



## Introduction / Status Report

# Working Group on Ambient Air Quality

August 2006

**Maria J. Sanz**

<sup>a</sup> CEAM, Parque Tecnológico, C/Charles Darwin 14, 46980 Paterna, Valencia, Spain

The WG continued to promote among several EU countries the ozone surveys on level II plots, including two main activities:

- the measurement of ozone air concentrations by passive samplers and/or active monitors
- and the evaluation of ozone-induced visible injury for an extended phase until 2008 for main tree species (LII plots), as well as at the light exposed sampling sites (LESS) plots located ad hoc for the evaluation (2nd Phase, 2005-2008).

The WG web page of the Coordination Center was updated in 2005 with the new manual and forms presented to the TF in Rome for the survey that took place in 2005.

## 2005 actions review

6<sup>th</sup> UN/ECE ICP-Forests Intercalibration Course for the Assessment of Ozone Injury at Follonica (Italy): To continue with the traditional activity of training of field evaluators a training course was organized in collaboration with the NFC of Italy (Marco Ferretti and Bruno Petriccioni)

Participation in the Critical Loads Meeting (Obergurgl, Austria, October 2005). The Forest Trees Working Group emphasized that there is a strong need for future research in order to fulfill the objective of developing scientifically robust methods for the quantitative evaluation of negative ozone effects on forests within the EMEP-domain under realistic field conditions.

The WG represented ICP-Forests at the ICP-Vegetation Task Force (Wales, UK, February 2006), and presented its achievements from the last pilot phase. The importance and the need of monitoring networks for ozone effects, and acknowledged the achievements of ICP-Forests, in particular the promotion of successful training was recognized. ICP-Forests was asked to give its inputs to a new report to be produced by ICP-Vegetation, based on the expertise gained from the ozone surveys which have been carried out since 1999.

## Future short-term directions of the WG / 2006-2008

Compilation and review of air concentration data (other gases than ozone 1st phase, and extended phase; ozone for extended phase)

The WG is considering the establishment of an active bio-monitoring approach (ozone -sensitive tree- or shrub-species planted close to the open-field meteorological monitoring station) at selected sites, preferably along a previous identification of hot spots for visible injury during the previous phase.

WG aims to promote the collection of harmonized data to provide biological meaningful parameterization and validation tools to test the feasibility and/or further development of the flux approach for trees across Europe.

The WG promotes further collaboration with ICP-Vegetation in respect to the literature review on ozone effects and in respect to the bio-monitoring activities .

## Mandate:

The assessment of ozone visible injury has proven to be a valuable tool and a unique effects monitoring system at European scale. In accordance with the previous mandate of the 21<sup>th</sup> Task Force of continuing and further developing the monitoring approach (2006-08), **the Task Force is asked to reaffirm its mandate by asking the WG to develop an active bioindicator survey at selected sites** (at least 1 or two per participating country, depending on the available funding) by providing protocols and materials for a pilot phase, starting in 2007.

Passive sampling of ambient air quality proved to be an inexpensive and valuable tool to assess ozone concentrations at remote sites. Other pollutants are also measured at selected Level II plots, but up until now, data are not being assessed. Nitrogen compounds are recognized as important compounds that can induce changes in forest ecosystem processes while the information on concentrations of gaseous nitrogen compounds in forested areas is very limited. In accordance with the previous mandate of the 21<sup>th</sup> Task Force, to continue and further develop the monitoring approach (2006-08), the continuation of the air quality measurements by passive sampling was extended and **the Task Force mandates the WG to asses the existing information on further gases other than ozone from the period 2001 to 2005.**

In respect to the previous cooperation and the available information from the pilot phase of the visible injury monitoring system, **the Task Force encourages the WG to contribute to the review activities proposed by the Task Force of ICP-Vegetation in Wales 2006.**

