SPAIN – 2008 INVENTORY RESULTS

RESULTS

General results show that in 2008, 84, 4% of the sampled trees looked healthy: they correspond to defoliation classes "0" and" 1 (between 0 and 25% of leaf volume loss). A 14, 2% of the trees pertain to classes" 2" and" 3", with defoliation levels higher than 25%. This values show that the improvement process already noticed in IDF – 2007, still continues.

Regarding the evolution of defoliation and discolouration levels for conifers, broadleaves and for the whole group of species between 1987 (1st Inventory) and 2008 for Iberian Peninsula and Balearic Islands (since 1994 including data from Canary Islands), results in 2008 show an improvement either for conifers and for broadleaves, this improvement is more noticeable in the case of conifers, obtaining very positive results.
Throughout the Mediterranean area, parameter defoliation is much more useful than discolouration for indicating the health condition of forests, as discolouration is in many times influenced by the local conditions of the forest site.

Spain results can have a certain geographical interpretation. The observed variations show some regional differences which can not be attributed to methodological errors, as the results have been generated by field teams which have been trained in the same way, and whose works have been carried out in the same period of year, with an homogenised methodology, and with continuous intercalibration routines.
Looking at the percentages of damaged trees in the IDF – 2007 and IDF – 2008, and considering the differences between these two inventories (it is assumed that changes lower than 5% are not indicating a real modification in forest condition) we can notice, through the values obtained, an improvement in most of the regions, highlighting Navarra where the group of "damaged" trees (classes 2+3) has been diminished in a percentage of 14%, followed by Catalonia with an improvement of a 5,3%. The Autonomic Community showing worse results than previous year are Cantabria, where the group of "damaged" trees (classes 2+3) has been incremented in a percentage of 5%, followed by Madrid, with a 4%; in the case of Cantabria when speaking about damaging agents occurrence, we have to remark the occurrence of fungi, mainly decay fungi and canker (*Cryphonectria parasítica*); in second place, we have to remark the occurrence of insects, mainly defoliators (*Gonipterus scutellatus*), followed by wood borers (*Coroebus florentinus*); in third place there are other damages mainly caused by lack of light and competition. With the data obtained, an in-depth analysis about the causes which have negatively influenced the condition of forests is not easy; the case of Madrid region deserves a separate analysis, due to the low representativity of plots in this autonomic community.

The number of dead or missing trees in 2008 inventory (207) represents a decrease comparing to 2007 inventory (272 trees), representing a 1,4% of the sample. If we look at the agents that have been identified in the dead trees, a 69% of the observed damages are caused by felling operations, followed by damages caused by abiotic agents with an 11% and the occurrence of fungi (cankers mainly) with a 7%. Comparing to 2007, an increase in the number of damages caused by action of man, fungi and abiotic damages is noticed, together with a decrease of damages due to forest fires. Among the species with a larger number of dead trees, *Pinus pinaster* is the most significant, representing 27,3% of the total number of dead trees, followed by *Eucalyptus* sp. (22,5%), *Castanea sativa* (11%) and Pinus nigra (4,9%).
Missing trees due to felling operations are the most important group among dead trees. In general death of trees is caused by perfectly explainable causes, independently that there can be factors which can set vegetation in an unbalanced situation favouring the occurrence of damaging agents.

ANALYSIS OF THE MAIN TREE SPECIES

The analysis of the four forest species more represented in the inventories (two conifers and two broadleaves: *Pinus sylvestris, Pinus halepensis, Quercus ilex and Quercus pyrenaica*) and the evolution of their defoliation levels, shows the following results:
During year 2008, all of the four species surveyed show better results than the previous year, except for *Quercus pyrenaica*. In the case of conifers, *Pinus halepensis* is the one which has reacted more favourably, *Pinus sylvestris* shows an improvement, although slighter. As for broadleaves, *Quercus ilex* continues a recovery which started in 2006, whereas *Quercus pyrenaica*, which experimented an spectacular improvement in 2007, this year has worsened slightly.

MAIN DAMAGES REPORTED DURING THE ASSESSMENTS

These are the main damages, biotic or abiotic, recorded during the assessments, together with a shallow indication of their location. This list does not imply in any case a characterization of the intensity or the distribution of processes of forests decline is only fruit of the assessments carried out by the field teams:

Biotic damages (pests, diseases and parasitic phanerogams)

Insects

- Pine proccessionary caterpillar, *Thaumetopoea pityocampa* continues being more extended in the Eastern part of Spain, and *Pinus nigra* is, as usual, the most affected tree species. Damages are similar to previous year in distribution and severity.

