IUFRO CONFERENCE

"POPULATION DYNAMICS AND INTEGRATED CONTROL OF FOREST DEFOLIATING AND OTHER INSECTS"

—— BOOK OF ABSTRACTS ——

IUFRO WP 7.03.07 "Population Dynamics of Forest Insects",
IUFRO WP 7.03.06 "Integrated management of forest defoliating insects",
IUFRO WP 7.03.13 "Biological control of forest insects and pathogens"
&
Forest Research Institute in Sękocin Stary, Poland
Regional Directorate of State Forests in Gdańsk, Poland

UNDER THE HONORARY PATRONAGE OF THE MINISTRY OF ENVIRONMENT

September 28 – October 2, 2015
Sopot (Poland)

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Have a nice conference and enjoy your stay in hospitable Sopot!
With our best wishes,

Organizing Committee:

Richard Fleming / Lidia Sukovata / Natalia Kirichenko – coordinators IUFRO WP 7.03.07
Marc Kenis / Joseph Elkinton / Brett Hurley – coordinators IUFRO WP 7.03.13
Andrea Battisti / Manuela Branco / Michael L. McManus– coordinators IUFRO WP 7.03.06
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Janusz Czerepko – Forest Research Institute in Sękocin Stary

AGENDA

Important notes:

- The main conference venue is the Hotel Haffner.
- All scientific sessions (except poster session) will be held in the conference room "Gdańsk" located at the ground floor in the Conference Center.
- Poster session will be held in the conference room "Morska" located at the ground floor in the Conference Center. Please, leave your posters with any supplementary materials at the registration desk. They will be mounted by the hotel staff. Each presenter will have 3 minutes to shortly describe the main idea of the poster. Posters should be removed by the participants on Friday, October 2, during coffee or lunch break.
- All meals, except the Conference dinner, will be served at the hotel restaurant located at the ground floor.
- Conference dinner will be served in the joined conference rooms "Gdynia" and "Sopot" located in the Conference Center.
- Coffee breaks will be served in the foyer of the Conference Center (close to the conference room).
- Accompanying persons are welcome to *Welcome dinner* on September 28, *Conference dinner* on September 29, and to *the field trip* on September 30.

Monday, September 28, 2015

Arrival

13:00-19:00 Registration of participants (Concierge desk vis-à-vis Reception)

19:00 *Welcome Dinner*

Tuesday, September 29, 2015

8:00-9:00 Registration of participants (Concierge desk vis-à-vis Reception)

09:00 – 09:50 Welcome and Introduction (Moderator – Lidia Sukovata)

Hilszczański Jacek, Vice-director for Scientific and Research Affairs at the Forest Research Institute – *welcome address*

Szramka Jan, Director of the Regional Directorate of State Forests in Gdańsk – *welcome address and short presentation*

Jactel Hervé, Deputy Coordinator of IUFRO Division 07.03.00 "Entomology" and IUFRO Task Force Coordinator – *welcome address and overview of Division activities*

Sukovata Lidia, Deputy Coordinator of IUFRO WP 7.03.07 "Population dynamics of forest insects", local organizer – *organizational announcements*

09:50 – 10:20 *Coffee Break*

10:20 – 12:00 Scientific session 1 "*Population dynamics of forest insects*", part I (Moderator – Tea Ammunét)

10:20 Battisti Andrea & Branco M. *Pine processionary moth population dynamics: a review*

10:40 Vogt-Altena Holger, Thies C. & A.I.M – Arnold. *Modelling Oak Processionary Moth – the MOPM project*

11:00 Fleming Richard A. & Candau J.-N. *Developing theories of insect population dynamics – the spruce budworm as a case study*

11:20 Schafellner C, Marschnig M., Schebeck M., Andrae A., Reichert C, Wegensteiner R., Petercord R. & Schopf Axel. *Outbreaks of the mountain spruce sawfly, Pachynematus montanus, caused by phenological shifts in host tree-herbivore interaction*

11:40 Økland Bjørn, Nikolov C., Krokene P. & Vakula J. *Ips typographus – the transition from windthrow to patch-driven outbreak dynamics*

12:00 – 13:10 *Lunch*

13:10 – 14:50 Scientific session 2 "*Population dynamics of forest insects*", part II (Moderator – Yuri Baranchikov)

13:10 Ammunét Tea & Bylund H. *Dynamics of coexistence - cyclic moths in perspective*

13:30 Halbig Paula, Delb H., Schumacher J. & Schopf A. *Model based risk assessment of oak processionary moth*

13:50 Salman Md Habibur Rahman, Hellrigl K., Minerbi S. & Battisti A. *Prolonged pupal diapause drives the population dynamics of pine processionary moth (Thaumetopoea pityocampa) in an outbreak expansion area*

14:10 Sukovata Lidia. *Dependence of the Lymantria monacha outbreak onset on the weather conditions in different regions of Poland: are there any patterns?*

14:30 Fält-Nardmann Julia, Leinonen R., Ruohomäki K., Saikkonen K., Tikkanen O.-P. & Neuvonen S. *The recent northward expansion of Lymantria monacha in Finland*

14:50 – 15:20 *Coffee Break*

15:20-17:00 Scientific session 3 "*Box tree moth – a new destructive pest in Europe*" (Moderator – Marc Kenis)

15:20 Kenis Marc. *Population dynamics and biological control of the box tree moth, Cydalima perspectalis*

15:40 Chatzidimitriou Evangelia & Pellizzari G. *First data on Cydalima perspectalis in Veneto region (north-eastern Italy)*

16:00 Herz Annette & Göttig S. *Eco-friendly regulation of the box tree pyralid Cydalima perspectalis*

16:20 Tabone Elisabeth, Enriquez T., Venard M., Colombel E., Gutleben C., Guérin M., Robert F., Lacordaire A.-I. & Martin J.C. *Development of a biocontrol program against the Box Tree Moth Cydalima perspectalis (Walker, 1859)*

16:40 General discussion on a global strategy against the box tree moth in Europe

17:00 – 18:40 Scientific session 4 – Poster presentations (3 minutes for a short description of the poster by each participant) (Moderator – Rudolf Wegensteiner)

Adjami Yasmine, Sedira K., Ghalem R., Mechri H., Ouakid M.L. & Pujade-Villar J. *Diversity of Coleoptera associated with Quercus suber in cork forests, North-East Algeria*

Benfekih Leïla, Karkar A. & Essaïdi K.B. *Specific diversity and spatial distribution of Coleoptera (Insecta) in the Beni Ali Forests of the National Park of Chrea (Blidean Atlas, Algeria)*

Berger G., Czarnoczka K., Nowakowska Justyna A., Cochard B., Oszako T. & Lefor F. *Biological and chemical endotherapy against Phytophthora species pathogenic to broadleaved tree species in Poland*

Bras A., Vetek G., Matosevic D., Chatzidimitriou E., Shurov V., Gomboc S., Glavendekić M., Göttig S., Herz A., Ivanova I., Seljak G., Tuba K., Roques A., Li H., Kenis Marc & Auger-Rozenberg M.-A. *Genetic diversity of the invasive box tree moth, Cydalima perspectalis, in its native and invaded areas and preliminary phylogeographic approach*

Cambron-Sandoval Victor Hugo, Garcia-Rubio O. R. & Luna-Soria H. *Bark beetle distribution in relation to climate variability and other factors in Mexican threatened forests*

Galko Juraj, Kimoto T., Rell S., Jendek E., Nikolov C., Gubka A., Vakula J., Kunca A. & Zúbrik M. *Use of the panel prism traps for the monitoring of the genus Agrilus in Slovakia*

Ghalem Rym, Mechri H., Adjami Y. & Ouakid M.L. *The fauna of Aleppo pine cones collected in the forests of north eastern Algeria*

Glavendekić Milka. *Box tree moth Cydalima perspectalis (Walk.): distribution, impact and pest management in Serbia*

Göttig Stefanie & Herz A. *Observations on the flight phenology and biological characteristics of the box-tree moth Cydalima perspectalis with light and pheromone traps*

Habbachi Wafa, Masna F., Ouakid M.L. & Farine J.-P. *Entomological biodiversity in semi-arid Algerian forests: the case of bio-indicator Blattellidae in pinewood*

Ipekdal Kahraman, Pamuk P., Emin A., Koçluk M., Kuzucu A.Ş. & Aksu Y. *Recent invasion of the chestnuts in western Turkey by the chestnut gall wasp, Dryocosmus kuriphilus,and early management practices by using the parasitoid wasp, Torymus sinensis*

Jagiełło Radosław & Giertych M.J. *Monitoring method of damage dynamics caused by Cameraria ohridella and Guignardia aesculi on young trees of Aesculus hippocastanum*

Carleton D., Johns Rob, Pureswaran D., Bourassa S., Martel V., MvQuarrie C., James P., De Grandpre L. & DeMerchant I. *Budworm Tracker: Harnessing citizen scientists to monitor spruce budworm*

Kereselidze M., Linde Andreas & Beruashvili M. *Comparison of the virulence of two Isaria fumosorosea Wize strains for Hyphantria cunea Drury (Lepidoptera, Arctiidae)*

Łukowski Adrian, Giertych M.J. & Karolewski P. *The influence of adult age on sex ratio in the flea beetle, Altica brevicollis coryletorum - a pest of Corylus avellana*

Nikolov Christo, Kajba M., Dubec M., Zúbrik M., Galko J., Vakula J., Gubka A., Rell S. & Kunca A. *Monitoring of the most harmful pests in forests of Slovakia using Web GIS application*

Ouakid Mohamed Laid, Adjami Y., Ghalem R., Habbachi W. & Sedira K. *Effect of health status of cork oak leaves on their content of allelochemicals compounds*

Özcan Gonca Ece, Akinci H.A. & Erğlu M. *Evaluating of four-year laboratory rearings of Rhizophagus grandis Gyll. in oriental spruce fresh logs*

Pasche S., Crovadore J., Pelleteret P., Jermini M., Mauch-Mani B., Nowakowska Justyna A. & Lefort F. *First trials of pathogens cleansing with Bacillus amyloliquefaciens and Trichoderma atroviride to remove opportunistic pathogens in trees*

Petrucco-Toffolo Edoardo, Faccoli M. & Battisti A. *Interactions between poplar and native and non-native defoliating insects*

Pralon T., Nowakowska Justyna A., Oszako T., Crovadore J. & Lefort F. *Selection of biological control agents against Phytophthora and Pythium species pathogenic of forest trees in Poland*

Sierpińska Alicja, Tarwacki G., Bystrowski C. & Sierpiński A. *Changes in populations densities of Melolontha spp. (Coleoptera: Scarabeidae) in central Poland stands under different sylvicultural management*

Skrzecz Iwona, Wolski R., Sowińska A. & Lipiński S. *The experiments with attractants in baited pitfall traps for control of Pissodes castaneus*

Supatashvili Archil, Burjanadze Manana & Lortkipanidze M. *Influence of ecological factors on the formation of nematode fauna of bark beetles (Coleoptera: Scolitidae)*

19:00 *Conference Dinner*

Wednesday, September 30, 2015

09:00-21:00 Field trip – organized and sponsored by the Regional Directorate of State Forests in Gdańsk (*meals are included; group photograph of participants will be taken during the field trip*)

Thursday, October 1, 2015

09:00 – 10:20 Scientific session 5 "*Impacts of forest insect pests*"
(Moderator – Deepa Pureswaran)

09:00 Grüning Maren, Zeller B., Simon J., Thies C., Lasch P., Reinhard A. & le Mellec-Arnold A. *Insect mass outbreaks affect the C, N and P balance in forest ecosystems*

09:20 Bisirova Elvina. *The rate of degradation in forest stands of the Siberian fir in the outbreak foci of the four-eyed fir bark beetle Polygraphus proximus Blandf. (Coleoptera, Curculionidae: Scolytinae) in Western Siberia*

09:40 Bisirova Elvina, Chernova N. & Pats E. *Transformation of fir forests in the outbreak foci of Polygraphus proximus Blandf. (Coleoptera, Curculionidae: Scolytinae) in Western Siberia*

10:00 Blomqvist Minna, Lyytikäinen-Saarenmaa P., Kantola T., Talvitie M., Kosunen M. & Holopainen M. *The effect of defoliation caused by the common pine sawfly to tree growth*

10:20 – 10:50 *Coffee Break*

10:50 – 12:50 Scientific session 6 "*Management of forest insects*"
(Moderator – Brett Hurley)

10:50 Delb Horst, Henke L., Nakou A. & Wagenhoff E. *Population dynamics and control of Melolontha hippocastani in South-West Germany*

11:10 Pureswaran Deepa, De Grandpré L., Johns R., Bourassa S., Boulanger Y. & Kneeshaw D. *Managing range expansion and spread of outbreaks - climate, dispersal and population growth of eastern spruce budworm*

11:30 Johns Rob C., Martel V. & Pureswaran D. *Spruce budworm 'Early intervention strategy' in Atlantic Canada: translating theory into practice*

11:50 Klapwijk Maartje J., Bylund H., Schroeder M. & Björkman C. *Forest management strategy affects the relative impact of bottom-up versus top-down pressure on populations of forest insects*

12:10 Guyot V., Castagneyrol B., Deconchat M., Vialatte A. & Jactel Hervé. *Tree diversity improves forest resistance to insect defoliators*

12:30 Meurisse Nicolas & Pawson S. *Phytosanitary management for export pine logs in New Zealand: modelling woody debris as potential habitats for bark beetles and wood borers*

12:50 – 14:00 *Lunch*

14:00 – 15:40 Session 7 "*Biological control of forest pests*", part I
(Moderator – Nicolas Meurisse)

14:00 Hurley Brett P., Slippers B., Garnas J. & Wingfield M.J. *Biological control of eucalypt pests: successes, challenges and opportunities*

14:20 Georgi Richard & Müller M. *Biological control of the red poplar leaf beetle in poplar short-rotation coppices (SRC)*

14:40 Wegensteiner Rudolf, Kölmel I. & Tkaczuk C. *Are entomopathogenic fungi effective against Hylobius abietis (Col., Curculionidae)?*

15:00 Glavendekić Milka. *Natural enemies of Lymantria dispar in the regression phase of outbreak in Serbia*

15:20 Siliņš Ingars, Jansons Ā. & Šmits A. *The role of bud burst phenology in parasitism of gypsy moth Lymantria dispar*

15:40 – 16:10 *Coffee Break*

16:10 – 16:40 Business meeting (all participants are welcome**)**

16:40 – 18:20 Session 8 "*Biological control of forest pests*", part II
(Moderator – Natalia Kirichenko)

16:40 Colombari Fernanda & Battisti A. *'By flight or by wind? Spread of the introduced biocontrol agent Torymus sinensis in north-eastern Italy*

17:00 Liman A.-S. & Björkman Christer. *Predator refuges for conservation biological control*
in willow plantations: the rise and fall of a simple solution

17:20 Krivets Svetlana A. & Kerchev I.A. *Natural enemies and fungal pathogens of the four-eyed fir bark beetle Polygraphus proximus Blandford (Coleoptera, Curculionidae: Scolytinae) in the West Siberian Region of invasion*