ICP Forest – 7th Intercalibration Course, Lattecaldo 2006

## Activities on progress:

### Current surveys and training for 2006

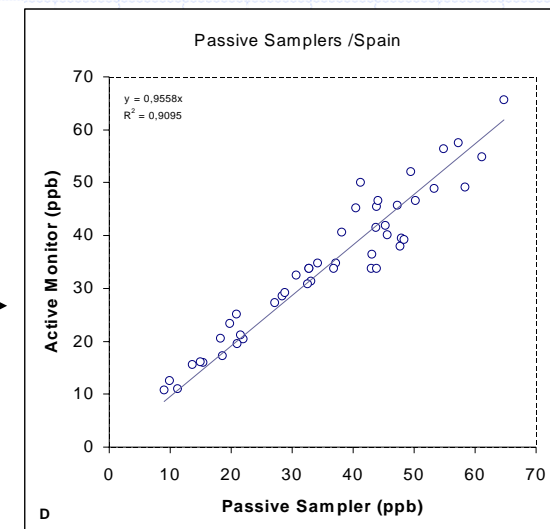
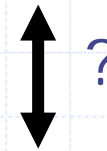
The bioindicator survey at selected sites (at least 1 or two per participating country, depending on the available funding) by providing protocols and materials for a pilot phase starting in 2007.

Questionnaire about existing information on further gases other than ozone from the period 2001 to 2005 will be sent soon

**Need of intercomparison of different PS...** →

Chair and Vice-Chair of WG are currently contributing review activities proposed by the Task Force of ICP-Vegetation in Wales 2006.

WG QA/QC



i.e. Ogawa type

Different PS !



# DATA SUBMISSION FORMS

PROBLEMS TO BE SOLVED....

**Maria J. Sanz**  
**Vicent Calatayud**

*CEAM, Parque Tecnológico, C/Charles Darwin 14, 46980 Paterna, Valencia,  
Spain*

During the 1st Phase data compilation by the WG and the process of data submission to JRC of Ozone Passive Sampler and Injury data, JRC detected some problems

We had the opportunity to discuss and clarify during the Course the submission forms for changes or improvement

## Passive samplers and active monitor forms

We propose that all the data are received in the form of the Air Quality manual (form AQM), and not using the deposition form (Form 7d DEA). Note also that in the form of deposition ozone concentrations are given in  $\mu\text{g}/\text{m}^3$  while in that of the Air Quality manual they are in ppb (!), manual will be changed.

Date should be submitted in the format DDMMYY (6 digits) to be consistent with the other manuals, while the digits available in the forms are 10 (prepared for DD.MM.YYYY).

# Information on active monitors and passam

**xx2000.pps**

Sequence	country	plot/station	pas_sampl_nr	latitude	longitude	altitude	start_date	end_date	nr_periods	station	Active sampler	Compound	Remarks
1-4	6-7	9-12	14-17	19-24	26-31	33-34	36-41	43-48	50-52	54-57	59-63	65-67	69-78
0003	11	0016 S002	P005 P006	+464646 -	+001125 -	- -	120404 120404	251004 251004	0010 0010	S0004	AS002	O3	
							DDMMYY	DDMMYY					

- 1-4 sequence number
- 6-7 country code (France=01, etc.)
- 9-12 observation plot number or station number where the passive sampler is located (9999 or S9999)
- 14-17 Number of passive sampler P001-P999 (passive sampler=Pxxx)
- 19-24 Latitude in DDMMSS
- 26-31 Longitude in (+ or -) DDMMSS
- 33-34 Altitude (in 50 m classes 1-51)
- 36-41 Start date measurement periods (ddmmyy)
- 43-48 End date measurement periods (ddmmyy)
- 50-52 Number of measurements with passive samplers
- 54-57 observation plot number where the related active sampler is located (xxxx or Sxxx)
- 59-63 Number of active sampler AS001-AS999 (active sampler =Asxxx)
- 65-67 Compound (O3, NH3, NO2, SO2, ...?)
- 69-78 Remarks

**IDEAL: Longitude and latitude should have 7 digits in all forms instead of 6 to be able to store also data from Azores and the Canary Islands.**

**Solution by JRC: changed DDMMSS by -DMMSS**

# Active monitor forms

xx2000.pac

Sequence	country	station	sampl_nr	compound	latitude	longitude	altitude	vegetation	Inlet height	Site classification	start_date	end_date	Remarks
1-4	6-7	9-13	15-19	21-23	25-30	32-37	39-40	42-43	45-48	50-51	53-58	60-65	67-76
0003	11	S0001	AS001	NO2	+464646	+001125	20		2.2		120404	251004	
											DDMMYY	DDMMYY	

