A: >5m; B: 4.9m - 1m; C: 0.9m - 0.5m; and, D: <0.5m).
  - While the remaining non-vascular flora is considered by groups as a whole.

Table 2. Abundance-dominance phytosociological values and their coverage range[2]

Abundance-Dominace	+	1	2	3	4	5
Coverage range	<1%	1-10%	10-25%	25-50%	50-75%	75-100%

[1]Wulfsohn, D. 2010). Sampling Techniques for Plants and Soil. Landbauforschung Völkenrode, Special Issue 340

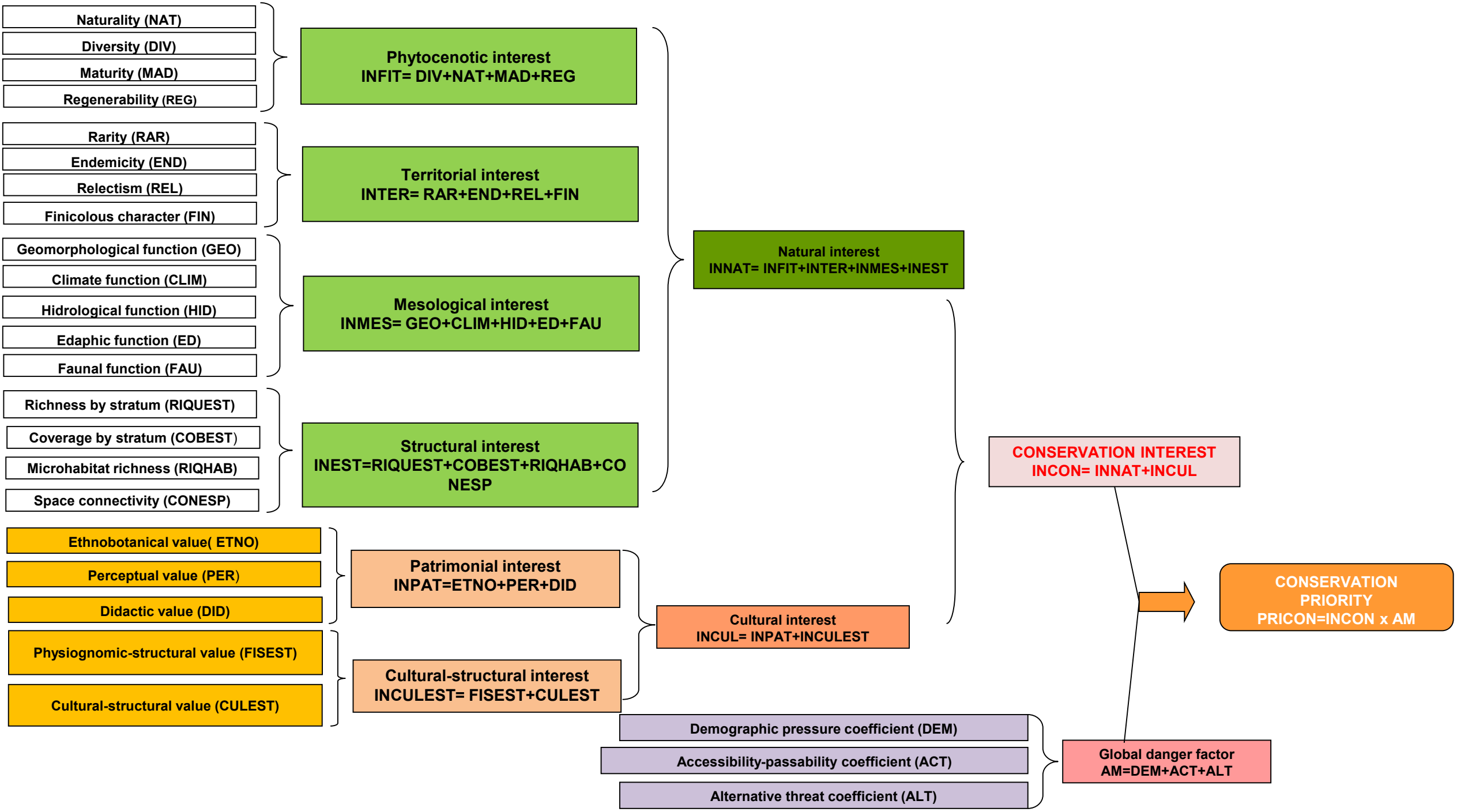
[2]Braun-Blanquet, J. (1979). *Fitosociología. Bases para el estudio de las comunidades vegetales*. Madrid, Editorial Blume, 820 pp.