17:40 Burjanadze Medea, Gaganidze G., Arjevanidze M., Nakaidze E. & Tsereteli G. *Pathogens occurrences in the mottled umber moth - Erannis defoliaria Clerrck in Georgia*

18:00 El Meddah S., Benfekih Leïla, Ammad-Sahraoui F., Outtar F. & Essaïdi K.B. *Evaluation of the potential for utilizing entomopathogens as a component of an integrated pest management against sucking and defoliating insect pests of pine forests in Algeria*

18:20 *Free evening*

Friday, October 2, 2015

09:00 – 10:40 Scientific session 9 "*Ecology of forest insect populations*", part I (Moderator – Milka Glavendekić)

09:00 Niemczyk Marzena, Ukalska J., Ukalski K. & Mionskowski M. *Influence of environmental factors and control methods on density of cockchafers (Melolontha spp.) population*

09:20 Ciesla William M., Halford M. & West D. *The pine sawfly, Neodiprion autumnalis, in Colorado*

09:40 Kosunen Maiju, Kantola T., Starr M., Blomqvist M., Talvitie M. & Lyytikäinen-Saarenmaa P. *Effect of soil and topography on the defoliation by the common pine sawfly (Diprion pini L.)*

10:00 Zalucki Myron P. *Bag shelter moth biology and ecology: the species down-under*

10:20 Kirichenko Natalia, Triberti P., Augustin S., Roques A. & Lopez-Vaamonde C. *Genetic diversity of the highly invasive lime leaf miner in Eurasia: where do invasive haplotypes come from?*

10:40 – 11:10 *Coffee Break (along with poster removal)*

11:10 - 12:50 Scientific session 10 "*Ecology of forest insect populations*", part II (Moderator – Andrea Battisti)

11:10 Baranchikov Yuri, Demidko D., Laptev A. & Petko V. *Dynamics of invasive bark beetle local population in fir forest of Southern Siberia: half-century retrospective evaluation*

11:30 Schroeder Martin, Kärvemo S. & Knape J. *Factors affecting the colonization density and reproductive success of the Eurasian spruce bark beetle (Ips typographus) during an outbreak*

11:50 Bylund Helena & Ranius T. *Is the risk of seedling damage by pine weevils in forest regenerations related to forest management in the surrounding landscape?*

12:10 Kantola Tuula, Lyytikäinen-Saarenmaa P., Tracy J.L., Saarenmaa H., Coulson R.N. & Holopainen M. *Potential distribution of hemlock woolly adelgid in North America under changing climate*

12:30 İpekdal Kahraman, Burban C., Sauné L., Kaya T. & Kerdelhué C. *Testing mito-nuclear discordance and Wolbachia hypothesis in a processionary moth contact zone*

12:50 – 13:05 Closing Remarks

13:05 – 14:15 *Lunch (along with poster removal)*

14:15 Departure

ORAL PRESENTATIONS

PINE PROCESSIONARY MOTH POPULATION DYNAMICS: A REVIEW

Andrea Battisti[1] & Manuela Branco[2]

[1]*University of Padova, Italy;* [2]*University of Lisbon, Portugal;* andrea.battisti@unipd.it

Understanding the factors driving the population dynamics of herbivorous insects is of critical importance in the case of dangerous pests, such as *Thaumetopoea pityocampa*. It is also fundamental for forest management and pest control. Damage caused by this defoliator is connected to the recurrent outbreaks of the populations, which happen at irregular intervals (every 4 to 10 years). The strength of this insect lies in its wide adaptability to different environmental conditions, due to the possibility to extend the diapause period and the larval reactivity to temperature. The main element that makes the analysis of the dynamics and therefore the fluctuation prediction extremely difficult, is the uncertainty related to the underground pupal phase, as emergence and diapause maintenance are driven by factors not yet understood. The sudden appearance of insect masses from the ground may cause unexpected outbreaks even after years of low density. Factors that seem to be decisive for the dynamics of *T. pityocampa* are related to both abiotic (e.g. winter temperatures and autumnal precipitations) and biotic (e.g. food quality, natural enemies) factors. In this review we present the historical data sets available and their most likely interpretation, keeping into account the heterogeneous population structure, and give directions about the future development of the research.

MODELLING OAK PROCESSIONARY MOTH – THE MOPM PROJECT

Holger Vogt-Altena[1], Carsten Thies[2] & A.I.M – Arnold[3]

[1]*University of Göttingen, Department of Geography, Goldschmidtstrasse 5, 37077 Göttingen, Germany; hvogtal@gwdg.de*
[2]*Natural Resources Research Laboratory, Bremer Strasse 15, 29308 Winsen, Germany;*
[3]*University of Göttingen, Department of Soil Science of Temperate Ecosystems, Büsgenweg 2, 37077 Göttingen, Germany*

Global climate change holds the potential to result in a dramatic increase of pest attacks, therefore yielding to widespread destruction of large areas of natural and manmade forests causing a loss or reduction of vital forest ecosystem function. However, until today, there exists no proactive risk management of landscapes in jeopardy, including outbreak predictive parameters (early warning system) focusing on insect pests.

The oak processionary moth (OPM), *Thaumetopoea processionea* L., is found in oak forests in many European countries. Its third to sixth larval instars are armed with poisonous hairs (setae) containing an urticating toxin (thaumetopoein) harmful to humans and animals. Recent events strongly indicate that the OPM not only has expanded its range, but also exhibits an increased magnitude of the severeness of its attacks on urban and non-urban forested areas. Our project has been launched to take action on identification of risk stand parameters (predictive values) in urban/non-urban forests at different spatial and temporal scales with the help of retrospective data analyses.

Here, we analyse OPM mass outbreaks in the German federal state of Bavaria at multiple spatial scales. Mass outbreaks in Bavaria have been observed only in comparatively warm regions, i.e. regions with viticultural climate. We examined OPM infestation rates in oak forests in vineyard landscapes differing in structural composition, geomorphology, and geographical height. At larger landscape scales (~13-20 km²) OPM infestation rates distinctly decreased as mean elevation in landscapes increased, suggesting that populations of this thermophilic pest are susceptible to local climate. At smaller landscape scales (1-3 km²) OPM infestation rates increased with the percentage of oak forest. Species traits such as resource specialisation, foraging range and population size variability of OPM therefore appear to connect to the landscape context via dispersal.

DEVELOPING THEORIES OF INSECT POPULATION DYNAMICS – THE SPRUCE BUDWORM AS A CASE STUDY

Richard A. Fleming & Jean-Noel Candau

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The spruce budworm (SBW), *Choristoneura fumiferana* has been the most destructive insect defoliator of forests in North America since well before Europeans arrived. The SBW causes extensive forest damage during the peaks of its 30-year outbreak cycle. During the peak years (1977–1981) of the previous outbreak, this insect destroyed what amounted to as much as 65-90% of a year's production from all of Canada's forests put together. In some stands, tree mortality reached 85%.

Because of this, there is a long history of research on SBW, and over the years, a number of theories have been developed to explain the rise and fall of its outbreaks in terms of population dynamics. The major theories are briefly explained.

We then discuss how the analysis of large scale spatial patterns in the historical records of defoliation can provide insight on these theories. In these analyses we try to take a holistic approach to SBW ecology and the SBW outbreak cycle by including other relevant data (e.g., forest condition, climate) when available. We finish with some key limitations of the approach.

OUTBREAKS OF THE MOUNTAIN SPRUCE SAWFLY, *PACHYNEMATUS MONTANUS*, CAUSED BY PHENOLOGICAL SHIFTS IN HOST TREE-HERBIVORE INTERACTION

Christa Schafellner[1], Martina Marschnig[1], Martin Schebeck[1], Agnes Andrae[2], Cornelia Reichert[2], Rudolf Wegensteiner[1], Ralf Petercord[2] & Axel Schopf[1]

[1]*BOKU – University of Natural Resources & Life Sciences, Institute of Forest Entomology, Forest Pathology & Forest Protection, Hasenauerstr. 38, A-1190 Vienna, Austria; axel.schopf@boku.ac.at*
[2]*Bayerische Landesanstalt für Wald und Forstwirtschaft, Hans-Carl-von-Carlowitz-Platz 1 D-85354 Freising, Germany*

Since the beginning of the 20th century, secondary spruce forests of the alpine foothills in Austria and Germany are known as chronic outbreak sites of the Small Spruce Sawfly, *Pristiphora abietina*, at altitudes between 400-600 m. However, since 2011 we find new sawfly outbreaks in the same regions that are caused exclusively by the Mountain Spruce Sawfly, *Pachynematus montanus*, resulting from small, insignificant local populations. Before, this species was known only from occasional infestations in spruce forests at higher elevations (800-1200 m). As outbreaks of *P. montanus* occurred simultaneously at the former locations of *P. abietina*, climatic effects might be involved.

In contrast to *P. abietina* larvae, which feed only new needles, larvae of *P. montanus* feed also old needles and thus are able to defoliate trees during outbreaks. These trees are then highly predisposed to bark beetle attack. Our study revealed that spring phenologies of spruce and sawflies advanced at different rates: warm spring temperatures promote spruce budburst more than wasp emergence from the soil. This phenological asynchrony affects sawfly performance differently due to the different oviposition behavior of the wasps: females of *P. abietina* lay their eggs only in compound buds, whereas *P. montanus* females are able to oviposit also on needles of elongated shoots (up to 5 cm). Accordingly, increasing spring temperatures during the past years allowed *P. montanus* to outcompete *P. abietina*.

IPS TYPOGRAPHUS – THE TRANSITION FROM WINDTHROW TO PATCH-DRIVEN OUTBREAK DYNAMICS

Bjørn Økland[1], Christo Nikolov[2], Paal Krokene[1] & Jozef Vakula[2]

[1]*Norwegian Institute of Bioeconomy Research, Ås, Norway; okb@skogoglandskap.no*
[2]*National Forest Centre, Zvolen, Slovakia*

Outbreaks of the Eurasian spruce bark beetle are often triggered by large windfall episodes. Usually, salvage logging is done to limit epidemic outbreaks and losses due to bark beetle damages, but here we utilized a unique opportunity to study the development of an outbreak in a national park where little salvation logging was performed after a large storm-felling.

The bark beetles used an increasing proportion of the wind-felled substrates during the two first seasons after the storm. After the second season, studies of distance distributions indicated a transition to a self-sustaining outbreak with new infestation patches developing independently of the windthrow area. Models to predict sizes of infestation patches did not correspond with the empirical data when patch formation was assumed to be a pure dispersal-diffusion process, but good correspondence was found when beetle aggregation on individual trees were included as a part of the dispersal process.

Efficient removal of storm-felled trees the two first years after a storm-felling may be important to avoid transition into a patch-driven outbreak that is very difficult to control.

DYNAMICS OF COEXISTENCE – CYCLIC MOTHS IN PERSPECTIVE

Tea Ammunét & Helena Bylund

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Species coexistence is a topic that arises in the fields of species conservation and invasion biology alike. Studies investigating the multitude of factors that contribute to coexistence have been carried out for more than four decades. Particularly the potentially harmful consequences of new species being able to establish and coexist in an invaded ecosystem has brought the basis of species coexistence back to light.

In northern Fennoscandia, factors affecting species coexistence became topical after two geometrid species started occurring at outbreak densities instead of one. Despite depending on the same resource, and sharing some natural enemies, the two species cycle with their population peaks following each other by a few years.

Hypothesis on the coexistence of the two species have been experimentally and theoretically tested. In this talk, I will present studies exploring the effects of shared predators and parasitoids on the coexisting, phase-lagged cycles of *Operophtera brumata* and *Epirrita autumnata*. The results show that asymmetric preferences of natural enemies may allow for the two species to coexists and continue fluctuating, reaching outbreak densities every 10 years. In addition, an ongoing project on virus disease, causing death at high densities, is presented with preliminary implications on the role of virus on species coexistence.

MODEL BASED RISK ASSESSMENT OF OAK PROCESSIONARY MOTH

Paula Halbig[1,2], Horst Delb[1], Jörg Schumacher[1] & Axel Schopf[2]

[1]*Forest Research Institute of Baden-Württemberg (FVA), Dept. of Forest Protection, Wonnhaldestr. 4, 79100 Freiburg, Germany; paula.halbig@forst.bwl.de*
[2]*University of Natural Resources and Life Sciences (BOKU), Vienna, Dept. of Forest Entomology, Forest Pathology and Forest Protection, Hasenauerstr. 38, 1190 Vienna, Austria*

In view of the increasing occurrence of oak processionary moth (OPM) *Thaumetopoea processionea* L. in Central Europe since the 1990s and expected influence by climate change, there is a strong need for timely prevention of moth outbreaks to reduce the risks for host trees' vitality due to defoliation and for human health due to urticating hairs (setae) which are released by caterpillars. Therefore, an online warning system for regionally differentiated evaluation of development conditions (phenology) and population density of OPM and the associated risk for forests and human health will be developed. Through combination of basics in phenology and population dynamics of OPM with aerial spread of setae dependent from spatial distance, weather conditions and weather forecast, current and future threat of setae pollution and defoliation by caterpillars is predictable. Hence, the model – which will be applicable to the whole range of OPM – enables a timely and effective application of preventive and regulatory measurements with respect to oak tree and human health protection.

PROLONGED PUPAL DIAPAUSE DRIVES THE POPULATION DYNAMICS OF PINE PROCESSIONARY MOTH (*THAUMETOPOEA PITYOCAMPA*) IN AN OUTBREAK EXPANSION AREA

Md Habibur Rahman Salman[1], Klaus Hellrigl[2], Stefano Minerbi[3] & Andrea Battisti[1]

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Owing to the negative impact on tree growth and human health, pine processionary moth is a major concern for forest managers, especially in the recent outbreak expansion areas. Understanding population dynamics of this species gets obscured due to the prolongation of diapause of some individuals over more than a single reproductive season. In an attempt to understand the mechanism of prolonged diapause and its role in population dynamics, a 15-year pest surveillance program deploying a pheromone trap network and installing large rearing cages was started in a pine processionary population of southern-central Alps, a recent range expansion zone for the species, since 1999, right after an outbreak began. Our study found a maximum of seven years of prolonged diapause. Prolongation of diapause and rate of mortality of pupae increased with elevation. Moreover, we found prolonged diapausing individuals to be emerged in advance of simple diapausing individuals, allowing inference of the proportion of prolonged diapause individuals in pheromone trap catch. Apart from this, population dynamics dropped clearly following annual applications of *Bacillus thuringiensis kurstaki* and establishment of parasitoid thereafter. However, despite the high effectiveness of insecticide and added mortality due to natural enemies, population density remained high for a certain period of time, which can only be explained by the prolongation of diapause of the individuals from cohorts before the application of insecticide started, and further contributions of cohorts which were not completely suppressed by the insecticide applications. We recommend further study on various issues regarding prolonged diapause in this species, to open a new window of managing pine processionary in an eco-friendly and effective way.

DEPENDENCE OF THE *LYMANTRIA MONACHA* OUTBREAK ONSET ON THE WEATHER CONDITIONS IN DIFFERENT REGIONS OF POLAND: ARE THERE ANY PATTERNS?

