

REGIA NAȚIONALĂ A PĂDURILOR  
INSTITUTUL DE CERCETĂRI ȘI AMENAJĂRI SILVICE

Total Fond forestier = 70.547,26 ha; Cimpie : 12.416,08 ha; Deal : 40.003,63 ha; Munte : 18.127,55 ha  
Proprietate publica a statului = 50.201,22 ha;  
Proprietate publica a unitatilor teritoriale (UT) = 7.575,53 ha  
Proprietate privata persoane fizice (PF) = 7.572,93 ha  
Proprietate privata a unitatilor de cult (UC) = 577,48 ha  
Proprietate privata obste = 4.620.1 ha  
Drumuri forestiere = 325,8 km

APROBAT  
prin Hotararea Consiliului de Administratie al RNP nr. 4/28.04.2011  
DIRECTOR GENERAL,  
Valerian SOLOVĂSTRU



Aprobata in sedinta Comitetului Director din : 13.04.2011

DIRECTOR,  
Gheorghe DUMITRIU

Lider sindicat,  
Cornel DUMITRESCU

ACADEMIA DE ȘTIINȚE AGRICOLE ȘI SILVICE  
"GHEORGHE IONESCU ȘIȘEȘTI"  
A.S.A.S.

MINISTERUL MEDIULUI ȘI PĂDURILOR

M. M. P.

REGIA NAȚIONALĂ A PĂDURILOR - ROMSILVA  
R.N.P. - ROMSILVA

INSTITUTUL DE CERCETĂRI ȘI AMENAJĂRI SILVICE - BUCUREȘTI  
I.C.A.S. - BUCUREȘTI

CONSILIUL ȘTIINTIFIC

COMITET DIRECTOR

DIRECTOR

CERCETARE

EXPERIMENTARE  
PRODUȚIE

DEZVOLTARE

INVENTAR FORESTIER NAȚIONAL  
I.F.N.

LABORATOARE, ATELIERE, SERVICII, BIROURI, COLECTIVE CENTRALE  
ȘI STAȚIUNI, BAZE EXPERIMENTALE ȘI OCOALE SILVICE EXPERIMENTALE TERITORIALE  
Brașov Pitești Simeria Craiova Ștefănești  
Bistrița Câmpulung Moldovenesc Focșani Oradea

ORGANIGRAMA I.C.A.S.	Total salariați	Din care		Total salariați	Din care		Total salariați	Din care		Total salariați	Din care		Total salariați	Din care	
		La sediu	La exter.		La sediu	La exter.		La sediu	La exter.		La sediu	La exter.			
TOTAL SALARIATI	862	174	688	197	81	116	335	33	302	252	34	218	78	26	52
Muncitori	148	19	129	16	5	11	114	7	107	16	5	11	2	2	
din care :indirect prod.	38	15	23	8	2	6	17	7	10	12	5	7	1	1	
TESA	714	155	559	181	76	105	221	26	195	236	29	207	76	24	52
din care: Conducere	61	22	39	17	7	10	21	5	16	17	5	12	6	5	1

## Activity Report of The Forest Research and Management Institute (ICAS)

**1. The General Status of the Institution.** The Forest Research and Management Institute was founded in 1933 by the Journal of Ministries Council no. 561 of 16<sup>th</sup> of May 1933 (issued in the Official Monitor no.115 of 22<sup>nd</sup> of May 1933) under the name “Institutul de Cercetări și Experimentație Forestieră (ICEF)/ Forestry Experimentation and Research Institute”. In its over 78 years of existence, ICAS has constantly evolved in the direction of maturity applying a series of changes towards the diversification of research topics and the development of new subunits at territorial level. Its long history explains the large spectrum of its missions and the diversity of its activities.

**Nowadays ICAS** is a public institution of national interest with legal status, under the coordination of Romanian Ministry of Environment and Forests (Law no.46/2008). ICAS is the main developer and manager of scientific and technical information in the national forestry sector.

**The Mission of ICAS** is to give a scientific background to the development and the management of the forestry sector through producing, developing and disseminating scientific and technical information, by setting the national forest inventory, providing professional consulting, generating, transferring and implementing of new and improved technologies, developing innovative products and contributing to the welfare of our society.

The activity of ICAS has taking place in the main headquarters located in Bucharest and in 9 territorial research stations located in the main biogeographical regions of Romania and 10 experimental bases.

**At the national level** ICAS has been certified by the National Authority for Scientific Research (ANCS) as a component institution of the National Research-Development System and as a Centre of Excellence in Silvobiology and Forest Management. ICAS is also certified as an empowered institution for elaborating environmental impact assessment studies, environmental reports, for forest management planning, watershed planning, forest road planning, for economic and technical studies concerning ecological reconstruction, for cadastral and photogrammetric works, for preserving and testing the quality of forest seeds, for testing pesticides in order to be homologated in the forestry field. The Quality Management System is in compliance with the ISO 9001 standard.

**At the international level** ICAS is a full member or collaborator of prestigious international organisations such as: IUFRO (International Union of Forest Research Organization), EFI (European Forest Institute), ICPForests, ILTER, LTER-Europe (International Long Term Ecological Research), Bioversity International, ISTA (International Seed Association), EARSeL (European Association of Remote Sensing Laboratories), FTP (Forest –Based Sector Technology Platform) etc. It has been an efficient partner for forest-related topics within large international projects in the frame of programmes LIFE+, FP 6, FP7, COST.

In accordance with the main research domains of the institute, 7 research teams were established as following: **E1** - Dendrometrics, forest management planning and forest monitoring; **E2** – Forest ecology; **E3** – Forest genetics and tree breeding; **E4** – Wildlife biology and management; **E5** - Silvotechnics and ecological reconstruction; **E6** – Forest protection; **E7** – Forestry geomatics.

**The ICAS’ major research directions** encompassed by the research teams are: **E1** – dendrometrics; surveillance and research on long-term status of forest ecosystems; forest management planning; **E2** - forest ecosystems and habitats typology; ecophysiology; climate change and greenhouse gases monitoring; forests biodiversity; **E3** – forest genetics and tree breeding; seed analysis and testing; establishment, conservation and sustainable management of the Forest Genetic Resources and Basic Material sources; applied biotechnologies for genetic certification and propagation of valuable genotypes; **E4** - wildlife conservation and management; salmonides resources management; development of breeding and intensive growth technologies for wildlife and salmonides; **E5** - tending operations and forest techniques; afforestation, revegetation and agro-forestry systems; ecological reconstruction; watersheds management; **E6** - forest entomology; forest phytopathology; forest mycology; **E7** - use of Geographic Information System



(GIS) in the field of forestry; use of remote sensing and digital photogrammetry in forestry; use of modern terrestrial measurement, mainly GPS, in forestry.

**2. Major achievements.** The most important scientific achievements of the institute in the last 4 years for each research team are the following:

**E1:** i) integrated monitoring system of the forest ecosystems status; ii) long-term ecological research (LTER) inter- and trans-disciplinary in the sites of national (LTER-Romania) and international network (LTER-Europe); iii) implementation of national dendrochronological network and complex dendroclimatological and dendroecological researches; iv) monitoring of intra-annual tree ring formation phases; v) development of new techniques and methods to monitor and forecast the drought risk and forest fires hazard; vi) the analysis of coniferous species dynamics cultivated outside of their natural distribution area in Romania; vii) elaboration of new forest management plan for different forest districts;

**E2:** i) elaboration of the forest ecosystems and habitats typology at country level; ii) development of a geospatial database of Romanian forest ecosystems and its associated digital map; iii) elaboration of a regional forest sites typology for Dobrogea region; iv) understanding the species tolerance to hydric stress at tree/organ level; v) understanding the photosynthesis physiology at cellular and molecular level and mineral nutrition of trees; vi) assessment of biogeochemical cycles: greenhouse gas (GHG) monitoring, impact of forest management on GHG fluxes; vii) evaluation of carbon storage in all ecosystem compartments (soil, dead and living wood) and study of the inner processes (mineralization, respiration); viii) understanding the disturbance regimes and their influence on natural and managed forests; ix) risk mapping of the major natural disturbance agents - drought, wind and insects attacks; x) establishment of the indicators for the assessment of old-growth forests; xi) establishment of inventory/monitoring networks in selected old-growth forests; xiii) analysis of the biotic processes in old-growth forests; xiv) estimation of the amount and quality of dead wood in old-growth forests and its consequences on biodiversity; xv) diversity of saproxylic beetles;

**E3:** i) designating as “tested category” for basic materials sources to: Norway spruce, silver fir, larch, beech, pedunculate oak and ash; ii) high genetic value genotypes (hybrid families) for silver fir and larch, in order to establish the 2<sup>nd</sup> generation of seed orchards; iii) development of a database with 199 long period experimental trials (including their tested genetic units) and 118 seed orchards; iv) assessment of intra and inter-populations genetic variability for: sessile oak, Hungarian oak, European beech and Norway spruce for establishing most valuable seed stands; v) update the National Catalogue of FGR and Technical Guidelines for their sustainable management and the National Catalogue of Forest Basic Materials, delineation of new regions of provenances according to the national law no. 107/2011, OECD Scheme, EEC’s Directive no. 105/1999; vi) development of a database for FGR (698 gene conservation units for 45 forest tree species), uploaded on the EUFGIS platform <http://www.eufgis.org/>; vii) evaluation and mapping cpDNA polymorphism for autochthonous oak species and delineation of their post glacial evolution; viii) assessment of genetic diversity in field trials: pedunculate oak, sessile oak, common ash and European beech; ix) building of synthetic geographic maps for present genetic diversity and postglacial history for white oaks and hornbeam species from Romania and Bulgaria; x) assessment of the genetic diversity with molecular markers for valuable oaks provenances and forest genetic resources from southern Romania and Bulgaria; xi) evaluation and monitoring of genetic diversity of broadleaves and conifers seed orchards and *in situ* FGR by the means of cpDNA and isozymes markers; xii) applying Real Time PCR techniques for detecting integration of resistance gene in the transgenic plants genome; xiii) “*ex situ*” conservation using *in vitro* technique for FGR: poplars and Hungarian oak, silver and pubescent birch, *Metasequoia* and *Chamaecyparis*; xiv) evaluation of polluted ecosystems of Austrian black pine, sessile oak, pedunculate oak and black locust species, using peroxidase and lecithin by chromatography affinity of phloem.

**E4:** i) methodological guidelines for assessing the bear, wolf, lynx and wildcat populations; ii) elaboration of management measures for reintroducing beaver population in Romania;

iii) technologies of wild boar, red deer and fallow deer breeding; iv) technical design framework for wild boar, red deer and fallow deer farms; v) practical guide to set up game farms; vi) management plans for game species in protected areas ; vii) assessment of genetic variability (by molecular analysis) of wild boar population in Romania; viii) establishing the ecological network for large carnivores in Piatra Craiului - Bucegi - Ciucas area; ix) development of intensive and over-intensive aquaculture of salmonides in classic growth and in recycling systems; x) assessment of the ecological and genetical variability of salmonides; xi) methodologies of assessment and monitoring of fish resources in mountain streams; xii) quality assessment and re-mapping of fishing grounds in mountain streams.

**E5:** i) silvotechnics methods and afforestation/ecological reconstruction technologies of degraded lands; ii) measures to protect the environment in high degradation risk areas (by forest crop, shelter-belts and agro-forestry protection systems); iii) silvicultural stands operation in natural hazards exposed areas; iv) technologies of ecological reconstruction of declining or degraded forest; v) watershed planning technologies.

