

State of the art for LTER and „LTER like” sites (WP- I3.1.)



**WP I3 A Network of long-term multi-
functional, inter-disciplinary,
ecosystem research (LTER) sites**

**University of Bucharest
Department of Systems Ecology
(DSES-UNIBUC)**

Prof. Dr. Angheluta Vadineanu
Drd. Sabina Datcu
Dr. Mihai Adamescu
Dr. Cazacu Constantin

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 2. A proposed digital format
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 5. Patterns in the variation of collated datasets
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 - Habitat types (after EUNIS)
 - Environmental variables
 - Biodiversity
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- Overall remarks

Remarks upon the report at the meeting in Bratislava

- Some countries (Germany, Poland, Italy, Hungary etc) underrepresented in terms of sites;
- The data/sites were based too much on a single network (TEMS);
- Cross checking of the data by partners;
- Need to establish links with I6 regarding database (structure, adding new GIS layers, database uses);

Addressing the remarks

- **Under representation issue: Germany from 3 sites in the draft report - 112 sites now, Poland from 2 sites – 159 now, Italy from 3 to 60, Hungary from 3 to 24 etc;**
- **Network issue: TEMS is still dominating the structure of the data but only due to the fact that there are 1200 sites in the network; Data from other networks have been collated also: ILTER (all data from the ALTER NET partners plus other European countries), BRIM (67 from 74), ICP –Forest and ICP IM;**
- **Cross checking of the data by partners – still an issue to be addressed;**
- **Link with I6 – started (ongoing process)**

Introduction



The report was developed in accordance with:

- the **overall framework and goal of the ALTER-Net** project and
- the **specific objectives established for the first task** entitled “State of the art for LTER activities in Europe” – of the WP I3

Overall aim of the ALTER-NET is to obtain:

Durable integration of the existing research institutions and infrastructures by networking partner organizations from European countries in order to create the critical mass and operational conditions for carrying out interdisciplinary and transdisciplinary research and integrated monitoring on “biodiversity, ecosystems and social systems” across European scale.

Specific objectives for I3.1.



- **identification and selection of existing LTER and LTER-like sites** which might be used for building the integrated research and monitoring infrastructure in the context of ALTER-Net;
- **to design and develop a structured digital format for collation of information** from existing databases of LTER and “LTER-like” programs, sites and projects (with contingency for expansion/adjustment as needed in view of current information available);
- **to collate most relevant information for the overall goal of ALTER-Net** from a representative sample of sites established at European scale where long term monitoring or both monitoring and research activities are carried out;
- **to validate the collated information and to gather supplementary information** from the ALTER- Net partners in order to ensure that most relevant sources of information has been covered;
- **to analyze the collated information along main dimensions relevant for ALTER-Net** and write a report focused on the main patterns of variation in the information provided by the LTER and “LTER-like” programs and sites involved in the analyze.

1. Definition of LTER site in the context of Alter-net



LTER site in the context of ALTER-Net is viewed as a “**specific site/location/platform designed and managed at local and landscape scale for long-term research and monitoring**, focused on the dynamics of:

- **major aspects of biological and ecological diversity** – composition, structure and functioning – under the influence of both natural and human drivers and pressures (e.g. climate changes, fragmentation, pollution, over-exploitation, invasive species);
- **human perception, attitudes and participation** related to biodiversity conservation and ecosystem management
- **spatio-temporal relationships** between **socio-economic systems** and the **components of biodiversity**, and;
- on the **development of appropriate methods and tools** for the **implementation of DPSIR operational model** in the integrated (ecosystem) and adaptative management of the environment, biodiversity and socio-economic systems”.

Information sources

- **TEMS;**
- **ILTER program and networks;**
- **ICP-Forest;**
- **ICP-IM;**
- **BRIM;**
- **ENFORS;**

	PROGRAMS	EUROPEAN SITES (FROM COUNTRIES INCLUDED IN THE ANALYSIS)	NO SITES ANALYZED	PERCENT SITES ANALYZED %
1	TEMS	1223	1139	93.1316
2	ENFORS	78	9	11.53
3	BRIM	74	67	90.5465
4	ILTER	106	111	
5	ICP Forest	811	807	99.50
6	ICP-IM	Not known	73	

Datasets have been assessed in order:

- **to design the digital format,**
- **to collate the available information and**
- **to appreciate the state of art of the LTER and “LTER sites” in Europe.**

Information sources

- **6 international programs/networks;**
- **1185 sites;**
- **31 countries;**
- **207375 data** regarding Administrative, Location, Monitoring indicators, research facilities etc

COUNTRY	TEMS	ENFOR	BRIM	ILTER	ICP FOREST	ICP IM
Austria	32	4	0	2	20	1
Belarus	2	0	1	0	0	1
Belgium	26	3	0	0	21	0
Bulgaria	2	2	1	0	2	0
Croatia	8	0	0	0	7	0
Czech Rep.	24	4	6	7	14	2
Denmark	29	5	1	0	18	0
Estonia	9	1	0	Not known	6	2
Finland	48	6	0	0	31	4
France	125	3	5	0	102	0
Germany	117	7	13	0	90	2
Greece	10	2	0	0	4	0
Hungary	30	2	2	3	15	1
Ireland	24	5	0	2	16	1
Israel	3	0	0	1	0	0
Italy	68	6	3	0	39	13
Latvia	7	1	0	3	3	2
Lithuania	12	1	0	not known	9	3
Luxembourg	4	0	0	0	4	0
Netherlands	16	2	0	0	14	0
Norway	38	2	0	0	19	2
Poland	162	3	7	7	150	1
Portugal	17	0	1	0	13	1
Romania	16	4	1	6	13	0
Russian	76	0	11	0	12	7
Slovakia	17	1	3	5	9	0
Spain	65	7	5	0	53	0
Sweden	113	4	1	0	100	3
Switzerland	27	1	0	16	16	0
UK	95	2	12	54	11	2
Ukraine	1	0	1	not known	0	0
TOTAL	1223	78	74	106	811	48

2. A proposed digital format for collation the available information relevant for AlterNet



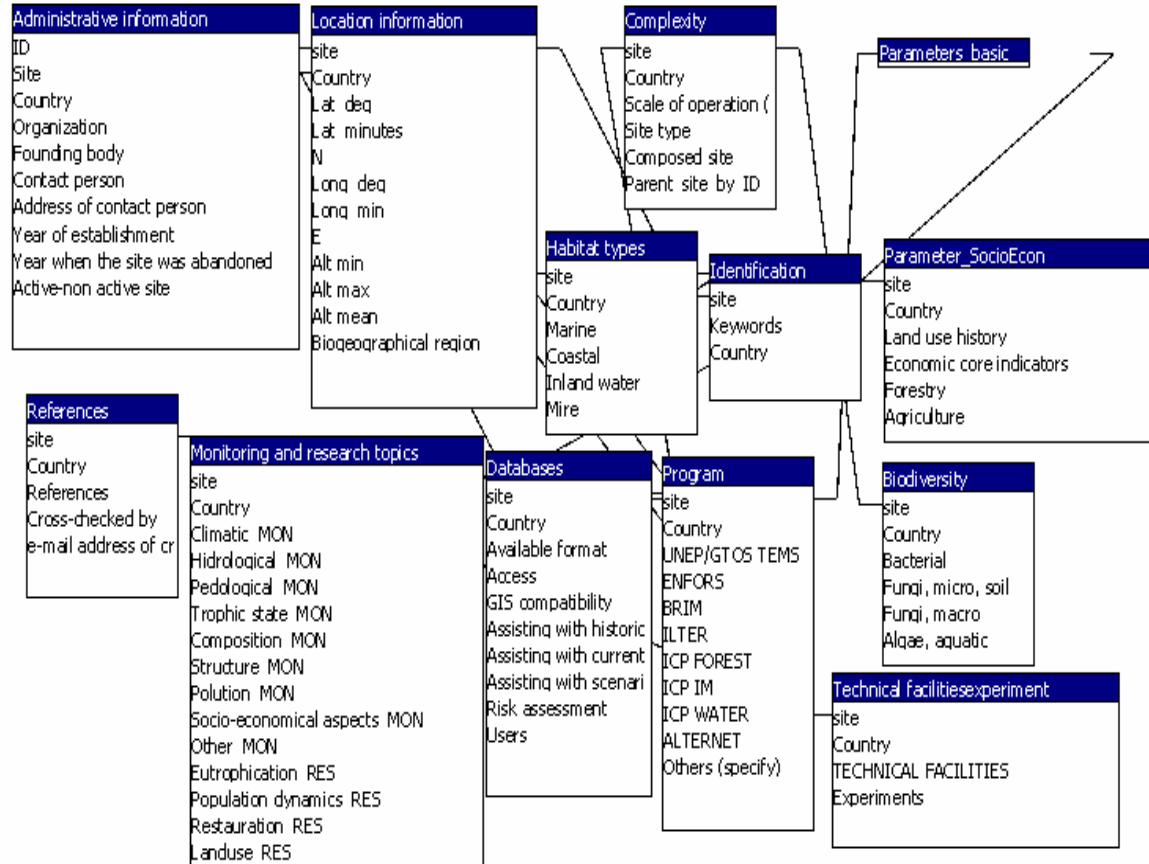
A 3 steps procedure consisting in:

- a) Development of the 14 EXCEL Spreadsheets for data collation;
- b) Development of a MS Access database;
- c) Integration, into a geo-relational database, of the information supplied by 1147 sites (having spatial references).

MS Access database

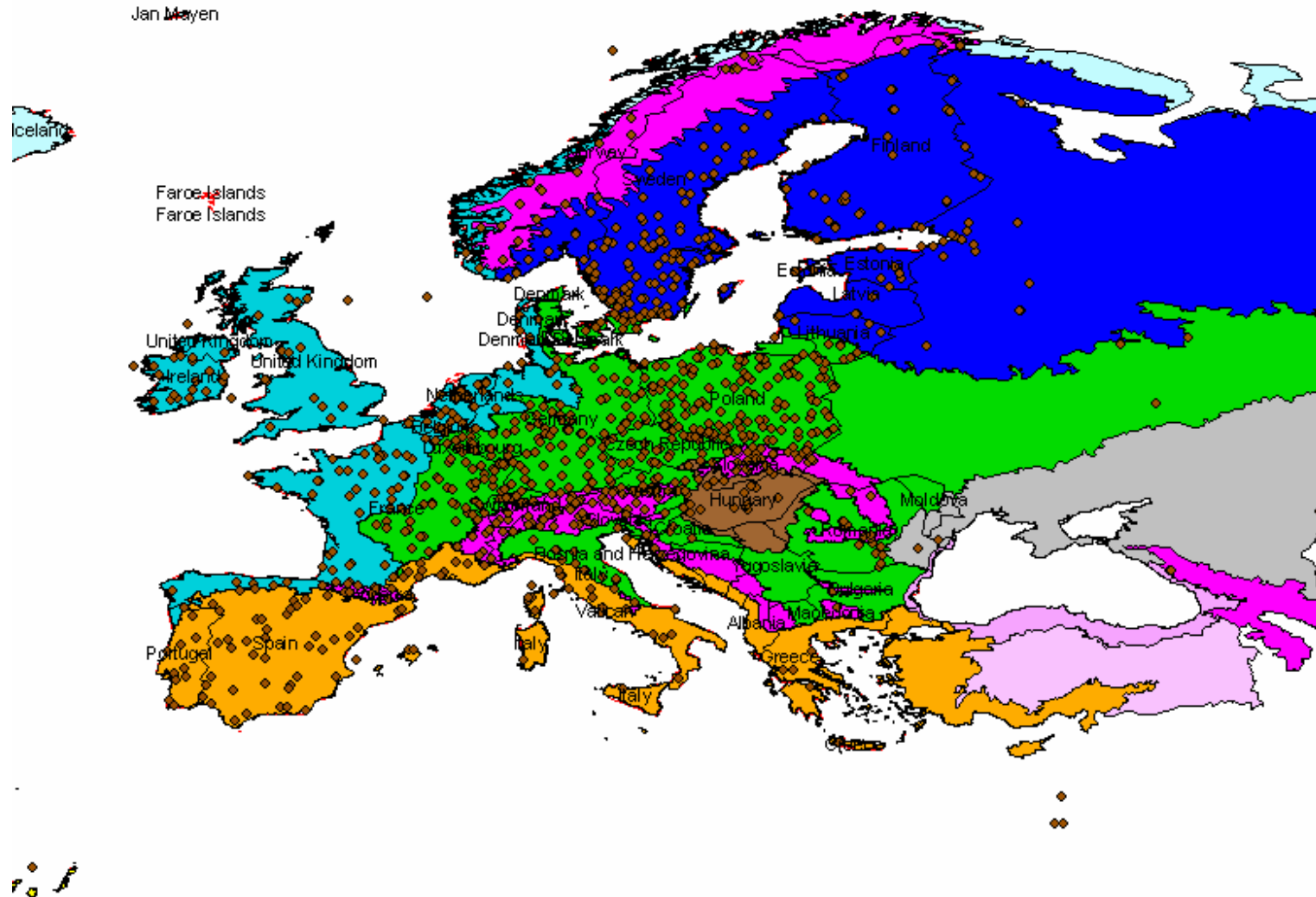
The second step was the development of a MS Access database with relation between tables. The excel spreadsheet have been imported in the program and the relationship have been created.

It allows the user to assess and analyze the available information or to add new information. In that respect we consider this type of databases, flexible enough and friendly.