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We analysed the outbreaks of the nun moth *Lymantria monacha* (L.) (Erebidae) in 16 regions of Poland in 1951-2010. The generalized linear model with a logit link function was used to test a dependence of the outbreak onset on 174 weather variables with *t*-2, *t*-3, and *t*-4 year shifts. The weather variables were created using 5 basic weather characteristics (mean, min, max daily temperature, precipitation and pressure at the sea level) collected at 47 weather stations. The outbreak onset was considered to be the first year of forest threat at the medium and high level assessed annually on the basis of counting the females on tree trunks along the transect(s) during the flight period. The historical data of the area of the forests threatened at different levels have been collected at the Forest Research Institute and published in the annual reports since 1950s.

The number of outbreaks varied between four and nine. The lowest number of the outbreaks was recorded in the south-western (Regional Directorate of State Forests in Wrocław) and south-eastern (RDSF in Krosno) parts of Poland, whereas the outbreaks occurred most often in the central-western (RDSF in Piła and Poznań) and eastern (RDSF in Lublin) parts. The analyses revealed that 111 combinations of weather variable and time shift had a significant effect on the outbreak onset. They will be discussed in the context of consistency among the regions and in time, taking into account the nun moth development. The models developed for middle-term prediction of the nun moth outbreak onset will also be presented.

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THE RECENT NORTHWARD EXPANSION OF *LYMANTRIA MONACHA* IN FINLAND

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The nun moth, *Lymantria monacha*, has until recently never caused noticeable forest damages in Finland despite being a notorious pest species on lower latitudes. Until mid-20th century nun moth had only been observed a handful of times in southern Finland, and also during the latter half of the century the species only occurred in low numbers, restricted to the southern coast. However, in 2010-2013 the first small-scale outbreaks of nun moth were observed on two islands in the SW Archipelago of Finland.

We examined three independent long-term datasets for nun moth abundances and distribution range in Finland: (1) The Luomus-database with observations of Finnish lepidopterologists (1960-2013), (2) light trap catches and other observations from a yearly ecology field course on one island in the south-western archipelago (1996-2013), and (3) data from Nocturna, a standardized light trap monitoring program by the Finnish environmental administration (1993-2012).

The datasets indicate, that the Finnish nun moth population was small and unstable during the previous century, but that the southern parts of the country have had a permanent nun moth population since the year 2000 with a rising trend in abundances, although population size has been fluctuating from year to year. The northern occurrence limits of the nun moth in Finland and Sweden show a similar pattern with an overall trend of moving towards higher latitudes.

We compared nun moth distribution with climatological data and concluded that the rise in abundances and the range expansion of the species matches well the trend of less severe winter colds in southern Finland.. This indicates that improved egg survival in winter has been the key to nun moth establishment in Finland. Our experiments on the cold hardiness of L. monacha eggs show that their supercooling point is about -30 oC, and these low temperatures have not been observed in southern Finland since the year 2000 although they were common during the earlier decades. Furthermore, during the last 50 years there have been no significant changes in the temperatures during the larval period (May-June) of the nun moth. If the minimum winter temperatures continue to rise at these northern latitudes, it is possible that the nun moth will become a common pest in southern Finland. Consequently, monitoring the spread and population densities of the nun moth should be continued, and the forest owners should be kept aware of preventive management of this risk.

POPULATION DYNAMICS AND BIOLOGICAL CONTROL OF THE BOX TREE MOTH, *CYDALIMA PERSPECTALIS*

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The box tree moth, *Cydalima perspectalis*, is an insect of Asian origin that recently invaded most of Europe, Turkey and the Caucasus. It probably arrived on traded ornamental plants from Asia around 2005. Since then, it has become a major pest of ornamental box trees in gardens, but it also represents a serious threat to native *Buxus* spp. in Europe and elsewhere in particular when it acts in conjunction with the box blight *Cylindrocladium buxicola*, an invasive fungal pathogen from Asia.

The moth overwinters as young or middle larval instars in the foliage. One to four generations are observed in Europe, depending on the local climate. To cause serious damage, however, *C. perspectalis* must be able to complete at least two generations per year, which is possible only in the southern half of Europe.

While, on ornamental box trees, the moth can be controlled by insecticides, preferably biopesticides such as *Bt*, in forests control is much more problematic. So far, only few natural enemies have been observed on *C. perspectalis*, mainly generalist predators such as wasps and birds and, occasionally larval and pupal polyphagous parasitoids. It is likely that the only long term solution to save natural box tree stands in Europe is the importation of specific parasitoids from Asia. The parasitoid complex in the area of origin is poorly known but the limited data available suggest that potential candidates occur in China.

FIRST DATA ON *CYADALIMA PERSPECTALIS* IN VENETO REGION (NORTH-EASTERN ITALY)

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The incidental introduction of alien phytophagous insects and mites has become quite a common event in the world. Apart from the environmental impacts alien species are known for their economic and health impacts.

A recent introduced alien species in Italy is *Cydalima perspectalis* (Lepidoptera, Crambiidae) (Walker, 1859). *C. perspectalis* originates in Asia and is a pest of *Buxus*. It was reported for the first time in Europe in Germany in 2007. It was included in the EPPO Alert List for more than 3 years. In Italy it was detected in 2011, in Lombardy, Como province. In a very short time it invaded the other northern regions and was recorded in Veneto in 2012. The larvae feed on leaves and shoots of the box trees and the infestations lead to defoliation of the plants.

The objective of this study was to investigate the phenology of *C. perspectalis.* More precisely we examined the biological cycle of life, the number of molts and the overwintering stage. In addition host plants were monitored by regular samplings, from late winter to late fall to collect data on phenology and species distribution over the territory. The life-cycle was studied in screen houses and in the field, to investigate the role of potential predators and parasitoids.

C. perspectalis overwinters as larvae of the 3rd instar inside a silk cocoon spun between 2 leaves. In 2014 overwintering larvae started their activity in early February and they were active until mid-April. Larvae are present in June-July and August while the overwintering larvae (third generation) are those born in September. In 2014 there were three flight periods in May, in July and from late August until late September. The number of larval instar is six.

With the purpose of checking monitoring and collecting data on species distribution over the territory and checking the potential differences between types of traps we placed 2 different types of pheromone traps (pagoda and funnel) in 9 locations characterized by different altitude and climate (0-696m.a.s.l.) (Trento 421m, 438m, 696m; Verona 683m, 580m; Belluno 400m; Padova 8m, 12m 25m). Results are in process.

ECO-FRIENDLY REGULATION OF THE BOX-TREE PYRALID *CYDALIMA PERSPECTALIS*

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The meanwhile well known Box-tree Pyralid *Cydalima perspectalis* (Walker 1859), an invasive alien moth from East Asia, has been recorded for the first time in Germany in 2007. Because of the current lack of natural antagonists and the rapid spread in 16 European countries, our project aims on the development of necessary elements of an effective plant protection strategy. In addition to the opportunities for innovative methods based on biological and biotechnological active mechanisms, the requirements for a suitable scheduling and the development of appropriate monitoring techniques were investigated.

Furthermore, possibilities of eco-friendly regulation using predators and parasitoids like *Chrysoperla carnea*, *Harmonia axyridis*, *Orius majusculus* and *Trichogramma* wasps were explored. Conducted acceptance and search performance tests in the laboratory showed that most beneficials accept *C. perspectalis* (eggs and larvae) as a host indeed, but cannot suppress it effective. Acceptance tests with eight *Trichogramma* species indicated that there is a present acceptance of *C. perspectalis* as a host especially for *T. dendrolimi*. In general females were attracted by the eggs, seem to be able to walk and to locate egg-masses on the *Buxus*-plants, but the resulted parasitism was low for all species (maximum mean 44%). Entomopathogenic Nematodes (EPN) were very effective in lab- and semi-field trials, but not reliably under field conditions, although the foliar application of EPN could be improved. Plant protection products based on *Bacillus thuringiensis* (*B.t.*) proved to be very efficient.

DEVELOPMENT OF A BIOCONTROL PROGRAM AGAINST THE BOX TREE MOTH *CYDALIMA PERSPECTALIS* (WALKER, 1859)

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The Box Tree Moth (BTM), *Cydalima perspectalis* (Walker, 1859), an invasive East-Asian pest, spread out in Europe and in France since 2008. These Lepidopteran Moths caused serious damages, defoliating box trees, causing among others serious economic problems. Strategies have to be setting up quickly in order to limit pest impact. In preparation for this control, the aim of the research program named SaveBuxus is to evaluate and to develop biocontrol solutions. Biocontrol laboratory goal is to improve moth biology knowledge and to develop a biocontrol strategy with oophagous parasitoids (*Trichogramma sp*.). This work is carried out at INRA UEFM (Entomology and Mediterranean Forest Unit), through the cooperation of Plante&Cité, ASTREDHOR (French Technic Institute of Ornemental productions), VAL'HOR (French Horticulture, Floriculture and Landscape Interprofession), FranceAgriMer (French National Establishment of Farming and Sea products), ONEMA (French National Water and Aquatic Environments Commission) as part of the Ecophyto plan, the France foundation and KOPPERT France

With this aim in mind, researchers have reared BTM in laboratory (25°C, 75%RH, 16L: 8D). Screenings were made on 54 strains of 17 different species of *Trichogramma* chosen among the biocontrol laboratory collection. The strains were tested more than 10 times each on 50 BTM eggs. *Trichogramma* efficiency to parasitize BTM eggs is variable in inter and intraspecific level. Five strains are statistically better than the others as well as for the parasitism that for the global efficiency (parasitism and abortion). *Trichogramma* more efficient strains will be tested in mesocosm in order to assess their dispersal ability in Box Tree.

In order to understand efficiency variability reasons according to different females from a same strain, a cross screening protocol is in progress. Four modes are presented to parasitoids. They seem to have similar parasitism rate on BTM eggs on box tree and on neutral environment. It's the same for *Ephestia kuehniella* eggs used for *Trichogramma* rearing. But the parasitism on *E. kuehniella* eggs is statistically better than the one on BTM eggs.

Females *Trichogramma* behavior is actually studied on the same conditions as for the cross screening. *Trichogramma* seem to go and lay on BTM eggs rather quickly. At the same time, F1 potential fertility on *E. kuehniella* eggs is studied as well as their efficiency on BTM eggs. Then, their biological features will be determined. Box tree chemicals compounds study must show the impact of the trophic link plants/pests/natural enemies.

These informations confirm that a BTM control strategy with oophagous parasitoids is conceivable. Other control solutions are being tested in the SaveBuxus project (pheromone traps, birds as predators, nematodes, *Bt,…*). Protection against BTM can only be effective by combining several methods that respect the environment.

INSECT MASS OUTBREAKS AFFECT THE C, N AND P BALANCE IN FOREST ECOSYSTEMS

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Insect mass outbreaks affect the C, N and P balance in forest ecosystems in various ways. The above- and below-ground fluxes and storages of the subsystems in forests are influenced both qualitatively and quantitatively by the altered inputs via litter, through fall, consequently leading to changing organic layer properties and matter output.

From the ecological perspective it is important to investigate how and to what extent insect pests can influence the dynamics of the C, N and P input/output flows in the forest, thereby regulating the forest functions. Therefore understanding these effects is important for evaluating the ecological processes which will subsequently facilitate the development of adaptable and predictive management strategies - this based on the fact that specifically under changing climatic conditions, the magnitude, frequency, intensity and duration of insect mass outbreaks are predicted to increase.

THE RATE OF DEGRADATION IN FOREST STANDS OF THE SIBERIAN FIR IN THE OUTBREAK FOCI OF THE FOUR-EYED FIR BARK BEETLE *POLYGRAPHUS PROXIMUS* BLANDF. (COLEOPTERA, CURCULIONIDAE: SCOLYTINAE) IN WESTERN SIBERIA

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Polygraphus proximus is an invasive beetle which has migrated to the territory of Western Siberia from the Russian Far East, and which has become one of the main causes of mortality of Siberian fir forests, resulting in a need for an estimation of the invader impact on the fir stands and the determination of the degree and rate of their degradation in the outbreak foci of *P. proximus*.

Our monitoring studies were carried out in 2012-2014 in the south of Western Siberia, in namely Tomsk region, in the same sample plots where, according to dendrochronological analysis, the onset of invasion was in the year 2000 (Demidko, 2014). The object of the examination was dark coniferous forests with 30 to 80% participation of the Siberian fir (*Abies sibirica*) aged 50-110 years.

Depending on the tree species composition and the term of being colonized by *P. proximus*, the revealed degree of deterioration caused to fir stands varied in the range from a weak deterioration to a complete one. The most resistant were mixed dark coniferous stands where the participation of the fir was below 30%. During the three years of observation, the mortality of fir trees caused by *P. proximus* was 1.6%, and, owing to its attack, the proportion of healthy trees decreased by 20%. Stands of trees with an 80% prevalence of the fir showed a complete degradation as the ratio of dead-standing trees in 2012 was already 97.5%, and it reached 99.9% in 2014.

The processes of degradation are more intensive in stands where the fir makes 40-70% of the tree species composition. Observation results of the year 2012 showed that pathological mortality in these cases exceeded the natural level by several times, and in 2013 the same stands were revealed to have a negative trend in the fir trees condition as the proportion of viable trees decreased significantly while the number of dying and dead-standing trees increased. The year 2014 also showed deterioration of their condition: the growth of the proportion of dead-standing trees, the colonization of previously weakened trees, and the attacks of *P. proximus* on healthy firs. In total, during the time of observation the proportion of dead-standing trees grew by 25% on average.

Thus, *P. proximus* is an aggressive pest capable of attacking both weakened and apparently healthy fir trees. The rapid degradation of stands of trees is conditioned by continuous attacks of *P. proximus* on weakened trees, as well as by the increase of its population numbers.

TRANSFORMATION OF FIR FORESTS IN THE OUTBREAK FOCI OF *POLYGRAPHUS PROXIMUS* BLANDF. (COLEOPTERA, CURCULIONIDAE: SCOLYTINAE) IN WESTERN SIBERIA

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Polygraphus proximus has become the main cause of the current zoogenic succession in dark coniferous forest ecosystems of Western Siberia. The outbreak of this insect over the vast territory caused the appearance of mortality foci of Siberian firs (*Abies sibirica*).

When assessing the impact of the invader on the fir forest, we was the estimation of the vitality of trees and stands. The process of degradation in the areas under study is marked with a dramatic decrease of the number of healthy trees and an increase of the portion of fir trees that have become weakened to a different extent, where 38.7–94.1% of the trees show signs of the invader activity. Dead-standing trees appeared, the share of which in some of the major mortality foci reached 99.9%. This caused an intensification of the illumination of habitats and, consequently, the rearrangement of forest communities which had been dominated originally by sciophilous taiga herbs and where 80% of the land area used to be covered by a mosses layer of *Hylocomium splendens*.

The increase of the level of illumination led to the formation of a multi-species shrub layer (up to 10 species) with the predominance of *Rubus idaeus*. The herbs layer became dominated by variiherbetum species (*Aegopodium podagraria*, *Rubus saxatilis*, etc.) which are currently being ousted gradually by *Urtica dioica*. In connection with this, parviherbetum and parviherbetum-mosses fir forests in outbreak foci of *P. proximus* are being replaced with variiherbetum and nettle phytocoenoses and their shrub variants.