**E6:** i) identification, prognosis, prevention and control of the major damaging insects and other organisms (including invasive new agents); ii) evaluation of defoliators and bark beetles impact in ecosystems stability; iii) testing new pesticides and control methodologies accepted by Forest Certification System; iv) evaluation of pests dynamics in climate change context; v) evaluation of impact of biotic and abiotic diseases on forest ecosystems; vi) correlation of climate fluctuation and pathogen virulence; vii) identification, survey, prevention and control of new pathogens; viii) biological control of pathogens (using competing / antagonic fungi); ix) assessment of the mycological spectrum – symbionts, saprophytes and pathogens – in forest ecosystems; x) assessment of the role of ecto-mycorrhizal symbiosis in forest culture stability; xi) development of new natural food or medicinal products from forest mushrooms.

**E7:** i) methodology for forest habitats mapping, geospatial database (GDB) building and validation; ii) forest management raster maps GDB of the national district units; iii) GDB of the forest management units located into Natura 2000 sites and natural reserves; iv) GDB and digital maps of black locust and *Tilia* species distribution, located in Southern and South-Western of Muntenia Region; v) GDB and digital maps of the provenance regions for basic materials for forest reproductive materials; vi) GDB and digital maps of *in situ* and *ex situ* conserved forest genetic resources; vii) design and production of GDB template and the user guide for protected areas of Romania; viii) methodology to correct forest management basic maps using very high resolution imagery and raster scanned maps; ix) methodology to collect biometrics data of the trees and stands using photogrammetry and intensive ground measurements with integrated device; x) methodology for digital terrain model (DTM) and digital surface/canopy model (DSM/DCM) extraction by Airborne LIDAR Scanner (ALS) eco classification; xi) methodology for determining biometric characteristics of trees and forest stands using ALS data; xii) methodology to calculate the stand volume and biomass using statistical inventory and ALS data; xiii) methodology to estimate position accuracy of ALS data of forest vegetation cover.

Besides the achievements of the research teams the institute has a series of remarkable accomplishments such as: i) the elaboration of national forest inventory; ii) studies and prognoses concerning the evolution and the development of national forestry sector; iii) the national inventory of greenhouse gases for LULUCF sector for reporting on UN Framework Convention on Climate Change and the Kyoto Protocol; iv) information and data concerning the reports for sustainable forest management; v) contributions to the implementation of Natura 2000 network in Romania; vi) informations and data for reporting to the Convention on biological diversity (CBD) and Habitats Directive.

*Publications.* The institute staff has contributed between 2007 and 2011 to the publication of 30 articles in journals with non-zero relative influence score, that have cumulated a number of 107 ISI citations. A number of 335 other relevant works has also been published (202 of them are articles published in journals indexed in international databases for scientific literature, 62 works in proceedings volumes of scientific conferences with scientific selection committee and 71 books and

book chapters). 15 publications were awarded by the most important academic and professional organisations in Romania (Romanian Academy - 2, Academy of Agricultural and Forestry Sciences – 2, General Association of Romanian Engineers – 1, The Academy of Romanian Scientists - 1, “Progresul Silvic” Society – 9).

*Patents.* Between 2007 and 2011 the institute R&D personnel have obtained 3 patents and submitted requests for another 4 patents (concerning silvotechnics and non-wood products processing).

*Projects.* Between 2007 and 2011 a number of 244 research-development projects (of which 230 and 14 funded from national and international sources, respectively) have been conducted with a cumulated value of 11 243 000 euros. On the other hand, 72 research-development projects (of which 68 and 4 funded from national and international sources, respectively) are still in progress and they cumulate a value of 10 390 000 euros.

**3. Significant investments.** Developing the research infrastructure to enable working with modern equipment is a prerequisite for the integration of our research teams into national and European research networks and for obtaining high scientific value results. Consequently, it has been a constant priority of the institute management especially in the last years, when national programmes allowed high investments in research capacities.

In 2007-2011 3.2 million euros were invested, of which about 50% from public and private funds raised by research and development projects, and 50% from the proper funds of the institute. The major part was invested in research equipment and equipment for micro-production and management of experimental heritage (about 2.05 million euros), constructions, maintenance and buildings repair (about 950,000 euros) and the difference of 200,000 euro are other investment expenditure.

In the research and development activity, the investment effort was focused on the modernization, the improvement of old laboratories facilities with advanced equipment or the development of new laboratories, as well as the purchase of modern and efficient equipment for field works (over 1.33 million euro) Among these can be quoted a soil and forest vegetation analysis laboratory, a greenhouse gas chromatography laboratory, a laboratory of plant physiology, quantitative genetics equipment, seed analysis and biotechnologies, molecular genetics laboratory at two stations, a wood anatomy laboratory, a large carnivore research centre, field equipment for monitoring forest ecosystems in long-term ecological research sites.

**4. Human resources recruitment.** In spite of a substantial reduction of the public funds for research and development in the last three years, the institute has made efforts to improve the quality of human resources, by increasing the training level and by recruiting young people with a high potential for scientific career and motivation for research.

The total number of employees in 2011 is 809, of which 469 R&D personnel, and the difference (340) is the staff involved in the micro-production and management of experimental forest heritage of the institute.

The R&D personnel includes 85 certified scientific researchers (16 ACS, 14 CS, 29 CS III, 12 CS II, 14 CS I), 94 technological development engineers (14 IDT, 26 IDT III, 20 IDT II, 34 IDT I) and 252 auxiliary R&D staff (staff with higher education non-certified as researchers or technological development engineers, as well as technicians and workers) 38 are administrative staff. The average age of R&D staff ranged from 38 years in 2007 to 40 years in 2011.

Out of R&D staff, 43 have a PhD, 16 of them graduated during the period 2007-2011, and 19 are doctoral students. 24 experts are associated professors within universities and colleges teaching forestry, biology and environmental protection, and 2 researchers are PhD supervisors.

In 2007-2011, 127 people were employed in R&D activity for new departments as well as for field activities in technological development.

Human resource recruitment has been done with the following goals: i) attracting young graduates of forestry faculties in the country, with good theoretical and practical skills; ii) attracting

young researchers with doctoral studies at the universities in the country (5) or abroad (1); iii) attracting prestigious researchers from the country and from abroad; iv) qualifying and retraining of specialists within the unit, following the transfer of personnel from one department to another.

**5. Technology transfer, dissemination and popularization of scientific knowledge** are a constant and major concern for the institute. The dissemination and technology transfer is made at different levels according to the scientific targets of the projects. The publication of research results in highly ranked papers is highly encouraged.

For the technical projects with practical applications, which are mainly ordered by the forestry authorities, the transfer is supplied along with a technical assistance. The tight relations between the institute and the forest authorities have ensured a regular and fruitful dialogue. Practical application of the research results by the technology transfer consisted of: i) development and/or updating of rules, instructions and technical guidelines for sustainable forest management and wildlife hunting (33 in the period 2007-2011); through their endorsement by the central authority for forestry or the NFA – Romsilva, they become official regulations for implementation in forestry practice; ii) development of specialized software for forestry activities; iii) development of geospatial databases and digital maps and prints; iv) developing forest management plans; v) development of technical and economic studies on ecological reconstruction, torrential watershed management, forest roads; vi) development of products for forecasting and prevention of forest pest attacks (synthetic pheromones); vii) development of biological products for disease control and forest pests; viii) technical assistance and expert advice in forestry; ix) development of studies / reports / documentation in the areas of competence for which the institute is certified.

The dissemination of research results obtained in the institute was done by: i) demonstrative meetings, exchanges of experience and practical applications for owners and managers of forests and hunting funds in experimental areas and demonstration plots; ii) organization of 11 scientific events (conferences, symposia, workshops, trainings), of which 8 with international participation; iii) participation of 189 ICAS specialists in conferences / symposia / national and international congresses, presenting over 200 works; iv) publication of research results in prestigious national or international publications; v) presentation of the institute, the activities and the obtained results through our own website; vi) presentation of research findings in "The offer of scientific research in agriculture, food industry and forestry" issued annually by the Academy of Agricultural and Forestry Sciences "Gheorghe Ionescu-Șișești; vii) participation in exhibitions to promote research results.

An important vector of dissemination is the Forestry Publishing House (ES) ([www.editurasilvica.ro](http://www.editurasilvica.ro)), established in the ICAS, which publishes scientific and technical books in the field of forestry and environmental sciences. ES carries out both functions of promoting the researches undergone, of dissemination at international level, but also a very important role of education and preparation of researches to the standards of older renowned publications. The works published are divided into six collections. 52 works were published during the period 2007-2011. ES has been evaluated and recognized nationally by the National Council of Scientific Research (CNCS) and is a member of the Publishers' Association in Romania (AER) and European Association of University Presses (AEUP).

The scientific journal *Annals of Forest Research* ([www.e-afr.org](http://www.e-afr.org)), issued by ICAS, publishes research articles/notes and critical reviews, exclusively in English, on topics dealing with forestry and environmental sciences. According to National Council of Scientific Research (CNCS), the journal is ranked B+ (scientific journals with high potential to be internationally recognized and available on-line) It is also indexed in many major abstracts/articles international databases, among which: ISI Thomson Scientific Master Journal List, Scopus, CAB Abstracts, EBSCOHost, ProQuest, Directory of Open Access Journals (DOAJ), ULRICHSWEB, AGRIS (F.A.O.), Index Copernicus.

## **Activity report of the Dendrometrics, forest management planning and forest monitoring team (E1)**

The forest research in the fields of dendrometrics, forest management planning and forest monitoring represent a fundamental component of ICAS research activities with significant experiences and results at both national and international levels.

### **1. Major research achievements.**

The research activity carried out by the research team dendrometrics, forest management planning and forest monitoring between 2007 and 2011 is characterized by an integrated approach of inter- and multi-disciplinarily issues specific to dendrometrics, forest management planning, dendrochronology and long-term ecological monitoring of forest ecosystems conditions under the action of diverse stress factors, in special atmospheric pollution and climatic changes.

#### *Scientific objectives and results:*

- monitoring of forest ecosystems conditions in an integrated system;
- long-term ecological research (LTER) inter- and trans-disciplinary in site of national (LTER-Romania) and international network (LTER-Europe);
- implementation of national dendrochronological network and complex dendroclimatological and dendroecological researches;
- monitoring of intra-annual tree ring formation phases;
- development of new techniques and methods to monitor and forecast the drought risk and forest fires hazard;
- dendrometric research in stands affected by biotic and abiotic risk factors;
- the analysis of coniferous species dynamics cultivated outside of their natural distribution area in Romania;
- elaboration of new forest management plan for different forest districts;
- technological transfer of scientific results for continue development and improving the management of sustainable forest.

#### *Publications*

i) 6 articles in ISI journal, at 4 of them team members being a first author, with a cumulative score of relative influences of 4.95 and 9 ISI citations.

ii) 49 articles in national CNCSIS certified journals (B+ and B) and/or indexed in international databases (BDI).

iii) a book was published abroad and eight books in the country. Two of these publications were awarded by the Academy of Agricultural Sciences and Forestry in 2007 and 2008.

iv) research results were presented at over 40 international and 15 national conferences.

#### *Projects*

They were 34 projects undertaken within the team, including five international projects and 29 national projects. A total of 28 projects (3 international projects and 25 national projects) research team has acted as project managers and for 6 as scientific responsible (2 international projects and four national projects). The research team through its members had the status of program director for two national programs: National program "Monitoring of forest vegetation and forest soils for forestry" and "Nucleu Program 0946/2009" Sustainable forest management in the context of global environmental change (GEDEFOR)". The total value of international projects carried out within the research team dendrometrics, forest management planning and forest monitoring in the period was over one million euros and for the national projects of over 1.98 million euros. These projects were obtained through competitions and have been completed or carried out in accordance with plans and related research in appropriate scientific quality conditions, with no objection from the donors or beneficiaries, national and international audit reports are favorable. Between 2007 and 2011, the research and development team, achievement more than 172 forest management planning projects and other research studies for National Forest – Romsilva and the other beneficiaries.