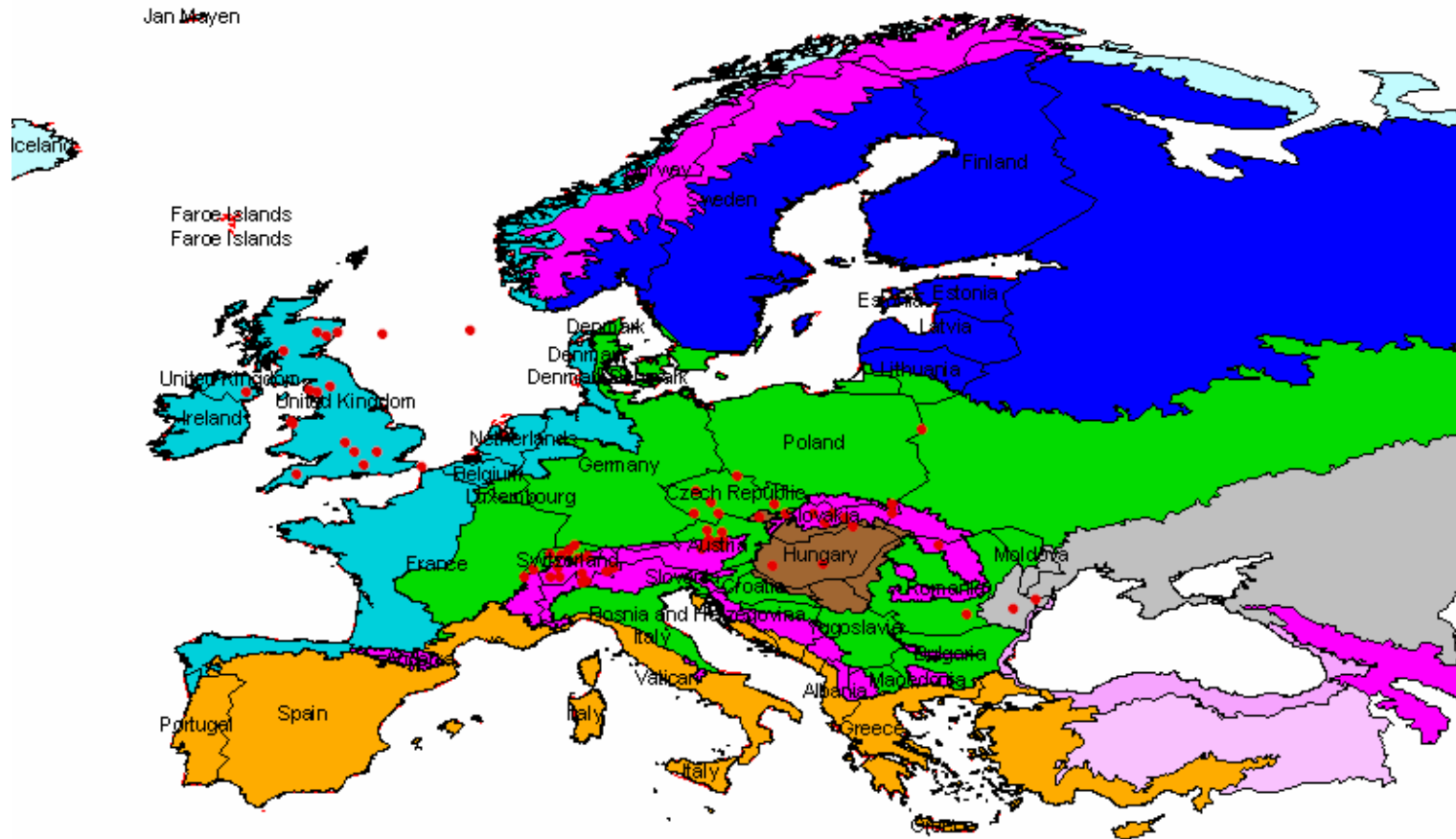
Geo-relational database

The geo-relational database was superposed with the bioregions shape file, thus obtaining an overview image regarding spatial distribution of sites (**LTER** and “**LTER-like**”) across Europe.



Geo-relational database

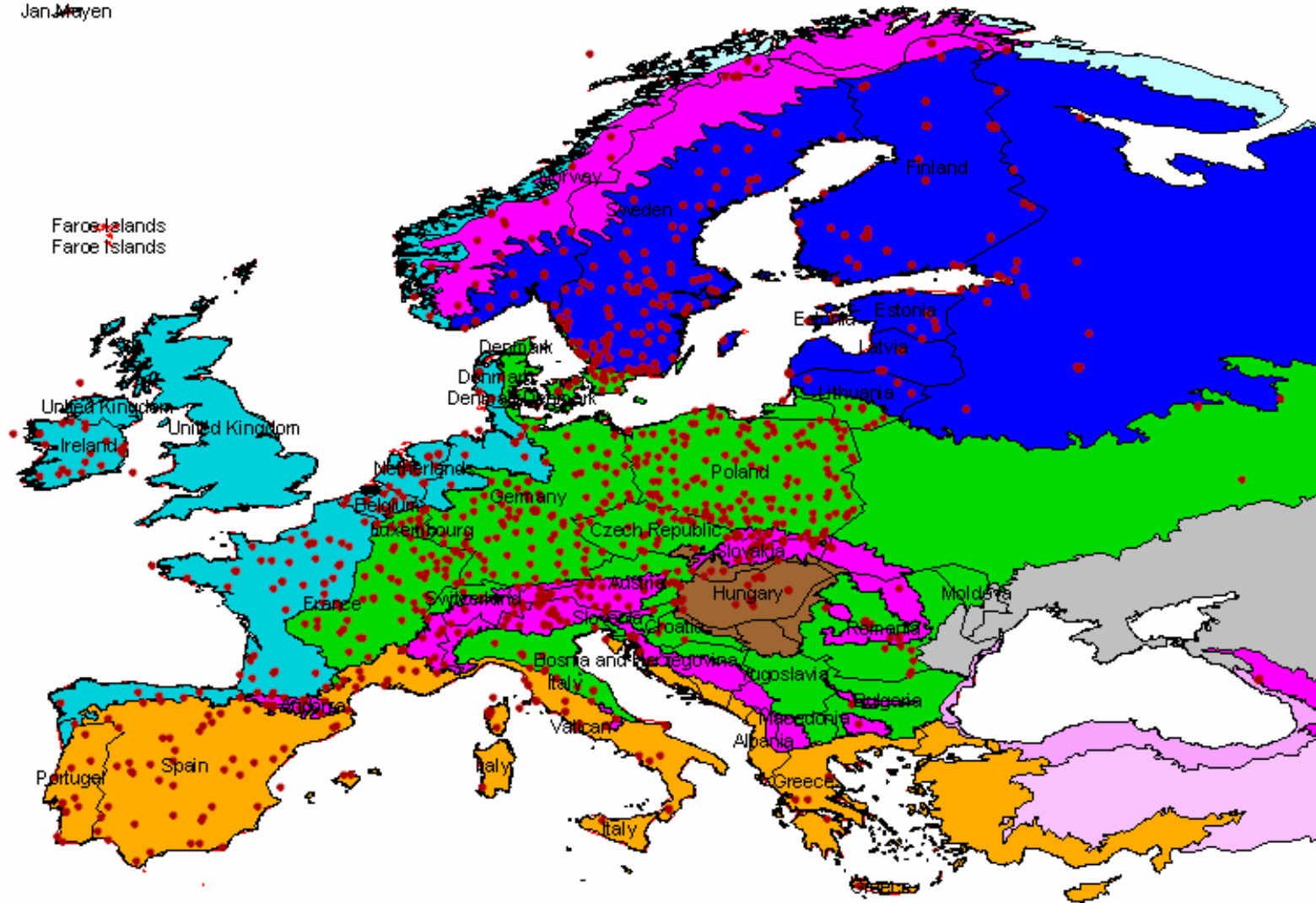
LTER sites in Europe



Geo-relational database

“LTER-like” sites

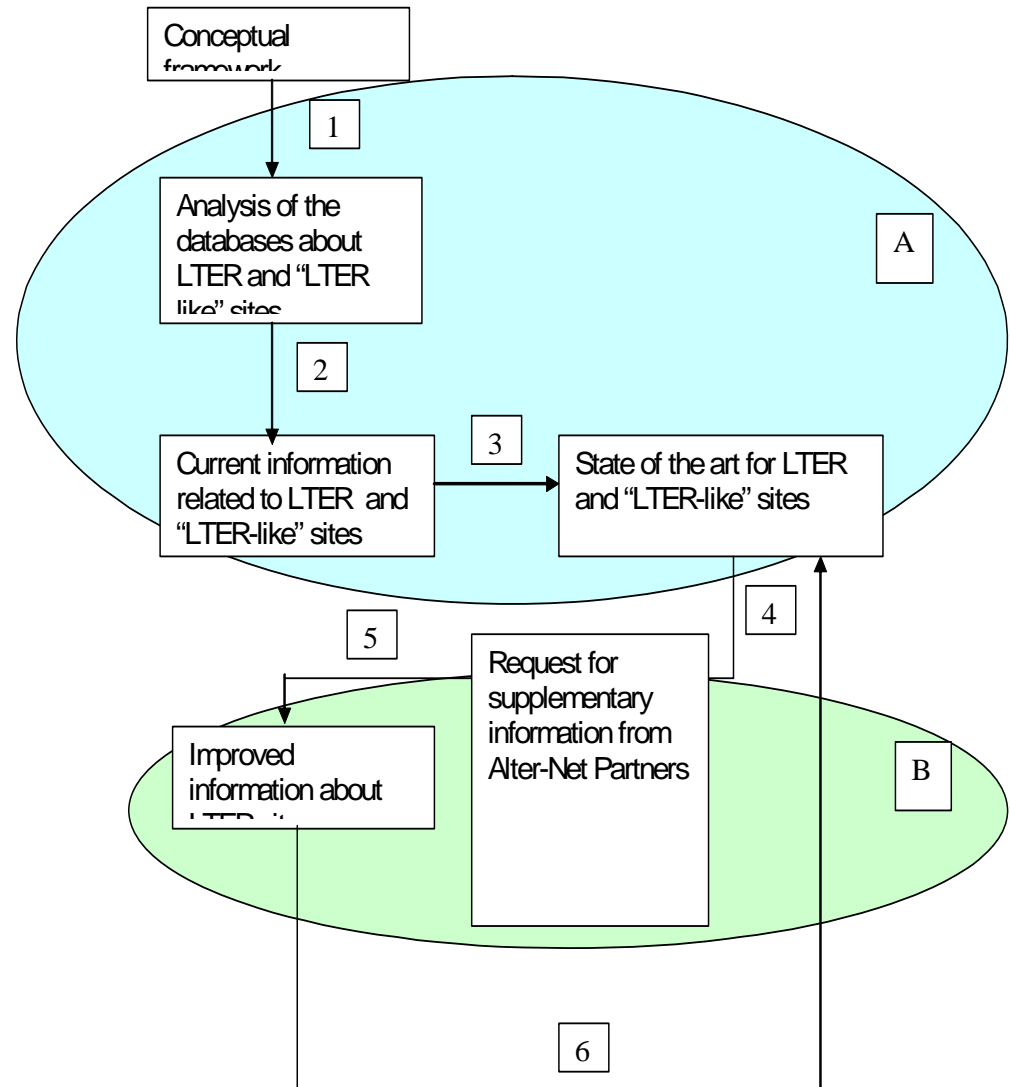
Jan Mayen



3&4. Collation (A) and validation (B) of the information



Multi-step procedure for data collation and validation



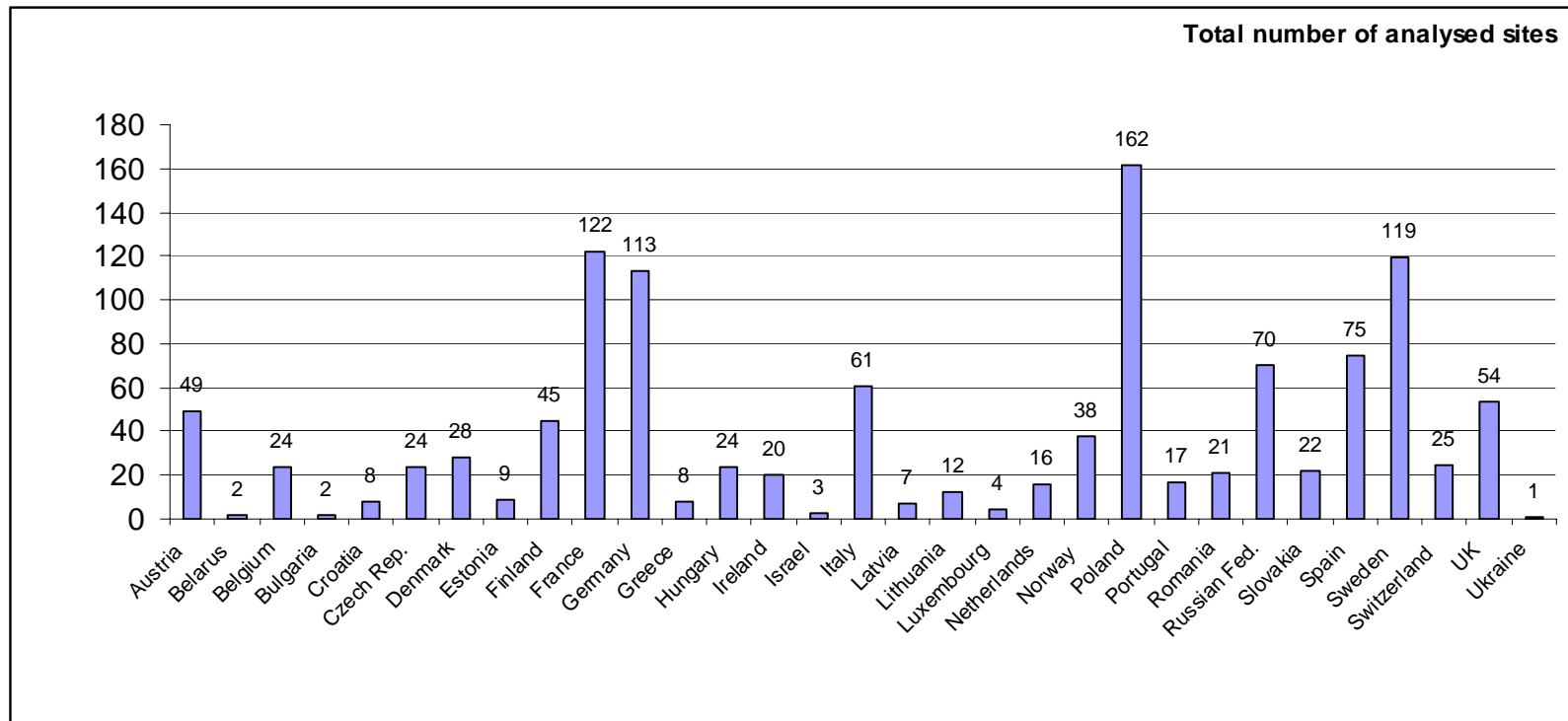
Remarks about data validation and collation