- 1-4 sequence number
- 6-7 country code (France=01, etc.)
- 9-13 Station with permanent air quality measurements (Sxxxx)
- 15-19 Number of active sampler AS001-AS999 (active sampler=ASxxx)
- 21-23 Compound (O3, NH3, NO2, SO2, ...?)
- 25-30 Latitude in DDMMSS
- 32-37 Longitude in (+ or -) DDMMSS
- 39-40 Altitude (in 50 m classes 1-51)
- 42-43 Vegetation at plot (1-20) (codes to be determined)
- 45-48 Inlet height (in 99.9 m)
- 50-51 Site classification (code obtained from...)
- 53-58 Start date measurement periods (ddmmyy)
- 60-65 End date measurement periods (ddmmyy)
- 67-76 Remarks

**IDEAL**  
**Not defined:**  
**Proposal: delete !**

**Solution by JRC: it is in stays as TS 2005**

**IDEAL: Longitude and latitude should have 7 digits in all forms instead of 6 to be able to store also data from Azores and the Canary Islands.**

**Solution by JRC: changed DDMMSS by -DMMSS**

# Passive sampler forms

## xx2000.aqm

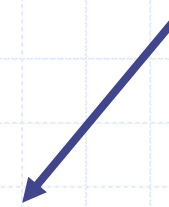
Sequence	country	plot	sampl_nr	start_date	end_date	variable_c	value	observations
1-4	6-7	9-12	14-18	20-25	27-32	34-39	41-46	48-57
0004	15	0023	P004	120405	120805	O3_MC	12.628	
9999	99	9999	P999	ddmmyy	ddmmyy	xxxxxxxx	99.999	xxxxxxx

- 1-4 sequence number
- 6-7 country code (France=01, etc.)
- 9-12 plot number or station number (9999 or S9999)
- 14-18 Number of active or passive sampler 1-999 (active sampler=Asxxx, passive sampler=Pxxx)
- 20-15 Start date measurement periods (ddmmyy)
- 27-32 End date measurement periods (ddmmyy)
- 34-39 variable code (see table below)
- 41-46 value
- 48-57 Observations

**Solution by JRC: inner space eliminated in the ones with 7 digits**

The variable codes are compound specific

		NH3	NO2	SO2
	(ppb/ppbh)	µg_N/m3	µg_N/m3	µg_N/m3
mean concentrations	O3_MC	NH3_MC	NO2_MC	SO2_MC
MC daytime (8-20)	O3_MCd	NH3_MCd	NO2_MCd	SO2_MCd
MC nighttime (20-8)	O3_MCn	NH3_MCn	NO2_MCn	SO2_MCn
max. concentration	O3_Max	NH3_Max	NO2_Max	SO2_Max
AOT40	AOT40			
AOT60	AOT60			



- Submission forms in JRC are those of the revised submanual, after 2004. It is not possible to submit data of years 2002 and 2003.
- In forms 2004, there are mistakes in the number of digits available in each field to introduce the data.

Form XX2004.PLL									
OZONE INJURY ASSESSMENT									
FORM 1. PLOT INFORMATION									
Sequence number	Country	Plot #	Latitude	Longitude	Altitude	Number of quadrats	Precision level	Soil Moisture	Observations
1 - 5	7 - 8	10 - 13	15 - 21	23 - 29	31 - 32	34-35	37-38	40	42-82
00001	11	1234	+454545	-012345	03	10	10	1	
00002	11	1235	+454545	-012346	03	16	20	1	
00003	11	1236	+454545	-012347	03	20	10	1	
00004	11	1237	+454545	-012348	03	18	10	2	
00005	11	1238	+464646	+001125	07	15	20	2	
00006	11	1239	+464646	+001126	07	20	20	3	
00007	11	1240	+474747	+012349	01	20	20	3	
00008	11	1241	+484848	+023460	12	10	20	1	
00009	11	1242	+494949	+034567	05	10	20	1	
99999	99	9999	+999999	+/-999999	99	99	99	9	

← The problems are here

Date should be submitted in the format DDMMYY (6 digits) to be consistent with the other manuals, while the digits available in the forms are 10 (prepared for DD.MM.YYYY).