### *Infrastructure*

The research developed in the period under review were conducted in specific national research networks, integrated into international networks and projects, consisting in monitoring and research sites heavily equipped with modern technical instruments and devices located "in situ", while disposing of laboratory equipment for samples analysis and for processing the scientific data recorder from regular, permanent and continuous measurements and observations.

The main research networks in which the team has a contribution are: the forest monitoring networks (intense monitoring –12: representative forest ecosystems and cross-country – 16x16 km), dendrochronological network RODENDRONET (with over 100 dendrochronological series), networks on long-term ecological researches of forest ecosystems in Retezat, Bucegi - Piatra Craiului, Pietrosul Rodnei at 33 different sites (LTER –Romania, LTER-Europe, ILTER) , network of transcarpathic research for the evaluation of the ozone pollution over the forest ecosystems and for the evaluation of the vegetation biodiversity in Carpathian forests (26 sites from which 6 in Romania), Carpathian network of continuous intra-annual growth monitoring (8 sites), a network of technology transfer in Oriental Carpathians for the ecological reconstruction of spruce ecosystems affected by biotic perturbation factors (game) (up to 9 pilot experiments realized within the last 20 years), network of permanent plots for long-duration in the Carpathians for the study of the influence of silvicultural works in spruce mountainous ecosystems affected by biotic and abiotic risks (over 20 experimental blocs).

The field research networks are equipped with weather stations WMO compatible, multiple devices for the continuous monitoring of trees growth, the dry and wet atmospheric deposition dry and wet, for the collection of soil samples, for litter collection, and for the measurement of O<sub>2</sub>, NO<sub>2</sub>, SO<sub>2</sub> (passive filters and continuous active ozone monitoring). The research infrastructure available for the research team is modern and used at full capacity, consisting in a laboratory for chemical analysis laboratory (chemical runoff, soil solution, air quality analysis using passive filters O<sub>3</sub>, NO<sub>2</sub>, SO<sub>2</sub>, analysis chemical soil) and a laboratory of dendrochronology and wood anatomy (structure quantitative measurements of annual ring, anatomical analysis of dynamic processes of annual tree ring formation). The management of the large volumes of raw data obtained from research networks is achieved through integrated management systems databases and their statistical processing is done by general statistical software, specialized or conducted within the research team.

### **2. Dynamics of research directions.**

The complex nature of integrated, inter - and trans-disciplinary specific activities conducted by the research team constitutes a research support and scientific human potential for maintaining and developing further the international cooperation and national partnerships and ensuring compatibility of the fields of scientific information and research directions discussed. Thus were built and continue specific research directions dendrochronology, surveillance and research on long-term status of forest ecosystems (biometry, dendrochronology, auxology, physiology, biodiversity, climatology, phenology, soil science, air quality, quality wet and dry atmospheric deposition, etc.). An other important approach is the introduction in the forest management planning of the last results obtained by mathematical modeling of growth, namely new romanian yield table, to address the following issues: establishment of normal production fund for forest planning in high forest system, simulation models of growing stock dynamics productive fund dynamic and structure.

### **3. Interdisciplinary initiatives.**

The inter- and trans-disciplinary approach was included in the activities of national and international project obtained through competition in which the research and development team members of the Dendrometrics, forest management planning and forest monitoring Biometrics and Forest Monitoring team were involved, thus obtaining results integrated and correlated to the organization, structure, operation and state forest ecosystems. Interdisciplinary initiatives are considering the potential of maintaining and extending the current research networks, but also increasing the multidisciplinary of the research activity in these networks with new approaches (Timelines of cell parameters, monitoring of ecophysiological parameters, hydrological



measurements etc.). It also aims at integrating the results of these research networks towards vulnerability assessment and adaptability of forest ecosystems under climate change, effects of environmental changes and stationary conditions on the development of forest ecosystems. These new research directions are already embodied in ongoing projects, proposals being under evaluation:

- LIFE +: EnForMon "Environmental Forest Monitoring " and Acer O3 "Developing a user-friendly integrated system to Improve Environmental Risk Assessment and Communication of due to Ozone" (on review);

- Partnerships Program: MonForDiv "Long term monitoring of structure, functionality and vegetation diversity of forest ecosystems in Southern Carpathians LTER sites (Retezat and Bucegi-Piatra Craiului)" ADFORMAN - Measures of adaptive forest management in forest of coniferous and beech mixed under the Risk Factors and the impact of climate change (on review);

- The Human Resources: Dendroecological reconstruction of disturbance history from Eastern Carpathians in old-growth Forests (accepted to finance).

#### **4. Human resources dynamics.**

The research team is well structured into research directions according to the distribution of human resources and to the scientific degrees and age categories of the personal. Thus, the research team is constituted by 15 attested researchers (6 senior researchers, 2 young researcher, 4 PhD students and 3 maters students), 6 technological development engineer and also 10 persons as technical assistants. From these a 6 young researchers were employed and 3 finish the PhDs thesis in the last 4 years. Most of the young researchers participate during this period, to training and summer schools in prestigious European research institutes and universities on the field of wood anatomy, dendrochronology, forest monitoring. Seniors researchers from this team participate as invited speakers to one summer school (about forest risk management) and two conferences. In this R&D team are involved two PhD advisors on the research area of biometry and forest management planning, making thus doctoral training in partnership with Transilvania University of Braşov and Stefan cel Mare University of Suceava.

## **Activity Report of the Forest Ecology Team (E2)**

**1. Major research achievements.** The Forest Ecology team has been functioning since the establishment of the Institute (1933), covering a broad spectrum of forest topics: soil sciences and forest sites, dendrology, typology, physiology, conservation biology and biodiversity assessment and adaptation of forest management practices to dynamic environmental conditions. Researches mainly focused on the analysis of the relationships between vegetation and different environmental (e.g. soil, bedrock, climate) and anthropogenic drivers. In response to the increasing interest for close-to-nature management, the team has developed new research directions in the field of old-growth forests, taking the advantage of their large spatial extent in Romania.

*The main achievements* of the Forest Ecology team during the last 4 years, on the research directions approached, are detailed bellow.

### **Forest ecosystems and habitats typology:**

- a) elaboration of the forest ecosystems and habitats typology at country level;
- b) development of a geospatial database of Romanian forest ecosystems and its associated digital map;
- c) assessment of forest sites from Lower Danube Floodplain and Danube Delta, with special emphasize on the highly anthropically transformed areas;
- d) elaboration of a regional forest sites typology for Dobrogea region (21.200 km<sup>2</sup>).

### **Ecophysiological studies:**

- e) analysis of the species tolerance to hydric stress at tree/organ level;
- f) analysis of the photosynthesis physiology at cellular and molecular level and mineral nutrition of trees;
- g) evaluation of the biogeochemical cycles: greenhouse gas monitoring, impact of forest management on GHG fluxes;
- h) evaluation of the carbon storage in all ecosystem compartments (soil and litter, dead and living wood) and study of the inner processes (mineralization, respiration);

### **Climate change, disturbance regimes:**

- i) analysis of the disturbance regimes and their influence on natural and managed forests;
- j) risk mapping of the major natural disturbance agents - drought, wind and insects attacks;

### **Old-growth forests biodiversity:**

- k) establishment of the indicators for the assessment of old-growth forests;
- l) inventory of the old-growth forests in Romania;
- m) establishment of inventory/monitoring networks in selected old-growth forests (5 protected areas, COST E4 approach);
- n) analysis of the biotic processes in old-growth forests (regeneration, growth, competition, mortality);
- o) estimation of the amount and quality of dead wood in old-growth forests and its consequences on biodiversity;
- p) assessment of the diversity of saproxylic beetles.

*Publications.* The scientific contribution of the team between 2007 and 2011 comprises 15 articles published in ISI journals, among which 6 as first author. The cumulated influence score of the 15 papers is 30,236 and represents 86 ISI quotations. 46 scientific articles were published in journals indexed in international databases (non-ISI ranked) and 7 articles were published in the proceedings of the scientific conferences. 9 members of the research team have published 26 books / book chapters: 10 of them in foreign publishing houses (i.e. Springer, VVB Laufersweiler Verlag), and 16 books in Romania (i.e. Editura Silvică). Additionally, 6 requirements for patents were submitted in the same period. Tree of the publications were awarded by Romanian scientific organizations: 1 in 2008, 1 in 2009 and 1 in 2010.

*Dissemination.* The team has presented 50 scientific papers to international conferences organized in foreign countries (23) or in Romania (27 from which 14 with international participation). The members of research team have been part of the organizing or scientific committees of 10 scientific conferences organized in our country (3 in 2008, 4 in 2009 and 3 in

2011), 7 conferences with international participation. Six members of the team are involved in editorial boards as members, while 11 as reviewers for renowned journals: 3 from Romania and 8 from abroad. The team is deeply invested in the re-birth of the publishing activities of the Institute through its Publishing House "Editura Silvică" and the international journal "Annals of Forest Research", which experienced a strong improvement process (switch to English, double blind review process with a strong involvement of foreign reviewers) and is expecting an ISI quotation.

*Projects.* The members of the research team have been in charge of 81 research projects, with international (e.g. FP 7, Life+, COST - 7 projects) or national financial support (PNII - Partnership, Ideas, Human resources-, CEEEX, POS Environment), of which 13 are on going projects. The team has proven its ability to work with large interdisciplinary groups, as being involved in long-term partnership research programs, both national (e.g. Transilvania University Braşov, Ştefan cel Mare University Suceava, Biological Institute & Speleological Institute - both within the Romanian Academy, Danube Delta Institute of Research-Development) and international (Max-Planck BGC Jena, Johann Heinrich von Thünen-Institut Hamburg, Laboratoire de Sciences du Climat et de l'Environnement Paris, Catholic University Louvanin la Neuve, University of Life Sciences Prague). The team further contributes to the core EFI Regional Office EFICEEC hosted by the University of Natural Resources and Applied Life Sciences, Vienna - Austria.

**2. Dynamics of research subjects and directions.** The strategy is to relate the research to the most relevant European research directions, policies and strategies (e.g. low carbon society, climate, biodiversity, sustainable development models, conservation and sustainable use of water and soil resources etc.). One target is to promote specific (local) topics, with potential impact on the scientific world (e.g. related to old-growth forests and LULUCF), where the team can have pertinent contributions and leading position at international level. The research subjects approached in the last years or planned for near future are the following:

- Development of pedological forest database and forest soils mapping at country level. The evaluation of the carbon stock from organic and mineral horizons;
- Greenhouse gas balance and climate change impacts in forest ecosystems, through long-term observations of fluxes of CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O between the biosphere and the atmosphere, and how they are affected by climate and forest management;
- Contribution to EU-wide datasets, mainly through collaboration to EU projects, and model-based techniques for monitoring carbon stocks and greenhouse gas fluxes (emissions and sinks) in the EU; their application to verify and improve the national emission inventory report;
- Enabling the calibration and application of models of GHG ecosystem-atmosphere exchanges, to predict future dynamics and evolutions under climate change and management adaptation for mitigation;
- Inventory of gas emissions with greenhouse effects and gas absorption in the land use at national level (historical and future modelling of land use and land use changes and their consequences);
- Climatic effects of afforestation (absorption of CO<sub>2</sub> and the emissions of gases (currently deficitary, but utterly necessary in the grounding of political engagements for emissions reduction);
- Dynamics and functioning of natural forests in a changing environment, disturbance regimes in Norway spruce old-growth forests, contribution of natural or old-growth forests to the terrestrial carbon sink;
- Modelling the evolution of carbon sink strength in the context of climate changes, including the impact of extreme climate events.