LANBIOEVA methodology: Evaluation (2nd phase)

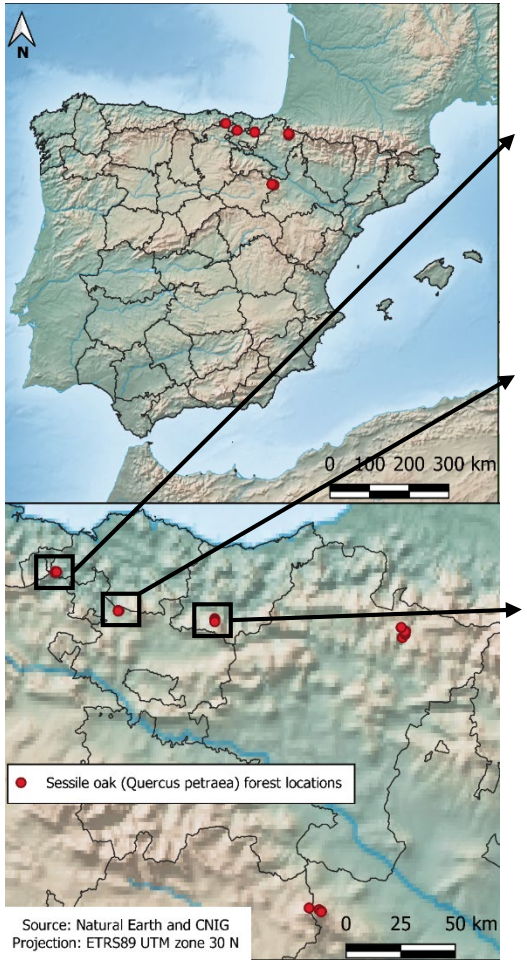
Conservation interest (INCON) and Conservation priority (PRICON)

Singular parameters	Natural, structuctural and cultural parameters	Shythetic parameters	Valuation parameters	Management decision parameter
Diversity (DIV) (1 - 10)	Phytocenotic interest (INFIT) = DIV + NAT + MAD + REG (4 - 50)	Natural interest (INNAT) = INFIT + INTER + INMES + INEST (11 – 267)	Conservation interest (INCON) = NATIN + INCUL (19 - 333)	Conservation priority (PRICON) = INCON * AM (57 - 9990)
Naturality (NAT) (0 - 10)				
Maturity (MAD) (2 - 20)				
Regenerability (REG) (1 - 10)				
Rarity (RAR) (0 - 20)	Territorial interest (INTER) = RAR + END + REL + FIN (0 - 50)			
Endemicity (END) (0 - 10)				
Relictism (REL) (0 - 10)				
Finicolous character (FIN) (0 - 10)				
Geomorphological function (GEO) (2 - 20)	Mesological interest (INMES) = GEO + CLIM + HIDR + EDAF + FAU (6 - 60)			
Climate function (CLIM) (1 - 10)				
Hidrological function (HIDR) (1 - 10)				
Edaphic function (EDAF) (1 - 10)				
Faunal function (FAU) (1 - 10)				
Richness by stratum (RIQUEST) (0,5 - 12,5)	Structural interest (INEST) = RIQUEST + COBEST + RIQHAB + CONEST (1 - 107)			
Coverage by stratum (COBEST) (0,5 - 12,5)				
Microhabitat richness (RIQHAB) (0 - 20)				
Space connectivity (CONEST) (0 - 62)				
Ethnobotanical value (ETNO) (2 - 20)	Patrimonial interest (INPAT) = ETNO + PER + DID (4 - 40)	Cultural interest (INCUL) = INPAT + INCULEST (8 – 66)		
Perceptual value (PER) (1 - 10)				
Didactic value (DID) (1 - 10)				
Physiognomic-structural value (FISEST) (1 - 3) * 2	Cultural-structural interest (INCULEST) = FISEST + CULEST (4 - 26)			
Cultural-structural value (CULEST) (1 - 10) * 2				

Anthropogenic parameters	
Demographic pressure coefficient (DEM) (1 - 10)	Global danger factor (AM) = DEM + ACT + ALT (3 - 30)
Accessibility-passability coefficient (ACT) (1 - 10)	
Alternative threat coefficient (ALT) (1 - 10)	