The high level of illumination also caused a decrease of the rate of height growth of fir undergrowth. Owing to the big number of attacks by *P. proximus* (up to 87%) on the undergrowth, the vitality went down. Quite often it is possible to observe more than 30 signs of the attempts by *P. proximus* to colonize one species of tree. A significant increase in the projective cover of the herbs layer (up to 100%) and shrubs (up to 25%) led to the disappearance of the young seedlings of the fir and to the destruction of the mosses layer. This suggests that the restoration of dark coniferous stands in these foci will take place via the stage of small-leaved forests.

Thus, the outbreak of *P. proximus* in fir stands leads to a significant alternation in the qualitative and quantitative structure of both the canopy and the sub-canopy vegetation. The low vitality of fir undergrowth is an unfavourable factor of the recovery of original taiga ecosystems.

THE EFFECT OF DEFOLIATION CAUSED BY THE COMMON PINE SAWFLY TO TREE GROWTH

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Insect pest outbreaks have become more frequent and intensive at higher latitudes as a consequence of the climate change. Effects of these outbreaks include decreased economic return by growth losses and tree mortality. The common pine sawfly (*Diprion pini* L.) has turned into a serious pest, causing decline in tree health of Scots pine (*Pinus sylvestris* L.) in Finland. Economic losses depend on severity of damage, disturbance history, age, and resistance of trees. Tree ring -analysis is a widely used means to study past events. For instance, effect of natural hazard, including insect outbreaks can be detected from tree rings. The present study focuses on investigating the effect of *D. pini* defoliation on tree ring growth and impacts on the economic yield in Eastern Finland, in Ilomantsi. Population densities of *D. pini* have been fluctuating since 1999 within the study area causing chronic defoliation at varying intensity levels. The objectives were to find out i) if defoliation by *D. pini* affects the tree growth, ii) if there are differences in growth between defoliation classes, and iii) estimate economic loss due to the *D. pini* outbreak. We carried out a tree-ring measurement campaign in the study site and collected tree growth chips from a sample of 201 trees. In a laboratory, annual growths in diameter were measured using a microscope and MeasureJ2X program (VoorTech Consulting, NH, USA). Sample trees were classified into four classes based on the defoliation intensity. Growth-index of different defoliation classes was compared using non-parametric Kruskall-Wallis -test and Tukey and Kramer post hoc –test. This study adds knowledge on impact of defoliating pest impacts on tree growth and economic return. The information can be used in risk assessment and forest management planning, as well as evaluating impacts of the climate change.

POPULATION DYNAMICS AND CONTROL OF *MELOLONTHA HIPPOCASTANI* IN SOUTH-WEST GERMANY

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The forest cockchafer, *Melolontha hippocastani* Fabr., is one of the most serious insect pests in the South-West of Germany. Damage is principally due to the subterranean feeding activity of *M. hippocastani* larvae (i.e., the so called white grubs) on the roots of forest plants. Feeding negatively affects the uptake of water and nutrients in affected plants, leading to the dieback of young plants and, at higher grub densities, chronic weakening of older trees.

Infested areas within the federal states of Baden-Wuerttemberg and Rhineland-Palatinate currently comprise ~31,000 ha. There are four distinct populations of *M. hippocastani* inhabiting forests that grow on comparatively sandy and dry soils in the northern part of the Upper Rhine Valley. The beetle's life cycle within each spatially distinct population is highly synchronous, leading to different years of mass flights followed by years when hardly any adult beetles are observed. The life cycle of *M. hippocastani* usually takes four years to complete.

Attempts to control *M. hippocastani* were initially based on mechanical methods, such as the manual collection of adults during the swarming flight period. Eventually the intensive use of broad-spectrum insecticides led to the collapse of *M. hippocastani* populations in the mid-20th century. Since the 1980s, however, population densities have been increasing again along with damage to woody plants. Consequently, several extensive control measures were performed in the forests of Baden-Wuerttemberg in the early 21st century, whereas infestations in Rhineland-Palatinate were left untreated. Organophosphorus insecticides such as Perfekthion® or Danadim® comprising the active constituent dimethoate, an anticholinesterase compound, were applied by helicopter. Furthermore, NeemAzal®-T/S consisting of azadirachtin A, a phytochemical extracted from seeds of the tropic neem tree *Azadirachta indica* A. Juss, was evaluated. The impacts of these two control measures on population densities of *M. hippocastani* are presented in comparison to the spatio-temporal development of populations that were left untreated.

MANAGING RANGE EXPANSION AND SPREAD OF OUTBREAKS – CLIMATE, DISPERSAL AND POPULATION GROWTH OF EASTERN SPRUCE BUDWORM

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Region-wide outbreaks of eastern spruce budworm *(Choristoneura fumiferana)* occur with a periodicity of ~35 years and cause large scale disturbance to the boreal forest. Early outbreak foci of the current outbreak in eastern Canada have begun further north of previous outbreaks, affecting black spruce, formerly a secondary host species. Populations are currently expanding and dispersing both north and south of these foci causing defoliation and mortality of spruce and fir. Using permanent plots along a gradient of species composition (pure balsam fir and black spruce vs. mixed) and latitude, we are examining the impacts of climate change and dispersal on population growth with respect to the feasibility of "early intervention strategies" to manage outbreaks. Data on defoliation and population dynamics since 2006 reveal that populations rise first in pure balsam fir stands, and on balsam fir trees in stands containing both species. As balsam fir becomes severely defoliated, populations switch to black spruce. This allows balsam fir to recover from the effects defoliation and produce new buds, after which, insects move back on to balsam fir. Mixed stands can therefore serve as reservoirs of source populations for several years from which insects can disperse to new areas and potentially prolong outbreaks. A potential strategy to quench incipient outbreaks would be to apply control methods in potential sinks before populations rise to levels that exceed natural controls. We are evaluating characteristics of source areas as a function of percent cumulative defoliation, population dynamics, health of the insect population, weather, dispersal and overlap of flight phenology of source and sink populations using both ground surveys and satellite imagery. Radar images during the flight period between 2013 and 2015 have shown echoes indicating moth dispersal across the St. Lawrence River. We are using these parameters to determine the probability of success of "early intervention" in potential low density population sinks.

SPRUCE BUDWORM 'EARLY INTERVENTION STRATEGY' IN ATLANTIC CANADA: TRANSLATING THEORY INTO PRACTICE

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Spruce budworm *(Choristoneura fumiferana)* is once again on the rise in the spruce-fir forests of eastern Canada, rekindling interest and investment in developing management options to reduce its impact. During the past decade there has been a gradual shift in our understanding of spruce budworm population dynamics, which has prompted us to reconsider our strategic approach to managing budworm outbreaks. The resulting 'Early-intervention strategy' (EIS) focuses on targeting relatively low density populations ('hot spots') as a means of containing the outbreak along its leading edge. In attempting to develop this strategic approach at an operational level, our research offers two interesting opportunities. First, these trials allow us to test experimentally some of the conflicting predictions that have arisen over nearly 65 years of spruce budworm population research regarding the feasibility of such a strategy for managing outbreaks. Second, this work allows us to consider more generally the steps required and potential viability of such a strategy for managing outbreaks of other major native insect pests.

We will discuss some of the key elements of this research program and the progress made to date on developing and testing this program in Atlantic Canada. One key challenge – detecting low density populations as they begin to rise – has been overcome through a co-ordinated effort between industry, government partners as well as a large-scale Citizen Science program. Preliminary results after two years of large-scale insecticide trials suggest that rising low density populations at the leading edge of the outbreak can be suppressed through treatment application. How long these effects can persist following treatment remains in question. We will also discuss ongoing worked aimed at understanding some of the potential non-target effects of the EIS and how these unintended consequences might alter its feasibility.

FOREST MANAGEMENT STRATEGY AFFECTS THE RELATIVE IMPACT OF BOTTOM-UP VERSUS TOP-DOWN PRESSURE ON POPULATIONS OF FOREST INSECTS

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In large parts of Northern Europe even-aged clear-cut forestry is dominating silvicultural practices. Changes in the global wood industry, climate change mitigation and changing demands on wood and wood products have renewed the interest in other forest management methods. This interest stems from potential increases in gains when using different management methods. However, there is a relationship between management method and potential of biotic damage as well. The probability (or risk) of occurrence of damage depends on direct effects on the performance of forest insects and also on through indirect, i.e. mortality pressure of natural enemies. Therefore, it is important to understand changes in these direct and indirect effects on forest pest insects. W reviewed the effect of forest management on the natural enemies of defoliators, bark beetles (i.e. *Ips typographus*) and regeneration pests (i.e. *Hylobius abietis*) and made predictions on direct and indirect effects on the pest insects. Our main conclusion is changes in forest management strategies could result in a change in the relative contribution of top-down versus bottom-up pressure on the population dynamics of especially the bark beetle and defoliators.

TREE DIVERSITY IMPROVES FOREST RESISTANCE TO INSECT DEFOLIATORS

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Whether increasing forest diversity should result in less insect damage (Associational Resistance, AR) or more damage (Associational Susceptibility, AS) is still debated. Moreover little is known about diversity - resistance relationships in mature forests due to methodological constraints.

To address this question we used the FundivEurope exploratory platform. In this network of 209 mature forest plots, sampled along two orthogonal gradients of increasing tree species richness (from one to five species mixtures) and latitude (spanning from the Mediterranean to the boreal forest biomes), we assessed insect defoliation in tree crown. Focusing on eleven broadleaved species, we could for the first time demonstrate a global pattern of reduced defoliation (AR) in mature forests across Europe. We replicated the comparison of insect herbivory in pure vs. mixed plots of oak trees, at the edge or within forest patches. Here we found again significantly less damage on oaks surrounded by heterospecific neighbors, and showed that the magnitude of AR was larger at forest edge than in forest interiors. Last we tested the AR hypothesis with an invasive alien species, the Asian chestnut gall wasp, in Italy. Based on the same methodological approach, our study showed a significant decrease in gall damage with increasing tree species richness in mixed chestnut stands.

Our work therefore provides new experimental evidence supporting the Associational Resistance hypothesis with three original contributions: i) AR does apply to mature forests, ii) irrespective of the identity of insect herbivores, iii) including alien pest species. These findings may have important implications for pest management in forest with the maintenance or improvement of tree species diversity being a promising tool for preventing insect damage.

PHYTOSANITARY MANAGEMENT FOR EXPORT PINE LOGS IN NEW ZEALAND: MODELLING WOODY DEBRIS AS POTENTIAL HABITATS FOR BARK BEETLES AND WOOD BORERS

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New Zealand annually exports more than 15 million m^3 of *Pinus radiata* logs. Currently all logs are treated with pesticides to comply with the phytosanitary requirements of importing countries. Scion's programme, "Protecting and enhancing New Zealand forest exports by mitigating current and future quarantine based market access risks", proposes to combine ecological information such as habitat requirements, developmental biology, insect phenology and dispersal capabilities to identify and quantify the risk that live forest insects colonise export logs.

This presentation provides an overview of our risk assessment approach and a more detailed coverage of its dead wood habitat modelling component. Using an existing model that predicts woody debris production in *Pinus radiata* plantations, we estimated the amount, quality and location of decaying bark and wood across the entire forest landscape. Modelling potential habitats for bark beetles and wood borers could prove useful for the management of unwanted species, but also more generally for estimating the abundance and diversity of saproxylic insects.

BIOLOGICAL CONTROL OF EUCALYPT PESTS: SUCCESSES, CHALLENGES AND OPPORTUNITIES

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There has been a considerable increase in the rate of introduction of alien invasive insects feeding on eucalypts. Many of these insects are now established in multiple continents outside their native range, where they are considered as serious pests of eucalypt trees. Classical biological control is one of the main options to manage populations of these insects. In South Africa alone there have been three releases of biological control agents in the last four years, namely *Selitrichodes neseri* for *Leptocybe invasa*, *Cleruchoides noackae* for *Thaumastocoris peregrinus* and *Psyllaephagus bliteus* for *Glycaspis brimblecombei*, released from 2012, 2013 and 2015 respectively. Data from sticky traps and collection of infested material shows that *S. neseri* has established in the main eucalypt areas, and there are also positive results from initial post-release monitoring for *C. noackae*. Challenges associated with these releases have included the need to develop suitable rearing methods for the agents and their hosts, delays in the processing of release applications and high costs associated with the development of biological control programs. However, these challenges have largely been addressed by increasing collaboration and exchange of information and agents with international partners, and effective communication and partnership with relevant government bodies. One of the main challenges that remain is the development of suitable methods to assess the impact of these agents on the pest populations.

BIOLOGICAL CONTROL OF THE RED POPLAR LEAF BEETLE IN POPLAR SHORT-ROTATION COPPICES (SRC)

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Damage by insect pests plays an increasing role in the management of short-rotation coppices (SRC) in Germany. We have studied several potential integrated pest management (IPM) strategies with special regard on biological control methods for the main pest species in SRC, the red poplar leaf beetle (*Chrysomela populi*). Despite the defensive secretion of the larvae, a significant influence by natural enemies was determined. The univoltine hoverfly *Parasyrphus nigritarsis*, feeding on eggs and larvae of *C. populi*, is the most important antagonist in spring. In 2013, 88.5% of all analysed egg clusters in the field were affected by this species.

The wasp *Schizonotus sieboldi* (Hymenoptera, Chalcidoidea) is a very common pupal parasitoid causing parasitation rates from 18% to 55% in the field. A laboratory experiment showed that the availability of sugar can enhance the longevity of *S. sieboldi* females from 1-2 days without food to 60 ± 9 days. Initial studies with different flowering plants indicate that plants from the parsley family (Apiaceae) are a suitable food source. Another pupal parasitoid is *Cleonice callida* (Tachinidae). Causing parasitation rates between 0 to 22%, the importance of this species is relatively low.

The parasitic mite *Linobia coccinellae* (Astigmata: Hermisarcoptidae) was found in high densities on adults of *C. populi*. The mites are exclusively linked to the adult stage, feeding on their haemolymph. During a survey in 2012, the mites were found on 28% of adults on 2 May, 66% on 6 June and 78% on 17 July in densities of up to app. 60 mites per beetle. However, a laboratory experiment in 2014 showed no significant influence on longevity or fecundity of the host.

Field surveys also revealed a number of generalist predators. *Pinthaeus sanguinipes* and *Arma custos* (Heteroptera: Pentatomidae) were the most frequent predatory species of *C. populi* larvae. In contrast, hardly any predators were found on adults.

The results of the studies show the high potential of biological control of *C. populi* in SRC. The main focus of future studies should be therefore on measures to enhance and/or stabilize the influence of natural enemies by habitat optimisation (conservation biological control). Our main goal is developing an integrated pest management strategy for SRC, in which biological control plays a key role.

ARE ENTOMOPATHOGENIC FUNGI EFFECTIVE AGAINST *HYLOBIUS ABIETIS* (COL., CURCULIONIDAE)?

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Control of *Hylobius abietis* is an unsolved problem even this beetle species causes a lot of damage in afforestation and reforestation areas. Until now, several chemical insecticides, anti-feedants and mechanical control measures (physical barriers) were tested. Furthermore, some attempts were made to use entomopathogenic nematodes and some few preliminary investigations focused on entomopathogenic fungi. This was the reason for extensive laboratory tests with some entomopathogenic fungi.