**3. Interdisciplinary initiatives.** The team is undergoing researches that are, by essence, interdisciplinary, as reflected also by the variety of topics encompassed within international projects (Life+, FP-7) and long-term partnerships. The major recent initiatives for interdisciplinary are:

- Biodiversity of natural/old-growth forests: the definition of biodiversity isn't as static as it used to be, and the functional diversity became a foremost preoccupation of the scientific

community. The diversity of the ecosystem functions studied is achieved by interdisciplinary investigations. The biodiversity assessment also requires the fusion of multiple knowledge and expertise fields (e.g. botany, entomology);

- Biodiversity assessment in Natura 2000 sites for reporting and elaboration of guidelines for the management of forest habitats and associated species of community importance;
- GHG fluxes in forest ecosystems: the old-growth forests are much undersampled ecosystems, more studied for their structure than for their contribution to GHG fluxes. The analysis of the fluxes and their representativity requires a combined approach of forest structure, biotic processes and physiology;
- Forests adaptation to global changes and risk assessment: the share of anthropic or natural factors to the pressure exerted on the forests needs peculiar knowledge and synthesis efforts, undergone in the newly started projects.

**4. Human resources.** The research team consists of 27 members: 19 researchers (2 CS1, 1 CS2, 10 CS3, 2 CS, 4 AS), 1 technological development engineer (IDT III), 7 technicians / laboratory assistants. 10 members have a Ph.D. degree and 5 members are Ph.D. students. 5 members are associate professors in forest sciences (University of Transylvania Braşov, University of Agricultural Sciences and Veterinary Medicine Bucharest, Banat University of Agricultural Sciences and Veterinary Medicine Timisoara, University of Oradea), giving lectures in pedology and forest typology, dendrology, forest physiology, silviculture, biodiversity conservation and protected areas.

The three main points pursued for the future of the team, in terms of human resources are: i). increasing the share of the young scientists in the team; ii). promoting the promising scientists, in developing their own directions and their contribution to collaborations, as much as possible; iii). investing in further training and learning activities (e.g. scientific writing, statistical short trainings, participation to summer schools, fellowships);

**5. Infrastructure.** The laboratory infrastructure consists of modern equipments, acquired during national /international projects, in accordance with the short-term research strategy of the group. Briefly, it is constituted of:

- Soil and forest vegetation analysis laboratory (ICAS Headquarters), qualified for the ISO9001 standards, with good performance rating at international calibration exercises. Main devices: CNS analyser, ICP-OES spectrometry apparatus, and atomic force spectrometer.
- Laboratory of plant physiology, greenhouse and growth chambers (ICAS Headquarters);
- Greenhouse gas chromatography laboratory (Mihăeşti Research Station). Main devices: brand new gas chromatograph Agilent devoted to gas concentration measurements (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O);
- Dendrochronology laboratory (Timișoara Research Station). Main devices: Velmex UniSlide tree-ring width measurement system, wood sanding machine, increment borers, digital scanners;
- Field measurement devices: 2 Field Map Data Collector (hardware + software), 2 GPS (Trimble), light measurement system (Hemiview) and canopy analyzer (Licor LAI 2000, TRAC, mobile laboratory, etc.);
- Botanical scientific collection - Herbarium (ICAS Central Unit), with over 30 000 specimens;
- Long-term permanent plots and experiments (FENOFOR Phenological Network, NATFORMAN Old-Growth Forest Monitoring Network).



## Activity Report of the FOREST GENETICS AND TREE BREEDING TEAM

### 1. Major research achievements

The main research objective carried out by the Forest Genetics Research Team during 2007-2011, is to conserve and improve forests genetic diversity by increasing their adaptive, protection and growth potential. The research results fundament the production of high biological value Forest Reproductive Materials, the preservation and sustainable management of Forest Genetic Resources (FGR). For the last 50 years, the Forest genetics and tree breeding researches represent a distinct domain in the Institute's activity

**Scientific directions:** (i) to elaborate strategies on *in situ* and *ex situ* conservation and sustainable management of FGR; (ii) to evaluate genetic diversity of forest species and to select most valuable genotypes/populations with the aim to increase forests growth potential; (iii) to identify and to describe new FGR for increasing adaptive capacity of forest ecosystems to undergoing global climate changes; (iv) to develop new advanced biotechnology techniques for micro propagation of valuable genotypes and *ex situ* conservation of FGR.

#### **The main achievements of the Forest Genetics team between 2007-2011**

a. Assessment of genetic diversity for main autochthonous forest tree species (evaluations made in long period multisite trials) lead to following results:

- Designation as “tested category” of basic materials sources for: Norway spruce, Silver fir, Larch, Beech, Pedunculate oak and Ash;
- High genetic value genotypes (hybrid families) for Silver fir and Larch, in order to establish the 2<sup>nd</sup> generation of seed orchards;
- Introduction new poplars and willow clones, highly productive and resistant to diseases, including the modernization of poplars cultivation technology;
- Development a database with 199 long period experimental trials (including their tested genetic units) and 118 seed orchards;
- Assessment intra and inter-populations genetic variability for: Sessile oak, Hungarian oak, European beech and Norway spruce for establishing most valuable seed stands;

b. Establishment, conservation and sustainable management of FGR and Basic Materials for production of forest reproductive materials. The main results refer to:

- Update of the National Catalogue of FGR and Technical Guideline for their sustainable management, the National Catalogue of Forest Basic Materials and delineation of new Regions of Provenances according to national law no. 107/2011, OECD Scheme, EEC's Directive no. 105/1999. The National Catalogue of FGR and the new Regions of Provenance were approved by the Ministry of Environment and Forests;

- Development database for FGR (698 gene conservation units for 45 forest tree species) from Romania. The database was also uploaded on the EUFGIS platform <http://www.eufgis.org/>. (COREGE - FOREST, EUFORGEN Programme, EUFGIS Project)

c. Assessment genetic diversity of main forest tree species by the means of molecular markers (isozymes and DNA markers). The main achieved results are:

- Evaluation and mapping cpDNA polymorphism for autochthonous oak species and delineation their post glacial evolution (OAKGIS Project);
- Assessment genetic diversity in field trials: Pedunculate oak, Sessile oak, Common ash and European beech (TREE-VARGEN Project);
- Study genetic diversity of Norway spruce and Silver fir forests located in NATURA 2000 sites (CONBIODIV Project);
- Construction synthetic geographic maps of present genetic diversity and postglacial history for white oaks and hornbeam species from Romania and Bulgaria (DIVAMAP Project);
- Assessment genetic diversity with molecular markers of valuable oaks provenances and forest genetic resources from southern Romania and Bulgaria (OAK Project);
- Evaluation and monitoring genetic diversity of broadleaves and conifers seed orchards and *in situ* FGR by the means of cpDNA and isozymes markers (PN 09460202 Project).

- Applying Real Time PCR technique for detecting integration of resistance gene in the transgenic plants genome (SALTRANS Project);

d. Evaluation and "ex situ" conservation using new biotechnologies. The main achieved results refer to:

- "ex situ" conservation using *in vitro* technique for FGR: poplars and Hungarian oak (COREGE-FOREST Project), Silver and Pubescent birch, Metasequoia and Chamaecyparis (ARBOOR Project);

- Evaluation polluted ecosystems of Austrian black pine, Sessile oak, Pedunculate oak and Black locust species, using peroxidase and lecithin by chromatography affinity of phloem (PN 09460102 Project).

*Publications:* 1 article in ISI journal (0.5243 relative score) with 5 ISI citations; 2 articles accepted for publishing in ISI journals; 34 articles in national CNCSIS certified journals (B+ and B) and/or indexed in international databases (BDI) or published in International conferences Proceedings (12 of the 34 articles were published in English); 10 books published in CNCSIS certified publishing house ([www.editurasilvica.ro](http://www.editurasilvica.ro)); participation to the elaboration of 8 monographs at European level for following species: Norway spruce, Silver fir, Scots pine, Larches, Douglas fir, Sycamore maple, Ash and Wild cherry (will be published to Der Springer Publishing House as results of the European TREEBREEDEX Project).

Three books written by the research team's members were awarded by the Romanian Academy, The Academy of Science People and "Progresul silvic" Society.

*Projects.* The Genetics team participated in the framework of 28 national and 9 international projects and has coordinated 32 projects of them.

A special attention was given to international cooperation in the frame of regional or European projects or programmes: TREEBREEDEX, EUFORGEN, EUFGIS; Bilateral cooperation with Bulgaria, Austria, Germany and participation in COST Actions (E52 and FP0905).

Eight project proposals have been elaborated in the previous 4 years and three of them in international programmes. In the autumn of 2011 the members of the Genetics research team have elaborated 4 new project proposals which are under the evaluation status in the frame of National Program Partnership II. In the framework of these project proposals the ICAS is the project coordinator and the project partners are from two universities, one national research institute and the National Forest Administration (ROMSILVA) as co-financing partner and end user.

The project "Designing trees for the future" (TREES4FUTURE) was approved under the FP 7 programme and started on November 2011 for 48 months.

The total income realized by the Genetics research team is approximately 1.950.000 Euros, funds distribution being mentioned in F2.

*Infrastructure.* During 2007-2011 there were establish a new laboratory of molecular genetics which increase the accuracy of analyses and create opportunities to join in the international research programs. Also the existing laboratories, such as biotechnologies, vegetative propagation, seed's quality testing, quantitative genetics and tree breeding, were upgraded with recent equipment acquisitions.

The available research infrastructure consist also in: experimental long term field plots, comparative provenance tests, seeds orchards, long period experimental trials.

*Dissemination.* The members of the Genetics research team have organized 4 international conferences and took part in 26 international and 4 national conferences, where a total of 31 scientific papers have been presented.

## **2. Dynamic of research directions**

The main research directions are:

- to continue breeding programme for main autochthonous and exotic species to increase the quality and quantity of wood products and to increase the protection and social functions of forests under the climate change;

- to identify, to describe and to conserve new FGR from natural forest ecosystems;

- to develop and to apply molecular markers methodology in the certification of FGR;

- to assess genetic diversity of main forest tree species for sustainable management;

- to evaluate postglacial evolution of Romanian forest tree species by means of DNA markers;

- to develop advanced biotechnologies for *ex situ* conservation of FGR and for *in vitro* propagation of forest trees and shrubs;

- to select and improve fast growing species and clones and to establish energetically plantations for biomass production.

The Genetics research team will tackle new research directions and opportunities by increasing research infrastructure, by training in advanced techniques and by participating in international research projects.

### **3. Interdisciplinary initiatives**

The research subjects and directions were realized within the national and international projects coordinated by the members of the research team in partnership with other teams from other institutions (universities, research institutes) specialized in the biology field

The members of the Genetics research team have participated in the following interdisciplinary projects:

- *Evaluation and mapping cpDNA polymorphism for autochthonous oak species and delineation their post glacial evolution* (OAKGIS Project). The project involved researchers from different fields of study: forest genetics, ecology, geomatics, botany, palynology, forest management and conservation.

- *Study genetic diversity of Norway spruce and Silver fir forests located in NATURA 2000 sites* (CONBIODIV Project). The project involved researchers dealing with aspects concerning geobotany, geomatics, quaternary palynology, population genetics, conservation, physics, biochemistry, taxonomy and phylogeny of fauna groups.

- *Molecular biotechnologies to improve quality of economic interests crops* (SALTRANS Project). The project involved researchers from several fields of study like: plant genetic transformation, cryobiology, *in vitro* culture, genomics and biotechnology.

- *Study of genetic variability of the main forest species in order to establish the tested seed sources and comply with the E.U. norms* (TREE-VARGEN Project). The project involved researchers from different forestry sciences domains like: forest ecology, silviculture, breeding, genetics and dendrology.