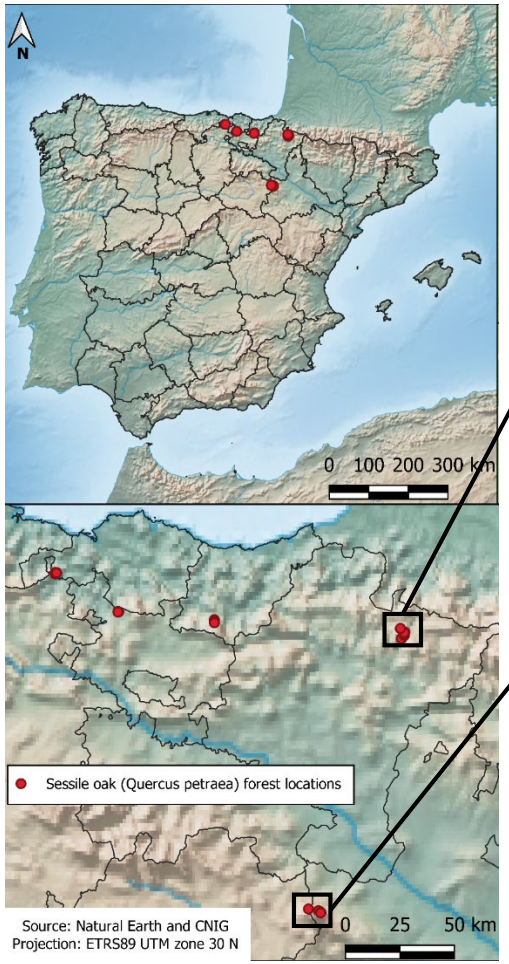

Naturality (NAT)
Diversity (DIV)
Maturity (MAD)
Regenerability (REG)
Phytocenotic interest
INFIT= DIV+NAT+MAD+REG
Rarity (RAR)
Endemicity (END)
Relectism (REL)
Finicolous character (FIN)
Territorial interest
INTER= RAR+END+REL+FIN
Geomorphological function (GEO)
Climate function (CLIM)
Hidrological function (HID)
Edaphic function (ED)
Faunal function (FAU)
Mesological interest
INMES= GEO+CLIM+HID+ED+FAU
Richness by stratum (RIQUEST)
Coverage by stratum (COBEST)
Microhabitat richness (RIQHAB)
Space connectivity (CONESP)
Structural interest
INEST=RIQUEST+COBEST+RIQHAB+CONESP
Natural interest
INNAT= INFIT+INTER+INMES+INEST
Ethnobotanical value(ETNO)
Perceptual value (PER)
Didactic value (DID)
Patrimonial interest
INPAT=ETNO+PER+DID
Physiognomic-structural value (FISEST)
Cultural-structural value (CULEST)
Cultural-structural interest
INCULEST= FISEST+CULEST
Cultural interest
INCUL= INPAT+INCULEST
CONSERVATION INTEREST
INCON= INNAT+INCUL
Demographic pressure coefficient (DEM)
Accessibility-passability coefficient (ACT)
Alternative threat coefficient (ALT)
Global danger factor
AM=DEM+ACT+ALT
CONSERVATION PRIORITY
PRICON=INCON x AM

Example of application of the LANBIOEVA methodology: Sessile oak (*Quercus petraea*) formations of the north of the Iberian Peninsula (phytosociological sampling)



Kolitza (Bizkaia)	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	Kolitza
Richness	47	34	27	19	23	30	21	23	28	21	70
Rare, very rare and endemic taxa	4	6	2	2	3	0	0	0	0	1	6
Percentage of taxa respect to the total taxa	27,01	19,54	15,52	10,92	13,22	17,24	12,07	13,22	16,09	12,07	40,23
Percentage of taxa respect to the point sample	67,14	48,57	38,57	27,14	32,86	42,86	30	32,86	40	30	100
Total coverage by sample	240,5	234,3	268,8	340,6	238,5	303,8	293,1	240,8	401,3	323	2884,7
Covered area	962,00	937,20	1075,20	1362,40	954,00	1215,20	1172,40	963,20	1605,20	1292,00	11538,80
Garrastatxu (Bizkaia)	G1	G2	G3	G4	G5	G6	G7	Garrastatxu			
Richness	17	18	16	16	14	17	19	25			
Rare, very rare and endemic taxa	0	0	0	0	0	0	0	0			
Percentage of taxa respect to the total taxa	9,77	10,34	9,2	9,2	8,05	9,77	10,92	14,37			
Percentage of taxa respect to the point sample	24,29	25,71	22,86	22,86	20	24,29	27,14	35,71			
Total coverage by sample	213	218	172,8	118,4	138,3	131	143,6	1135,1			
Covered area	852,00	872,00	691,20	473,60	553,20	524,00	574,40	4540,40			
Pikandi (Gipuzkoa)	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Pikandi
Richness	27	21	28	20	20	34	35	18	16	25	50
Rare, very rare and endemic taxa	0	1	0	0	0	1	1	0	0	1	2
Percentage of taxa respect to the total taxa	15,52	12,07	16,09	11,49	11,49	19,54	20,11	10,34	9,2	14,37	28,74
Percentage of taxa respect to the point sample	54	42	56	40	40	68	70	36	32	50	100
Total coverage by sample	283,9	198,6	157	178,5	178,5	144,7	194,7	210,8	178,5	171,4	1896,6
Covered area	1135,60	794,40	628,00	714,00	714,00	578,80	778,80	843,20	714,00	685,60	7586,40