-1-

At this stage it has to be noticed that:

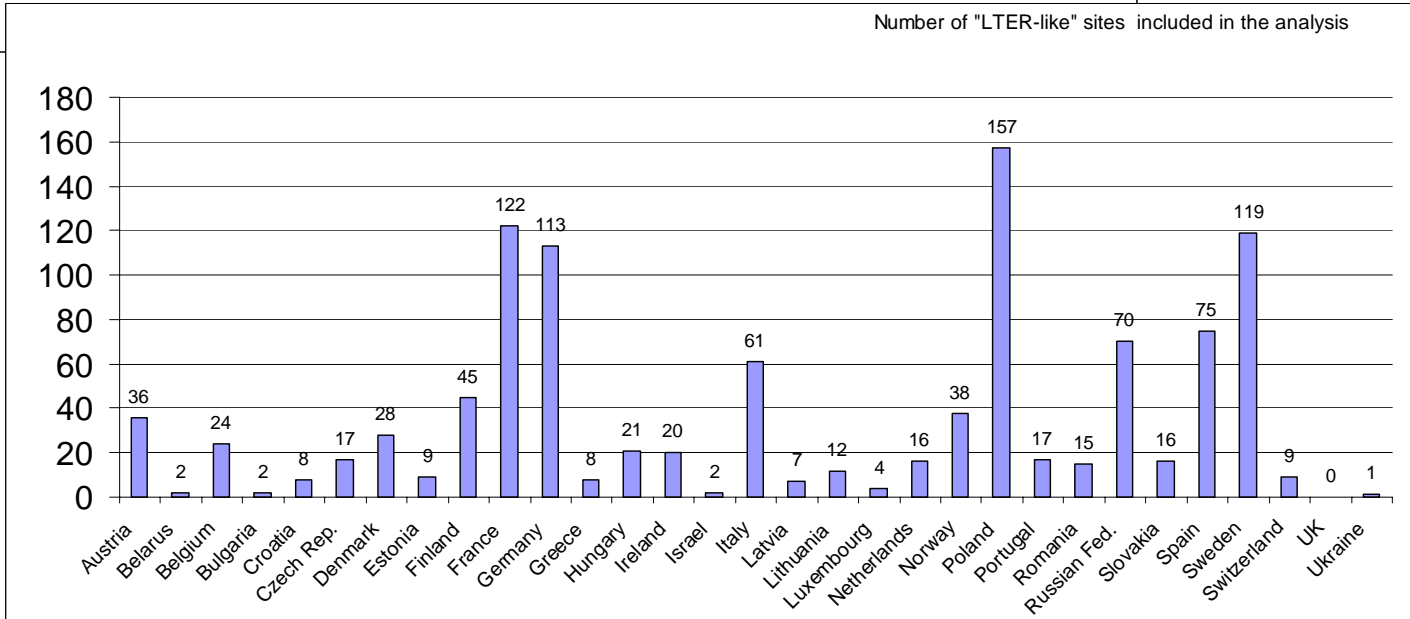
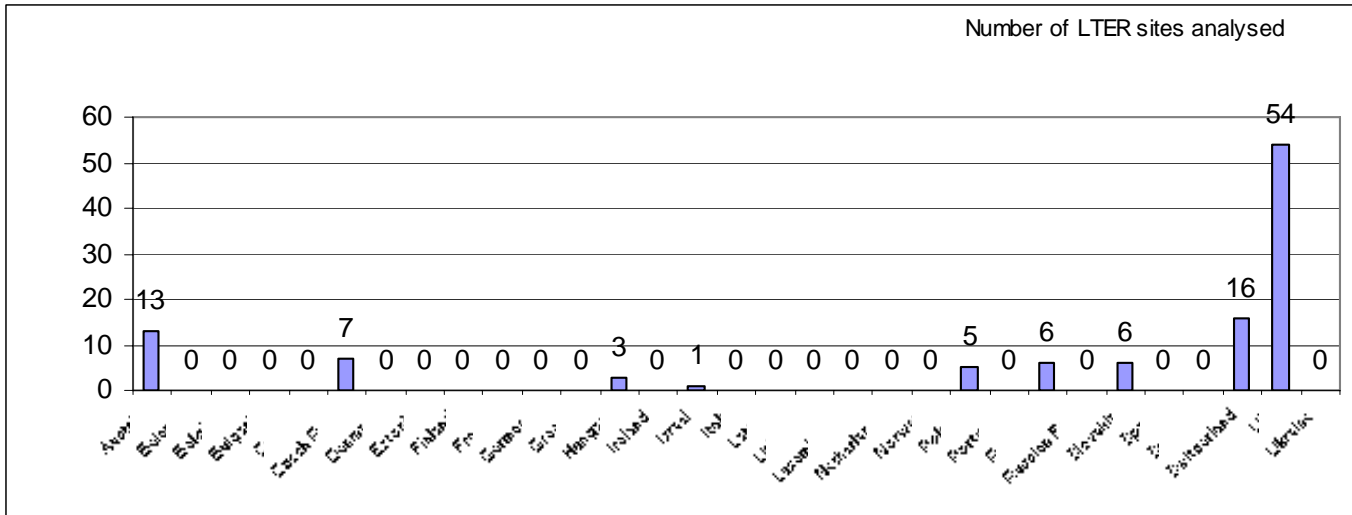
- all (84) LTER sites from the **partner countries** officially recognised as part of the LTER, have been integrated in the considered sample;
- another 1074 sites, not officially declared as LTER sites, have been integrated in this analysis;



Remarks about data validation and collation



-2-



Remarks about data validation and collation

-2-

- seven partners have been reacted in order to validate the datasets regarding their countries

All of these observations have to be taken into consideration when we judge some specific statements, concerning the patterns of variation in the collated information.

5. Patterns in the variation of collated information



It is, now, recognized that the human civilization is and will be confronted with **two majors and complementary problems**:

a) **globalization** and,

b) **global transition** towards a developing model that integrates the social and ecological externalities of the economic and demographic growth.

5. Patterns in the variation of collated information



In that regard, there is a **need for developing the information systems and infrastructure for communication and cognitive transfer of knowledge** and information towards policy and decision makers and public.

The **decision support system** should be built on:

- a) the best available information and knowledge about biodiversity, ecosystem and landscape structure, processes and functions and flow of resources and services;
- b) a set of indicators for monitoring the structural and functional changes, under natural and human drivers and pressures;
- c) a toolbox of socio-economic evaluation methods and techniques and;
- d) an enabling analytical framework

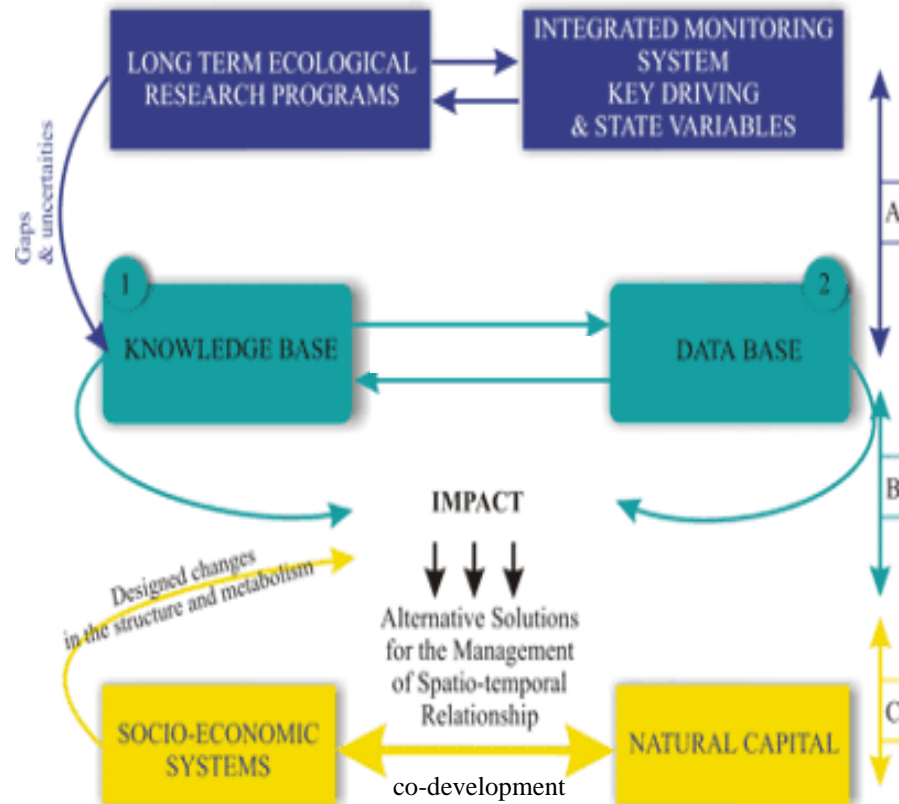
5. Patterns in the variation of collated information



The set of well defined and sensitive indicators allow for estimation of the reference state of biodiversity, ecosystems and landscapes and, identification of the trend in the state transition under the pressure of natural and human driving forces while, the availability of information and knowledge about the ecosystem and the landscape processes allow for identification and assessment of changes in the ecosystem functions and in the density flow of resources and services.

The socio-economic valuation methods and techniques allow for making explicit the economic and social benefits of the multiple functions of biodiversity, ecosystems and landscapes, within decision making process.

The flow diagram showing the relationships between: a) research and monitoring infrastructure; b) information system (core of the Decision support system) and; c) adaptive management for co-development (sustainability) of local SES and biophysical structure of NC within socio-ecological system



5. Patterns in the variation of collated information



In order to generate that required types of information and knowledge, different approaches have been applied in the last 2-3 decades at national, European and global scale:

- a) establishing network of sites at different space scale;
- b) undertaking long term monitoring of environmental and/or biodiversity and ecosystem state variables;
- c) caring on research activities regarding the structure and functioning of biodiversity components, ecosystems and landscapes. The data and information were stored in more or less structured databases with little and weak linkage among them.

5. Patterns in the variation of collated information



This section is focused on:

- a) the assessment of major approaches occurred at the European scale;
- b) space scale of sites and their biogeographical distribution;
- c) type of data and knowledge produced and on;
- d) the identification of trend in the approaches for data and knowledge generation.

