A new improved database to support spanish phenological observations

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1. INTRODUCTION:

AEMET (Spanish National Meteorological Agency) serves society and science by promoting broad understanding of plants and animal phenology and its relationship with environmental change. The Agency has long records in the field of phenological observations since the 1940s. However, some of this information is still incomplete and widely scattered in many different resources. A key activity of AEMET has been the creation of a long-term, multi-taxa database to support research and scientific studies about climate, their variability and influence on natural ecosystems, agriculture, etc.

2. METHODOLOGY

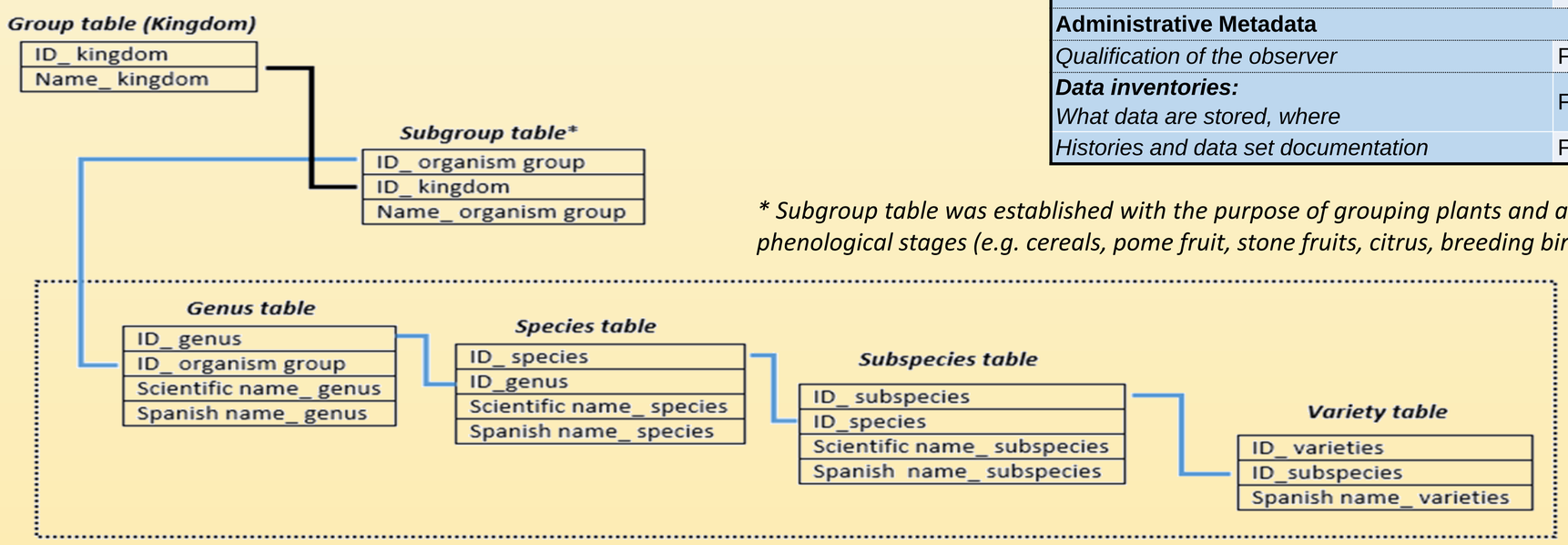
2.1 PHENOLOGY DATABASE

The new AEMET phenology database is a collection of integrated data with controlled redundancy, using a structure that reflects the interrelations and restrictions of the real world. At this sense, the database has been created keeping in mind different knowledge (the biology species, taxonomy, phytotomy…) in order to sort of the species incorporated to the database (Fig.1).The data, that can be shared by different users and applications, are independent. Besides, it's remarkable that the new applications has been added to the climatic existing database of Spanish national data bank of AEMET (BNDC). The update and recovery procedures are capable of preserving the integrity, security and confidentiality of the data set. Data can be come to the processing center by mail or via the Internet.

Metadata could be defined as all the information which goes with the phenological data and allows the evaluation of its quality. Therefore, the database has incorporated tables that compile metadata information: how, where, when and by whom the information was collected. In addition to data on phenological events, observers are invited to provide a range on ancillary information about their sites, individual plants, and observation instances. The following table (Table 1) summarizes these fields.

Table 1. Main metadata information recorded in the database.

QUESTION	VALUES
Site Metadata	
Latitude/longitude	Value in ETRS89
Elevation	Value in meters
Identification of Observation Area	Numeric value
Degree of development surrounding site	Urban, Suburban, rural, wildlands, etc.
Landscape description	Forest, shrubland, landscaped, etc.
Type of forest at area	Deciduous, evergreen, mixed, other.
Soil type	Clay, alkaline soils, peat, permafrost, etc.
Comments	Free text box
Individual Plant Metadata	
Wild *whether the plant was grown from a seed brought there naturally by wind, water or animal*	Yes, No, Unknown
Watered *whether the individual plant receives supplemental water*	Yes, No, Unknown
Fertilized *whether the individual plant receives supplemental fertilizer*	Yes, No, Unknown
Comments *Death plant, apparent reason of death…*	Free text box
Administrative Metadata	
Qualification of the observer	Free text box
Data inventories: *What data are stored, where*	Free text box
Histories and data set documentation	Free text box



** Subgroup table was established with the purpose of grouping plants and animals species that have similar phenological stages (e.g. cereals, pome fruit, stone fruits, citrus, breeding birds, bees, butterflies…)*

Fig 1. Schematic diagram of the new AEMET phenological database showing some tables and their interrelationships