Example of application of the LANBIOEVA methodology: Sessile oak (*Quercus petraea*) formations of the north of the Iberian Peninsula (phytosociological sampling)



Garralda (Navarra)	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	Garralda
Richness	50	38	23	32	48	33	37	34	48	50	128
Rare, very rare and endemic taxa	0	0	0	0	1	0	1	0	1	1	3
Percentage of taxa respect to the total taxa	28,74	21,84	13,22	18,39	27,59	18,97	21,26	19,54	27,59	28,74	73,56
Percentage of taxa respect to the point sample	39,06	29,69	17,97	25	37,5	25,78	28,91	26,56	37,5	39,06	100
Total coverage by sample	310,8	274,8	243,9	209,1	243,3	234,7	204,7	339	416,7	397,5	2874,5
Covered area	1243,20	1099,20	975,60	836,40	973,20	938,80	818,80	1356,00	1666,80	1590,00	11498,00
Moncayo (Zaragoza)	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**	**Z10**	**Moncayo**
Richness	16	16	18	13	19	16	14	26	18	19	44
Rare, very rare and endemic taxa	0	0	0	0	1	0	1	2	3	4	6
Percentage of taxa respect to the total taxa	9,2	9,2	10,34	7,47	10,92	9,2	8,05	14,94	10,34	10,92	25,29
Percentage of taxa respect to the point sample	9,2	9,2	10,34	7,47	10,92	9,2	8,05	14,94	10,34	10,92	169,23
Total coverage by sample	145,6	180,8	128,4	90,9	126,3	143,4	148,1	268,2	125,7	91	1448,4
Covered area	582,40	723,20	513,60	363,60	505,20	573,60	592,40	1072,80	502,80	364,00	5793,60

Multivariate analysis Sessile oak (*Quercus petraea*) formations of the north of the Iberian Peninsula (phytosociological cover data)

The preliminary correspondence analysis of the average coverage of all inventories carried out highlights the difference in the floristic composition of these five Sessile oak forest zones. This exploratory test would confirm a courtship of different species. Figure 2 only shows the distribution of the samples and their centroids (localities).

Although the ordering obtained through the first two factorial axes (Figure 2) collects only 23.01% of all the variability, three trends can be observed: Aragonese forests (1), Navarrese forests (2) and Basque forests (3).