- Regarding *Escolitidae*, this year a sometimes higher sometimes lower proliferation is noticed in some locations, associated to the presence of wood and debris in pine forests. There are *Ips acuminatus* and *Ips sexdentatus* damages in forests stands of main tree species *Pinus sylvestris*, only *Ips sexdentatus in Pinus pinaster* stands, and *Tomicus destruens* & *Orthotomicus erosus* in *Pinus halepensis* stands.
- There are some damages (similar intensity as previous years) of *Dioryctria splendidella* affecting weakened *Pinus pinaster* trees.
- Some slight – moderate defoliations have been noticed (though in any case lower levels than the ones recorded previous years), caused by caterpillars of *Tortricidae, Noctuidae,* and *Lymantridae* families affecting *Quercus* stands (mostly *Quercus ilex*). Remarkable species are: *Lymantria dispar, Catocala* sp. and *Lymantria dispar* associated with *Malacosoma neustria, Euproctis crysorrhoea*, *Tortrix viridana*, etc.
- Similar damages to previous years of dead branches, branchlets caused by branch borer *Coroebus florentinus*.
- Damages caused by *Cerambyx* sp. and *Oryctes nasicornis* are frequent in *Quercus* stands (specially *Quercus ilex* and *Quercus suber*) distributed mainly in the Southern half of Spain, with variable infestation levels depending on the locations and forest stands.
- The gall maker *Dryomyia lichtensteini* is frequent in all types of holm oak stands, but in lower levels if compared to previous years. On the other hand, *Asterodiapsis ilicicola* is starting to be noticed, more frequently each time, generally associated to *D. lichtensteini,* being the levels of infestation similar to the ones in 2007.
- Defoliator *Gonipterus scutellatus* is present in almost all *Eucalyptus globulus* stands being the damages slightly higher than in 2007.
- The levels of wood borer *Phoracantha semipunctata* have experimented a sligth descent, due to the fact that most eucalyptus stands are recovering little by little from the weakening caused by the drought suffered during last years.
- Presence of miner *Rhynchaenus fagi* and *Phyllaphis fagi* in *Fagus sylvatica* stands.
- On alder-trees (*Agnus glutinosa*), field teams have continued noticing damages caused by defoliator *Agelastica alni*, which this year are lower than in 2007.
- This year there have been detected punctual defoliations in *Crataegus monogyna* trees, distributed in punctual zones throughout Iberian Peninsula, caused by defoliator *Aglaope infausta*, but in much lower levels than previous years.
- On *Salix* sp. trees (alignments or groups) moderate defoliations have been noticed again (the same as in 2003, 2006 and 2007) caused by *Phrathora laticolis*.
- Frequent defoliations of *Xanthogaleruca luteola* registered in several areas of Iberian Peninsula in elms (*Ulmus minor* and *U. pumila*).

Fungi

- Damages caused by *Sirococcus conigenus* on *Pinus halepensis* trees are this year light and not very important, in locations like water-courses and hillsides with favourable exposure (and which show old damages), being the damages occasional and less severe than other years, located in the lower part of the crown.
- The existence of circles of dead trees due to *Armillaria mellea* infestation is relatively frequent in many *Pinus pinaster* stands. Although this year the appearance of new circles and the expansion of the already existing ones has been slightly lower than the records of 2007.
- The damages caused by defoliator fungus *Thyriopsis halepensis* that ocurred with higher or lower intensity in *Pinus pinea* and *P. halepensis* stands are maintained in low levels, managing to be practically non-existent in most of the areas.
- Needle fungi as *Scirrhia* sp., *Mycosphaerella pini*, *Naemacyclus* sp., and *Lophodermiun pinastri* or branchlet fungi, like *Sphaeropsis sapinea* frequently cause "flash" shaped damages and death of needles in *Pinus radiata* crowns, being the levels this year lower than values in 2006 and 2007.
- The presence of oidium (Microsphaera alphitoides) experiment a slight increase, comparing to 2007, in *Quercus petraea* and *Q.robur* stands, being detected more extensively in the new shoots under mature trees. In some cases, it is accompanied by anthracnose (*Apiognomonia errabunda*), sucking insects whose effects are visible in leaves as well as various defoliators, generally *Lepidoptera.*
- The presence of canker of chestnut-tree (*Cryphonectria parasitica*) on *Castanea sativa* trees continues being generalized. It is rare to find trees of certain size not showing symptoms and frequent the number of trees which have already lost most of their crown. The appearance of new damages and the level of infestation in 2008 are similar to the ones registered in 2006 and 2007.
- In beech stands, branch fungi as *Nectria coccinea*, are detected, though in lower levels than previous years. Some beech stands maintain the decline observed in previous years probably caused by the stem decay fungus *Nectria ditissima*.
- Some young *Eucalyptus* reforestations have been found affected by the foliar fungus *Harknessia* sp. They mainly affect the lower part of the crown and manage to cause, in some trees, important defoliations.
- The damages caused by the Dutch elm disease (*Ceratocystis novo-ulmi*), are generalized year after year throughout the Iberian Peninsula and Balearic islands, being the damages this year especially intense.