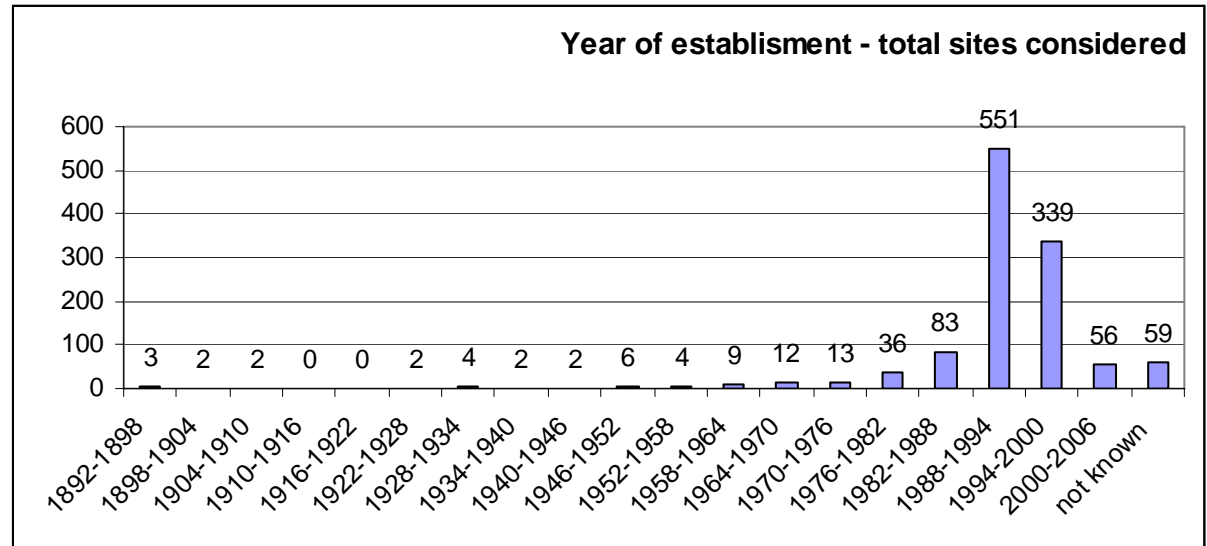
5. Patterns in the variation of collated information

The assessment is taken into consideration the following three levels of analysis:

- a) total sites,
- b) LTER sites,
- c) “LTER-like” sites,

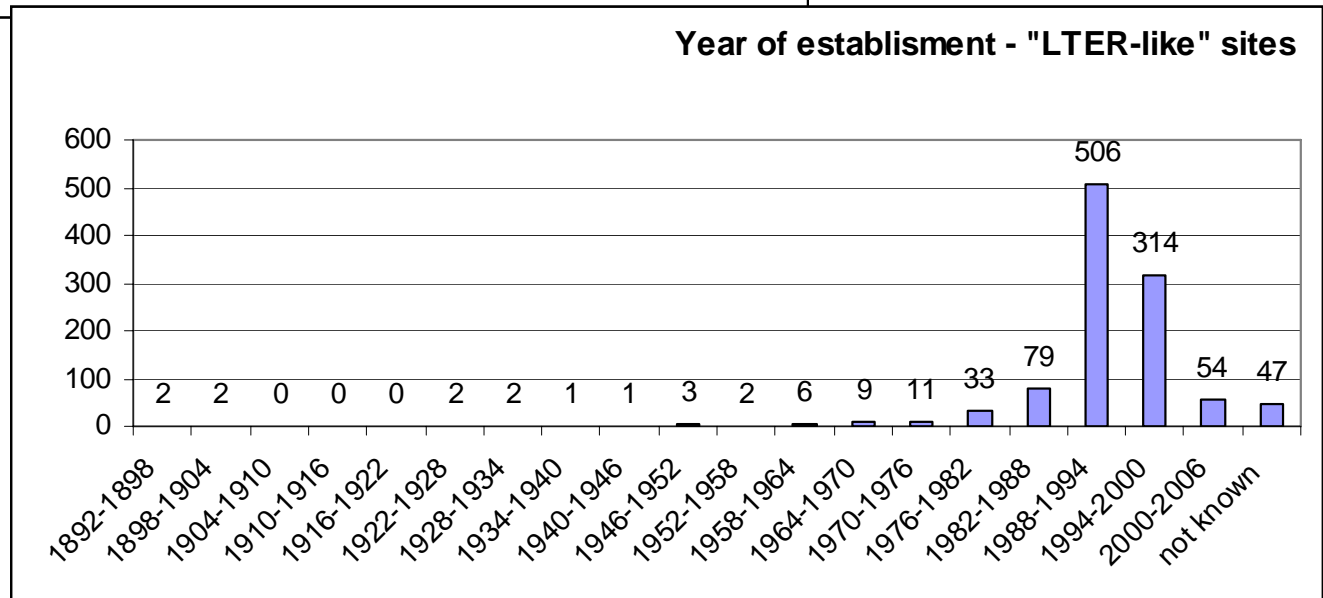
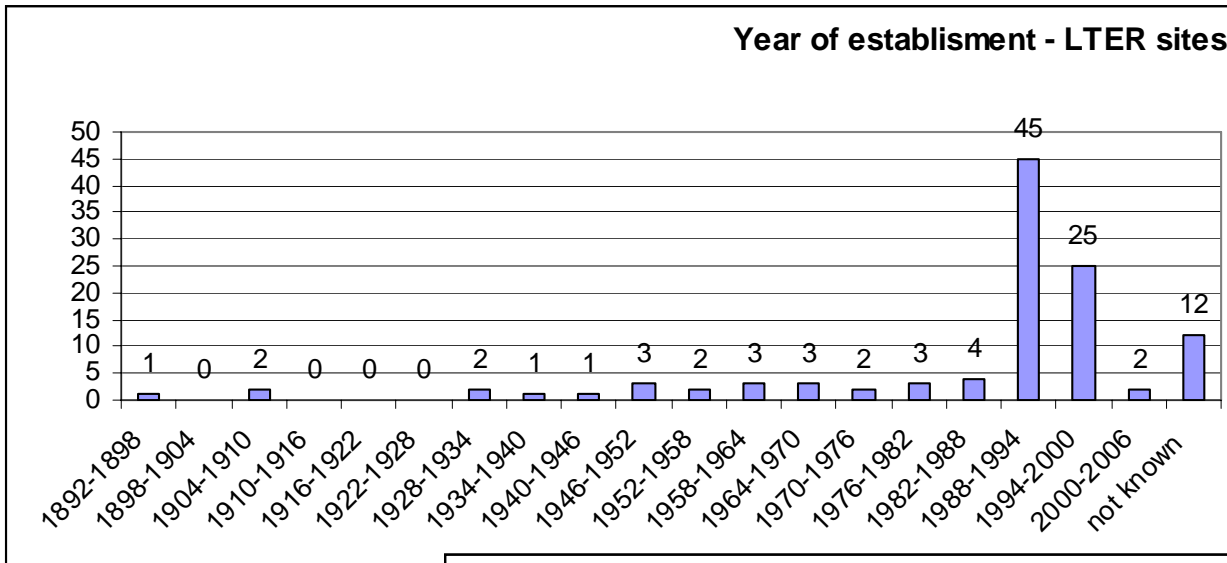
Administrative Time scale

Most of the analysed sites have been established during the 1988- 1994 period.

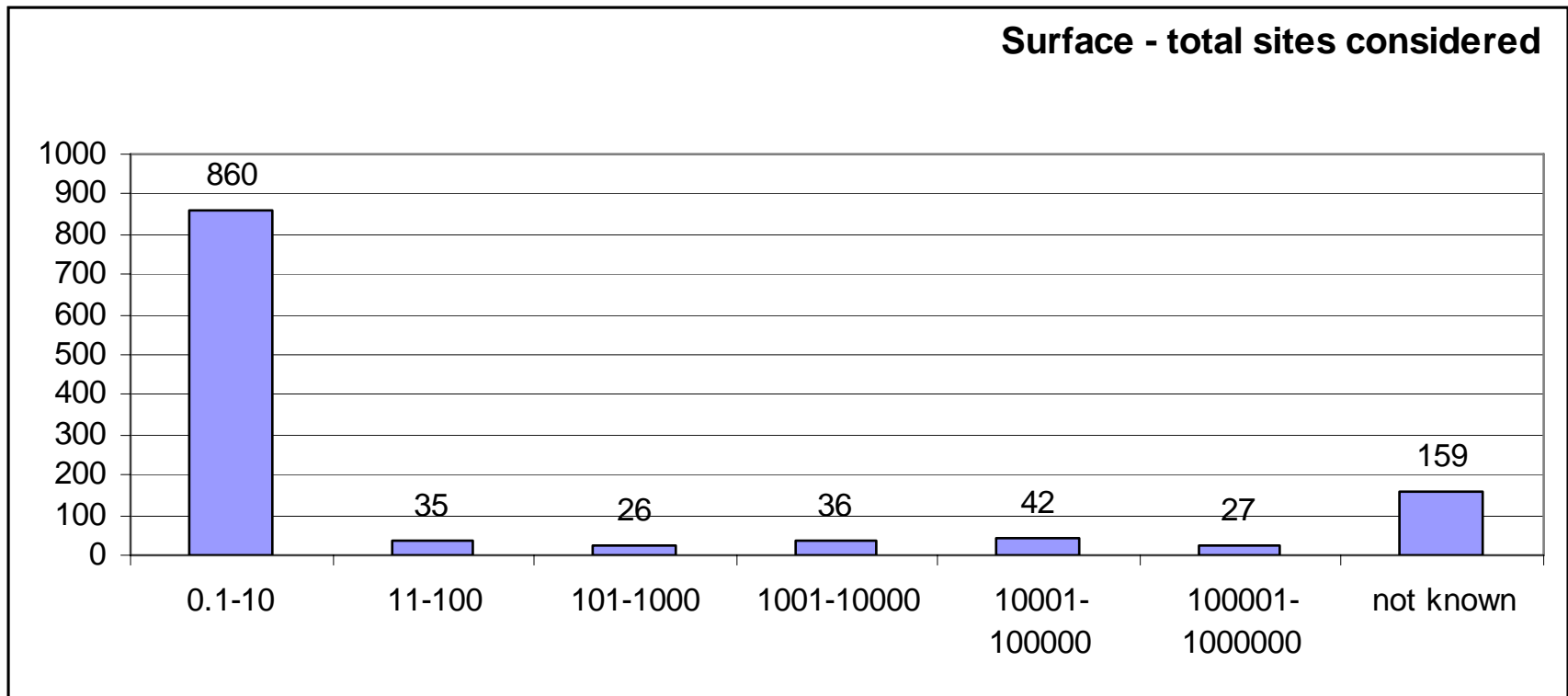


Some sites (e.g. Sonnblick Observatory 1886- Austria, Lake Balaton Tihany 1981– Hungary, Svartberget, 1923 – Sweden, Esthwaite water and Windermere – 1929, UK) provide long time series of data about structure and functioning of different ecosystem types.

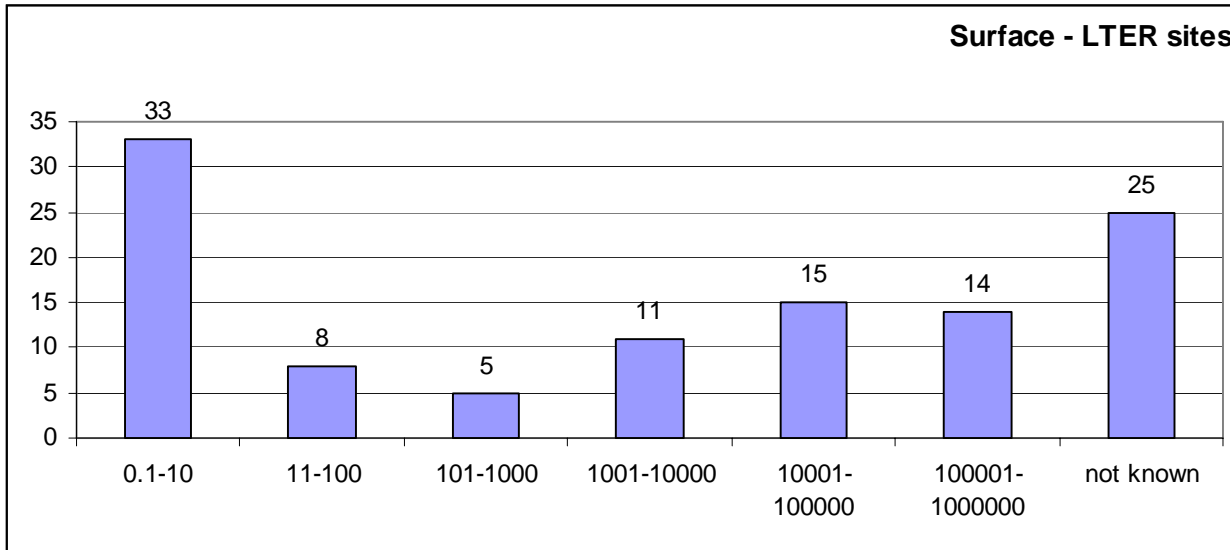
Administrative – Time scale



The size of sites (ha)(total sites considered)