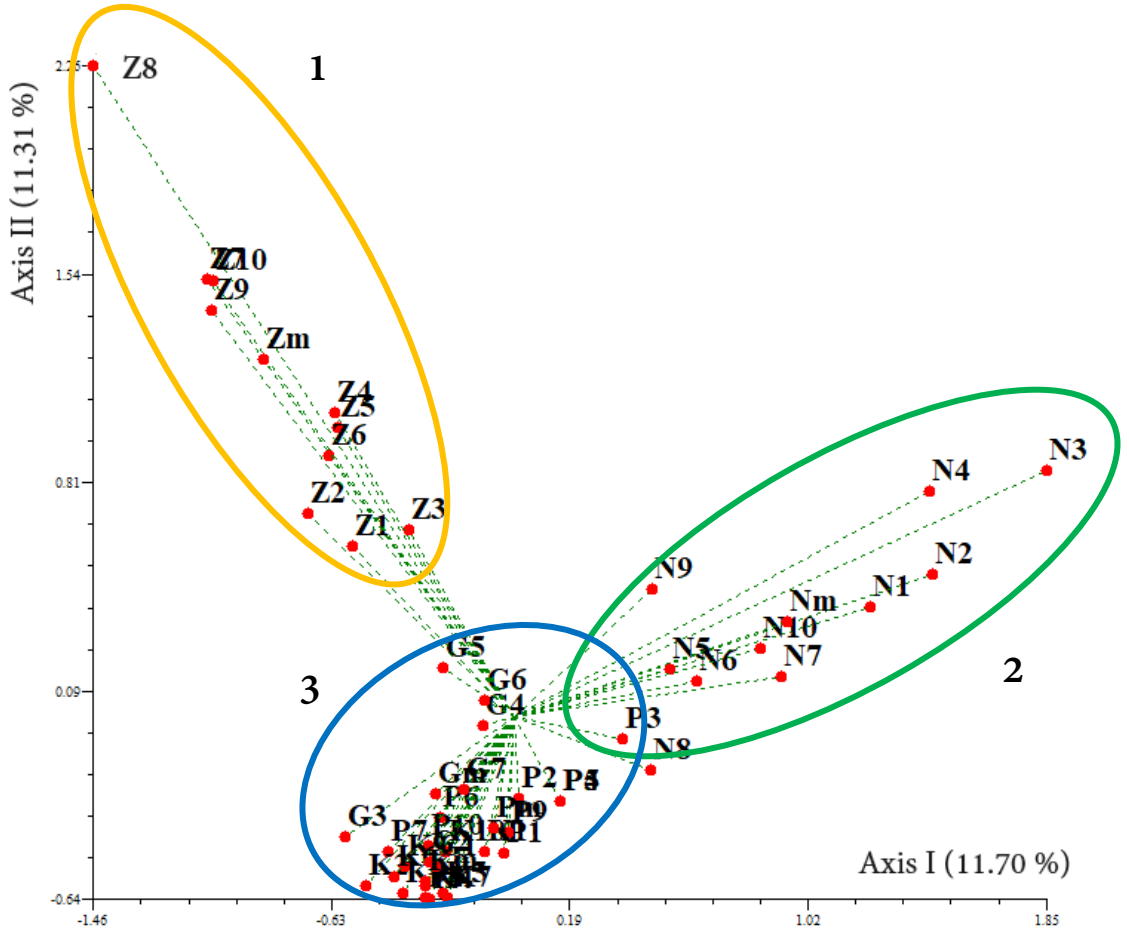
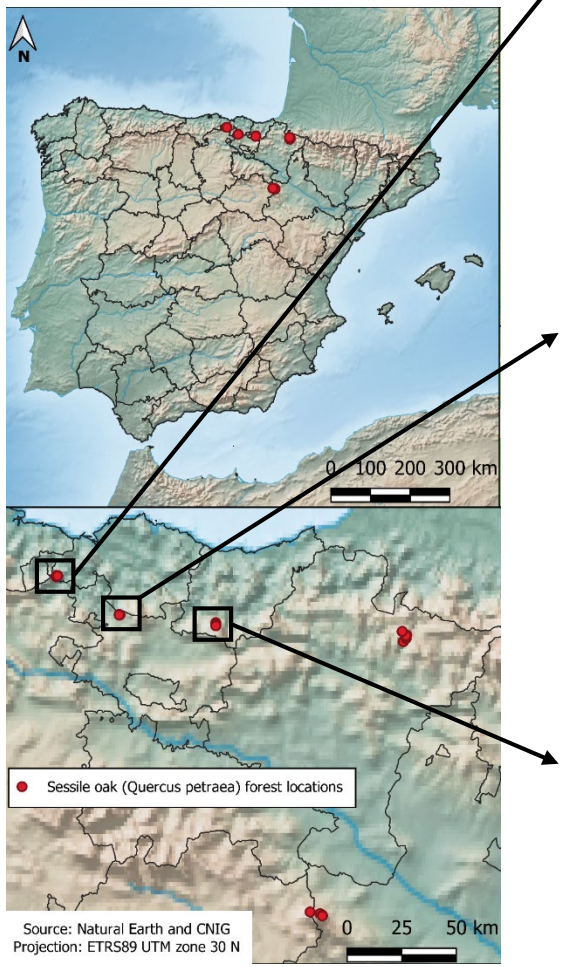


Figure 2. Ordination of the sampled localities and their centroids in factorial axes I (11.70%) and II (11.31%).