- *The effects of pollution and climate changes to some forest ecosystems from Retezat National Park*. The project involved researchers from the following fields of study: geobotany, forest ecology, dendrology, biometry, auxology, pedology and climatology.

### **4. Human resources evolution.**

The research team is structured according to main research directions and includes 28 persons employed as permanent staff. Among them 13 are attested researchers (2 CS1, 3 CSII, 4CS III, 3CS and 1 AS), 8 of them hold PhD diploma, 3 are PhD students, and 4 are young researchers. In the last four years 4 young researchers were employed; nowadays three of them are PhD students. A relevant aspect concerning the team is that six members followed international training specialisations in the fields of molecular genetics, biotechnology and trees eco physiology in high prestige laboratories from France (INRA Tree Improvement stations Orleans and Bordeaux), Germany (Institute for Forest Research, Escherode, ASP Institute from Teisendorf), Austria (BOKU University, and FBW Institute Viena), Russia (Training on Biodiveristy conservation organized by IPGRI in Moscow), Venezuela (Techniques and application of the biotechnology to forest trees” IDEA - Caracas), and Luxemburg. During last four years young researchers from the team participated to different international training specialisations organized by ASP Institute from Teisendorf – (Germany); “Plant Genetic Institute, National Research Council”, Florence (Italy) and Institute of Biology, Freie Universitat Berlin (Germany).

Three members of the R&D team are involved in higher education activities at the University of Agricultural Science and Veterinary Medicine, Faculty of Agriculture, Silviculture Specialization, where they hold courses in: Forest Genetics and Tree Breeding, Afforestation, Plants Physiology etc.

## **ACTIVITY REPORT OF WILDLIFE BIOLOGY AND MANAGEMENT TEAM (E4)**

### **Major research achievements**

The laboratory researches are directed toward the study of wildlife and salmonid resources restoration, conservation and management. The major objective is the study of wildlife in the context of society development and mitigation of this impact on wildlife populations in Romania.

The scientific researches are the bases of conservation and wildlife management. Romania in the last 20 years has major changes in society, moving from a system where state controls everything, to a system of private property with or without financial resources. In these conditions, the main pressure was on natural resources including wildlife.

### ***Conservation and wildlife management***

The complex researches on large carnivore species, held within nine national and international projects, using the most advanced equipment in the field, have shown new information in the following aspects:

- Large carnivores ecology;
- Possibility of conflict mitigation between large carnivores and human activity;
- Infrastructure development and barriers for large carnivore movements;
- Improvement of evaluation methodology for large carnivores and wild cat;
- Large carnivore connectivity;
- Management plans for game species in protected areas in Romania;
- Management plan for beaver reintroducing in Romanian;
- Genetic variability of wild boar and brown bear for several areas of the country.

### ***Development of breeding technologies for wildlife and mountain fish species***

Imposed by market, the research on breeding in captivity of wild boar, red deer and fallow deer have grown in this period. Research activity had the following results:

- Planning the technologies for wild boar, roe deer and fallow deer breeding;
- Technical frame project - models for hunting areas for wild boar, roe deer and fallow deer;
- Development of intensive aquaculture technologies for salmonids;
- Establishment for aquaculture technology of grayling (*Thymallus thymallus* L.).

### ***Conservation and Salmonids management***

Ecological and genetic studies on salmonids in Romania were able to establish the following:

- Methodology for assessing and monitoring the status of living aquatic resources in the mountain waters;
- Suitability of fishing units for mountain waters;
- Aquatic resources management plan in mountain basins according to EU requirements.

The research results are used by managers of the hunting units, Ministry of Environment and Forests, Ministry of Agriculture, Ministry of Transport, Ministry of Regional Development and Tourism, environmental protection agencies, administrators and custodians of protected areas (including Natura 2000 sites), environmental NGOs, the state and private administration. This was the first time when private forest districts and municipalities of many cities were interested to cofinance collaborative research on large carnivores.

The research activities from this period were conducted within the frame of 22 projects, from which 21 projects were conducted by staff from the laboratory.

The main scientific results were published as the follows:

- a) 2 articles in ISI rated publications with impact factor and relative influence cumulative score 4.51269,
- b) one article in an ISI rated publication with impact factor but not cumulative score of relative influence,
- c) 7 articles in journals BDI (B+, B, NURC),
- d) 9 papers (proceedings) of international meetings,



- e) 10 papers (proceedings) of national meetings,
- f) 7 books,
- g) 2 chapters in books.

Maintaining and developing a strong team, with a high degree of expertise through continuous improvement of researchers (preparation and participation in national and international trainings).

Dissemination of the results was done also through:

- 10 participations in national symposiums and 8 at international symposiums,
- publication of the following:
  - methodological guide for evaluating of the large carnivore and wild cat,
  - technology for breeding wild boar, roe deer and fallow deer, technical design,
  - model for hunting complexes with wild boar, roe deer and fallow deer,
  - a practical guide to set up hunting complexes with wild boar, roe deer and fallow deer, - management measures for reintroduced species *Castor fiber*,
- 14 communicates in the media - TVR2, PRO TV, Antena 1.

The research developed by wildlife department were interdisciplinary from aspects (ecology, ethology, genetics, etc.) to involved groups (foresters, wildlife biologist, vets, sociologist, agronomists, etc.)

### **Dynamic of research subjects and directions**

During 2007-2011 main research directions were:

***Conservation and wildlife management:*** biology, ecology, ethology and management of mammals and birds; manipulation wildlife species in Romania; using GPS and GIS in wildlife management in Romania; designing thematic maps for distribution of wildlife species; reintroduction of species which have disappeared from Romanian fauna in areas with proper habitats and human acceptance, including restocking fauna; management of conflicts between human activities and wildlife; animal genetics;

Major new directions:

***Biodiversity management in the Natura 2000 network in Romania:*** hunting management in Natura 2000 sites, ecological network for large carnivore species in Natura 2000 sites, taking custody and management of Natura 2000 sites;

***Genetics of game species:*** determination of genetic diversity and genotypes of wild fauna and game in Romania in order to protect valuable genotypes, avoiding inbreeding and genetic drift.

***Conflict management between game species and human activity:*** especially between agriculture, livestock breeders and forestry and wildlife; habitat fragmentation by infrastructure development; reducing conflict areas with special conservation measures for European protected species.

***Salmonids conservation and management:*** evaluation and monitoring of biotopes and biocenoses current state for fisheries, research regarding the management of fishing units on mountain rivers, management of endangered species (huck, grayling); genetic study of salmonids in Romania (natural habitat and trout farms).

***Development of breeding technologies for wildlife and mountain fish species:*** technologies of reproduction and growth in captivity of wildlife and salmonid species for restocking game in the hunting units and fishes in mountain waters; consulting, technical assistance and impact studies in hunting and salmonids activities, improvement of trout production.

### **Interdisciplinary initiatives**

In collaboration with other research teams and diverse national or international institutes/universities, team has been approached:

- Genetic of wild animals (collaboration with other national and international universities);
- Administration of Natura 2000 sites (collaboration with local administration, environment protection agencies, NGO, people, education institutions etc.);
- Monitoring of wild fauna (collaboration with forest and game administration);

- Conflicts between wildlife and human activity (collaboration with local people organization, local administration, environment protection agencies, etc.).

### **Human resources evolution**

The research team consists of 18 people with permanent employment contract, including 8 researchers with the following scientific degrees: 2 CS I, 2 CS II, CS III 2, 2CS. From those, 4 have a Ph.D., 2 are Ph.D students and 2 are well-known researchers (national and international project managers, referees in the doctoral committee, with additional university teaching activity).

During 2007-2011 period, 3 people have attended training courses on capturing and tranquilize mammals, 3 people have graduated the course of European projects management, 2 specializations in Finland and Germany for young researchers, 1 person attended a course of public acquisitions and 1 person attended a human resource course. From personal with medium level studies, 4 persons finished technical colleges and faculties but could not be assigned to researchers posts, due to personal policy of National Forest Administration.

### **Infrastructure**

Research laboratories from Bucharest and Brasov made research services and technical expertise on the conservation and management of wild fauna and salmonids.

*The laboratory in Brasov* is specialized in conservation of large carnivores and aquatic mammals and it has managed to acquire specific research equipment:

- for capture activities, tranquilizing and relocation of wild fauna (mounting type box traps, cage type, type leghold traps for carnivores, herbivores nets and traps for aquatic mammals, tranquilizing kit, transport cages, special cars, trailers and ATVs).

- for monitoring the activity of wildlife (GPS transmitters for large carnivores, ear tag transmitters for aquatic mammals, receivers, software for data analysis; phototrap cameras, photo and video cameras, GPSs, portable ultrasound system, binoculars, night vision, motor boats, sonar, special cars for radio telemetry; snake cameras; field equipment.

- for pathology and genetic analysis (Real Time PCR; DNA sequencer system, analytical balance, freezer, microscope, software)

- for management of conflicts between human activities and wildlife (electric fences, phototrap cameras;)

- for office work (computers, software for data processing, peripherals: printers, plotter, copier, scanners)

*Specialized laboratory in Bucharest* is specialized on the salmonid species management and increasing wildlife and salmonids potential

- for activities of salmonids management (electrofishing system, sonar, GPS, pneumatic boat)

- for increasing the potential of hunting and fishing activities (binoculars, night vision, computers, software for data processing, peripherals: printer, scanner, field equipment)

### **Other mentions**

In the last period, team has done technical assistance for unchaining, capturing, tranquilizing and relocation of wild animals (40 bears/year, becoming the most qualified emergency team for bear in Romania). In order to diminish the conflict human - wild animal (large carnivores and aquatic mammals) 4 projects have been proposed into LIFE+ and POS Mediu programs (5 mil. Euro). Private or public forest districts have been attracted as co-financing partners into the projects. The most recent direction of the team was into animal genetics and administration of Natura 2000 sites.

## **ACTIVITY REPORT OF SILVOTECHNICS AND ECOLOGICAL RECONSTRUCTION TEAM (E5)**

### **1. Major research achievements**

The research and development activity carried out by the Silvotechnics and Ecological Reconstruction team during the period 2007-2011, is characterized by an integrated approach of inter- and multidisciplinary complex issues specific to afforestation, ecological reconstruction and management of watersheds, forest and land degraded site, silvobiology.

The strategic objective of the research team is the capacity increasing, quality and complexity of research in Ecological reconstruction and Silvotechnics domain for sustainable forest management in the context of climate change and socio-economic regional and global transformation.

The major research achievements consist in:

- substantiation of measures to protect the environment and the productive agricultural land in high degradation risk areas through the establishment of forest crop, shelter-belt and agro-forestry protection systems;
- ecological reconstruction technologies by silvotechnics methods of ravined and sliding lands of Moldavian Plateau;
- ecological reconstruction technologies of declining forest in the meadows and Danube Delta embanked areas;
- management measures drawing of forest areas in depression zones at risk of flooding and prolonged water stagnation;
- afforestation technologies of eroded, ravined, slipping, polluted and anthropic degraded lands;
- ecological reconstruction technologies of waste heaps through the use of species (*Mischantus*) with energetic potential;
- the restoration / substitution technologies of inadequate stands;
- watershed planning technologies, monitoring and adoption methodology of hydrotechnical works used in torrent control;
- alternative technologies on substitution of gaseous fuels and sustainable utilization of both forestry resources and coals.

Scientific contribution of research team between 2007-2011 is marked out in a total of 14 published articles, including 2 abroad, 8 indexed in international databases BDI (B + and B), and 3 articles in publications recognized by CNCSIS. Were also published 7 chapters in scientific books, of which 1 abroad (Springer Publishing) and 10 books in the country. One of these was awarded by the Romanian Academy in 2010 with the "Marin Drăcea" award.

The team members participated at the scientific meetings with 25 papers, of which 4 posters presented at international scientific meetings. Also, the group members organised five scientific activities (5 workshops).