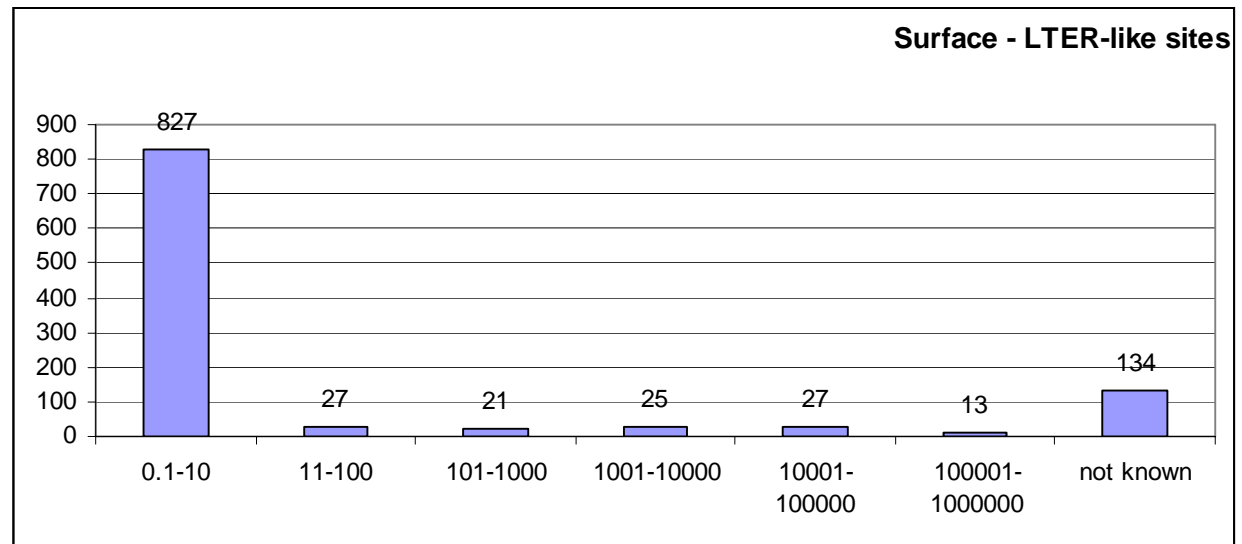


Complexity – Spatial scale

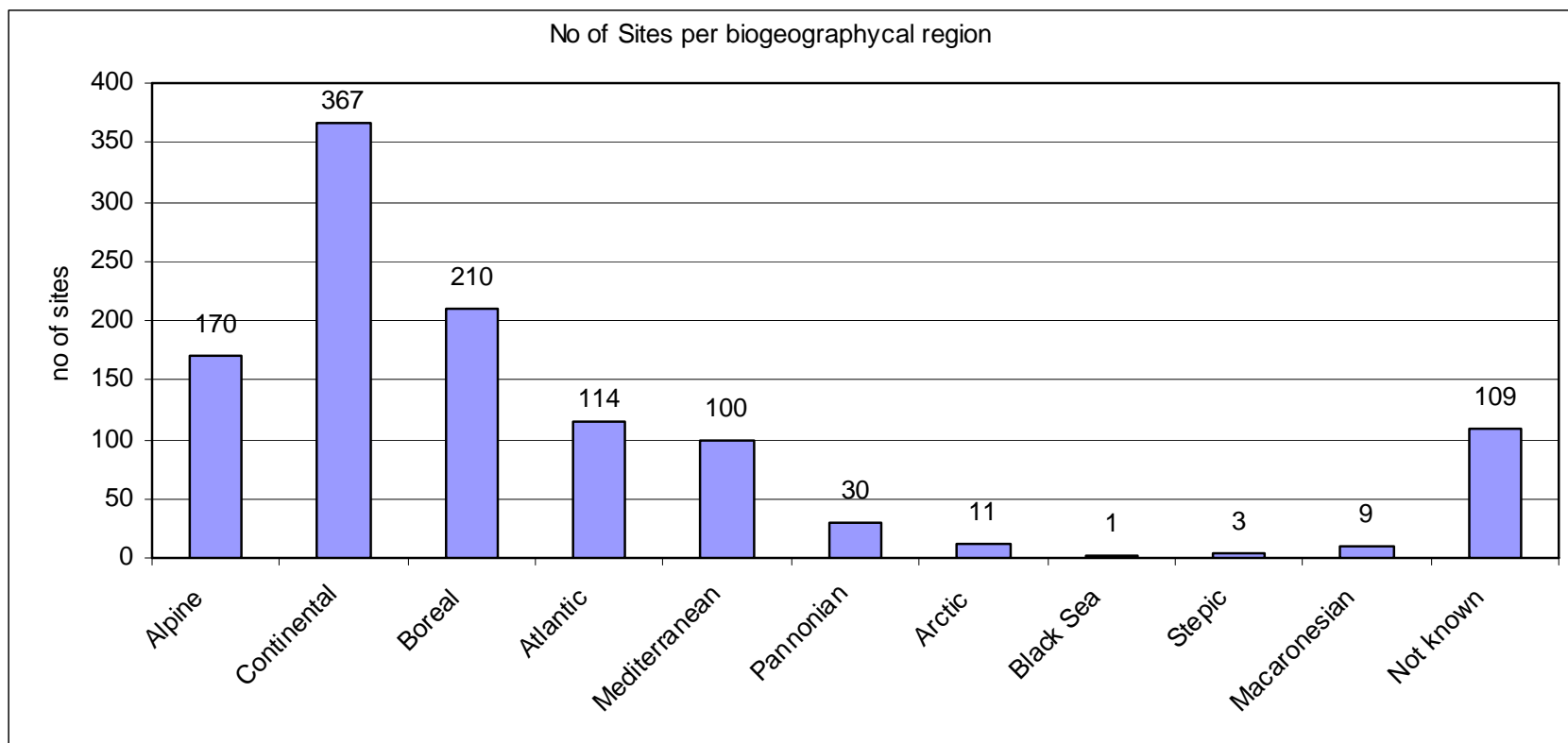


The size of
LTER sites (ha)

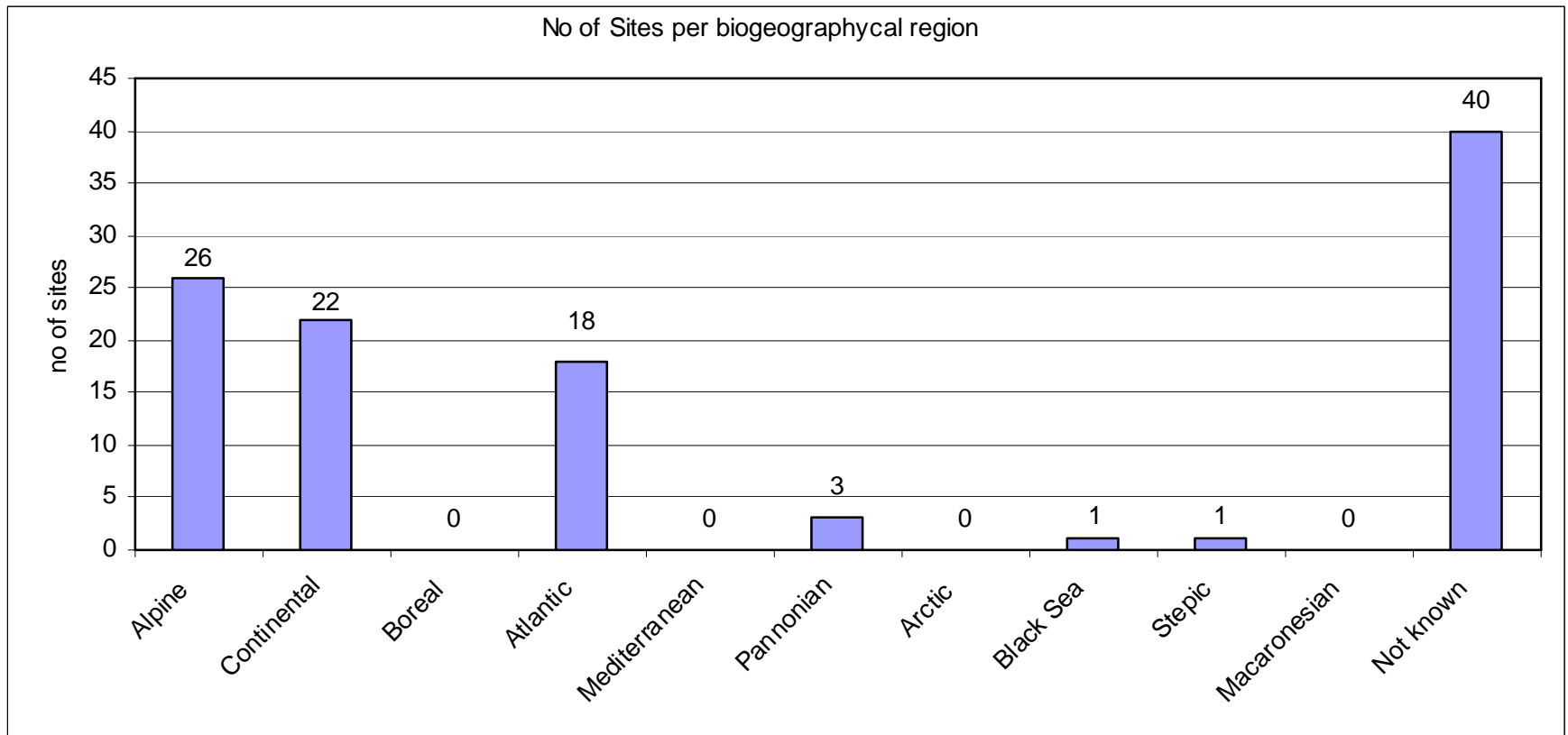
The size of "LTER-
like" sites (ha)



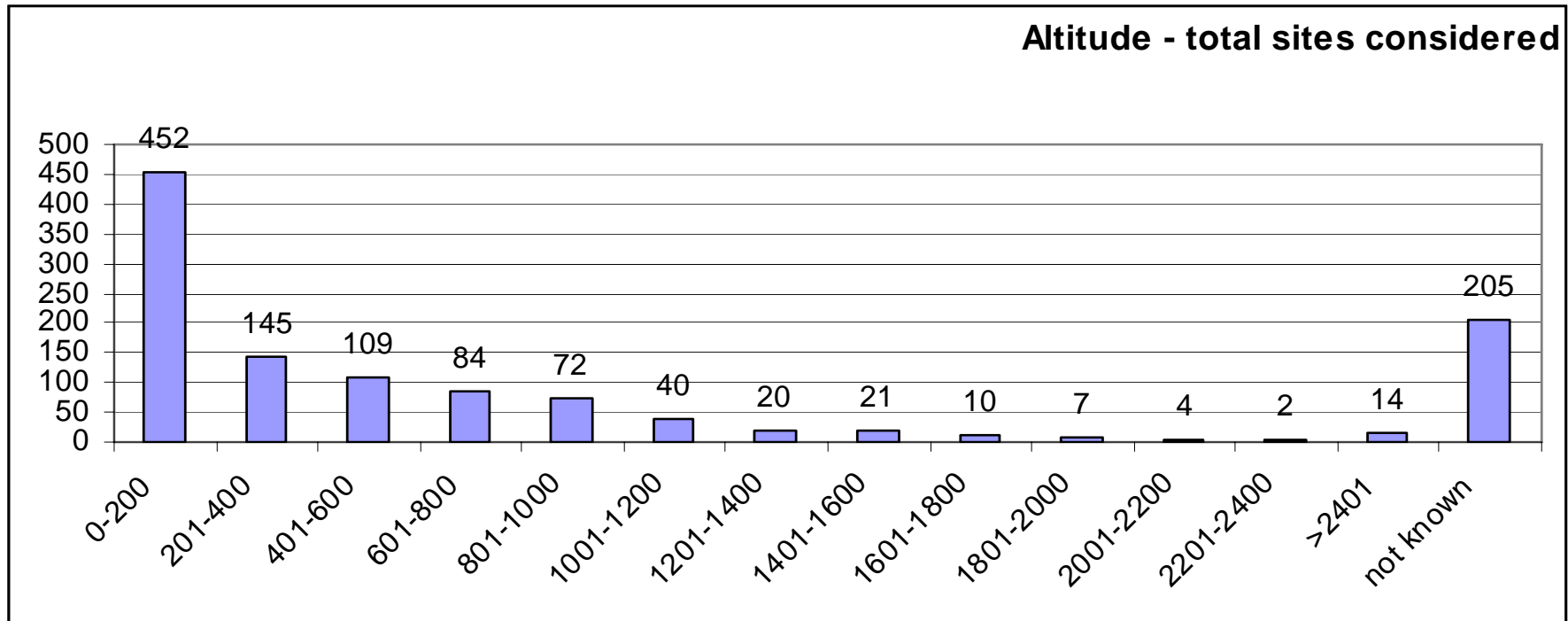
Biogeographical distribution - total sites considered