Example of application of the LANBIOEVA methodology: Sessile oak (*Quercus petraea*) formations of the north of the Iberian Peninsula (evaluation)

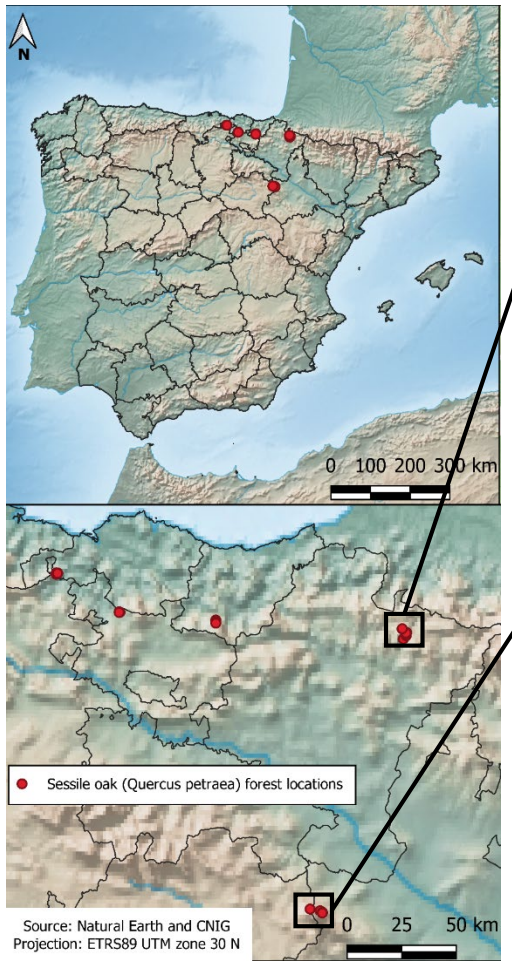


Kolitza (Bizkaia)	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	Global
INFIT	48	45	45	44	45	42	41	42	43	39	43,4
INTER	19	18	14,5	10,8	12,3	11,3	11	10,8	10,5	9,5	12,8
INMES	58	58	58	58	58	57	57	57	57	56	57,4
INEST	33	31	31	36	36,5	31	30	29,5	30,5	30,5	31,9
Natural Interest INNAT	158	152	149	149	152	141	139	139	141	135	145,5
INPAT	36	29	29	32	32	29	29	29	29	29	30,3
INCULEST	6	6	6	6	6	4	4	4	4	4	5
Cultural Interest INCUL	42	35	35	38	38	33	33	33	33	33	35,3
INCON	200	187	184	187	190	174	172	172	174	168	180,8
Global danger factor AM	6	9	9	9	9	6	6	6	6	6	7,2
PRICON	1200	1683	1652	1681	1708	1046	1032	1034	1044	1008	1308,6

Garrastatxu (Bizkaia)	G1	G2	G3	G4	G5	G6	G7	Global
INFIT	45	45	45	45	45	45	46	45,1
INTER	15	15	14,5	15	14,5	15	16	15
INMES	57	57	57	57	57	57	57	57
INEST	33	35	34	31	31	30,5	33	32,5
Natural Interest INNAT	150	152	151	148	148	148	152	150
INPAT	34	34	32	34	36	36	36	34,6
INCULEST	8	8	8	8	8	8	8	8
Cultural Interest INCUL	38	38	36	38	40	40	40	38,6
INCON	188	190	187	186	188	188	192	188
Global danger factor AM	7	7	7	7	7	7	7	7
PRICON	1316	1330	1306	1302	1313	1313	1344	1318

Pikandi (Gipuzkoa)	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Global
INFIT	48	46	48	46	46	49	50	46	45	46	47
INTER	18,5	18,5	19,8	16,5	16,5	19,5	20,5	16	15	18	17,9
INMES	57	57	57	57	57	57	57	57	57	57	57
INEST	38,5	36	38	37	36	37,5	38,5	38,5	34	38	37,2
Natural Interest INNAT	162	158	163	157	156	163	166	158	151	159	159,1
INPAT	35	35	33	36	34	36	36	35	35	35	35
INCULEST	8	6	6	8	6	8	8	6	6	8	7
Cultural Interest INCUL	43	41	39	44	40	44	44	41	41	43	42
INCON	205	199	202	201	196	207	210	199	192	202	201,1
Global danger factor AM	10	10	10	10	10	10	10	9	9	9	9,7
PRICON	2050	1985	2018	2005	1955	2070	2100	1787	1728	1818	1951,5

Example of application of the LANBIOEVA methodology: Sessile oak (*Quercus petraea*) formations of the north of the Iberian Peninsula (evaluation)