# Form: Plot Information

Form XX2004.PLL

## OZONE INJURY ASSESSMENT

### FORM 1. PLOT INFORMATION

Sequence number	Country	Plot #	Latitude	Longitude	Altitude	Number of quadrats	Precision level	Soil Moisture	Observations
1 - 5	7 - 8	10 - 13	15 - 21	23 - 29	31 - 32	34-35	37-38	40	42-82
00001	11	1234	+454545	-012345	03	10	10	1	
00002	11	1235	+454545	-012346	03	16	20	1	
00003	11	1236	+454545	-012347	03	20	10	1	
00004	11	1237	+454545	-012348	03	18	10	2	
00005	11	1238	+464646	+001125	07	15	20	2	
00006	11	1239	+464646	+001126	07	20	20	3	
00007	11	1240	+474747	+012349	01	20	20	3	
00008	11	1241	+484848	+023460	12	10	20	1	
00009	11	1242	+494949	+034567	05	10	20	1	
99999	99	9999	+999999	+/-999999	99	99	99	9	

**IDEAL: eduction of 1 digit**

Not accepted by JRC, not necessary

Change to improve clarity: ("10"=10% or "20"=20% error, see.....)

Precision level of the sampling (10% or 20% error, see Table 4 of submanual)

Solution by PCC: OK improves clarity and not affect DBase

Column	
1-5	Sequence number
7-8	Country code
10-13	Plotcode
15-21	Latitude (+DDMMSS)
23-29	Longitude (+/-DDMMSS)
31-32	Altitude (50 m classes from 1-51 )
34-35	Number of quadrats established
37-38	Precision level of the sampling (10% or 20% error, see Table 4 of submanual)
40	Soil Moisture
	1= Wet or damp (riparian zones and wet or damp areas along a
	2 = Moderately dry (grassland or meadow, or North or East facin
	3 = Very dry (exposed rocky edges)
42-82	Other observations (text)

Form XX2004.LTF													
OZONE INJURY ASSESSMENT													
FORM 2. MainTree Species (MTS); CONIFERS and BROADLEAVES													
STANDARD INFORMATION						ASSESSMENT INFORMATION				SYMPTOM VALIDATION		OBSERVATIONS	
Sequence number	Country	Plot #	Tree #	Species code	Scientific name	Sample #	Date sampling	Date analysis	C	C+1	Validated	Type of validation	(e.g. presence of other biotic or abiotic factors)
1-5	7-8	10-13	15-18	20-22	24-61	63	65-70	71-77	79	81	83-84	86-88	90-130
00001	05	1234	0001	129	Pinus nigra	1	010401	020401	0	1	Y	LM	
00002	05	1234	0001	129	Pinus nigra	2	010401	020401	0	0	NR	-	
00003	05	1234	0001	129	Pinus nigra	3	010401	020401	0	2	Y	LM	
00004	05	1234	0001	129	Pinus nigra	4	010401	020401	0	3	Y	LM	
00005	05	1234	0001	129	Pinus nigra	5	010401	020401	0	0	NR	-	
00006	05	1234	0002	129	Pinus nigra	1	010401	020401	0	0	NR	-	
00007	05	1234	0002	129	Pinus nigra	2	010401	020401	0	2	Y	LM	
00008	05	1234	0002	129	Pinus nigra	3	010401	020401	1	1	Y	LM	
00009	05	1234	0002	129	Pinus nigra	4	010401	020401	2	0	NR	-	
00010	05	1234	0002	129	Pinus nigra	5	010401	020401	2	2	Y	LM	
00011	05	1234	0003	129	Pinus nigra	1	010401	020401	1	3	Y	LM	
00012	05	1234	0003	129	Pinus nigra	2	010401	020401	1	0	Y	LMP	
00013	05	1234	0003	129	Pinus nigra	3	010401	020401	0	0	NR	-	
00050	05	1235	0001	046	Fagus sylvatica	1	010401	020401	1	-	Y	P	
00051	05	1235	0001	046	Fagus sylvatica	2	010401	020401	0	-	NR	-	
00052	05	1235	0001	046	Fagus sylvatica	3	010401	020401	2	-	Y	P	
00053	05	1235	0001	046	Fagus sylvatica	4	010401	020401	1	-	Y	P	
00054	05	1235	0001	046	Fagus sylvatica	5	010401	020401	1	-	Y	P	
00055	05	1235	0002	046	Fagus sylvatica	1	010401	020401	1	-	Y	P	
00056	05	1235	0002	046	Fagus sylvatica	2	010401	020401	3	-	Y	P	
99999	99	9999	9999	999		9	DDMMYY	DDMMYY	9	9			

Solution by JRC: no change, but ideal in future

Reduction from 2 to 1 digit.