The team members activity consist in the management of 53 research and development projects of which 8 in progress at the file submission date of. The earnings of the period 2007-2011 are 1.687 thousands euros (7.254 thousands lei). Of these, a project with external funding (29,9 thousands euros), 12 from budgetary sources (942,6 thousands euros), 28 funded by the RNP-Romsilva and Forestry Branch (558,7 thousands euros) and 13 contracts with third parties (155,8 thousands euros). Were also specialized technical support services during the execution of the works in over 20 projects

The projects were obtained through competitions and were accomplished or carry on in accordance with the plans for research and in appropriate quality scientific-technical conditions,

without objection from the financier or beneficiary. Most research projects have been completed with technical guidance for the implementing of the forestry work, used in the forestry practice.

Research carried on between 2007-2011 in the national forest, including hydrographical network (on itinerary), in the temporary research areas and specific national research network, consisting of 175 permanent experimental research plots, 5 of them having devices, instruments and equipment located "in situ" for forest hydrology research. It is also disposed equipment for regular, permanent and continuous measurements and observations in the field, samples analysis taken from the field and scientific information processing.

## **2.The dynamics of research subjects and direction**

Approached research directions aim at the scientific and experimental substantiation of forestry technologies, such as:

- forests regeneration (silvicultural treatments), tending operations and forests technical management (of stands and forest plantations);

- forests plantation technique (afforestation of degraded lands, revegetation, shelter-belts and agro forestry);

- ecological reconstruction of innappropriate stands or affected by harmful factors (improvement, rehabilitation or substitution of stands);

- watersheds planning (the scientific substantiation of watersheds development works);

Of new directions, of team approached are: reconstruction of degraded lands or exposed aridity through afforestation, establishment and tending operations of shelter-belts and agro-systems, mapping and stational classification of agricultural degraded lands for afforestation, watersheds planning technologies.

Future research directions consider the maintenance and spatial extent of the current research networks, and increase the multidisciplinary research degree in these networks with new approaches (improvement of installation and supervision technologies of forest plantations and shelter-belts; technologies of ecological reconstruction and stands regeneration of degraded lands), optimize the treatments method and techniques of forest management and regeneration, improve the stationery typology for degraded lands of agricultural fund, new solutions for the recovery and complementary land use, monitoring and planning of complex watershed. It also aims to integrate the results of these research networks in scientific substantiation direction of silvotechnics works and ecological reconstruction by continuous monitoring of forest plantations and their functional efficiency in relation with the environmental conditions and the effects of silvotechnics works on the evolution of forest ecosystems.

These new research direction are already embodied in ongoing projects, proposal being under evaluation in Partnerships Program: ECOREGATD - Ecological reconstruction and stands regeneration on degraded land; MIPASAP - Cultivation and energetic use technologies and methods of fast increasing species less widely usable in Romania to promote the sustainable renewable resources.

## **3. Interdisciplinary initiatives**

The multidisciplinary character of the research activities consist in integration the research methods and specific application of several scientific fields, such as: forestry, ecology, hydrology, forest biometry, ecological reconstruction, forestry improvement, pedology, integrated management etc.

Through the complex, integrated, inter - and multidisciplinary specific activities character of the research team was accomplished the scientific and human potential research support for maintenance and future development of international cooperation and national partnerships,



ensuring the scientific information compatibility of the approached domains and research directions. Through partnerships with universities and institutions of the environmental protection, agriculture domain were integrated the specific environmental research directions (ecological reconstruction, watershed management), silvotechniques (afforestation, forests supervision and management, forest regeneration), monitoring and research on long term of forest ecosystems on degraded lands and their functional efficiency (dendrometric, forest site, ecology, soil science, hydrology, etc.

#### **4. Human resources evolution**

R & D team consists of 29 members, of which 22 certified (9 researchers, 6 technologists and 7 research assistant). Of these, 9 researchers have a Ph.D title and one is doctoral student. 2 researchers working half time equivalent in the team, 13 are senior researchers (over 40 years), and three are young researchers. The structure of scientific degrees of the research team is: 1 - CS I, 4 - IDT I; 2 - CS II; 5 - CS III; 2 - IDT III; 1 - CS ; 7 AS (of which a PhD), 3 - T I, 2 - TIII, 1 - TS and 1 Non-R&D staff. In the last four years were employed 2 young researchers and 4 research (in which 2 young researcher) have obtained a PhD title. R & D team members carry on ICAS Headquarters and on five Research-Development Station being representative for the topic of research.

Scientific development of the research team on short and medium period is based on human resource balanced, well trained and competitive, partnerships with national and international research teams and a modern research infrastructure comparable to the partners.

#### **5. Other significant aspects**

Research on forest plantation techniques, afforestation of degraded lands and watersheds development have a long tradition in the institute, since its establishment from 1933, operating as distinct specializations (silvotechnique, forest improvement), and were a constant concern of researchers.

The approached issue represents a continuation for the Romanian forest research, correlated with some aspects of the research strategy of EFI (European Forest Institute), being an important contribution to the sustainable management of the natural resources, at the European level or even at the worldwide one.

## Activity report of Forest protection Team (E6)

### Major research achievements

Forest protection has been one of the three basic domains of institute's establishment in 1933, designated for the better knowledge of biotic / abiotic damaging factors characteristics for woody species, respectively continuous improvement of forest health status. Forest protection research team has obtained new national information on:

#### - *Forest Entomology:*

- Identification, prognosis, prevention and control of the major damaging insects and other organisms (including invasive new agents);
- Impact of defoliators and bark beetles in ecosystem stability;
- New efficient pesticides and control methodology accepted by Forest Certification System;
- Climate change influence on pests dynamics;

#### - *Forest Phytopathology:*

- Impact of biotic and abiotic diseases on forest ecosystems;
- Correlation of climate fluctuation and pathogen virulence;
- Identification, survey, prevention and control of new pathogens;
- Biological control of pathogens (using competition/antagonism fungi);

In large consortiums with other research teams and diverse national or international institutes/universities, team has been approached the „*complex diseases*”, with multiple causes, respective “*abiotic diseases*” caused by drought, fire, flooding, frost, pollution etc.

#### - *Forest Mycology:*

- Mycology spectrum – symbionts, saprophytes and pathogens – in forest ecosystems;
- Role of ecto-mycorrhizal symbiosis in forest culture stability;
- Development of new natural food or medicinal products from forest mushrooms.

The main results may be summarized as follows:

- New or improved methods of identification and survey (using new Romanian pheromone traps or the specific fenology of each biotic organism – i.e.: defoliators and bark beetles; using molecular analyses or compatibility tests for invasive pathogens identification – i.e. oomycetes);
- Elaboration and testing new biological products to control aggressive diseases (i.e.: chestnut blight) or soil insects (i.e. cockchafers);
- Testing the improved control methods for main damaging insects (i.e.: using helicopters in hilly zones; integrated control of soil insects; prognosis, prevention and control methods for the new pests of poplar, ash, and other forest species), on production scale;
- Better knowledge of evolution of main pests and diseases in new climate change conditions (i.e.: spreading of *Lymantia dispar* in hilly zones, in beech stands; new invasive insects and pathogens; new aspects of forest decline of different species of beech, ash, oak, alder, hornbeam, poplar, maple, pine, fir etc.).

The scientific results in the last years are based on the following indicators:

*Publications:* 108

- 7 articles + 1\* article accepted to be published in ISI journals (with relative influence score >0), with a cumulative score of 4.5248 + 5.3030\*;
- 3 articles published in ISI journals (with relative influence score 0, but impact factor >0);
- 68 scientific publications in journal indexed in international database BDI;
- 11 articles in proceedings of international scientific meetings;

- 8 articles in proceedings of national scientific conferences;
- 8 books published;
- 2 book chapters published in collective volumes;

*Invention patents: 2*

- 2 patents in process of evaluation on OSIM (1 published in *Buletinul Oficial de Proprietate Intelectuală*);

*Scientific awards: 4*

- 4 awards of national Society „Progresul Silvic” („Forest Progress”) with „diploma of excellence” for „forest book” (2007-2009);

*Projects: 61*

- 18 ongoing projects/contracts at the date of submission (from public, private, and national sources, other than the "nucleu" program), led (director of project, responsible of project partner in complex projects) by Forest Protection team; total projects value for ICAS: 597,346 euro;
- 40 projects/contracts finalized in the period 2007-2010 (majority from public, private, and national sources, other than the "nucleu" program; 2 from international sources), led (director of project, responsible of project partner in complex projects) by Forest Protection team; total projects value for ICAS: 1,371,403 euro;
- 3 other international projects: 1 bilateral project (Romania/Greece, as responsible of Romanian partner) and 2 COST projects (financed by EU, as responsible/MC of Romanian partner);

*Dissemination materials: 14*

- 4 published dissemination materials in Academy of Agronomy and Sylviculture Sciences publications;
- 10 unpublished dissemination materials delivered to National Forest Administration RNP-Romsilva;

*Organization of scientific meetings: 1 meeting (2 participants);*

*Participation on scientific conferences with unpublished presentations/posters:*

- 35 national + 25 international;

*Participation in redaction board of scientific national journals: 3 participants.*

Research results are significant in terms of scientific national publication, national research projects (majority from non-budget funds), respectively results dissemination in sylviculture, participation on scientific meetings, and editorial activity. These allow a superior utilization of research activity results and their dissemination on national scale (especially in state and private forest administration). There are recent efforts (2010-2011) to increase result indicators with lower performance of the research team: integration in international programs, publication into important international journals, respectively innovation patents.

### **Dynamic of research subjects and directions**

Basic subjects have included study of evolution and impact of new biotic forest damaging factors, respectively testing and establishment new methods of identification, survey, prognosis, prevention and control of forest diseases and pests.

New research directions have been launched, in strong collaboration with the other teams, in the last years:

- Forest genetics: genetic variability of pathogens;
- Physiology: tree reaction affected by stress factors;
- Forest (and other) ecosystem biodiversity; conservation status of species and habitats of community or national interest; invasive species (insects, fungi, oomycetes, plants, etc.);
- Sylvotechnics: management and ecological reconstruction / rehabilitation of stands affected by stress factors;
- Wood (and wooden products) protection;
- Environment protection (including pollution impact and management);
- Wildlife protection (including animal pathogens and pests);

- Use of forest non-wood products (including fungi, mushrooms, insects for developing of new sources for human therapeutic and nutritive use).

### **Interdisciplinary initiatives**

In collaboration with other research teams and diverse national or international institutes/universities, team has been approached:

- Biologic control in agro- and forest ecosystems;
- Improvement of forest protection technology in aviation industry;
- Biodiversity of natural / national parks and other Natura 2000 sites;
- Monitoring of forest sanitary state (FutMon);
- Integrating the forest protection methodology in general forest management (many projects financed by RNP-Romsilva).

### **Human resources evolution**

Forest protection team includes 18 researchers (7 senior / 7 major / 3 young researchers + 1 research engineer; one PhD preparing) and 9 technical and lab assistants. Seniors are referents in PhD commissions and 7 senior/major researchers have/had supplementary teaching activity in universities (coordinating routine student research activities and integrating some of them into the projects, one of them being recently promoted into the team). Team policy is to ensure a good age and sex ration balance, and also the continuity in the field, thus all 3 young researchers have been integrated in the team in the last years.