H. abietis was collected with bark traps in Carinthia (Austria). Within three years isolates of entomopathogenic fungi were tested, *Beauveria bassiana, Isaria fumosorosea* and *Metarhizium anisopliae* from soil samples in Austria, *Metarhizium flavoviride* from soil samples in Poland, one *B. bassiana* bark beetle isolate and one *Beauveria brongniartii-H. abietis* larval isolate (both from Austria). Beetles were inoculated with aqueous fungal spore suspensions. 20 to 30 beetles per group were incubated in Petri dishes (13.5cm Ø) together with fresh spruce bark chips in an incubator at 22°C. Beetles mortality was checked every day.

In a first preliminary test series in 2012, *B. bassiana* (60.1%, n = 148) and *M. anisopliae* (56.3%, n = 96) inoculated beetles showed relatively high infection rates; *I. fumosorosea* inoculated beetles had very low infection (22.6%, n = 190), no infection was found in the control group (n = 113).

In a second test series (in 2013, n = 25 in all variants) high infection rates were found with *B. bassiana* (76.0%), and low with *M. anisopliae* and *I. fumosorosea* (each 32.0%). No infection was found in the control group.

In a third series of infection experiments (in 2014, n = 30 in all variants) 100% infection was found with the *B. bassiana* soil isolate and with the *B. bassiana* beetle isolate, 73.3% infection with *M. flavoviride*, only 50% infection with the *B. brongniartii* weevil isolate and no infection in the control group.

NATURAL ENEMIES OF *LYMANTRIA DISPAR* L. IN THE REGRESSION PHASE OF OUTBREAK IN SERBIA

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Serbia is mediate afforested with average 29,1% of forest cover (source: data of the National Forest Inventory, 2009). Forest cover is 2,252 million ha. Ownership is state (1,194 million ha or 53,0%) and private (1,058 million ha or 47%. Pure broadleaved stands are dominant with 59,0%, followed by mixed broadleaved stands (29,3%) and pure coniferous stands (8,7%).

Gypsy moth *Lymantria dispar* L. (Lepidoptera: Lymantriidae) is in Serbia one of the most important outbreaking defoliators causing severe loss in forest production as well as one of major species which could contribute to dieback of deciduous forests. Based on long time research, there is evidence that natural enemies of *L. dispar* strongly influence population dynamic. Recent research conducted in 2014 show that NPV caused mortality of gypsy moth larvae from 12,35 to 61,70 %. *Anastatus japonicas* Ashm. and *Oencyrtus kuvanae* How. contribute significantly to egg mortality. Larval and pupal parasitism by Tachinidae varied from 2,63 to 31,58 %. Very high mortality of tachinid pupae was observed, which affect their influence on population dynamic of gypsy moth. Significant parasitism has been achieved by braconid wasp *Cotesia melanoscela* (Raz.) and it's parasitism varied between 2,63 and 26,32 %. Predators such as birds, insects *Calosoma* and *Carabus* spp. (Coleoptera: Carabidae) and mites (Trombidium sp.) also contribute to collapse of gypsy moth population. In southern and central part of Serbia, entomopathogenic nematodes have been observed. *Entomophaga maimaiga* (Entomophthorales: Entomophthoraceae) is a fungal pathogen of gypsy moth larvae. It originates from Japan, but it was introduced for biological control in USA and Europe. After few intentional introductions in Bulgaria and Serbia, now it is spread in Southeastern Europe as well as in Middle Europe, Turkey and Georgia.

Changed weather conditions in Serbia with extremely high summer temperatures and lack of precipitation are common in last decades, which affect host plants and insect populations.

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THE ROLE OF BUD BURST PHENOLOGY IN PARASITISM OF GYPSY MOTH *LYMANTRIA DISPAR*

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Gypsy moth *Lymantria dispar* is considered as highly dangerous pest for forestry, horticulture and city recreation green zones. Usually larvae of this species completely defoliate broadleaved trees and shrubs during intense outbreak periods and are limited with delayed response of parasitoids – usually in next year. Excessive population growth of *L. dispar* negatively affects biodiversity. In Latvia, the first mass outbreak of this pest was recorded in 2008 in the city of Liepaja and second outbreak in 2011 near Engure's lake in nature reserve territory.

It is known that sudden spring onsets leads to delay in bud burst process, leaving early hatched moth larvae suffering from starvation. Besides incompletely blown leaf buds can serve as poor quality food source for optimal larval performance. Considering that majority of *L. dispar* parasitoids are feeding with preimago of moth – therefore are active in spring, it is crucial to understand how different leaf formations can affect *L. dispar* resistance against parasitism. We presume that spring shifts in future during climate change can affect larval performance and therefore affect activity of *L. dispar* parasitoids. The aim of this study is to find if there is a link between host plant quality, larval performance and parasitism, also population status of *L. dispar*.

Firstly, population status was determined by using mark- recapture of adult flying *L. dispar* males. Egg masses of two different *L. dispar* populations (near Liepaja – with growth phase, and Engure's lake – with decline phase; in Latvian territory) were selected for laboratory experiment. Hatched *L. dispar* larvae were placed in 16 acrylic insectariums with differently bursted *Betula* sp. and *Quercus robur* branches; then were weighted to estimate larval performance in comparison with bud burst phenology and source population status. After start of *L. dispar* pupation, all insectariums were modified and exhibited in field – 8 in Bērzciems, 8 in Liepāja – for 20 days. Emerged and trapped parasitoids were collected, counted and determined.

In result *L. dispar* larvae from Engure's lake region showed 30% lower growth rate in L1-L3 instar stages compared to larvae from Liepāja. 23% more of parasitoids appeared in insectariums placed in Bērzciems.

BY FLIGHT OR BY WIND? SPREAD OF THE INTRODUCED BIOCONTROL AGENT *TORYMUS SINENSIS* IN NORTH-EASTERN ITALY

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In successful biological control, natural enemies can provide enduring pest control if they replicate and disperse without continued human management. To explain the efficient control exerted on the invasive Asian chestnut gall wasp (ACGW) *Dryocosmus kuriphilus* Yasumatsu (Hymenoptera: Cynipidae), the introduced parasitoid *Torymus sinensis* Kamijo (Hymenoptera: Torymidae) has been supposed to expand its geographic range alongside expanding ACGW populations.

In the present study, we describe the spread of several established *T. sinensis* populations in north-eastern Italy (Veneto region) during the three years immediately following the release of the parasitoid. We hypothesized that the uninterrupted occurrence of host trees (European chestnut *Castanea sativa* Mill.) across the study area and the direction of prevailing winds would interactively influence and accelerate the spread of the introduced biocontrol agent. We assessed short distance dispersal by monitoring the abundance of natural enemies at increasing distances from the point of release and long distance dispersal by monitoring non-release sites at distances up to about 100 km from the nearest release site.

Results showed that the spread capability of *T. sinensis*, due to a combination of short- and long-distance flights, is high and likely affected by both the factors considered. Spread distance up to 650 m is likely best explained by an active flight, as no winds were found to justify wind-aided flight along this distance. In all the remaining cases wind directions offered the most plausible explanation of parasitoid movement at large distances. Recently, the spatio-temporal dynamics of *D. kuriphilus* have been investigated. On a localized scale, ACGW dispersal occurs by adult flight whereas, on a large scale, the invasiveness of the ACGW is enhanced by abiotic factors such as host plant distribution, landscape traits, and prevailing winds. We have evidence of the importance of the same factors for its parasitoid *T. sinensis*.

The combination of different dispersal mechanisms, known as stratified dispersal, may ensure that the parasitoid rapidly colonizes the range of its host. In particular, the ability to disperse long distances represents a key trait of the introduced biocontrol agent given that *D. kuriphilus* has spread very quickly and widely across a new invaded area by unintentional human-mediated transportation ('jump dispersal') of asymptomatic infested material.

PREDATOR REFUGES FOR CONSERVATION BIOLOGICAL CONTROL IN WILLOW PLANTATIONS: THE RISE AND FALL OF A SIMPLE SOLUTION

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Managed systems with intermediate harvest cycles allow for more stable ecosystem processes and are less likely to experience insect outbreaks, compared to short-cycle systems. One way to further reduce the risk for herbivore outbreaks in intermediately disturbed systems could be to utilize the flexible harvesting regimes to stabilize predator-prey population dynamics across harvests.

A theoretical model suggests that retaining 50% of a willow short rotation coppice (SRC) at harvest could reduce the average predator mortality to 40%, which would increase predation pressure, stabilize predator–prey dynamics and thereby limit the risk of detrimental leaf beetle outbreaks. We tested this theoretical prediction in a full-scale field experiment. Predator refuges were retained at eight coppiced sites, while no refuges were provided at eight control sites. Population densities of three predator species and three leaf beetle species were monitored over the four years after stem coppicing, and predation pressure was estimated in years three and four.

Contrary to our predictions, leaf beetle densities were higher in stands with refuges and predator densities were higher in stands without. Leaf beetle egg mortality increased with total predator density, but did not differ between stands with and without refuges. The refuges had higher densities of both trophic levels during the first year after coppicing.

These unexpected results can be attributed to interactions between dispersal and patch age. The older stems in the refuges were preferred by both predators and leaf beetles. This delayed the predator dispersal into the re-growing part of the stands. The altered phenology of coppiced stems may also have triggered leaf beetle migration from stands without refuges.

Saving predator refuges came at the cost of more attractive herbivore habitats, thus increasing rather than decreasing the risk of willow leaf beetle outbreaks in SRC willow stands. Our study highlights the complexity of management for conservation biological control in intermediately disturbed systems and the need to consider indirect effects of management and basic ecological understanding of the interacting species before applying simple solutions to complex problems.

NATURAL ENEMIES AND FUNGAL PATHOGENS OF THE FOUR-EYED FIR BARK BEETLE *POLYGRAPHUS PROXIMUS* BLANDFORD (COLEOPTERA, CURCULIONIDAE: SCOLYTINAE) IN THE WEST SIBERIAN REGION OF INVASION

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Polygraphus proximus is an invader originating from the Russian Far East which has been recently found in Siberian forests. It causes the mortality of the fir *Abies sibirica* Ledeb. Now, *P. proximus* established stable relationships with predatory and parasitic insects and entomopathogenic fungi in its new habitats.

In West Siberia, in the galleries of *P. proximus*, there have been found 23 species of predatory insects: Coleoptera, such as *Thanasimus femoralis* (Zett.), *T. formicarius* (L.) (Cleridae), *Lasconotus jelskii* (Wank.) (Colydiidae), *Plegaderus vulneratus* (Panz.), *Paromalus parallelepipedus* (Hbst.) (Histeridae), *Leptophloeus alternans* (Er.) (Laemophloeidae), *Epuraea longipennis* Sjöberg, *E. pallescens* (Steph.), *Glischrochilus quadripunctatus* (L.) (Nitidulidae), *Rhizophagus dispar* (Pk.) (Monotomidae), *Nudobius lentus* (Grav.), *Placusa depressa* Maekl., *Phloeopora testacea* (Mannh.), *Phloeonomus lapponicus* Zett. (Staphylinidae), *Corticeus fraxini* (Kug.), *C. suturalis* (Pk.), *C. linearis* (F.) (Tenebrionidae), and *Denticollis varians* (Germ.) (Elateridae); Diptera, such as *Medetera penicillata* Neg. (Dolichopodidae) and *Xylophagus cinctus* Deg. (Xylophagidae); the bug *Scoloposcelis pulchella* Zett. (Hemiptera, Anthocoridae); the ants *Formica rufa* L. and *Lasius niger* L. (Hymenoptera, Formicidae).

The most abundant of the predators is *M. penicillata* which most likely inhabited Siberia as a result of a joint invasion with *P. proximus* from the Russian Far East. This species is found in 50% of the nests of the four-eyed fir bark beetle and can kill from 30 to 75% of its offspring.

Three species of Hymenoptera parasitize on the larvae of *P. proximus*: *Dinotiscus eupterus* (Walk.), *Roptrocerus mirus* (Walk.) (Pteromalidae) and *Meteorus ipidivorus* Tob. (Braconidae). Among them, only *D. eupterus* reaches high numbers – up to 6 larvae in the host family, consuming approximately 13% of its larvae in particular years.

Among the pathogens, the most prominent part in the reduction of the number of *P. proximus* is played by entomopathogenic ascomycetes *Beauveria bassiana* s.l. and *Isaria* sp. The frequency of occurrence of *B. bassiana* among other fungal infections in samples picked at the outbreak foci of the four-eyed fir bark beetle is almost 90%. The mortality of *P. proximus* caused by fungal pathogens in declining foci in some trees may reach 41.6%, mainly its larvae.

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PATHOGENS OCCURRENCES IN THE MOTTLED UMBER MOTH – *ERANNIS DEFOLIARIA* CLERRCK IN GEORGIA

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Mottled umber moth – *Erannis defoliaria* Cl. (Lepidoptera, Geometridae) is polyphagous pest, monovoltine species, destructive defoliator of a wide range of broadleaf trees of forest, orchid and shrubs, which responsible to defoliation of trees and successive defoliations over several years can cause growth loss, branch dieback and eventual tree mortality. This insect occurs throughout Europe, east to Russia and the Republic of Georgia. During last years (2012-2014), *Erannis defoliaria* created local outbreaks in all foliage forest vegetation and recreation zones east part of the country and surrounding of the Tbilisi to differing degrees.

The occurrence and epizootiology of pathogens of *Erannis defoliaria* is one of the least studied aspects in their population dynamics. The aim of our research was focusing for the identification pathogens in the populations of *E. defoliaria.* as natural regulation agents. Infected and healthy caterpillars (III-V) instars were collected from foliage forest of Bazaleti and Tskneti district in Georgia, 2014-2015.

As results of investigations two pathogens bacteria and fungi were occurred. Morphological and biochemical study shown, that five of the emitted 10 isolates (BZ1, BZ2, BZ3,TS1, TS3) are Gram positive *Bacillus spp.* For the evaluation of spore formation ability isolates were cultivated in liquid media (Nutrient Broth and Selective Media) and the microscopic analysis revealed the existence of spores in all isolates

After investigation infected caterpillars observed in nature (1.5%) with fungus symptoms, the *Beauveria bassiana* have been revealed.

Entomopathogens isolated from the populations of *E.defoliaria* are very important for biological forest protection.