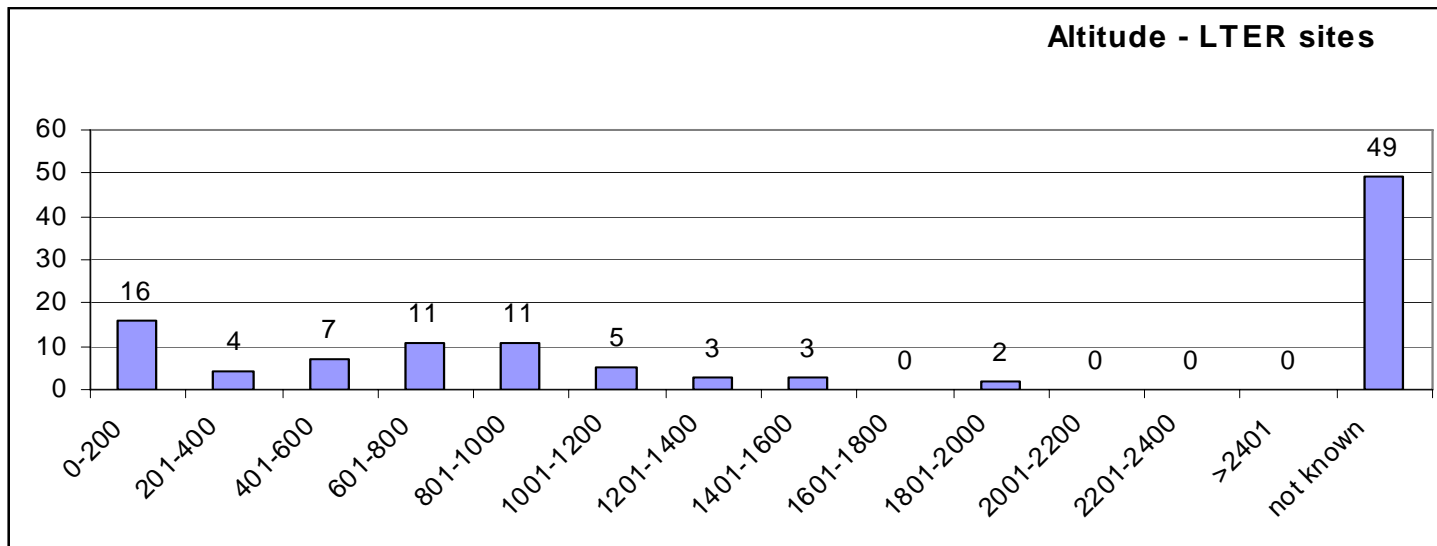
Biogeographical distribution LTER sites



Altitude – total sites considered

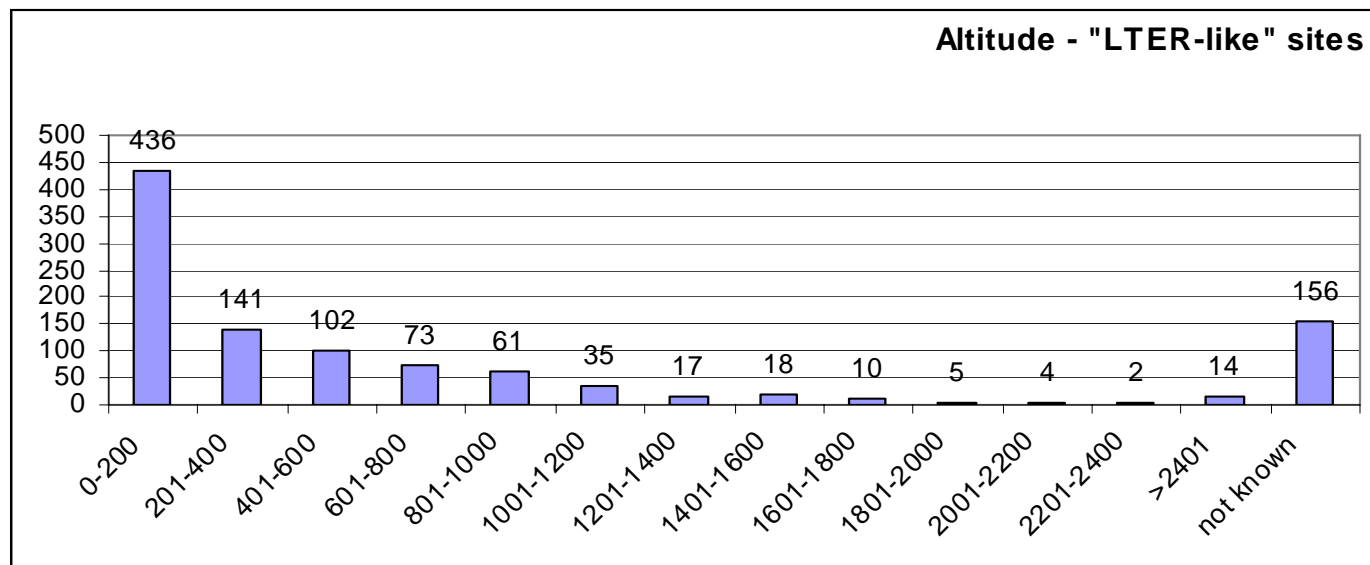


Location



Altitude –
LTER sites

Altitude –
“LTER-like”
sites



Habitat types

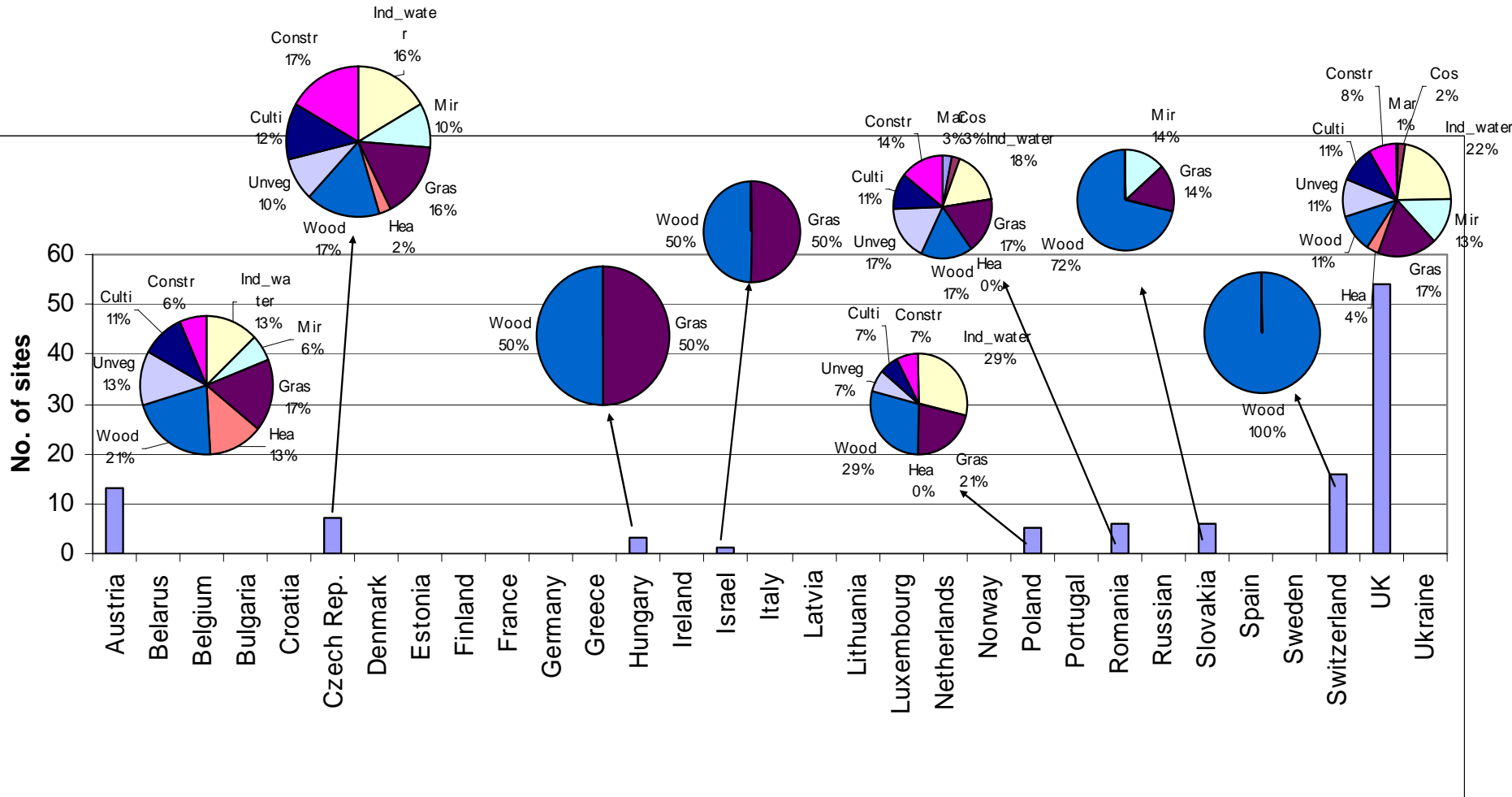


Habitat type is defined for the purposes of the EUNIS habitat type classification as follows: *'Plant and animal communities as the characterising elements of the biotic environment, together with abiotic factors operating together at a particular scale.'* All factors included in the definition are addressed in the descriptive framework of the habitat classification. (EUNIS definition)

Habitat types



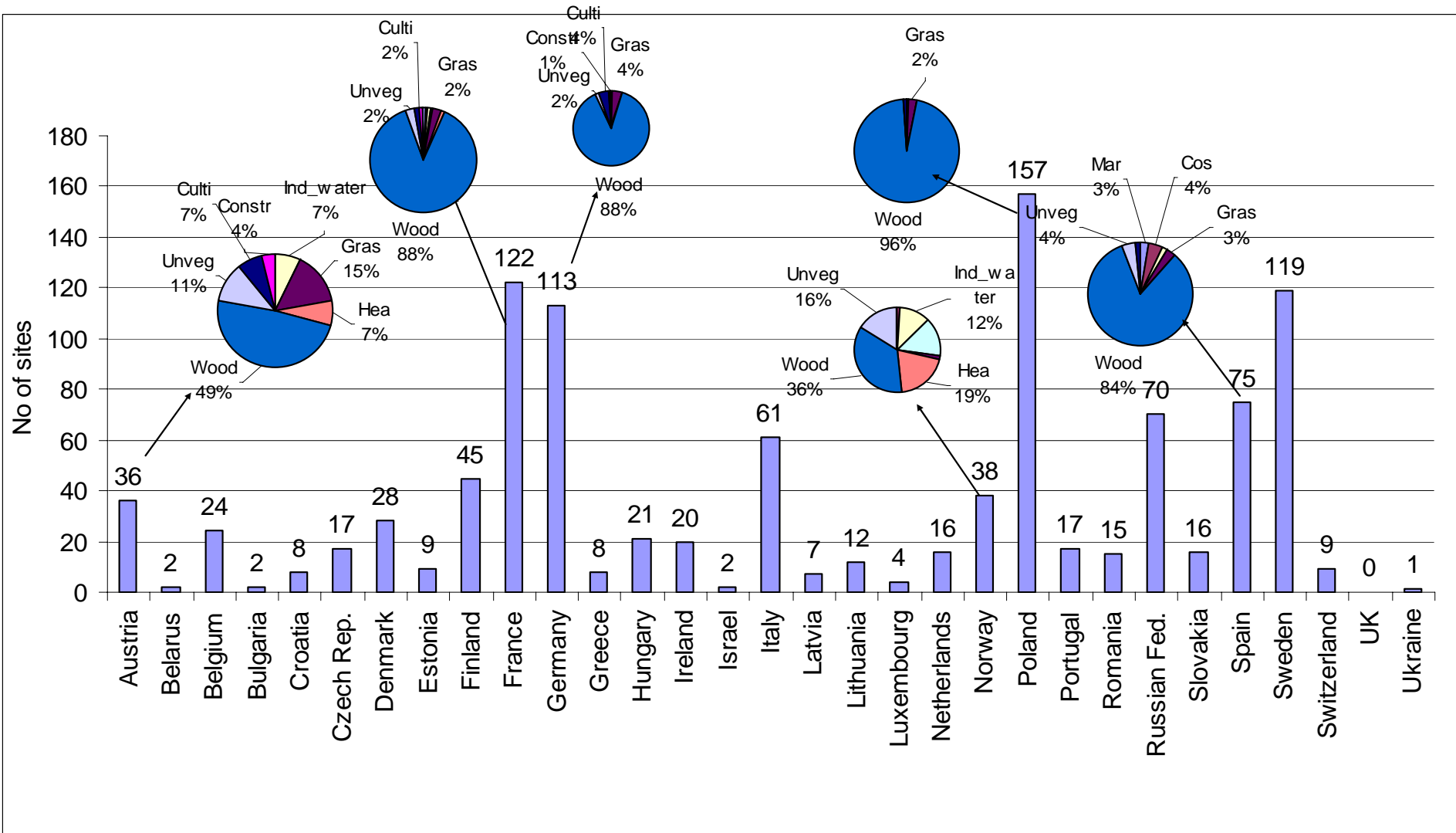
Number of LTER sites and the distribution of habitat types (after EUNIS)



Habitat types



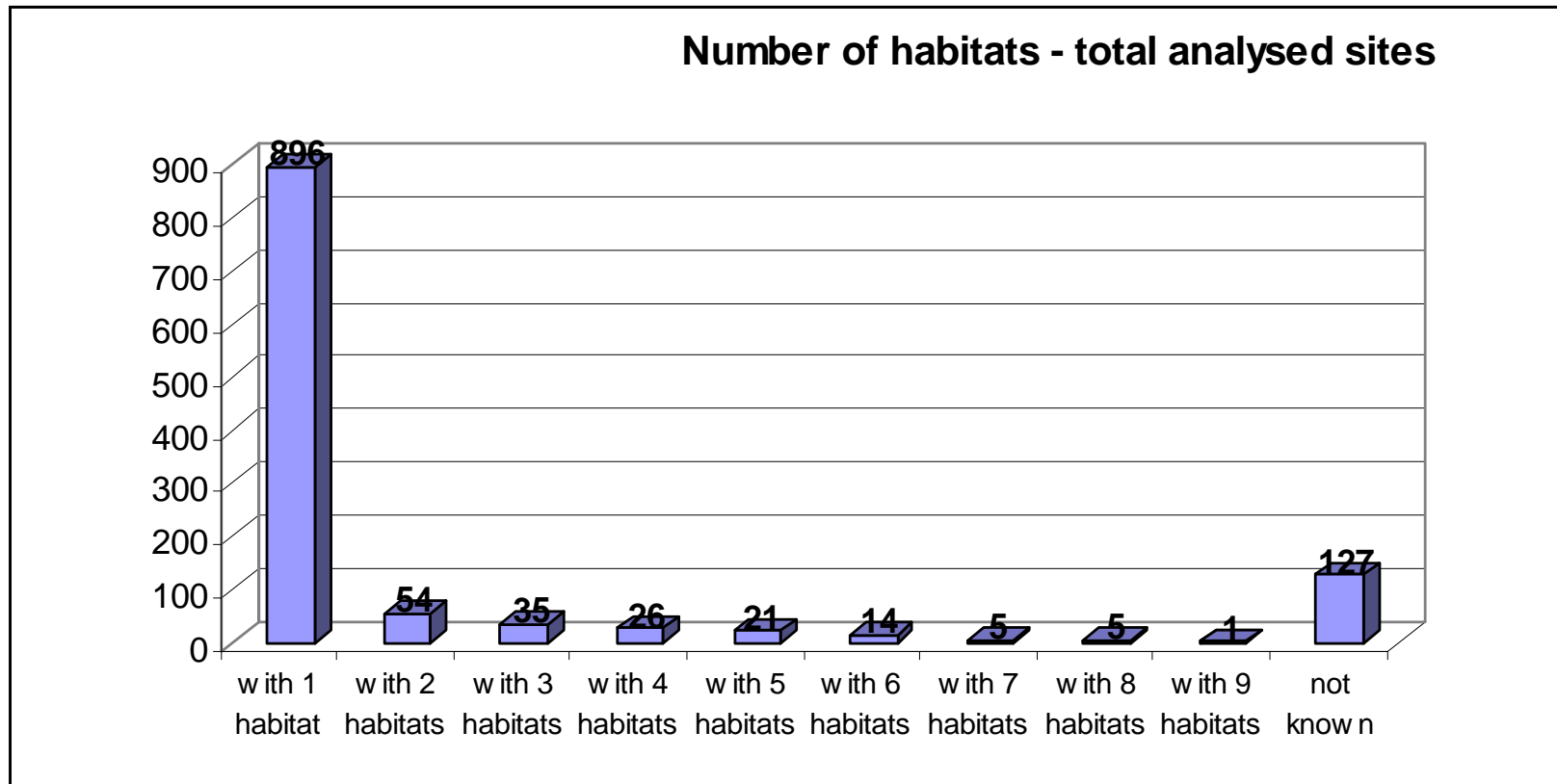
Number of “LTER-like” sites and the distribution of habitat types (after EUNIS)