Reduction from 4 to 2 digits: It is more consistent with the rest of manuals

4 digits needed instead of 1. Add: e.g. F002

Solution by JRC: no change, but ideal in future

Change "Scientific name" for "Scientific name (name of the foliar assessment)"

Just for clarification, does not affect database

Column	
1-5	Sequence number
7-8	Country code
10-13	Plot number
15-18	Tree number (identical to the number in the foliar assessment)
20-22	Species code (identical to the foliar assessment)
24-61	Scientific name
63	Sample number (identical to number in foliar assessment, if possible)
65-70	Date sampling (in DDMMYY)
71-77	Date analysis (in DDMMYY)
79 and 81	Percentage of symptomatic leaves for actual year's leaves or needles (C), and the needles of last year (C+1) in cover
	0= No injury, none of the leaves injured
	1 = 1%-5% of the leaves show ozone symptoms
	2= 6%-50% of the leaves show ozone symptoms
	3= More than 51% of the leaves show ozone symptoms
83-84	Validated (Y/N/NR)
	NR: Not revised. Material was not sent to the validation center for validation
	Y: Sent to the validation centre, which confirmed that the symptoms were produced by ozone
	N: Sent to the validation centre, which confirmed that the symptoms were not produced by ozone
86-88	Type of validation: The ozone symptom has been validated by the validation centre based on:
	L= Leaves
	M= Microscopy
	P= Photos
	LP= Leaves and photos
	LM= Leaves and microscopy
	MP= Microscopy and photos
	LMP= Leaves, microscopy and photos
90-130	Other observations (e.g. presence of other biotic or abiotic factors)

# Form: LESS

## OZONE INJURY ASSESSMENT

### FORM 3. Less Exposed Sampling Site (LESS)

Solution by JRC: changed as suggested

**NOTE:**  
**WE WANT 13 CHARACTERS**  
 Ground Vegetation codes

STANDARD INFORMATION			ASSESSMENT INFORMATION				SPECIES INFORMATION		
sequence number	Country	Plot #	Number of Quadrats	Precision level	Quadrat number	Date	Scientific name	Species code	Perennial/ Annual
1-5	7-8	10-13	15-16	18-19	21-22	24-29	31-56	58-72	74
00001	11	0012	06	10	01	010401	Fagus sylvatica	123.123.122	P
00002	11	0012	06	10	01	010401	Rubus ulmifolius	123.123.123	P
00003	11	0012	06	10	01	010401	Erica arborea	123.123.124	P
00004	11	0012	06	10	02	010401	Fagus sylvatica	123.123.122	P
00005	11	0012	06	10	02	010401	Cistus albidus	123.123.126	P
00006	11	0012	06	10	02	010401	Juniperus oxycedrus	123.123.127	P
00007	11	0012	06	10	03	010401	Rubus ulmifolius	123.123.128	P
00008	11	0012	06	10	04	010401	Erica arborea	123.123.124	P
00009	11	0012	06	10	04	010401	Fagus sylvatica	123.123.122	P
00010	11	0012	06	10	05	010401	Cistus albidus	123.123.126	P
00011	11	0012	06	10	06	010401	Juniperus oxycedrus hemisph	123.123.127b	P
00012	11	0025	04	20	01	020401	Ruscus aculeatus		
00013	11	0025	04	20	01	020401	Rosmarinus officinalis		
00014	11	0025	04	20	01	020401	Thymus vulgaris		
00015	11	0025	04	20	01	020401	Rosa canina		
00016	11	0025	04	20	02	020401	Vinca difformis		
00017	11	0025	04	20	02	020401	Juniperus oxycedrus		
00018	11	0025	04	20	02	020401	Rubus ulmifolius		
00019	11	0025	04	20	03	020401	Thymus vulgaris		
00020	11	0025	04	20	03	020401	Rosa canina		
00021	11	0025	04	20	04	020401	Rosa canina		
00022	11	0025	04	20	04	020401	Vinca difformis		

Clarify that “Number of quadrats” is the total number of quadrats established in each plot, and “quadrat number” identify each every quadrat (e.g. [column 15-16] 6 quadrats are established in plot 0012, with numbers 1, 2, 3....6 [column 21-22])