Ways and means for team development:

- Maintaining and developing a strong and balanced team staff, with high expertise rank, by continuous training (in national and international level) of researchers;
- Superior use of new modern equipments and lab / field technologies in forest protection;
- Organization and up-gradation of forest protection laboratories in order to fulfill the (quality and pesticide homologation) certification criteria;
- Integration of forest protection team into national and international research community, by participation in research organisations, projects, scientific conferences and meetings, relevant high impact publications; in this purpose team is trying to integrate its scientific activity into many international (i.e. FP6: *Forthreats*; Life+: *FutMon*; COST Action: FP0081 *Phytophthora*; bilateral projects: chestnut blight control in Romania and Greece; different international and federal funds: Nera virgin beech forests) and national (PNCDI2; MMP – POS Mediu; POS-DRU; RNP-Romsilva; MADR; PNucleu etc.) programs.

### **Infrastructure**

*Laboratory infrastructure.* Entomology and phytopathology laboratories (București, Brașov, Câmpulung Moldovenesc, Craiova, Cluj-Napoca, and Hemeiuși) are prepared to activate into specialized forest / wood research and expertise activity. The recent acquisitions (insect rearing chambers, RealTime PCR, spectrophotometer etc.) were made to increase the accuracy of analyses and to create new opportunity for forest protection research. Lab equipments are common for entomology or pathology activity (microscopy, climaterised and sterile culture chambers, molecular / genetic analyses, etc.).

*Field infrastructure.* All over the country, there are settled down experimental long term field plots: national network for *Lymantria monacha* survey; experimental survey plots for forest decline; comparative tests for forest species / provenance / variety / clone resistance to disease and insects; short time experimental plots (for testing the control pesticides or methodology).

## Activity Report of the Forestry Geomatics Team (E7)

**Major research achievements.** The Geomatics team was established 1994 and the activity mainly use techniques and technologies of collecting, computing, and exploitation of data and information from earth surface (geospatial data/information) applied in forestry (GIS, remote sensing, terrestrial data collection with specific advanced devices).

*The team main achievements* during 2007-2011 have been:

**Using GIS in forestry:** i) methodology for forest habitats mapping, geospatial database (GDB) building and validation by field GPS measurements; ii) forest management raster maps GDB of the national district units; iii) GDB of the forest management units located into Natura 2000 sites (Sites of Community Interest and Special Protected Areas) and natural reserves; iv) GDB and digital maps of black locust and tilia species distribution, located in Southern and South-Western of Muntenia Region; v) GDB and digital maps of the provenance regions for basic materials for forest reproductive materials; vi) GDB and digital maps of *in situ* and *ex situ* conserved forest genetic resources; vii) design and production of GDB template and the user guide for protected areas of Romania; GDB of hiking paths and touristic objective for Bucegi mountains.

**Remote sensing and digital photogrammetry applied in forestry:** viii) methodology to correct forest management basic maps using very high resolution imagery and raster scanned maps; ix) detection and effect evaluation of areas affected by forest windthrow using multi-temporal satellite imagery methodology; x) methodology to collect biometrics data of the trees and stands using photogrammetry and intensive ground measurements with integrated device; xi) land cover classification and segmentation methodology of the satellite images using object classification oriented software; xii) methodology for automatic extraction in vector format of sea coast line from medium spatial resolution satellite imagery and put into evidence coast line variation over time; xiii) methodology for digital terrain model (DTM) and digital surface/canopy model (DSM/DCM) extraction by ALS\* eco classification; xiv) methodology for determining biometric characteristics of trees and forest stands using ALS data; xv) methodology to calculate the stand volume and biomass using statistical inventory and ALS data;

**Terrestrial measurements and data collection:** xvi) mapping methodology and update forest limits by the use of GPS field measurements and differential correction; xvii) methodology for GPS post-processing data to increase position accuracy, including under trees canopy; xviii) methodology to estimate position accuracy of ALS data of forest vegetation cover.

*Publications.* During 2007-2011 two papers were sent to ISI indexed magazines, one was published and the other is in process of the second review. 14 papers were published in non-ISI ranked magazines or proceedings where one or more team members were co-authors. From these 7 were published abroad. Also 6 books were published where one, or more, member(s) of the team is/are co-author(s).

*Dissemination.* Team members have participated to six work-shops/conferences from which four international and one with international participation, where team achievements were presented.

Also, team members have organized two work-shops from which one was with international participation.

Several team members were awarded with the General Association of Engineers of Romanian prize for digital map (and geospatial database) of "Forest Map of Romania based on forest ecosystem types"

*Projects.* The team has been involved within 51 projects from which 40 projects team members were project leader and for 10 projects team members were project responsible (on ICAS behalf). One of the projects was bi-lateral co-operation (Romania- Flemish region, Belgium). Within 2 projects (FP6 and Life Nature) team was involved as GIS/remote sensing support. From

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\* ALS – Airborne LIDAR (LIght Detection And Ranging) Scanner

these 35 were contracts for geospatial database building and digital and paper maps product for different forest districts granted by Forest National Administration (RNP-Romsilva)

These projects have a cumulative budget of approximate 1,553,000 Euros.

Two new projects proposals, within consortia, were submitted to ANCS (Romanian National Authority for Scientific Research) for 2011 competition and there is a proposal submitted by University of Wisconsin-Madison to NASA-Land Use and Land Cover Program where one of the team member is within the project team.

## **2. Dynamics of research subjects and directions**

The main goal of the team is to implement geomatics specific technology in day by day activity in Romanian forestry and to offer specific support to different projects of ICAS. The research subjects approached in the last years or planned for near future could be grouped into following main directions which are interleaved and mutually supported:

- Methodological research concerning use of Geographic Information System (GIS) into forestry and forest economy. Within this activity are included: design and building the geospatial databases according with the purpose, within forestry and environment protection and filling out the geospatial databases from different sources, (paper maps, satellite and aerial imagery, terrain data, alphanumeric data, etc.); exploitation of the geospatial databases using GIS analyze, building digital and paper maps, synthesis, tables and graphs, and combinations of all these, etc.; building and exploitation of the digital elevation models (DEM), digital surface models (DSM), etc.;

- Methodological researches concerning use of remote sensing and digital photogrammetry in forestry and forest economy, including processing, analyze and interpretation of the remote sensing (satellite-borne, airborne) optical imagery, radar and ALS datasets for various aims; production of digital products and hardcopy based on satellite and aerial imagery (orthophotomaps, 3D products, etc.) useable for forestry purposes; designing technologies, procedures and methods based on geomatics technologies aiming to offer forestry modern instruments to collect/up-date data and information, both for research and development projects and to be used into common practice (i.e. in forest management planning, forest cadastre, etc.);

- Methodological researches concerning use of modern terrestrial measurement, mainly GPS, within forestry and forest economy. This include intensive in situ measurements of sampling plots with specific devices (i.e. FieldMap) and design of necessary procedures and methods;

- Bibliographical research to keep ourselves up-date with geomatics technology state of the art and opening new ways to use these technologies within Romanian forestry;

- Activities aiming to put into practice geomatics technology, not only from technical point of view but also up-dating the rules, legislation and procedures, according with new technologies. Public and forestry specialist awareness, dissemination of these technologies and results on the Internet and watching to put into practice INSPIRE/INIS initiative within Romanian forestry;

**3. Interdisciplinary initiatives.** The whole activity and researches performed by geomatics team are, by essence, interdisciplinary as can be seen above. The new approaches and initiatives for interdisciplinary research are:

- Using ALS technology to obtain accurate DTM and DSM and measure biometrics characteristics of the trees and tree stands, for torrential watershed management and correction design, for forest roads design, etc.;

- Using digital photogrammetry, based on both airborne and satellite-borne imagery to realize new products useful in forestry (orthophotomaps, DTM, 3D models, etc.);

- Use of object-oriented classification of the remote sensing imagery, including data fusion from other different sources;

- Intensive exploitation of freeware satellite imagery distributed by USGS and ESA;

- Applying GNSS technologies to increase accuracy measurements for forestry (i.e. to meet forestry cadastre requirements);



- Applying geomatics technologies to increase the efficiency of the protected area management and forestry administration;
- Applying geomatics technologies in environment protection and environment degradation mitigation;
- Applying geomatics technologies to design shelter belts and agro-forest systems;
- Applying geomatics technologies in emergency situation and hazard maps/database building for forest found of the anthropogenic, biological and hydro-meteorological factors;
- Use of remote sensing satellite-borne SAR\* data in forestry.

**4. Human resources.** The research team has 12 persons from which 11 with university degree. 5 members are researchers, 2 of them are PhD and 2 are PhD students. 2 are experienced researchers (CSII and CSIII) and 3 are young researchers (CS and ACS). Also there are technological development engineers (3 persons) and 1 technician. 4 persons are non-R&D staff involved into geospatial databases production.

During 2007-2011 two young researches join the team, and another one leave the team. One non-R&D staff has join the team during last four years

One of the team members finish his PhD studies and achieve the PhD title. Another member becomes PhD student.

Two members of the research team teach to the University of Agriculture and Veterinary Medicine, Faculty of Agriculture, Forestry specialization, one as chief lecturer (topography, remote sensing and GIS) and other as university assistant (topography).

All team members have been specialized during training courses and/or summer schools in GIS, remote sensing, digital photogrammetry, etc.

Generally, the team has grown and is stable with good team spirit and commitment.

**5. Infrastructure.** The forestry geomatics team has state of the art equipment purchased from own efforts from research projects budget and ICAS investments.

The main hardware equipment is computers network made from 14 desktop graphic workstations (Windows XP/7) and a data server. All are equipped with high performance processors, graphic cards and wide monitors. There is also a 3D visualization device. Within the network are connected specific peripherals: A0+ format cartographic scanner, A0 format plotter, printers, external hard-disks, etc. There are also six portable computers for field work.

For terrain data collection there are GPS professional receivers (Trimble) with state of the art performances and specific accessories (including a external „Zephir” antenna). Field collection data equipment includes a FieldMap device for intensive field sampling plot measurements, inventory, mapping and navigation, which includes forestry professional GIS-ready software and rugged equipment (integrated field computer, GPS, electronic compass, laser rangefinder and inclinometer, vertex, electronic calliper). The team has also an automobile laboratory (4x4 vehicle).

Software include GIS systems (ArcGIS 9.x – 10 licenses), remote sensing imagery processing (ERDAS Imagine 9.x, ERDAS Imagine Analyses, Definiens’s Developer 7.0), digital photogrammetry (Leica Photogrammetry Suite Core), ALS (LIDAR) data processing (QCoherent LP360), GPS data collection (Trimble’s Terrasync) and post-processing GPS data (Trimble’s PathFinder Office). Also the team has other auxiliary equipment (digital cameras, flash memories, video projector, walky-talkies, personal terrain equipment, etc.)

On the geospatial data server is stored a large collection of aerial and satellite imagery, scanned topographic maps and forestry management maps covering whole country. There are also many vectorial data, covering at national level different layers like administrative units, towns and villages, roads, waters, soils, land cover, forest ecosystems, protected areas, etc. The GIS database of the administrative units created for forest management purpose is also available. There is also a very detailed geospatial database of a great number of forest districts based on 1:5,000 scale maps.

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\* SAR – Synthetic Aperture Radar: airborne or satellite-borne RADAR used to collect specific geospatial information

## **2.4 Representative major project**

### ***SUSTAINABLE MANAGEMENT OF FOREST ECOSYSTEMS IN THE CONTEXT OF GLOBAL CHANGES – GEDEFOR***

#### **1. Concept framework**

In order to implement the National Strategy for research - development and innovation (RDI) for the period 2007-2013, one of the main tools used to achieve its objectives was the setting up of core - programs for research, defined as specific programs of each research institutes in the Research – Development System of national interest, developed annual and multi-annual periods.

The main objectives of the national strategy for CDI, defined by OG 57/2002 on scientific research and technological development which were used to achieve the core - programs for research are:

- a) promote and develop national research - development system to support the country's economic and social development and knowledge;
- b) integration into the international scientific community;
- c) protection of technical and scientific Romanian Scientific patrimony;
- d) development of human resources within the research – development activities;
- e) development of materials basis and funding of research activities.