Habitat types



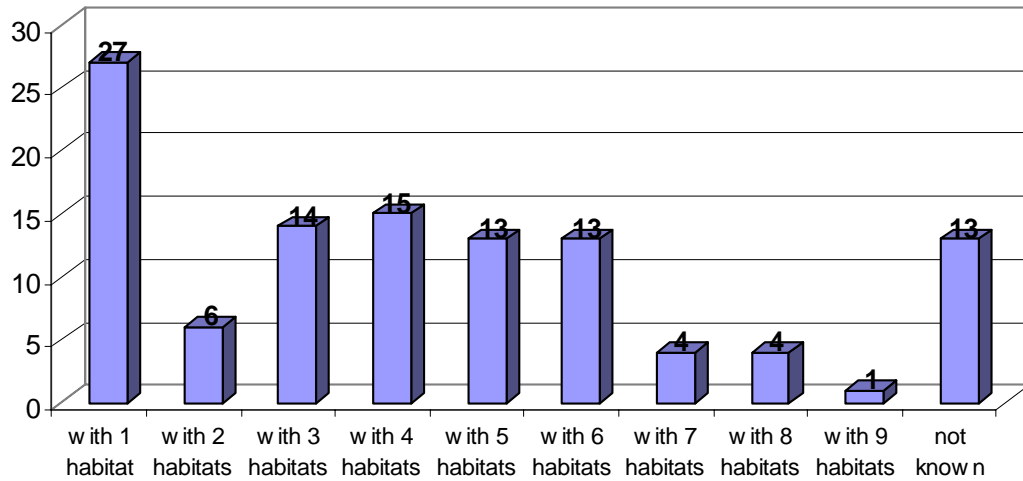
Number of sites and the corresponding number of habitats



Habitat types



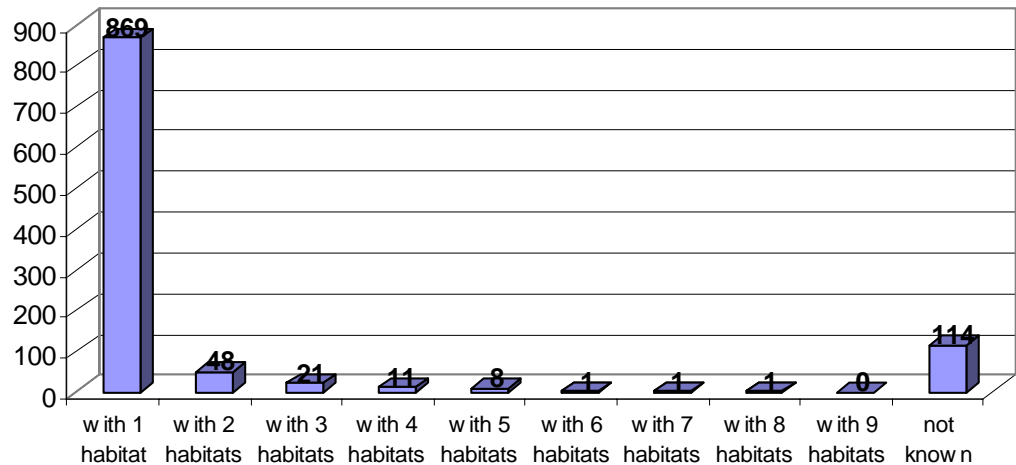
Number of habitats - LTER sites



Number of LTER sites and the corresponding number of habitats

Number of "LTER-like" sites and the corresponding number of habitats

Number of habitats - "LTER-like" sites



Environmental variables



Based on different variables measured in several networks a list with 85 environmental variables was developed. From this total number of environmental variables, 54 of them are measured in more than 20 “LTER-like” sites.

Despite this positive aspect the number of LTER sites measuring the same variable is surprisingly low.

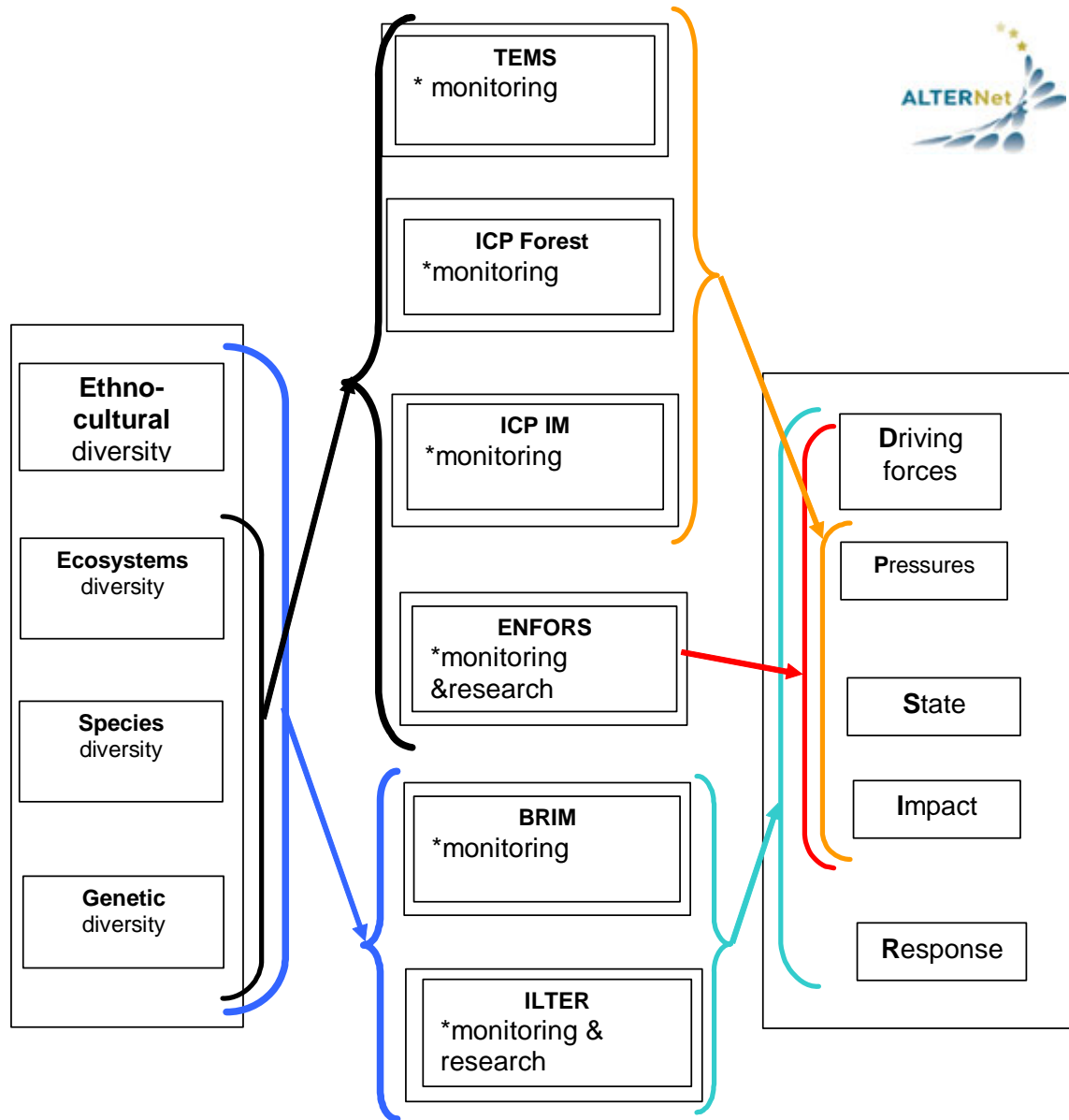
Number of common measured parameters

NUMBER OF SITES	NUMBER OF ENVIRONMENTAL VARIABLES		
	Total	LTER	LTER-like
>20	68	6	54
(10;20)	8	33	19
[0;10]	9	46	12

Biodiversity



The current analysis is an attempt to identify in what extent different approaches for data and knowledge generation addressed to different levels of biodiversity and components of DPSIR model.



Programs/Networks approach to biodiversity and DPSIR model

Biodiversity

A list containing 35 biodiversity variables/indicators was developed based on the same methodology as for environmental variables.

The Table shows in what extent these state variables are covered by the LTER sites, “LTER-like” sites and the total sites considered in this analysis.

	LTER SITES	LTER-LIKE SITES	TOTAL
Bacterial	9	2	11
Fungi, micro, soil	5	8	13
Fungi, macro	4	9	13
Algae, aquatic	10	3	13
Algae, terrestrial	1	7	8
Lichens	9	33	42
Bryophytes	15	39	54
Vascular plants, aquatic	8	3	11
Vascular plants, trees, shrubs	27	679	706
Vascular plants, ground layer	26	675	701
Invertebrates, aquatic	18	8	26
Invertebrates, soil	14	4	18
Invertebrates, above ground	16	8	24
Fish	14	4	18
Amphibians	11	2	13
Reptiles	8	2	10
Birds	16	16	32
Mammals	17	12	29
Total species richness	17	50	67
Indicator species	23	55	78
Threatened species	16	49	65
Invasive species	14	32	46
Pollinator species	3	4	7
Biomass below ground	10	19	29
Biomass above ground	14	740	754
Net ecosystem productivity	13	35	48
Net primary productivity	9	35	44
Chemical profile of biological tissues	10	31	41
Spectral vegetation greenness indices	5	8	13
Leaf area index	6	50	56
Dead organic matter dynamics	10	27	37
Vegetation structure/ layers	27	517	544
Phenology	10	89	99
Land Cover information	20	78	98
Land Use information	26	40	66

Socio-economic topics

SOCIO-ECONOMIC TOPICS	NUMBER OF LTER SITES
Land use history	18
Economic core indicators	16
Forestry	21
Agriculture	14
Tourism	13
Environmental pollution statistics	15
Population statistics	15
Subsidies	11
Regional development programmes	14
Traffic	7
Nature conservation programmes	15
Income structure	11
Pattern of employment	14

A number of 13 topics concerning the socio-economic system were identified.

It is obvious that the information related to the socio-economic topics, is missing in most of the analyzed sites .

Socio-economic topics vs sites in LTER locations

The “LTER-like” sites are not included in the analysis of socio-economic topics because many of them are not covering such topics.

Databases

DATA STORAGE	NO. OF SITES		
	Total	ILTER sites	ILTER-like sites
database	1032 (87.09%)	94 (84.68%)	938 (87.33%)
Paper	20 (1.68%)	1 (0.90%)	19 (1.76%)
not known	137 (11.56%)	16 (14.41%)	121 (11.27%)
None	2 (0.17%)	0	2 (0.18%)

ACCESS TO DATASETS	NO. OF SITES		
	Total	ILTER sites	ILTER-like sites
Controlled	808 (68.18%)	10 (9.01%)	798 (74.30%)
Limited	109 (9.20%)	53 (47.75%)	56 (5.21%)
Open	117 (9.87%)	31 (27.93%)	86 (8.00%)
Partly open	4 (0.34%)	0	4 (0.37%)
not known	147 (12.40%)	17 (15.31%)	130 (12.10%)
None	0	0	0

In more than 85 % of the total sites, LTER sites and “LTER-like” sites the information is stored in a digital format (starting from Excel files and finishing with more complex databases)

Great typology of storing data - need of harmonization between the different databases or at least to address this issue of high diversity in storing data across partners.

Databases - uses

TOTAL SITES	NO		YES		NOT KNOWN	
Assisting with historical state	18	1.51 %	841	70.97 %	326	27.74 %
Assisting with current state	44	3.71 %	823	69.45 %	318	27.06 %
Assisting with scenario/modeling future states	15	1.26 %	844	71.22 %	326	27.74 %
Risk assessment	59	4.97 %	82	6.92 %	1044	88.85 %

Uses of the datasets – total sites considered in this analysis

LTER SITES	NO		YES		NOT KNOWN	
Assisting with historical state	8	7.20 %	92	82.88 %	11	9.91 %
Assisting with current state	3	2.70 %	100	90.09 %	8	7.21 %
Assisting with scenario/modeling future states	12	10.81 %	89	80.18 %	10	9.01 %
Risk assessment	20	18.02 %	81	72.97 %	10	9.01%

Uses of the datasets – LTER sites

LTER-LIKE SITES	NO		YES		NOT KNOWN	
Assisting with historical state	10	0.93 %	749	69.74 %	315	29.33 %
Assisting with current state	41	3.82 %	723	67.32 %	310	28.86 %
Assisting with scenario/modeling future states	3	0.28 %	755	70.30 %	316	29.42 %
Risk assessment	39	3.63 %	1	0.09 %	1034	96.28 %

Uses of the datasets – “LTER-like” sites

Monitoring topics

Total number of sites covering the monitoring topics



TOTAL SITES	YES		NO		NOT KNOWN	
	#	%	#	%	#	%
Climatic	1009	85.15	64	5.40	112	9.45
Hidrological	997	84.14	72	6.08	116	9.79
Pedological	1003	84.64	65	5.49	117	9.87
Trophic state	962	81.18	94	7.93	129	10.89
Composition	195	16.46	84	7.09	906	76.46
Structure	975	82.28	81	6.84	129	10.89
Polution	949	80.08	107	9.03	129	10.89
Socio-economical aspects	87	7.34	973	82.11	125	10.55

- The importance of climatic changes;
- Low monitoring activities of functions and services of ecological systems;
- Low monitoring activities of the socio-economic systems (considered as part of the research).