# Form: LESS (cont.)

Form XX2004.LSS					
Ozone symptoms? (Y/N)	LEAVES OR SEEDS COLLECTED (Y/N)		SYMPTOM VALIDATION		NOTES  (e.g. notes on the abundance of individual plant of each species affected for ozone symptoms, intensity of the symptom, and presence of other biotic or abiotic factors)
	Leaves collected	Seeds collected	Validated	Type of validation	
76	78	80	81-83	83-85	87-155
N	N	N	NR		
Y	Y	N	NR	M	Leaves: 1234.01.00-RedBush-02; Seeds: 1234.01.00-RedBush-4
N	N	N	NR		
N	N	N	NR		
N	N	N	NR		
N	N	N	NR		
Y	Y	N	Y	LMP	
N	N	N	N		
N	N	N	N		
N	N	N	N		
N	N	N	N		
N	N	N	N		
N	N	N	N		
N	N	N	NR		
N	N	N	NR		
N	N	N	NR		
N	N	N	NR		
N	N	N	NR		
N	N	N	NR		
N	N	N	NR		
Y	N	N	Y	M	
N	N	N	N	LMP	

**NOTE:**  
**Validated (Y/N/NR)**  
**NR:** Not revised. Material was not sent to the validation center for validation  
**Y:** Sent to the validation centre, which confirmed that the symptoms were produced by ozone  
**N:** Sent to the validation centre, which confirmed that the symptoms were not produced by ozone

# Form: Additional species

OZONE INJURY ASSESSMENT										
FORM 4. Additional species showing ozone symptoms within the area of 500 m radius, but outside the quadrats of the LESS										
STANDARD INFORMATION		ASSESSMENT INFORMATION	SPECIES INFORMATION			VALIDATION		OBSERVATIONS		
sequence number	Country	Plot #	Date	Scientific name	Species code	Perennial/ Annual	Validated	Type of validation	(e.g. notes on the abundance of individual plant of each species affected for ozone symptoms, intensity of the symptom, and presence of other biotic or abiotic factors)	
1- 5	7-8	10-13	15-20	21-46	47-61	63	65-66	68-70	72-125	
00001	11	0012	010401	<i>Fagus sylvatica</i>	123.123.123	P	Y	M	Visible injury abundant	
00002	11	0012	010401	<i>Rubus ulmifolius</i>	123.123.123	P	Y	LMP		
00003	11	0012	010401	<i>Erica arborea</i>	123.123.124	P	Y	M		
00004	11	0012	010401	<i>Fagus sylvatica</i>	123.123.022	P	NR	-		
00005	11	0012	010401	<i>Cistus albidus</i>	123.123.026	P	Y	LMP	Scarce visible injury	
00006	11	0012	010401	<i>Juniperus oxycedrus</i>	123.123.127a	P	NR	-		

Column	
1-5	Sequence number
7-8	Country code
10-13	Plot number
15-20	Date sampling (in DDDMMYY)
21-46	Scientific name
47-61	Species code (code of ground vegetation, Flora Europea)
63	Perennial/Annual
	P= Perennial
	A= Annual
65-66	Validated (Y/N/NR)
	NR: Not revised. Material was not sent to the validation center for validation
	Y: Sent to the validation centre, which confirmed that the symptoms were produced by ozone
	N: Sent to the validation centre, which confirmed that the symptoms were not produced by ozone
68-70	Type of validation: The ozone symptom has been validated by the validation centre based on:
	L= Leaves
	M= Microscopy
	P= Photos
	LP= Leaves and photos
	LM= Leaves and microscopy
	MP= Microscopy and photos
	LMP= Leaves, microscopy and photos
68-120	Other observations

4 digits instead of 2 needed

IDEAL: Enlarged to 15 digits

Solution by JRC: changed as suggested

Solution by JRC: IN ALL CASES 13 FOR SPECIES CODE – COMMING FORM GROUND VEGETATION – APPLICABLE TO ALL FORMAS – STAYS AS IT IS

- 1. Passive sampler data should be received using the of the Air Quality manual (form AQM), and not using the forms of Deposition (Form 7d DEA).**
- 2. Submission forms have to be modified to correct the available digits of each field of the database. Do we need to provide them for 2005 submissions?**
- 3. Need to add explanatory items to the manual body as an annex. Based in the deposition ones.**
- 4. Manual improvement:**
  - 1. Changes on the on the annex for the LESS, better description.**
  - 2. Elimination of foto recommendations because they are obsolete**

The following guidelines are strongly recommended for *quality assurance* and uniformity of the pictorial documentation:

