

SPAIN – 2007 INVENTORY RESULTS

RESULTS

General results show that in 2007, 82,4% of the sampled trees looked healthy: they correspond to defoliation classes “0” and” 1 (between 0 and 25% of leaf volume loss). A 15,8% of the trees pertain to classes” 2” and” 3”, with defoliation levels higher than 25%. This values show a remarkable improvement comparing to IDF – 2005.

Regarding the evolution of defoliation and discolouration levels for conifers, broadleaves and for the whole group of species between 1987 (1st Inventory) and 2007 for Iberian Peninsula and Balearic Islands (since 1994 including data from Canary Islands), results in 2007 show that a remarkable improvement is noticed either for conifers and for broadleaves, this improvement is more noticeable in the case of broadleaves, 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 – 2006 and IDF – 2007, 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, a general improvement in most of the regions, highlighting Navarra and Extremadura where the group of “damaged” trees (classes 2+3) has been diminished in a percentage of 7,4%, followed by Castilla la Mancha and Castilla León with an improvement of a 4,2%. The only Autonomic Community showing worse results than previous year is Canary Islands, where the group of “damaged” trees (classes 2+3) has been incremented in a percentage of 7,4%; here we have to remark the occurrence of damages by insects, mainly *Calliteara fortunata* and *Brachyderes rugatus*, although with the data obtained it is difficult to carry out an in-depth analysis about the causes that have negatively influenced the condition of forests in this region.

The number of dead or missing trees in 2007 inventory (272) represents a decrease comparing to 2006 inventory (308 trees), representing an 1,8% of the sample. If we look at the agents that have been identified in

the dead trees, a 56% of the observed damages are caused by felling operations, followed by forest fires (22%) and insect damages (wood borers, etc) with a 12,5%. Comparing to 2006, an increase in the number of damages caused by forests fires and by insects is detected accompanied by a decrease of damages caused by felling operations. Among the species with a larger number of dead trees, *Pinus pinaster* is the most significant, representing 28,5% of the total number of dead trees, followed by *Eucalyptus* sp. (20,5%), *Pinus halepensis* (10,5%), *Pinus radiata* (10%) and *Populus nigra* (9%). Comparing to the previous year, the increase in the number of dead trees observed for *Pinus pinaster* is due to felling operations and forest fires, the number of dead *Populus nigra* and *Quercus robur* trees also increases, the numbers of *Eucalyptus* sp. dead trees remains approximately the same although causes change: whereas previous year main cause was the felling operations, in 2007 is forests fires. However, in 2007 the number of *Pinus nigra* and *Quercus pyrenaica* dead trees decreases.

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 2007, all of the four species surveyed show better results than the previous year, being the results even better in the case of broadleaves, where the most spectacular results correspond to *Quercus pyrenaica*, which had worsened clearly during the previous year and has reacted to the favourable climatic conditions during 2007, a significant number of trees have passed from class 2 (moderately damaged) to class "1" (slightly damaged). The holm oak (*Quercus ilex*) has also recovered although in a smaller percentage: among the conifers, Scots pine (*Pinus sylvestris*) presents better results than *Pinus halepensis* which seems to be the least influenced by the good climatic conditions.