Garralda (Navarra)	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	Global
INFIT	47,0	47,0	44,0	47,0	49,0	47,0	46,0	46,0	49,0	49,0	47,1
INTER	16,5	17,0	12,0	15,5	21,0	16,0	16,0	16,0	20,5	20,0	17,1
INMES	58,0	58,0	58,0	58,0	58,0	58,0	58,0	58,0	58,0	58,0	58,0
INEST	26,5	29,0	28,0	28,0	41,0	38,0	39,0	43,0	44,0	44,0	36,1
Natural Interest INNAT	148,0	61,0	61,0	61,0	61,0	61,0	61,0	61,0	61,0	61,0	69,7
INPAT	40,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0
INCULEST	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
Cultural Interest INCUL	54,0	54,0	54,0	54,0	54,0	54,0	54,0	54,0	54,0	54,0	54,0
INCON	202	205	196	202,5	223	213	213	217	225,5	225	212,2
Global danger factor AM	7,0	7,0	7,0	7,0	11,0	9,0	9,0	9,0	11,0	11,0	8,8
PRICON	1414	1435	1372	1417,5	2453	1917	1917	1953	2480,5	2475	1883,4
Moncayo (Zaragoza)	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**	**Z10**	**Global**
INFIT	40,0	40,0	40,0	40,0	41,0	40,0	40,0	43,0	42,0	41,0	40,7
INTER	18,0	17,0	20,0	17,5	21,0	17,0	19,0	23,5	24,0	26,0	20,3
INMES	49,0	49,0	49,0	49,0	49,0	49,0	49,0	49,0	49,0	49,0	49,0
INEST	34,0	34,0	33,0	29,5	34,0	34,5	32,0	36,5	35,0	35,0	33,8
Natural Interest INNAT	141,0	140,0	142,0	136,0	145,0	140,5	140,0	152,0	150,0	151,0	143,8
INPAT	28,0	28,0	28,0	28,0	29,0	29,0	28,0	31,0	31,0	28,0	28,8
INCULEST	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0
Cultural Interest INCUL	36,0	36,0	36,0	36,0	37,0	37,0	36,0	39,0	39,0	36,0	36,8
INCON	177,0	176,0	178,0	172,0	182,0	177,5	176,0	191,0	189,0	187,0	180,6
Global danger factor AM	12,0	12,0	10,0	10,0	12,0	12,0	12,0	12,0	12,0	12,0	11,6
PRICON	2124,0	2112,0	1780,0	1720,0	2184,0	2130,0	2112,0	2292,0	2268,0	2244,0	2096,6

Multivariate analysis Sessile oak (*Quercus petraea*) formations of the north of the Iberian Peninsula (LANBIOEVA: parameters data)

The exploratory analysis of correspondences of the parameters evaluated using the LANBIOEVA method does not detect differences between the sessile oak forest samples (including their centroids) (χ^2 = 1348.272, df = 1326, p = 0.3289). This implies a very condensed positioning towards the geometric center of the system in the all representations. The parameters "RELIC", "ED", "CONESP" and "DEM" do not provide information as they are invariants. Ordination with the first and third factorial axes (Fig. 3) collects only 23.01% of all the variability. Four trends can be observed: Aragonese forests (1), Kolitza forest (2), Garrastatxu forest (3) and Pikandi forest (4); Navarrese forests are dispersed between groups (3) and (4) –green ellipse-.