EVALUATION OF THE POTENTIAL FOR UTILIZING ENTOMOPATHOGENS AS A COMPONENT OF AN INTEGRATED PEST MANAGEMENT AGAINST SUCKING AND DEFOLIATING INSECT PESTS OF PINE FORESTS IN ALGERIA

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We investigated in field and laboratory the compared potential of *Bacillus thuringiensis kurstaki (BTK)*, two *Bacillus subtilis* strains (BsVIII3, 9372) and *Metarhizium anisopliae* var *acridum* preparations for the control of the processionary moth caterpillars *Thaumetopea pytiocampa* and the conifer aphid *Cinara maghrebica*. Bioassays were conducted in a forest selected site on a young Aleppo pine tree plantation, on infested pine needles and also on fifth instar caterpillars with a one time spraying formulating spores powder into emulsifiable suspensions. We obtained the following dilutions for microbial treatment against processionary caterpillars : *Bacillus thuringiensis kurstaki* (D1 = 1, 34 10^7 cfu/ml, D2 = 9,3.10^6 cfu/ml), *Bacillus subtilis* (strain VIII3) : (D1 = 1,36.10^7 cfu/ml, D2 = 9,2.10^6 UFC / ml), *Bacillus subtilis* (strain 9372) (D1 = 1,33 10^7 33 CFU / ml , D2 = 9,5.10^6 cfu / ml). The respective doses for treatment in the laboratory and in the field on the aphid *Cinara maghrebica* Mimeur are as follows: *B. thuringiensis kurstaki* (D1 = 3.5 10^6 cfu/ml, D2 = 2.5 10^5 cfu/ml), *B. subtilis* (strain VIII3) (D1 = 3.7 10^6 cfu/ml, D2 = 2.6 10^5 cfu/ml), *B. subtilis* (strain 9372) (D1 = 3.3 10^6 cfu/ml / ml , D2 = 2.4 10^5 cfu/ml / ml), *M. anisopliae var acridum* (D1 = 1.16 10^7 spores/µl, D2 = 1.16 10^6 spores/µl).

Overall, the mortality of aged caterpillars of the processionary moth increase until the 7 day after application of the solutions with an efficiency much higher at dose 1. Mortalities observed in larvae treated with the two bacterial strains of *Bacillus subtilis* showed lower values not exceeding 30 %. As for the effect of btk, there is a dose dependent response in particular with dose 1 relative to dose 2 for the VIII3 and 9372 strains, respectively. The effectiveness of the two strains is even higher with time after application.

In the laboratory, Individuals of the aphid *C. maghrebica* treated with the solutions of different microbial treatments, showed variable mortality related to the tested strains and doses. Over a period of four days, the highest mortality was recorded after 72h and 96h for all strains used at rates between 50% and 70% according to our observations. The effect of btk increases with a mortality rate of 25 % to almost 100% in particular with the dose1 between 24h and 96h. The effect of the VIII3 Bs strain comes second and increases with a mortality rate of 25 % to 40 % recorded between 24h and 48h. In addition, the effect stabilizes at 40 %. Concerning the 9372 strain Bs and strain of *M. anisopliae var acridum* approved, low growth in mortality is observed in the range of 10% to 30 % between 24h and 48h, respectively, then the rates stabilize thereafter at a value 40 % for both microbial agents.

Insecticides btk potential on the conifer aphid *C. maghrebica* proved weak in comparison with those of other strains tested in the field, especially with the VIII3 strain Bs and especially between 24h and 72h. The strain of *M. anisopliae var acridum* has instead created a mortality rate of over 60% after one week after application of treatments.

INFLUENCE OF ENVIRONMENTAL FACTORS AND CONTROL METHODS ON DENSITY OF COCKCHAFERS (*MELOLONTHA* SPP.) POPULATION

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Common and forest cockchafers (*Melolontha melolontha* L. and *Melolontha hippocastani* F.) are the most damaging root insect pests in Poland. In this study influence of environmental factors, such as forest site types, forest land use category, forest soils humidity, generation of *Melolontha* and outbreak centres were evaluated. We also studied effectiveness of control methods on the density of cockchafers population. The study of grub colonization in forest soils (1x0.5x0.5 m pits) was carried out from 2008 to 2012 and included two succeeding insect generations (in stage L_2).

Our results show that the fresh, broadleaved mixed forests are associated with a significantly higher number of cockchafers grubs than deciduous forest sites and moist sites. Forest young plantation, plantations and failed patches are areas of most frequent cockchafer grubs occurrence. The analyses indicate that the first generation (2008) was significantly more numerous than the generation of *Melolontha* occurring in 2011-2015. However, only in one of three examined outbreak centres a significant difference in cockchafers population was observed.

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THE PINE SAWFLY, *NEODIPRION AUTUMNALIS*, IN COLORADO

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Neodiprion autumnalis is the most widespread sawfly affecting *Pinus ponderosa* forests in western North America. This species has been abundant along the eastern fringes of *P. ponderosa* forests in Elbert and adjoining counties, Colorado for a number of years. In 2014, this insect erupted into an outbreak that caused complete defoliation of almost 3000 ha of forests. This sawfly overwinters in the egg stage. A special egg survey was designed and conducted in an attempt to predict potential for defoliation in 2015. The insect's life history, public concerns and results of the egg survey are described.

EFFECT OF SOIL AND TOPOGRAPHY ON THE DEFOLIATION BY THE COMMON PINE SAWFLY (*DIPRION PINI* L.)

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The common pine sawfly (*Diprion pini* L.) larvae feed on Scots pine (*Pinus sylvestris* L.) needles, thereby weakening, or with high population densities killing the trees. Causes of outbreak dynamics have been studied, but the effect of soil and topographical features have not been given much emphasis. In this study, effects of soil properties (carbon/nitrogen ratio (C/N), thickness of soil horizon, pH and texture), and topographical features (elevation, aspect, slope) on defoliation intensity caused by the common pine sawfly were viewed. In 2010, defoliation assessment and soil sampling was conducted on plots located in Palokangas, Ilomantsi (62° 52' N, 30° 56' E), Finland. The chronic outbreak of the common pine sawfly emerged in the study area in 1999. The topographical patterns were determined with utilization of a digital elevation model (DEM), which includes the surface patterns of the study area in a 3D form. Most of the sampling plots located on poor and rather poor site types. Trees on plots with lower soil C/N ratios, finer texture and thicker A-horizons had higher defoliation levels. Topographical variation in the study area was rather low and did not seem to greatly affect defoliation intensity. However, trees growing on plots with steeper slopes seemed to have suffered from slightly milder defoliation than trees on flatter areas. The results of this study could be utilized in risk analysis and forest health planning, when predicting stand losses and most susceptible areas for outbreaks of the common pine sawfly.

BAG SHELTER MOTH BIOLOGY AND ECOLOGY: THE SPECIES DOWN-UNDER

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The bunny-tail or bag-shelter moth, *Ochrogaster lunifer* Herrich-Schäffer (Notodontidae; Thaumetopoeinae), is a wide spread species in Australia and has been linked to pregnant horses aborting their foals. The causal agent appears to be javelin like setae that occur on caterpillars. These setae also cause urticarial reaction in humans. The species appears to be univoltine. Egg masses (200-300 eggs) are laid in late Spring (ca October-November) and look like a cotton wool ball being covered in scales that are urticarial from the females' abdomen. Egg masses are laid at the base of trees or in the canopy. Larvae feed gregariously, building large conspicuous "bag shelters" or bivouacs. Larvae pass through 6-8 instars and disperse in the pre-pupal stage in late autumn, pupating in early Spring. The final instar is estimated to have *ca* 2M javelin like setae and the remaining nest material has high densities of these setae. The species has a very wide host range utilizing various species of *Acacia* and eucalypts. Hosts may be defoliated and the moth outbreaks from time to time causing problems for the thoroughbred horse racing industry. With 5 nesting "types" described and a wide host range *O. lunifer* is likely a species complex but this has yet to be clarified.

GENETIC DIVERSITY OF THE HIGHLY INVASIVE LIME LEAF MINER IN EURASIA: WHERE DO INVASIVE HAPLOTYPES COME FROM?

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The lime leaf mining micromoth *Phyllonorycter issikii* (Kumata, 1963) (Lepidoptera: Gracillariidae) is known to occur in East Asia (Japan, Korea and the Russian Far East). In the last two decades, this insect has been recorded in many European countries, Western Russia and Siberia and it is now considered a potential pest for the European lime species *Tilia cordata.*

If *P. issikii* has suddenly expanded from East Asia westwards and during this fast invasion there has been a genetic bottleneck, then we would expect the species to show a loss of genetic diversity from east to west. We tested this hypothesis using mitochondrial DNA data (cytochrome oxidase I gene, COI). Analysis of 371 specimens collected in 14 countries and 63 localities throughout the insect's broad modern range in Eurasia allowed us to determine 29 haplotypes: 23 of them were detected in eastern and central Europe (allegedly neocolonized area), whereas only 8 haplotypes were found in East Asia (putative native range). Thus, this result did not support the suggestion of genetic loss during the insect invasion. We detected 5 unique haplotypes from the Russian Far East represented by 95% of insect individuals from that area, pointing at geographic isolation of *P issikii* there. Such geographical isolation in the Russian Far East was supported by nuclear data and by morphometric study of the male genitalia. In addition we found that 96% of insect individuals originating from Japan carried the haplotype that was dominant in neocolonized area.

The fact we found higher genetic diversity in the neocolonized area than in putative native range suggests possible scenarios: 1) the species is native to the neocolonized area but its density was too low to be detected; 2) the genetic diversity in East Asia – putative native range is much higher and further sampling is needed to characterize it. Indeed a deeper population genetic analysis of *P. issikii*, involving the populations from other places in Eastern Asia – Korea and particularly Eastern China, where the insects likely occurs, will be required to test these explanations, to defining the boundary of the insect's native range and to detect the spots of high genetic diversity of the lime leafminer within East Asian populations.

This study has been supported by LE STUDIUM® Loire Valley Institute for Advanced Studies, France and RFBR (Russian Foundation for Basic Research), Russia (№ 15-29-02645).

DYNAMICS OF INVASIVE BARK BEETLE LOCAL POPULATION IN FIR FOREST OF SOUTHERN SIBERIA: HALF-CENTURY RETROSPECTIVE EVALUATION

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Cross-dating procedure of Siberian fir dieback in the outbreak area of the four eyed fir bark beetle *Polygraphus proximus* Blandford (Coleoptera: Curculionidae: Scolytinae) at the Southern region of the Krasnoyarsk Kray (Central Siberia, Russia) proved an existence of this Far Eastern invader in the Kray in the early 1970ies. Dendrochronologically determined dates of appr. 200 firs' death provided annual resolution of tree mortality at small 0,25 ha sample plot in the dead stand of *Abies sibirica*. The forest is in 3 km from the Trans-Siberian railroad – the most possible source of invasive pest.

First signs of *Polygraphus*' infestation were found on trees, which have died in 1976-1988; these trees were obviously weakened and had the lowest radial increment in the habitat.

In 2002 the local population of *Polygraphus* was high enough to start intensive fir infestation. The beetles quickly colonized all remaining weakened trees. Resistance of these firs was overcame at the year of colonization: there was a luck of any signs of even short period of increment loss in that period.

Finally in 2005-2006 an outbreak foci reached the stage of a "fixed outbreak", when population was able to support its high density during few years by massive attack of healthy firs, weakening them till ready to infest condition. These attacks of each individual tree lasted not longer that 2-3 years and were accompanied by the significant loss of increment before the year of dieback.

At the core area of outbreak all firs were eliminated in 2010-2011.

Nowadays fir stands are damaged to different extent by *P. proximus* on the huge territory of 700 by 700 kilometers in the Southern Siberia. The pest was found also in European part of Russia. At the landscape exposition of Siberian fir at the Main Botanical Garden (Moscow) the beetle with associated ophiostomal fungus *Grosmannia aoshimae* (Ohtaka et Masuya) Masiya et Yamaoka eliminated nearly two thirds of trees and after that attacked collection of firs located near by. Beetles exclusively attacked trees of fir species from the sections Balsamea and Grandis.

The work was supported by the Russian Foundation for Basic Research (grant 14-04-01235a).

FACTORS AFFECTING THE COLONIZATION DENSITY AND REPRODUCTIVE SUCCESS OF THE EURASIAN SPRUCE BARK BEETLE (*IPS TYPOGRAPHUS*) DURING AN OUTBREAK

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The spruce bark beetle is one of the economically most important forest pests in Europe. During outbreaks it may kill millions of mature spruce trees. It is relatively well known which factors that trigger outbreaks, i.e. large scale storm-fellings and drought, while factors influencing outbreak intensity have been less studied. Outbreak intensity is likely to be strongly influenced by both colonization density and reproductive success, which respectively determine the numbers of trees that can be killed by a given number of beetles and whether numbers of beetles participating in tree-killing in the next generation will increase or decrease. In the present study we followed colonization density and reproductive success of the spruce bark beetle during an entire outbreak by yearly sampling of bark from infested trees. Both year and size of local beetle population had a strong impact on these factors.

IS THE RISK OF SEEDLING DAMAGE BY PINE WEEVILS IN FOREST REGENERATIONS RELATED TO FOREST MANAGEMENT IN THE SURROUNDING LANDSCAPE?

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Damaged caused by the large pine weevil (*Hylobius abietis*) is one of the largest problems on planted conifer clear-cutting sites in Europe. We have investigated if the damage risk level is related to the amount and distribution of fresh and two-year old clear-cuttings in the surrounding landscape when the core clear-cut area was fresh. We aimed to test the hypothesis that the risk level of seedling damage is partly dependent on the number of pine weevils arriving to a clear-cutting to utilize the abundant breeding substrate constituted by freshly cut stumps. The number of arriving weevils would then be related to the area of and distance to two-year old clear-cuttings producing swarming pine weevils (source) and the area of and distance to fresh clear-cuttings in the surrounding landscape that could attract swarming pine weevils (sinks).

The study utilized data from a published study on seedling protection measures at in total 30 clear-cuttings planted 2006-2008 in a 1680 km^2area in mid Sweden (Nordlander et al. 2011). Information on the year and area of clear-cuttings performed in surrounding landscapes (buffer-zone 30 km and 10 km) was retrieved for each clear-cutting was retrieved from the Swedish Forestry Board's yearly inventory of final cuttings. The data was analyzed using spatial statistics testing if the rate of seedling mortality and attack rate at clear-cuttings were related to the amount of fresh and two-year old clear-cuttings in the surrounding, and connectivity measures. Preliminary results indicate significant influence of several the factors tested including connectivity. Possible mechanisms for the discerned patterns and possible implications for forest management planning are discussed.

POTENTIAL DISTRIBUTION OF HEMLOCK WOOLLY ADELGID IN NORTH AMERICA UNDER CHANGING CLIMATE

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Hemlock woolly adelgid (*Adelges tsugae* Annand, HWA), native to Asia, poses a major threat to survival of eastern (*Tsuga canadensis* L. Carr.) and Carolina (*Tsuga caroliniana* Engelm.) hemlock communities in the eastern USA. HWA can rapidly spread, infest, and kill hemlocks in all age- and size-classes, making it a major target of monitoring and control efforts. Information on the potential distribution and dispersal of the HWA in North America is critical for ongoing risk assessment and management. Spatial modeling with ecological niche models (ENMs) provides an effective tool for prediction of species distribution and projections of range shifts of pests in novel environments. Maximum Entropy (MaxEnt) is widely employed in ENM tasks and it only needs presence data and environmental information within the target area. The algorithm utilizes both continuous and categorical data, and includes an option to incorporate between-feature interactions. The Biodiversity Virtual e-Laboratory (BioVel project, http://www.biovel.eu/) provides a platform and workflow framework for scientists that enables use of large data sets for ENM modeling. Our goal is to use the BioVel platform to project potential distribution of HWA in North America under current and future climate conditions. Specific objectives include 1) calibrating MaxEnt models for potential distribution of HWA using historical native range observations from the Global Biodiversity Information Facility (GBIF) and WorldClim 10′ resolution climatic layers, 2) evaluate models with and without inclusion of host *Tsuga* spp. distribution data using the area under the ROC curves (AUCs) statistic and comparison to models calibrated with another common ENM, the Genetic Algorithm for Rule Set Production (GARP), and 3) project HWA distribution in in North America under current and future climate conditions. These predictions will aid in developing strategies to mitigate current and future risk to hemlock communities, and planning conservation and management actions for protection of these communities.