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 processionary 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. 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 (only severe in some punctual cases), 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.
- Defoliator *Gonipterus scutellatus* is present in almost all *Eucalyptus globulus* stands presenting the damages similar severity as in 2006.
- The levels of wood borer *Phoracantha semipunctata* have experimented a slight descent.
- Presence of miner *Rhynchaenus fagi* and *Phyllaphis fagi* in *Fagus sylvatica* stands.
- On alder-trees (*Agnus glutinosa*), this year the field teams have continued noticing damages caused by defoliator *Agelastica alni*, which this year are moderated, more severe than in 2006.
- 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 lower levels than previous years.
- On *Salix* sp. trees (alignments or groups) serious defoliations have been started to be noticed again (the same as in 2003 and 2006) 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 still detected, in locations like water-courses and hillsides with favorable exposure (and which show old damages).
- The existence of circles of dead trees due to *Armillaria mellea* infestation is relatively frequent in many *Pinus pinaster* stands. This year the appearance of new circles and the expansion of the already existing ones has been slightly higher than the records of 2006.
- The damages caused by defoliator fungus *Thyriopsis halepensis* that occurred 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 *Lophodermium 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 slightly superior to values in 2006.
- Also in *Pinus radiata*, the extensive presence of several symptoms attributable to *Sphaeropsis sapinea* or other pathogens is noticed, showing stem and branch cankers with strong resin exudations and partial or total death of the crown. Some plantations of *Pinus radiata* suffer show damages possibly attributable to *Fusarium* sp.
- The presence of oidium (*Microsphaera alphitoides*) continues, comparing to 2006, in *Quercus petraea* and *Q. robur* stands, being detected more extensively in the new shoots under mature trees.
- The presence of canker of chestnut-tree (*Cryphonectria parasitica*) on *Castanea sativa* trees continues being generalized. The appearance of new damages and the level of infestation in 2007 are similar to the ones registered in 2006.
- 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.
- *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, has not caused significant damages in 2007. 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.

During the 28th and 29th of November 2005, the Canary Islands suffered a tropical storm, called Delta that caused damages in the vegetation in all islands, though the higher effects were located in “La Palma” and “Tenerife”, whereas in the rest of the islands damages were much lower. In the affected areas there have been damages by wood borers (*Escolitidae*) in fallen trees. This is specially significant in some pine areas of La Palma island, especially in the area called “La Cumbrecita” inside “Caldera de Taburiente” National Park.

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, as well as in land properties situated in the centre and South of Iberian Peninsula.

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, but in lower levels than in previous years.

- 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) in alder stands in river banks.

- There are new fir trees (*Abies alba*) presenting reddish tonalities of needle, trees standing dead without a clear causal agent. It is the case of adult forests stands formed by mature trees, located in hillsides, which are weakened because of a high level of infestation of mistletoe (*Viscum album abietis*).

- Natural *Pinus sylvestris* forest stands or reforested *Pinus nigra* ones have been affected, although in lower levels than previous years, by a decay syndrome causing a reddening of the needles (affecting both isolated trees and trees in small groups). The trees experience a progressive decline, keeping the needles in the crown during a whole

vegetative cycle. This situation, attributable in principle to the drought accumulated from previous years has led to the existence of a large amount of target trees for *Escolitidae* wood borers in general (up to the moment a clear increase of populations of *Ips acuminatus* or *I. sexdentatus* has not still been noticed).

- 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 fungic origin of the problem (*Phytophthora* 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-breza".

CONCLUSIONS

Results obtained after 2007 Inventory show that general condition has improved remarkably comparing to previous year, increasing the number of healthy trees and decreasing the number of damaged and dead ones. This improvement is noticeable for both groups of species (conifers and broadleaves), being the recovery more significant in the case of broadleaves which has remarkably increased the percentage of healthy trees (80,5%), accompanied by a similar decrease in the number of damaged trees, reaching a percentage of 17,9%; the case of conifers is similar though the improvement is less notable, increasing the percentage of healthy trees up to 84,2 % and a similar decrease in the damaged ones, with 13,8 % of trees in this category. Though the improvement comparing to the previous year is less accused for conifers, results are always better for this group of species, which continue having a higher percentage of healthy trees.

When trying to link in the field forms the parameters defoliation and discolouration, with the possible causal agents, in principle we can say that for classes 2 and 3 (moderate and serious defoliation) among all the codes reported the main causing agents are the abiotic ones and almost all the registers are due to "drought", followed by damages caused by insects, mainly defoliators and afterwards other damages as the ones due to the lack of light, competition, damages caused by parasitic and epiphytic plants, etc. The damages which have been detected but not identified represent a 7,6% inside the moderate and severe defoliation classes. Concerning the proportion of damages due to the direct action of man, it does not reach the 1% of the total amount of trees assessed. 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. The continuous and periodic evaluation of the plots belonging to the European Level I grid net seems to be a useful and easy method to know the trees condition, and the evolution

of the forests health status. In Spain, the study of defoliation levels seems to be a very useful work tool, whereas the evaluation of the discoloration does not turn out to be so significant.