-Comparing this situation with that related to LTER sites, a more balanced one can be observed;

- Nevertheless even in some LTER sites, the socio-economic aspects are still neglected.

LTER SITES	YES		NO		NOT KNOWN	
	#	%	#	%	#	%
Climatic	102	91.89	7	6.31	2	1.80
Hidrological	102	91.89	7	6.31	2	1.80
Pedological	100	90.09	7	6.31	4	3.60
Trophic state	91	81.98	13	11.71	7	6.31
Composition	61	54.95	16	14.41	34	30.63
Structure	101	90.99	7	6.31	3	2.70
Polution	99	89.19	7	6.31	5	4.50
Socio-economical aspects	56	50.45	37	33.33	18	16.22

Number of LTER sites covering the monitoring topics

Research topics



TOTAL SITES	YES		NO		NOT KNOWN	
	#	%	#	%	#	%
Eutrophication	65	5.49	979	82.62	141	11.90
Population dynamics	954	80.51	102	8.61	129	10.89
Restauracion	65	5.49	977	82.45	143	12.07
Landuse	115	9.70	938	79.16	132	11.14
Biogeochemical cycles	193	16.29	867	73.16	125	10.55
Management changes	110	9.28	944	79.66	131	11.05
Socio-economical issues	40	3.38	1026	86.58	119	10.04

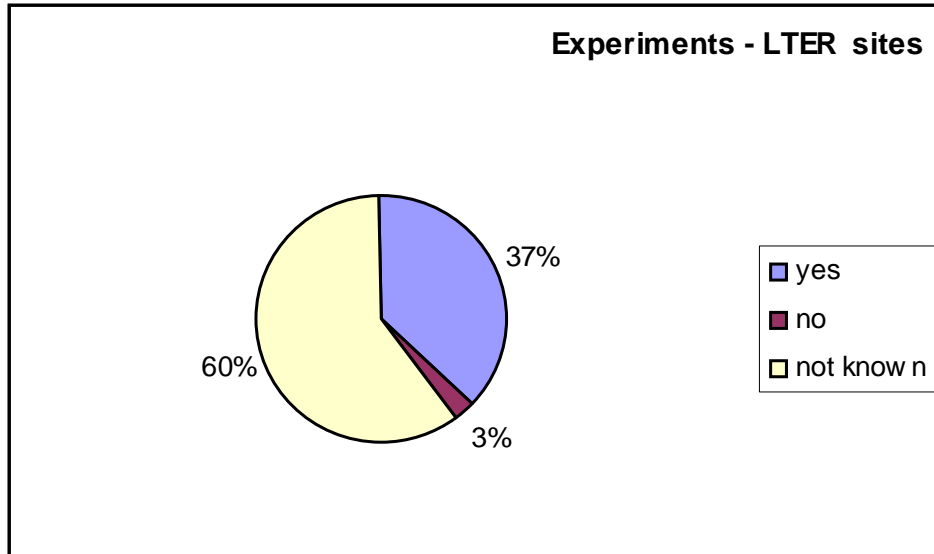
Total number of sites covering the research topics

There is a trend towards the socio-economical issues, but this remains one of the most neglected aspects of the research topics even in LTER sites.

LTER SITES	YES		NO		NOT KNOWN	
	#	%	#	%	#	%
Eutrophication	39	35.14	64	57.66	8	7.21
Population dynamics	87	78.38	22	19.82	2	1.80
Restauracion	52	46.85	50	45.05	9	8.11
Landuse	80	72.07	25	22.52	6	5.41
Biogeochemical cycles	73	65.77	29	26.13	9	8.11
Management changes	72	64.86	32	28.83	7	6.31
Socio-economical issues	17	15.32	81	72.97	13	11.71

Number of LTER sites covering the research topics

Technical facilities and experiments



From the total of 1185 analyzed sites, only 5% are performing different types of experiments.

In other 5 % no experiments are conducted and in 90 % this information is missing.

These experiments are carried out in the LTER sites (37% of LTER sites are performing experiments).

Some networks (TEMS) require the existence of **standardized methods** for sampling and analyzing different parameters.

The need for utilizing the same parameters and using the standardized methods for determining them is a constant preoccupation of the monitoring programs.

Nevertheless this should be also a requirement for research activities including experiments.

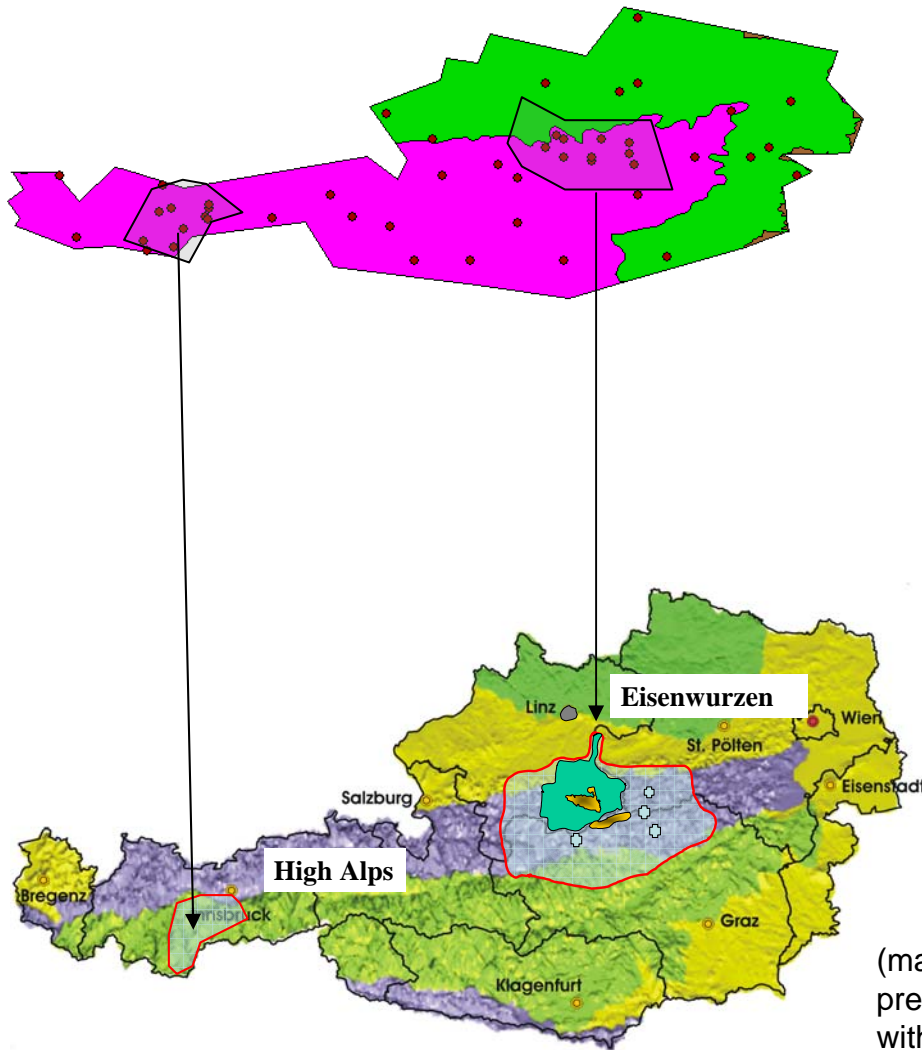
Potential uses of the I.3. database

- **Multifunctional research platforms identification – definitions of criteria;**
- **Specific research carried out in network of sites covering more than one biogeographical region and where the long-term data are available;**
- **Identification of parameters and state variables for LTER sites;**
- **Standardization for selected variables**

Multifunctional research platforms identification

- Using the database and a set of criteria (developed for different levels: European, country and regional) the sites selected for inclusion in the LTER network will allow a better coverage of the high heterogeneity of the socio-ecological complexes;
- This should be used in conjunction with other information and data scaling upwards (from local to national/European level);

Multifunctional research platforms identification

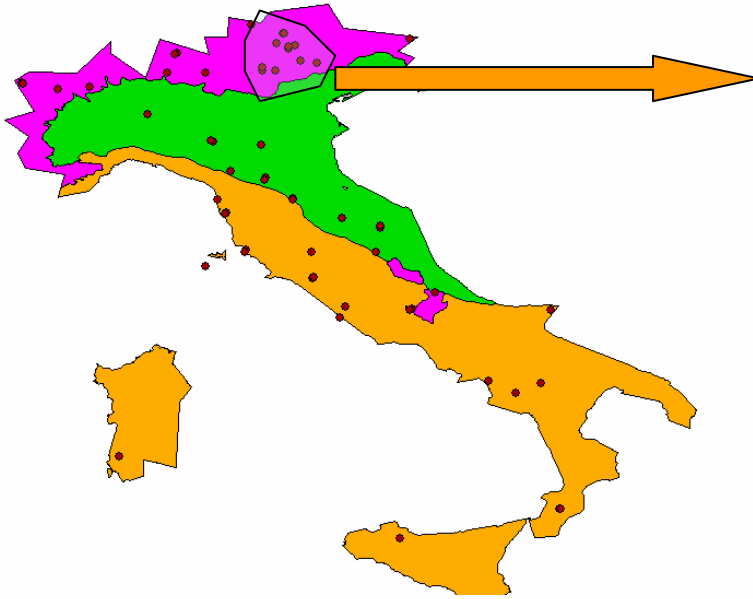


-country selected: **Austria**

- reason: multifunctional research platforms - already identified

(map from "LTER Austria" presentation [Bratislava] and used with Michael Mirtl's permission)

Multifunctional research platforms identification



LAT_DEC	LONG_DEC	SITE	COUNTRY
46.3817	11.6064	Dolomites/ S-Alps	Italy
46.3333	11.5000	Intensive Monitoring IT17	Italy
46.0833	12.0000	Intensive Monitoring IT20	Italy
46.5833	11.4167	Intensive Monitoring IT27	Italy
45.9550	11.2810	Lavarone	Italy
46.1167	11.7028	Malga Arpaco	Italy
46.4269	11.2969	Monticolo/Montiggli	Italy
46.3603	11.4950	Passo Lavazé	Italy
45.9447	11.0578	Pomarolo	Italy
46.5878	11.4347	Renon/Ritten	Italy
46.0156	11.0467	Viote del Monte Bondone	Italy

SITE	UNEP_GTOS_	ENFORS	BRIM	ILTER	ICP_FOREST	ICP_IM
Dolomites/ S-Alps	1	0	0	0	0	0
Intensive Monitoring IT17	1	0	0	0	1	0
Intensive Monitoring IT20	1	0	0	0	1	0
Intensive Monitoring IT27	1	0	0	0	1	0
Lavarone	1	0	0	0	0	0
Malga Arpaco	1	0	0	0	0	0
Monticolo/Montiggli	1	0	0	0	1	1
Passo Lavazé	1	0	0	0	0	1
Pomarolo	1	0	0	0	0	1
Renon/Ritten	1	0	0	0	1	1
Viote del Monte Bondone	1	0	0	0	0	0

Overall remarks – 1-

1. The current operational sites in major monitoring or both monitoring and research programs and networks are spread out in a wide range defined by space scale (size) and complexity:

- from small sampling and experiment scale (**micro-landscape**) and up to large landscape scale (**macro-landscapes**);

- from **single landscape unit** or habitat (EUNIS/level I) to **very complex landscape**, consisting in natural/semi-natural, human-controlled and human created units.

Overall remarks -2-



2. Almost all sites are designed and equipped to:

-**support specific** or more **complex monitoring activities** (e.g. climate changes; changes in the land use; pollution impact on biodiversity and ecosystems) or

-**very particular research** activities and

- around one third are used for **complex research** on functioning of different biodiversity components (e.g. populations, groups of populations) or complex ecological process (mostly in ILTER type sites and BR's);

3. **Recently** in some large sites (in particular in some ILTER type and BR's) the approach has been adapted in order that both research and monitoring activities to address also in different extents, **social and economic aspects**.

Overall remarks -3-



4. There are **huge bulks of data and information** mostly generated in all sites in the last 3-4 decades and in some of them since more than one century.

They are **structured in different digital formats** and **managed** usual by the **national authorities, research institutes** and **universities** or **international agencies**.

The **conditions for their availability** and accessibility are **not clear** enough for the time being.

However, very often is reported that the **produced information** was widely **used for decision and policy making** at local, national and international levels in order to comply with domestic and international regulations.

Overall remarks -4-

6. At this stage the patterns of variation in the assembled information shows a very **clear trend in the development and evolution of the approach for designing and establishing the sites and networks** in the majors programs focused both on **research and monitoring** (e.g ILTER; MAB-BR's, ENFORS);

The trend is oriented towards complex (socio-economic systems included) and large (macro-landscapes scale) sites.

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