TESTING MITO-NUCLEAR DISCRODANCE AND *WOLBACHIA* HYPOTHESIS IN A PROCESSIONARY MOTH CONTACT ZONE

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We recently showed that ranges of the two species of the pine processionary moth complex, *Thaumetopoea pityocampa* (Dennis & Schiffermüller) and *T. wilkinsoni* Tams (Lepidoptera: Notodontidae), two dangerous and allergic forest pests in the Mediterranean Basin, contact in Turkey and few individuals bearing molecular evidences of a possible hybridization. However, the pattern of the hybridization and the factors affecting this pattern remained unsolved.

In this study, we asked two main questions: 1) What is the nature of the hybridization between the two species? 2) Do the endosymbiont bacteria, such as *Wolbachia*, contribute to this hybridization?

We analyzed COI, ITS-1, photolyase gene sequences, ITS-1 RFLP gel patterns and 13 microsatellite loci for 216 individuals from Turkey, Cyprus, Bulgaria, and Lebanon. We aimed to assess directionality and actuality of the hybridization. We also scanned the sampling for endosymbiont bacterial flora for further explanation regarding to the observed hybridization pattern.

We showed the limits of the contact zone, found signatures of past hybridization events in the nuclear genome and also a mito-nuclear discordance pattern. We found that the two parental species are well differentiated and backcrosses with the parental forms eroded much traces of hybridization in the contact zone. Microsatellite analyses did not reveal any first generation hybrids. This result along with mito-nuclear discordance that was found in 7 individuals in the contact zone triggered the hypothesis of endosymbiont bacteria contribution to the hybridization which is shown widely in the literature that to cause such discordance phenomena in the hybrid zones. To test this hypothesis, we extracted DNA from 10 individuals in each parental populations and 10 in the contact zone, amplified the extracted DNA with *Wolbachia*, *Cardinium*, *Arsenophonus*, and *Rickettsia* specific primers, and inspected electrophoretic agarose gel patterns with positive controls. We could not find presence of any of these bacteria in the analyzed individuals. This study did not support the hypothesis that the observed pattern of mito-nuclear discordance and asymmetric introgression is due to the endosymbionts.

Our next research concern will be phenology and mating behavior of the parental species and the hybrids.

POSTERS

– Poster № 1 –

DIVERSITY OF COLEOPTERA ASSOCIATED WITH *QUERCUS SUBER* IN CORK FORESTS, NORTH - EAST ALGERIA

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Algerian forests have important cork oak formations (*Quercus suber L.*), real conservatories of biodiversity. They are home to a diverse entomological wealth, where the beetles play an important role in the proper functioning of these ecosystems and represent a model of choice for evaluating the wealth of these environments.

Our study aims to characterize the diversity of beetles in the forests of cork oak of the Northeast Algerian area Edough (Seraidi - Annaba). We used different types of trap (Barber trap , air trap, colorful and container harvesting by hand) to achieve our harvest. In this region the most represented families are those of Carabidae, Cucujidae, Curculionidae, Tenebrionidae and Cleroidae, Anobiidae, Bostrichoidae, Cantharidae, Coccinelidae, Elteroidae, Hydrophyiloidae, Lucanidae, Latridiidae, Melandrydae.

The calculation of the diversity index shows that the forest stands are diversified and their environment is favorable to the installation of a large number of beetles. The equitability index close to one; shows that the observed diversity is near the maximum diversity. It translated an abundance of distribution close to balance. Beetles that we have identified, have diversified diets, predators are the most abundant group, monitoring of scavengers mecytophages , phytophagous , scavengers and dung.

– Poster № 2 –

SPECIFIC DIVERSITY AND SPATIAL DISTRIBUTION OF COLEOPTERA (INSECTA) IN THE BENI ALI FORESTS OF THE NATIONAL PARK OF CHREA (BLIDEAN ATLAS, ALGERIA)

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Ground beetles are often used to assess the impact of habitat changes. Few Algerian works have compared coleoptera communities between anthropized and natural forest stands. In this study we compared the diversity of the coleopteran fauna in terms of total species richness and species richness of trophic groups, within three forest sites from the Beni Ali Arboretum situated in the National Park of Chrea (Northern Algeria). In each station (an oak forest *Quercus ilex* L, an Aleppo pine forest *Pinus halepensis* L and an reforestation of *P. halepensis* station), we have defined three transects separated from each other 15m. The coleoptera fauna was harvested in two ways using traps or interception Barber pots as well as in view of the harvest herbaceous vegetation in trunks and dead wood bark . 15 traps were placed in each of the stations 5 traps at each transect and separated from each other by a distance of 10m. We conducted 14 surveys beetles from March to August

The total richness beetles vary from one station to another. The oak forest appears highest with 42 species. The Aleppo pine resort is represented especially by the families of Tenebrionidae and Scarabeidae on a total of 21 beetle families. By month, the Tenebrionidae are very abundant in July; while Scarabeidae are especially abundant in May but with lower numbers. In young plantations station, the abundances of the different beetle families seem weak. The Tenebrionidae and the Scarabeidae are best represented with Cicindelidae. The monthly change of the families indicates that the Tenebrionidae are especially abundant in July and August, Scarabeidae are more precociously abundant in June while Cicindelidae were especially abundant in our surveys in April. Among all the beetles' families of oak station, the Tenebrionidae as well as Scarabeidae are among the most representative families whose abundances are highest. However, the presence of Staphilinidae is distinguished with significant temporal abundances between 7 individuals in May and 20 individuals in July. The correspondence analysis allowed to recognize the different trophic groups and temporal diversity of communities per station. Phytophages and coprophages are relatively more frequent and are dominating among species. Our results highlight that vegetation cover and landscape heterogeneity seem necessary to preserve overall ground beetle specific diversity.

– Poster № 3 –

BIOLOGICAL AND CHEMICAL ENDOTHERAPY AGAINST *PHYTOPHTHORA* SPECIES PATHOGENIC TO BROADLEAVED TREE SPECIES IN POLAND

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We report here an innovative approach where biological control agents, such as *Trichoderma* spp. and *Bacillus amyloliquefaciens*, were used in biocontrol endotherapy trials against several *Phytophthora* species, *Phytophthora cactorum*, *P. quercina* and *P. plurivora*. These major pathogens of *Quercus robur* and *Fagus sylvatica* cause important losses in nurseries and forest stands. The efficiency of such biocontrol treatments was compared with the endotherapy by phosphonate. *Phytophthora* species are particularly aggressive plant pathogens and are often associated with the decline of many tree species, including oak and beech. Several fungi and bacteria species are known as potential antagonists usable as biological control agents. Phosphonate (H_3PO_3), commonly known as phosphite, has also been used in the recent past to protect trees against invasive *Phytophthora* spp. In this study, nine antagonistic fungal strains belonging to the species of *T. asperellum*, *T. atroviride*, *T. aureoviride*, *T. hamatum* and *T. harzianum*, as well as two bacterial strains of *B. amyloliquefaciens*, were first tested for their high inhibitory activities against *P. cactorum*, *P. quercina* and *P. plurivora*. The efficiency of three selected endophytic species *T. atroviride* (2 strains), *T. harzianum*, and *B. amyloliquefaciens*, was then assessed in comparison to a phosphonate treatment. Two application methods were used in this study: the injection of a solution of spores or phosphite into the sap vessels of beech and the foliar treatment of oaks. The phosphite and two strains of *Trichoderma* have significantly reduced the necrotic areas on oak leaves inoculated with *P. plurivora* and one strain of *Trichoderma atroviride* significantly reduced necrotic areas on beech branches. The results confirm that the approaches used in this study may offer a novel and efficient approach to control *Phytophthora* species in forest nurseries and stands.

– Poster № 4 –

GENETIC DIVERSITY OF THE INVASIVE BOX TREE MOTH, *CYDALIMA PERSPECTALIS,* IN ITS NATIVE AND INVADED AREAS AND PRELIMINARY PHYLOGEOGRAPHIC APPROACH

Audrey Bras[1], Gabor Vetek[2], Dinka Matosevic[3], Evangelia Chatzidimitriou[4], Valery Shurov[5], Stanislav Gomboc[6], Milka Glavendekić[7], Stefanie Göttig[8], Annette Herz[8], Ivanka Ivanova[9], Gabrijel Seljak[10], Katalin Tuba[11], Alain Roques[1], Hongmei Li[12], Marc Kenis[13] & Marie-Anne Auger-Rozenberg[1]

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During the recent decades, ornamental plant trade has triggered the introduction of alien invasive insects in Europe. An ever increasing number of these alien species originates from Asia, such as the box tree moth *Cydalima perspectalis*, a species native of China, Korea and Japan, which has recently been introduced into Europe. Since its first observation in Germany in 2007, the box tree moth has spread rapidly all over Europe, causing important damage on commonly planted ornamental box trees. The ornamental trade between Europe and China is hypothesized as the pathway of its primary introduction while the trade within Europe could have favored its rapid spread. In order to disentangle invasion pathways, samples of *C. perspectalis* were collected in China, Korea and in 13 of the 25 invaded European countries. We analyzed 174 sequences of mitochondrial markers COI and COII from the native and invaded areas in order to check the genetic variability, and to develop a preliminary phylogeographical approach. In the Asian populations, we observed 7 haplotypes divided into 3 haplogroups, and 4 of those haplotypes were also observed in Europe. Our preliminary results did not show evidence of genetic structure in the native range, which did not allow to define the potential donor regions but the presence of several Asian haplotypes in Europe in addition to a low but significant geographical structure is in favor of multiple introductions. Nevertheless, more populations need to be sampled in the area of origin together with the definition of more polymorphic markers in order to better understand the invasion pathways of *C. perspectalis*.

– Poster № 5 –

BARK BEETLE DISTRIBUTION IN RELATION TO CLIMATE VARIABILITY AND OTHER FACTORS IN MEXICAN THREATENED FORESTS

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The bark beetle has increased its density population all over the world. It is becoming a problem all over North America affecting hundreds of square kilometers of coniferous forests. These large coniferous, mainly *Pine spp.*, affected areas in Mexico are receiving the attention of national forest institutions, such as CONAFOR, as cleared death forests areas are increasing. The purpose of this investigation is to explore the relations between climate and other factors, such as forest health, to set the base line for further preventing phytosanitary management of Mexican Forests. We establish 361 traps, 169 controls and 192 pheromone baited, from South through North, covering the Eastern Sierra Madre, Western Sierra Madre and the Transmexican Neovolcanic Belt in 11 states in México. Traps where set on an altitude gradient on 27 sampling sites (the number of sites was different in each region) along with a temperature and humidity data loggers. We collected 120,027 bark beetles, being the central part of México the region with the highest abundance. We identified 13 morphospecies, being *Dendroctonus frontalis* the most abundant followed by *D. mexicanus*. Time series from climatological stations closed to sites, showed different tendencies. While some parts of México showed a tendency of an increasing minimum temperature others showed a decrease or no significant tendency at all. This study is a preliminary report of a three-year national effort between nine Universities and Research Centers.

– Poster № 6 –

USE OF THE PANEL PRISM TRAPS FOR THE MONITORING OF THE GENUS *AGRILUS* IN SLOVAKIA

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The emerald ash borer (EAB), *Agrilus planipennis*, has been introduced into North America where it now occurs in 25 states (US) and 2 provinces (Canada). Purple and green sticky panel prism traps (PPT) are sold by pest management companies in North America and have been demonstrated to effectively capture EAB in the US (purple PPT) and Canada (green PPT).

Because other *Agrilus* species could be aggressive like EAB, we wanted to test the attraction of commercially available traps and lures to native *Agrilus* species in Slovakia.

In 2013, experiments were carried out in oak, poplar and beech sites (60 PPT per site). 30 green and 30 purple PPT were placed at each site (1/3 baited with cubeb oil, 1/3 baited with Z-3-hexenol, 1/3 blank). At the poplar site, 99% of all *Agrilus* specimens were *A. convexicollis* and the majority of these (97%) were captured on green PPT. At the oak site *Agrilus sulcicollis* was the most commonly captured species and 71% of all specimens were captured on purple PPT. At the beech site, *A. viridis* and *A. olivicolor* were the most commonly captured *Agrilus* species. The presence of the cubeb oil lure appeared to increase attraction of *A. viridis* to purple PPT.

In 2014, 2 experiments were conducted in beech forests. In the 1st experiment, 4 treatments were tested: blank purple PPT; purple PPT baited with cubeb oil; blank purple non-sticky intercept panel traps (IPT); and purple IPT baited with cubeb oil. Baited PPT captured significantly more *A. viridis* than all other treatments; an average of 15.4 imagoes or 81% of *A. viridis* specimens were caught on baited PPT. In the 2nd experiment, the attraction of *A. viridis* to various coloured IPTs was tested. Yellow, green, red and purple IPTs were either baited with cubeb oil or were blank (10 replicates per treatment). All treatments were ineffective at capturing buprestids.

Our results provide new information and insight into detection methodology for buprestids in central Europe. From 2015 onwards, our research in this field will continue.

– Poster № 7 –

THE FAUNA OF ALEPPO PINE CONES COLLECTED IN THE FORESTS OF NORTH EASTERN ALGERIA

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The Aleppo pine a major forest caital around the Mediterranean area. In Algeria, it occupies more than 35% of the total forest area of the country. These pine forests have very modest ecological requirements for weak but acceptable productivities, hence its widespread use as a variety of reforestation. The Aleppo pine cone is considered as a microhabitat which can accommodate a large faunal diversity.

This study aims to provide an exhaustive list different arthropod species that colonize the Aleppo pinecones. For this, we have chosen two study sites located in north-eastern Algeria, the region of Guelma and the region of Souk-Ahras.

Significant differences in species abundance in the cones were observed from one season to another, with higher abundance denoted in winter and that on the two study sites. All species recorded were classified and identified according to their diet, which allowed us to distinguish two kinds of guilds: the conophytes species as Orsillus sp, Ortholomus sp and the Leptoglossus occidentalis, which are part of the order of Heteroptera, but also hétéroconophytes species which are part of the order of the Spiders, Acarina and Coleoptera.

The results allowed us to note the presence of 45 species in the area of Souk Ahras, including 27 species of insects, 15 species of spiders and 3 mite species. Concerning the site of Guelma 49 species were observed, among we find 24 species of insects, 22 species of spiders and 3 mite species.