2.2 ADAPTION TO GUIDELINES FOR PLANT OBSERVATIONS OF WORLD METEOROLOGICAL ORGANIZATION (WMO)

The following work highlight has been the creation of a new national plant and animal phenology observation program appropriate for scientist and nonscientist alike. Through this program, phenology observations on hundreds of species of plants and animals are collected following WMO protocols:

- **Target species**: criteria for selecting them are varied: ease of identification and observation, sensitivity to different temperature and precipitation thresholds; breadth of distribution in Spain…
- **Phases**: adaption historical AEMET code, called C-43, to BBCH code for plants (Fig. 2). For the description of the phenological development stages the differences between male and female plants are emphasized. Also, this code has been adapted for animal observations events. Finally, it has been selected a set of phenophases as recommendation observation, being significant flowering stages.
- **Field notebook** (Fig. 3**)**: it has been elaborated a personalized phenology notebook for each phenological Observation Area. The notebook presents all the species and phases that will be observed, identification pictures, short observation guidelines, etc.

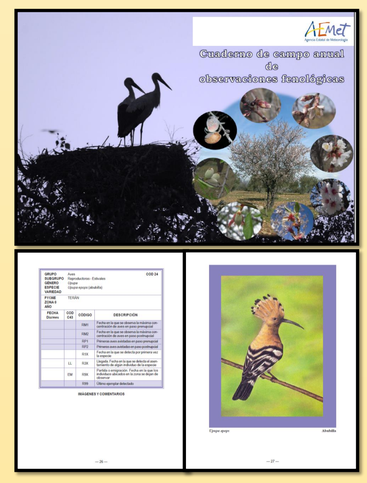
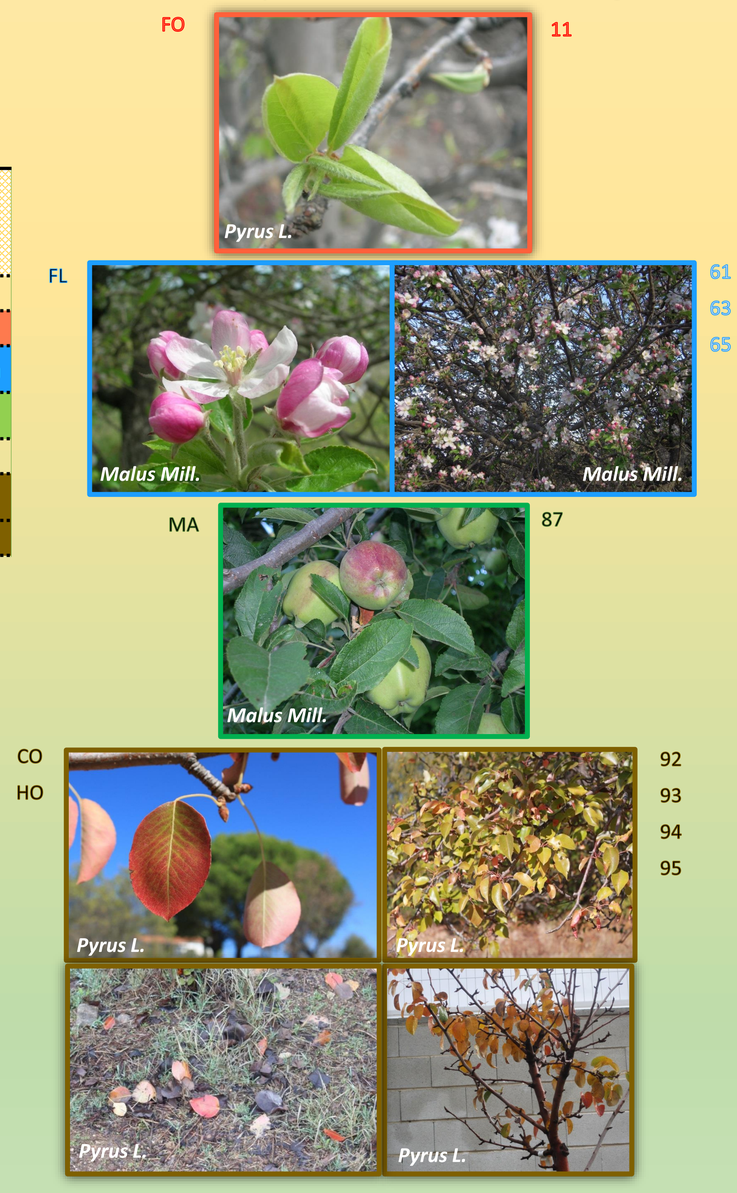


***Fig 3. AEMET* phenological field notebook**

A)

C-43 AEMET code	DESCRIPTION
SI	Sowing
FO	Leaves unfolded
FL	Flowering: about 30% of flowers open
MA	Ripening
RE	Harvest product
CO	Leaf discolouration
HO	Leaf-fall



B)

BBCH code	DESCRIPTION
0S	Sowing
07	Beginning of bud break: first green leaf tips just visible
11	First leaves unfolded
53	Bud burst: green leaf tips enclosing flowers visible
59	Most flowers with petals forming a hollow ball
61	Beginning of flowering: about 10% of flowers open
63	Early flowering: about 30% of flowers open
65	Full flowering: about 50% of flowers open
69	End of flowering: all petals fallen
71	Fruit setting after flowering
87	Fruit ripe for picking
89	Fruit ripe for consumption: fruit have typical taste and firmness
9R	Harvest product
92	Beginning of leaf discolouration
93	Beginning of leaf-fall
94	About 50% of leaves discoloured.
95	About 50% of leaves fallen.
97	End of leaf-fall

Fig 2. Phenological growth stages of pome trees observed with code C-43 (A) and BBCH code (B) and the correlation between them.

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