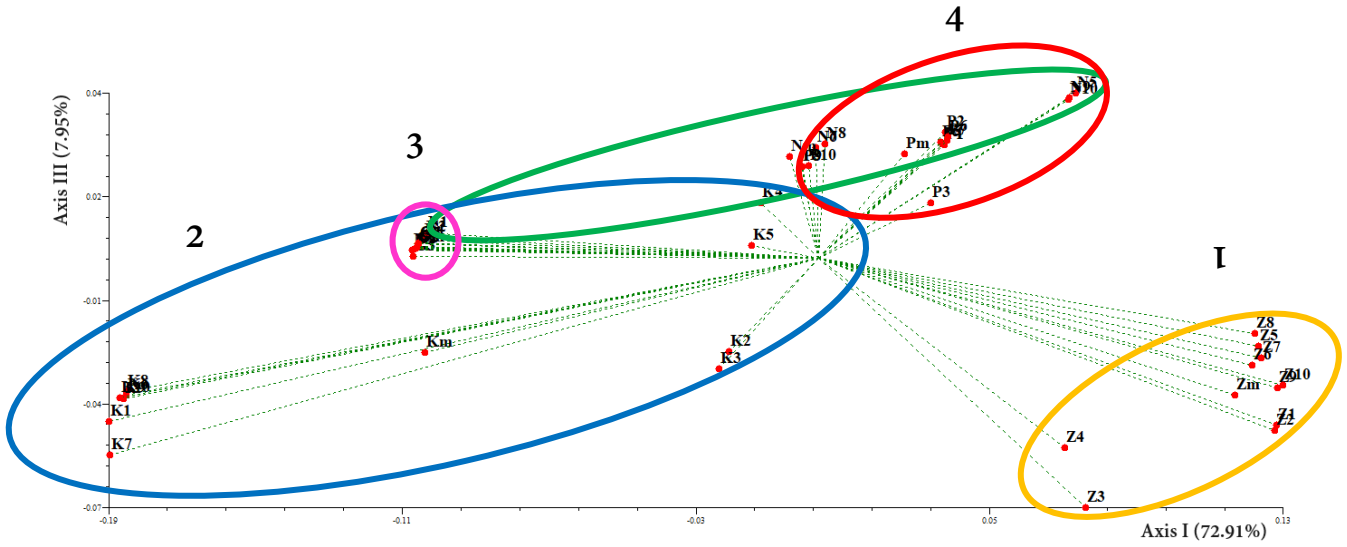


Figure 3. Ordination of the sampled localities and their centroids in factorial axes I (72,91%) and III (7,95%).

Multivariate analysis Sessile oak (*Quercus petraea*) formations of the north of the Iberian Peninsula (LANBIOEVA: INCON and PRICON)

INCON values for these samples range between 168.0 and 225.5, corresponding to the values included in the third quartile considering all the formations studied to date[1], which characterize a high qualification (Fig. 4).

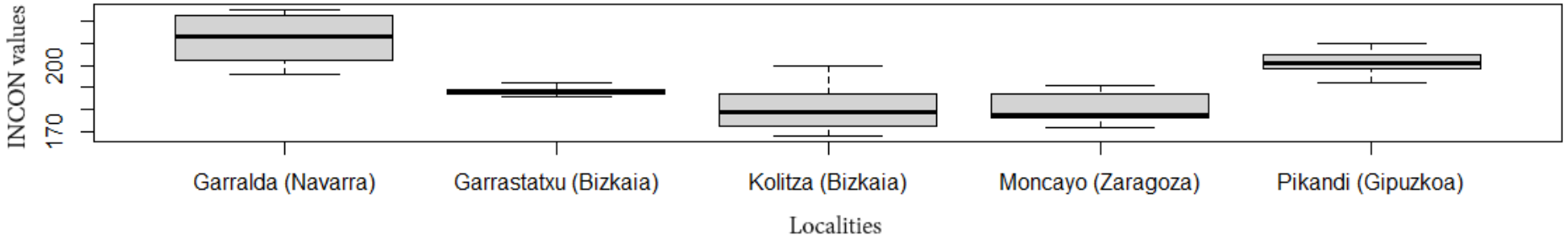


Figure 4. Box-plot of INCON values for the five sessile oak locations studied

PRICON values range from 1008.0 to 2480.5, corresponding to low, medium and high classifications[1]. The easternmost localities (Garralda and Moncayo) are those that show higher values and therefore require conservation measures (Fig. 5).

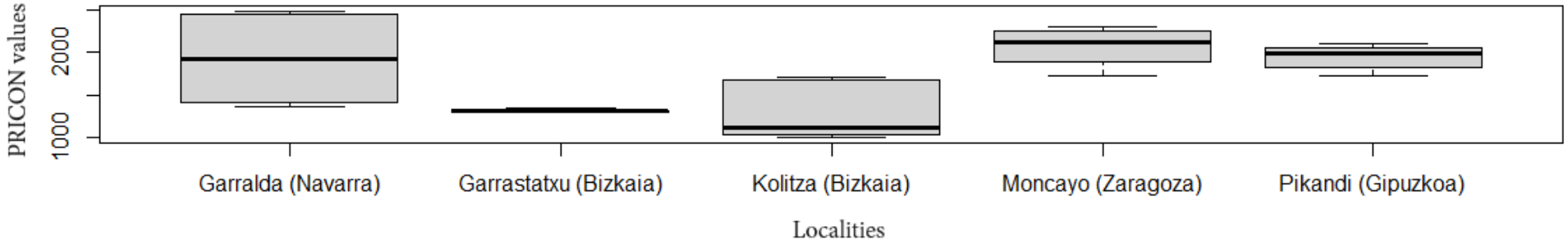


Figure 5. Box-plot of PRICON values for the five sessile oak locations studied

[1]Lozano-Valencia, P.J., Varela, R., Latasa, I., Lozano-Fernández, A. & Meaza, G. (2020) Biogeographical valuation of global plant landscapes using "lanbioeva" (landscape biogeographical evaluation) methodology. In Iternational Geographical Union, *Spain, bridge between* continents. Spanish contribution to 34th International Geographical Congress, Istanbul 2020. Pp: 174-187.


Thank you for your attention