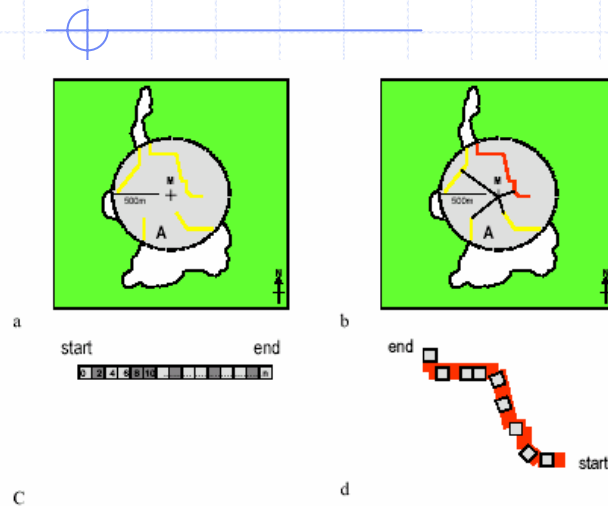
- Pictures should be taken under full sun light exposition or with a camera equipped with a flash.
- Exposure film with the speed of 200-400 ASA is recommended.
- The same slide exposure film should be used for the same pictorial series, for all pictures if possible (colour bar reference in the picture recommended).
- Electronic pictures must have a good resolution (for example 1500 pixel per inch), JPG or TIFF format and no correction.
- The leaf sample should cover at least  $\frac{3}{4}$  of the final picture area to enable proper symptom identification if possible.
- Any shading effect should be avoided.

**Elimination of foto recommendations because they are obsolete**

## Annex I: Procedure for the establishment of a Level II LESS

The procedure is as follows:

1. Identify an area (A) (500 m radius) centred around the ozone measurement site (M) (Fig. 1a).
2. Identify all the light exposed forest edges within A (Fig. 3a).
3. From those, choose the forest edges closest to M (Fig. 3b).
4. Measure the length of the selected forest edges and virtually identify a 1 m width area along them. You now have an  $x$  m long and 1 m width transect. (Fig. 3b).
5. Consider how many possible 2 x 1 m not overlapping quadrates fit into the selected forest edge area. To do this, just divide it by 2. The rectangular shape (with the longer size along the forest edge) is more effective given the nature of the forest edge. The total number of non-overlapping quadrates is our target population.
6. Select your sampling quadrates, which will constitute the respective LESS:
  - a. On a paper, number all the possible not overlapping quadrates. For practical reasons, start from the point closest to M and label each quadrate assigning a code 0, 2, 4, 6, 8, 10...,  $n$  which means the distance of the beginning of each quadrate from the beginning of the selected forest edge (very useful for planning the field work) (Fig. 3c).
  - b. Extract randomly the  $n$  non overlapping quadrates (see Table 1. for sampling density) and compile a list. Replace any extraction, i.e. put again the extracted number in the "basket": if you extract again the same number, repeat this step until you "draw" a different number.
7. At the end you will obtain a list of  $n$  codes. Each code is a 2 x 1 m quadrate within the LESS; the codes will give you the distance of the beginning of each quadrate of the LESS from the beginning of the selected forest edge. Now you can go in the field and install your LESS (Fig. 3d).



**Changes on the on the annex for the LESS, better description.**



Thank you for your attention!

## Form: Plot Information

**Table 4.** Sample sizes at specified precision level, for different length of the selected forest edge.

Length of the light exposed forest edge.	Possible 2x1 m non overlapping quadrates	Adjusted sample size (FPC adjusted), 10% error	Adjusted sample size (FPC adjusted), 20% error
10	5	5	4
15	8	7	6
20	10	9	7
25	13	11	8
30	15	13	9
35	18	15	10
40	20	17	11
45	23	18	12
50	25	20	12
60	30	23	13
70	35	26	14
80	40	28	15
90	45	31	16
100	50	33	16
150	75	42	18
200	100	49	19
250	125	54	20
300	150	59	21
350	175	62	21
400	200	65	21
450	225	67	22
500	250	69	22
600	300	73	22
700	350	75	22
800	400	77	23
900	450	79	23
1000	500	81	23
2000	1000	88	23

Another possible improvements to form PLL: inclusion of the Length of the Light Exposed Forest Edge

Not accepted by JRC, not necessary

- Length of the Light exposed forest edge is not directly requested, although it can be derived by knowing the Number of Possible Quadrats established and the Precision Level (error).
- However, note than for example in 23 quadrates with a 20% error corresponds to a length of the light exposed forest edge from 800 to 2000 (!).