Parasitic phanerogams

- Important infestations by Viscum album are still found in several areas of Iberian Peninsula. They are responsible for the weakening of the colonized trees and favour the entry of other pathogen agents which in some cases can cause the death of the tree.

- *Juniperus oxycedrus* and *J.thurifera* stands are affected by the combined action of branchlet fungi (Gymnosporangium sp.) and dwarf mistletoe (Arceuthobium oxycedri).

Meteorological agents

The agent which affected most to defoliation levels of Mediterranean tree species during 2005 and 2006 surveys, drought (causing microfilia and low growth levels) caused little damage in 2007 and in 2008, due to the fact that there have been enough precipitations in spring, before trees started their vegetative period . In *Quercus* stands the only related event noticed is the existence of dry branches caused by former droughts or because of being located on poor soils, sunny exposures and rocks.
Among the group of deciduous broadleaves (ash tree, poplar, *Q. pyrenaica*, *Q. faginea*), the early autumn noticed during previous years at the end of August, has been delayed in time this year starting to be noticeable in mid September.

Vertebrates

Though the damages in stem and branches caused by different game and cattle species are frequent in most of the Iberian Peninsula forests, they are especially significant in the case of young reforestations. The most important as for extension and level of damage have been observed in different areas of the North of Spain by the increase of the populations of roe deer.

Other damages

- The symptomatology known as "Seca of Quercus", continues being noticed, specially in those locations which were more affected in previous years, of Holm oak and cork oak
- There are continuously frequent Alnus glutinosa trees with branches, part of the crown or the whole tree dead (decay symptomatology), presumably because of a vascular disease which causes a sudden death of the affected part, remaining in many cases the leaves still on the tree. These damages have been observed more frequently in alder stands situated in mountain areas, though also has been noticed (more than in 2006 and 2007) in alder stands in river banks.
- The high mortality of fir trees (*Abies alba*) noticed during last three years, continues increasing slightly. This is the case of really weakened stands due to high levels of mistletoe infestation (*Viscum album abietis*) which together with the high slope and rocky locations as well as the hydric stress situations suffered during last years, cause an important loss o trees.
- Natural *Pinus sylvestris* forest stands or reforestated *Pinus nigra* ones have been benefited by the abundant spring rainfalls, alleviating the effects attributable to drought noticed in previous years, which caused a decline process in which the trees (both isolated and in small

groups) suffered a reddening of the needles and a progressive death, keeping the needles in the crown during a whole vegetative cycle.

- The decline process of vegetation at Garajonay's National Park remains happening gradually. Due to the similarity of symptoms with the action of some vascular fungi, there exists a theory of a possible fungi origin of the problem (*Phythophtora* type), although this is not confirmed. This affection which in origin had a local character has been spreading over the areas of laurisilva and in minor degree in areas of "fayal-brezal".

CONCLUSSIONS

Results obtained after 2008 Inventory show that the general improvement process already noticed in 2007 still continues. 84,4% of surveyed trees show look healthy, similar percentage to the ones recorded at the beginning of present decade. Only a 14, 2% of the trees pertain to classes" 2" and" 3", indicating defoliation levels higher than 25%, with clear devitalisation. It is remarkable the really low percentage of death trees, only similar to the one in 1991 whereas in last years the trend was around 2-3%. Most of death trees are due to sanitary cuts and felling operations. Talking about possible causal agents, the occurrence of broadleaves spring defoliators and a slight increase of pine processionary caterpillar are the most quoted, followed by *Escolitidae,* defoliating fungi and Gonipterus and foliar fungi infestations in Eucalyptus stands, as well as the decline processes in *Pinus radiata* stands near the Cantabrian coasts. Last but not least, we have to mention the increasing damage due to mistletoe infestations in certain areas as well as the mortality processes related to the Dutch elm disease and a new decline process of still not known origin that seems to affect alder forest stands near the Cantabrian coasts.

The importance of atmospheric pollution in the evolution of forest condition is a factor which can not be quantified directly, as it is frequently disguised by other kind of processes which are more apparent. However, its role (in combination with other agents), contributing to the degradation processes of the forests falling under their influence, can't be denied.