The way of development and structure of the core - programs for research, of assessment and approval, contracting, and monitoring of their funding was provided in specific norms, approved by Government Decision No. 137 / 2003.

In this context, the Forest Research and Management Institute (ICAS), as a component of System Research - Development institution of national interest, with the role to develop forest science and technology in order to increase the competitiveness of Romanian forestry and improve the quality of social life, in early 2009 designed and developed a proposal for multiannual core program (2009-2011) domain specific activity with respect to a mandatory frame structure:

- the scope of the core program
- the duration of the program
- the objectives and the projects, listed in priority order
- the estimated results of the projects proposed
- the human resources and necessary materials.

Hence, the program proposed, conceived and elaborated by the Forest Research and Management Institute (ICAS), entitled “Sustainable management of forest ecosystems in the context of global changes” was launched at the occasion of the competition organized by the National Research Authority (Autoritatea Națională pentru Cercetare Științifică - ANCS) and evaluated based on the criteria described in HG 137/2003.

Following the evaluation, Core-Program GEDEFOR was approved by ANCS, contracted and funded during 2009-2011, according to the budget to fund these core programs set by the annual state budget law.

#### **2. Core-Program GEDEFOR development**

In line with the main objectives of the national strategy for Research - Development and Innovation for the period 2007 – 2011, with the Strategy for Sustainable Forestry Development in Romania for the period 2001 - 2010, with the Strategic Research Agenda for Competitiveness, Innovation and Quality of Life, developed under Forest Technology Platform, the EU forestry strategy, forestry Action Plan of the EU, the provisions of the Ministerial Conferences on the Protection of Forests in Europe (Strasbourg, 1990, Helsinki 1993, Lisbon, 1998, Vienna, 2003, Warsaw, 2008), the program objectives framework EU Research (FP7), the objectives of LIFE + the European Commission (Regulation 614/2008), ICAS has defined the scope, key objectives and other elements of structure - framework of the core-program (GEDEFOR), and established the list of project components required to meet these objectives.

## **2.1 The scope of the Core – Program GEDEFOR**

The scope of the program was to substantiate the proposed core measures of sustainable forest management on the basis of the knowledge and the assessment of the effects of global changes on forest ecosystems, aiming to help conserving and enhance the biodiversity and productive and protection potentials of forests.

## **2.2 Objectives of the Core - Program GEDEFOR**

The core program proposed is multidisciplinary and it integrates researches involving scientific and technological development not addressed in the branch programs.

The main objectives proposed were:

i). *Sustainable production and management of forest resources. Evaluation and analysis of the effects of environmental changes and socio-economic conditions on forest ecosystems and their mitigation.*

ii). *Conservation and improvement of forests biodiversity, of their productive potential, protection and landscape potential.*

iii). *Substantiation and promotion of agrosystems, special crops for biomass / energy and other non-wood purpose. Increase the contribution of forestry to rural development and environmental protection.*

Under each of the main objectives was also established a list of secondary objectives for the execution of which were proposed specific research projects listed in order of priority.

Thus, within the first objective (i) were proposed 9 research projects, under the second objective (ii) 7 projects, and in the third objective (iii) 9 projects, for a total of 25 research projects.

## **2.3 Estimated results of the projects within the program**

By the research projects component of Core - Program GEDEFOR was estimated that the results are embodied in studies, plans, databases, networks, technologies, methods, models, processes and techniques with particular reference to:

- Integrated studies and network of monitoring of forest ecosystems status under climate change action and other risk factors;
- Specific models for determining the carbon stock in forest biomass;
- ALS (Airborne LIDAR Scanner) data processing methods for biometric characterization of trees;
- New methods, improved, based on appropriate measures to combat forest pests and diseases, to prevent growth losses caused by them and ecological reconstruction measures of affected stands;
- Specific technologies for ecological restoration of degraded lands outside the forest;
- Studies and database on the diversity and genetic vulnerability;
- Studies and databases on the state of hydrotechniques builds used for controlling torrents;
- Eco-ethology studies on large carnivores and technology intensive growing of common deer and aquaculture.

## **2.4 Human resources and material needed**

During the period of implementation of the Core - Programme GEDEFOR (2009-2011), was proposed the development of critical mass of specialists in research and development by attracting young researchers, graduates of doctoral schools, increasing the number of PhD students and PhDs in science and reducing the average age below 45 years.

It was also proposed that during this period to increase the access of ICAS specialists to performance research infrastructure at national and international, acquisition of field equipments and laboratory equipments in areas of biometry, forest growth, ecology, monitoring of forest ecosystems, forest genetics, hunting and fisheries, forest protection and forest mapping. However, it was intended to increase the performance and competitiveness of the human scientific potential.

### 3. Core - Program GEDEFOR implementation

The total amount of the Core - Program GEDEFOR for the 25 research projects proposed for completion was 7.5 million euros, of which 2.2 million Euro in 2009, 2.7 in 2010 and 2.6 in 2011.

Based on the values approved by the annual state budget law, by the core programs, the state Authority for research - development (ANCS) has allocated for Core – Program GEDEFOR a total of 4.8 million euros, of which, 1.5 million Euro in the first year, second year 1.6 million Euro and in 2011 a value of 1.7 million Euro.

In this period were fully funded and conducted 15 research projects, one under each of five objectives of the program, annual funding being split in two stages with the exception of 2011, when it performed in three stages.

The projects funded in this period are the followings:

- **PN 09460101:** Effects of atmospheric pollution and of climate changes on the state of forest ecosystems in Retezat National Park
- **PN 09460102:** State and evolution of forest ecosystems under air pollution
- **PN 09460103:** Analysis of factors that drive emission and absorption of greenhouse gases of the forest sector
- **PN 09460104:** Use of geomatic technology (remote sensing, digital photogrammetry, GIS) for the study and the sustainable management of forest ecosystems
- **PN 09460108:** Integrated monitoring of growth processes in Eastern Carpathians within the context of climate changes
- **PN 09460201:** Dynamic and control of pest insect populations in forest ecosystems in the context of climate changes
- **PN 09460202:** Evaluation, management and monitoring of the genetic diversity of orchards and the genetic resource constituted “in situ” using molecular genetic markers
- **PN 09460203:** Evaluation of biodiversity on representative protected forest areas, as a mark for sustainable management of the cultivated forests.
- **PN 09460204:** Monitoring, prevention and fighting against the invasive forest diseases that destabilize the forest ecosystem
- **PN 09460207:** Study of the genetic variability of the following species: packed-crown spruce, oak, Hungarian oak, common beech tested on multiple site types within the context of global changes
- **PN 09460301:** Environment protection on zones with high risks of degradation (outside forest fund) by forest vegetation settlement
- **PN 09460303 :** Performance during exploitation of different hydrotechnical builds used for the torrential watershed planning
- **PN 09460305:** Eco-ethological researches concerning the large carnivores for the establishment of an ecological national network, within the context of European infrastructure development in Romania
- **PN 09460305:** Studies of population ecology and elaboration of intensive and extensive technology of grayling fish (*Thymallus thymallus* L.) for reproduction and consumption
- **PN 09460308:** Development of game farm and rural territorial communities game farm complex

Designed primarily to support human resource capacity, maintenance and operation of maintenance research - development of ICAS, the Core - Program GEDEFOR, the largest share of spending was focused on direct costs (75.6%), which mainly comprise costs to wages (61.6% of the total program value). Overheads costs accounted for 15.2%, and the equipment was made 9.2% of the total value of the Core - Program.

The project execution phases of the Core – Program GEDEFOR were developed according to their achievement schemes set out in the contract, paying also attention to the phase objectives and expected results in the development proposals. It also made every year an annual report on activities carried out under ICAS - GEDEFOR core, which was evaluated, reviewed and approved

by the Food and Agriculture Committee Advisory Board of the National Authority for Scientific Research (ANCS). These annual reports have highlighted the main list of projects funded in that year, the structure of expenditure for the entire core - program , the analysis stage of the program objectives and expected results including preliminary results and dissemination aspects of their recovery.

#### **4. Core - Program GEDEFOR completion and promotion**

With the completion of the Core - Program GEDEFOR, in 2011, a report was completed for each project, which highlighted the specific type of result (study, methodology, technology, networks, databases, etc.), the performance achieved, estimates of the results of the innovations, acquisitions, etc.. Based on these reports and their contents was prepared the report of the entire program - implemented by ICAS during the years 2009 to 2011. Therefore, scientific results have been embodied in the studies (12) technology (3) and new methodologies (1).

Within the studies undergone were settled permanent networks of integrated monitoring of forest ecosystems state under climate change influence and other risk factors, and a network of forest biodiversity monitoring in protected areas., Specific models to determine carbon stock in forest biomass were also developed, modern methods of using LIDAR data in the estimation of stand characteristics and methods of growth losses prevention to increase mortality based on adequate forest pests and diseases of ecological restoration, the management and monitoring of genetic diversity and variability. Descriptive databases were constructed, spatial and thematic maps, which constitute inter-and multidisciplinary informational infrastructures particularly valuable for the development of decision-level reports, or as background in forestry strategies and integration into new projects designed in partnership nationally and internationally. Technologies and methodologies of specific ecological restoration of degraded lands, monitoring hydrotechnical builds used in correcting torrents and intensive growing of large game and salmonids.

Scientific results that contain elements novelty at national and international level were materialized by 46 publications, of which 13 abroad and 33 in the country, as well as 52 scientific presentations at different conferences, of which 30 abroad and 22 in the country. The number of ISI publications was 8 and 7 of nonzero relative influence score.

The researches conducted with the projects, by their problematic, their preliminary scientific results and their dissemination through publication and presentation in symposia, conferences and national and international congresses, resulted the integration of ICAS in 10 projects with international financing (FP7, FP6, LIFE +) and the participation in national and international consortia to develop proposals in FP7 of EU and European Commission LIFE + Programme (4) and Partnerships Program of ANCS (15).

A considerable part of the scientific results of research activity - development carried out under the Core - Program GEDEFOR were transferred to beneficiaries (state authorities for forestry, environment and agriculture, forest managers, managers of protected forest areas, owners of forests, etc.).

In the period of the Core - Program GEDEFOR the number of specialists who obtained a Ph.D. title was 11 and the number of Ph.D students increased with 18. Number of young researchers employed in the institute during this period (2009 - 2011) was 127.

In terms of research infrastructure, the budget of the Core Program (4.8 million), which amounted to approximately Euro 0.5 million and consisted of field equipment for each specific issues addressed (biometry, forest growth, ecology, monitoring, records of climate and pollution data, etc.), laboratory instruments on aspects of molecular genetics, chemical analysis of soil filters pollutants, deposition / etc foliar analysis., which contributed to the development of materials ICAS research.

#### **5. Conclusions**

- The funding of the Core - Program GEDEFOR had as main objective the strengthening of the scientific and technological competence in forestry, as a fields of national interest, according to Romania's development strategy.

- During its execution, the Core - Program GEDEFOR had a substantial contribution to the support of the human resources capacity, maintenance and operation of maintenance research – development in ICAS.

- The research conducted in the project components have contributed to the scientific performance and resource development by increasing the contribution of specialists from all fields of competence of the ICAS program objectives, to attract young researchers.

- By addressing issues within the diverse projects of the Core - Program GEDEFOR components, new research subjects were identified, which resulted in substantiating the possibility of a large number of projects that were submitted in open competition at both the ideas and the Partnerships programs launched by the research authority ANCS.

- The scientific human potential, the research and development infrastructure, particularly research networks and databases created, the results obtained in the Core - Program GEDEFOR, the institute ICAS contributed to attracting international partnerships to achieve some international proposals FP7 EU, European Commission LIFE + etc.