– Poster № 8 –

BOX TREE MOTH *CYDALIMA PERSPECTALIS* (WALK.): DISTRIBUTION, IMPACT AND PEST MANAGEMENT IN SERBIA

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The box tree moth *Cydalima perspectalis* (Walker) (Lepidoptera: Crambidae) originates from Asia. In 2014 it was for the first time recorded in Serbia. The research on distribution, phenology and ecology of box tree moth were done in semi-urban area and in urban green infrastructure in Belgrade, Šabac, Novi Sad, Vršac, Sremski Karlovci, Valjevo and Ljig. During the research, were applied standard methods in entomology. All developmental stages were reared in the laboratory of Faculty of Forestry

Box tree moth has been found in Belgrade in July 2014 for the first time in two nurseries. They have developed trade with Italy and Croatia. In the surrounding many private gardens were severely defoliated. It was occupied approximately territory of 5.560 ha. Till October 2014 box tree moth expanded its range to almost 20.000 ha. In 2015, due to trade with plants for planting, moderately to severely infested plants were recorded from the nursery 75 km to the south from Belgrade and in private gardens in Mionica and Valjevo, which are 80- 90 km from the place of the first infestation. It is likely that both plants for planting and active flight of box tree moth contribute to its rapid spred in Serbia. Severe damage was recorded on host plant *Buxus sempervirens* L. Lower level of infestation was found on *B. microphylla* Siebold & Zucc. was. Urban green infrastructure is the most affected such as small trees, shrubs or hedges in private gardens, cemeteries, arboreta, botanical gardens and parks. Very valuable hedges 20-60 years old were cut and destroyed because of severe infestation.

Pest management include visual phytosantary inspection of plants for planting on the border, in garden centers and nurseries. Education of phytosanitary inspectors, forest inspection and agricultural extention service was done in January and July 2015. Public awereness was impoved by seminars and delivering information about box tree moth on web sites, articles in newspapers, electronic media and TV programme. Trials were condicted with the aim to find the most appropriate control measure.

The research has been done in the frame of research on Projects III43002 and III43007 supported by Ministry of Education, Science and Technological development of Serbia.

– Poster № 9 –

OBSERVATIONS ON THE FLIGHT PHENOLOGY AND BIOLOGICAL CHARACTERISTICS OF THE BOX-TREE MOTH *CYDALIMA PERSPECTALIS* WITH LIGHT AND PHEROMONE TRAPS

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A long term trapping of the invasive Box-tree moth *Cydalima perspectalis* was conducted at two locations in Hesse (Darmstadt and Seligenstadt), in southern Germany. Seasonal phenology of adult flight was surveyed over a time period of three years between 2012 and 2014 by light trapping. In parallel an effective pheromone trap system was developed between 2013 and 2015. Annual course and basic data on the appearance of the gender and the different morphovarities of *C. perspectalis* were obtained.

A recurrent surplus of catched male moths could be detected as well as the mean proportion of 84 % moths of the white and 16 % moths of the brown morphovariety. This distribution could be observed every year.

Two flight periods per year were identified. The first flight phase is relatively weak with a peak at the beginning of July. It is followed by a very extensive and intensive flight phase of the second generation from mid-August until October with a peak in September. This could also be proved by a comparison of the moth catches by the pheromone traps of the two locations and the light trapping results per month.

– Poster № 10 –

ENTOMOLOGICAL BIODIVERSITY IN SEMI-ARID ALGERIAN FORESTS: THE CASE OF BIO-INDICATOR BLATTELLIDAE IN PINEWOOD

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In North Africa, little research has been done on wildlife Orthopteroid and especially on Dictyoptera. Cockroaches are species that live at night and take shelter in places that provide a suitable microclimate and allow them to have easy access to food. These species are considered bioindicator of the forest health as they play an important role in decomposition of organic matter in the soil.

To identify the different cockroach's species existing in Algerian forest, we made an inventory of this insect that live in semi arid areas through monthly crops harvested in Aleppo pine forests of Aflou region (34 06'50"North °, 2 ° 05'50" East and more than 1400 m above sea level).

Six species of cockroaches were collected from different sites: *Loboptera decipiens*, *Loboptera ovolobata*, *Dziriblatta nigriventris*, *Dziriblatta stenoptera*, *Phyllodromica trivittata* and *Ectobius sp*. The kind *Loboptera* is the most represented, followed by the genre *Ectobius, Dziriblatta* and finally the genre *Phyllodromica*.

– Poster № 11 –

RECENT INVASION OF THE CHESTNUTS IN WESTERN TURKEY BY THE CHESTNUT GALL WASP, *DRYOCOSMUS KURIPHILUS* AND EARLY MANAGEMENT PRACTICES BY USING THE PARASITOID WASP, *TORYMUS SINENSIS*

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The most important insect pest of chestnut, chestnut gall wasp, *Dryocosmus kuriphilus* Yasumatsu (Hymenoptera: Cynipidae) was detected in April 2014 in Yalova and Bursa Regions in Turkey. The invasion probably started at least six years ago and it is expected to reach all the Turkish chestnut forests in a very near future. A year after its detection in Yalova, it reached to the adjacent regions (Karamürsel and Bursa, max. 20 km from the original infestation area) by April 2015.

Management of the chestnut gall wasp is a hard task. Chemical insecticides are mostly unsuccessful and not preferred in natural stands. Some cultural measures could be taken in private orchards. The most successful method so far has been producing and releasing the parasitoid *Torymus sinensis* Kamijo (Hymenoptera: Torymidae). After the pest's first record in Turkey, a laboratory for rearing *T. sinensis* has been built in Yalova by the Turkish General Directorate of Forestry, Department of Forest Pest Management and it has been activated by March 2015. First management trials started with *T. sinensis* adults transported from Padova Uni. (Italy).

Chestnut gall wasp has an important component of its community as being in interaction mainly with oak gall wasps and their parasitoids. 11 parasitoid species has already been found in chestnut gall wasp galls in Turkey. This system will get even more complicated and interesting for community ecology studies with addition of *T. sinensis*. As a general principle, structuring a successful pest management study depends on understanding potential impacts of the control measures at the ecosystem and community level. Chestnut gall wasp system is not an exception to this principle. The Yalova Laboratory will be serving mainly to management practices but also to studies related to community ecology.

This study aims to summarize measures taken and applications made so far in terms of management of the chestnut gall wasp invasion in Turkey.

– Poster № 12 –

MONITORING METHOD OF DAMAGE DYNAMICS CAUSED BY *CAMERARIA OHRIDELLA* AND *GUIGNARDIA AESCULI* ON YOUNG TREES OF *AESCULUS HIPPOCASTANUM*

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Non-destructive methods for taking a leaf area are intensively developed in recently years. We propose a method for fast data collecting from leaves and crowns using simple digital camera and professional software for analysis. Current observations connected with additional measurements (e.g. temperature, humidity, leaf thickness) can explain which factors response for dynamics of fungal diseases and development of herbivore organisms and interactions between them. First aim of the study was to solve problems connected with this method in the case of damage dynamics measuring caused by fungi and herbivorous insects on the leaf and crown level. Second was to define correctness of getting this type of data.

Images were taken with digital camera equipped with wide angle lens, what is justified for taking photographs from a short distance. To eliminate the aberration connected with wide angle lens, camera with function "distortion correction" were used. Parallelism between camera and photographed object were set up with round levels. Camera was mount on tripod stand. For every image objects with known dimensions for taking proportions were used. Images of leaves and crowns were analyzed in WinFolia Pro 2013 (Regent Instruments Inc.). Color analysis allowed to exclude background and to measure area of healthy and damaged area separately.

To check leaf level measurement precision 28 leaves of *Aesculus hippocastanum* were collected then photographed and scanned. Scans and photographs were compared. Error of leaves areas ranged from -1,16% to 1,85%, and it is mainly linked with not perfect parallelism between camera and photographed object. This value of error is acceptable in case of measuring development of leaf mine and disease dynamic. It also allows to compare different leaves. Additionally, for crown imaging calibration were made with which it is possible to compare crowns of different trees.

In case of title problem data have been received as fallow: remaining photosynthetic active surface (relative to initial area), leaf mine number and size, area of infested tissue separately for fungus and insect, time taken for larval stage development, appearance and dynamics of new infections. This method can be recommended for any observations on leaves, especially low located on trees and shrubs.

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– Poster № 13 –

BUDWORM TRACKER: HARNESSING CITIZEN SCIENTISTS TO MONITOR SPRUCE BUDWORM

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For many science organizations, Citizen Science programs are becoming increasingly used as a low-cost solution to help collect essential data on organisms of interest. However, although examples of successful Citizen Science programs developed to aid conservation programs are fairly common, there are still relatively few examples of these programs in the context of integrated pest management. We will present on the development, implementation, and costing of our Citizen Science program for spruce budworm (aka, 'Budworm Tracker'), which is the major defoliating pest of spruce and fir in Canada. This program has become an invaluable and significant cost-saving method for monitoring the activity of spruce budworm moths throughout Atlantic Canada.

– Poster № 14 –

COMPARISON OF THE VIRULENCE OF TWO *ISARIA FUMOSOROSEA* WIZE STRAINS FOR *HYPHANTRIA CUNEA* DRURY (LEPIDOPTERA, ARCTIIDAE)

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The American fall webworm *Hyphantria cunea* is a highly polyphagous insect with approx. 600 host plant species, causing considerable damage. Two generations/year and it´s high fecundity make the control of *H. cunea* a challenge. To reduce the use of chemical pesticides, entomopathogens are considered as a biological control option.

We report on laboratory experiments with *Hyphantria cunea.* Two strains of *Isaria fumosorosea* (Ascomycota: Cordycipitaceae) isolated from *H. cunea* in Georgia (ARSEF access no. 10244) and isolate ARSEF access no.1569 were tested. We studied the virulence of each individual isolate as well as a mixed suspension against larvae of *H. cunea* and effects on adult emergence.

Conidia of *I. fumosorosea* were obtained by washing down the fungal rearing tubes with sterilized water. Concentration of suspensions was determined with a haemocytometer. Suspensions of $2*10^9$ conidia / ml were used in experiments with 4^{th} to5^{th} instar larvae of *H. cunea* of the first generation. Larvae were placed in a petri dish for 24 h. Infection occurred by surface contact with 1 ml of conidial suspensions, placed on filter paper discs (Ø 100 mm) in the Petri dishes. Control larvae were exposed to water instead of conidial suspension. Experiments were carried out at temperature 25 ± 2^o C and 60 % RH. After the treatment larvae were fed on leaves of *Morus alba*. Insect mortality was recorded daily and efficacy corrected with mortality in the control treatment was calculated according to Schneider-Orelli's formula.

At day 3 post treatment, mortality rates of 25 %, 46,8 % and 43,7 % by isolate ARSEF access no. 10244, isolate ARSEF access no. 1569, and mixed suspension, respectively, were recorded. Mortality rates increased to 37,5 %, 68,7 % and 65,6 % at day 9 post treatment with the resp. treatment. At the end of the experiment, 50 %, 25 % and 27 % adults emerged from the larvae exposed to the resp. treatment, while 80 % of adults in the control group emerged.

The results of this study suggest that *I. fumosorosea* isolate ARSEF access no.1569 was more virulent than the Georgian *I. fumosorosea* isolate ARSEF access no. 10244. Effects of the mixed suspension of both isolates did not differ from the results obtained with isolate ARSEF access no. 1569 alone. More experiments should be conducted to evaluate further the effects of the Georgian *I. fumosorosea* isolate in combination with other fungal isolates for biological control, not only of *H. cunea*, but of other important pest insects.

– Poster № 15 –

THE INFLUENCE OF ADULT AGE ON SEX RATIO IN THE FLEA BEETLE *ALTICA BREVICOLLIS CORYLETORUM* – A PEST OF *CORYLUS AVELLANA*

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A study was conducted on the monophagous beetle, *Altica brevicollis coryletorum* (a pest of *Corylus avellana*). This beetle species has a life cycle with emergence of current-year adults in summer, and reproduction of 1-year-old insects in spring. *A. brevicollis coryletorum* feeds mainly on leaves of sunlit shrubs. The present study was designed to determine how insect age (current-year vs. 1-year-old, after winter diapause) affects body mass and the ratio of females to males (F/M) in a natural environment. Additionally, how these relationships are affected by light conditions of host plant growth was examined. Among the many parameters that reflect more favourable living conditions for insects, e.g. shorter duration of larval development, increased potential fecundity and realized fertility, the most frequently recognized and easily measured parameter is body mass. The sex ratio F/M may also be used to evaluate living conditions, preferences in the selection of favourable sites for offspring, and to explain differences in the body mass of beetles, depending on their age, before and during reproduction. We hypothesized that a change in body mass in current-year insects would be determined only by the amount of consumed food, while the sex ratio would be relatively stable. In 1-year-old insects, we assumed that females would die shortly after oviposition, while males would be active on shrubs for a prolonged time.

Results confirmed the hypothesis that in summer (current-year), after the eggs hatch into larvae, the body mass of both male and female adult beetles increases. During that period, the F/M ratio is relatively stable. In the following spring, the F/M ratio changes dramatically, primarily due to the disappearance of females at a period of time after oviposition; resulting in fluctuations of the mean mass for females. In this species 1-year-old beetles were heavier than current-year beetles. The preference of *A. brevicollis coryletorum* for sunlit leaves of *C. avellana* results in a higher body weight in both seasons. The data indicate seasonal fluctuations in body mass and changes in the F/M ratio in 1-year-old beetles, due to the entrance into their reproductive period.

Taking into account the different adaptations of males and females to their distinct reproductive roles, seasonal fluctuations in body mass and the F/M ratio occur in relation to the reproductive cycle. We believe that additional research on other species in the Chrysomelidae, or in other insect families possessing species that have a similar life cycle, will confirm our conclusions.

– Poster № 16 –

MONITORING OF THE MOST HARMFUL PESTS IN FORESTS OF SLOVAKIA USING WEB GIS APPLICATION

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Complex influence of insect pests affecting in parallel or subsequently is the most important problem in forest protection. In the recent years the insect damages in forests of Slovakia rapidly increased. There is a need for managing and displaying the distribution of the most harmful forest pests at both spatial and temporal scales. To collect the data on the presence, distribution and abundance of approximately twenty most harmful species of forest pests, we are developing an online Web GIS application using ArcGIS API. Data on the incidence of harmful agents into the system will be recorded by specialists of Forest Protection Service (FPS), foresters and public users. Monitored pests will be described on the project website. This will simplify identification of monitored pests. We expect that the improved web-based data collection tools will result in increased data availability and thereby new opportunities for risk assessment. Based on spatially recorded data we may identify, understand and model patterns of insect pests spreading and so predict the future population increases and point the areas where the pest management should be carried out to prevent the mass outbreak of these pests. Foresters and researchers will take great advantage of variety information which provides critical implications for forest management and decisions making. Developed GIS application will enable using of advanced GIS functionalities to a broader user spectrum without need for specialised GIS software; only standard information infrastructure (basic hardware, software and Internet connection) will be required.

– Poster № 17 –

EFFECT OF HEALTH STATUS OF CORK OAK LEAVES ON THEIR CONTENT OF ALLELOCHEMICALS COMPOUNDS

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The Algerian forest represents an essential element of the ecological, climatic and socioeconomic balance of various regions of the country. His current situation appears as one of the most critical in the Mediterranean region indeed, the obstinacy of the destructive factors such as the fires, the surpâturage, the clearings and the parasitic attacks, is only stressing the process of degradation of the forest system.

We were interested to the evaluation of the sanitary state of the populating of cork oak through the examination of leaves from cork oak forest of the National park of El Kala, through the search for the biotics agents and quantification their damages.

Leaves were the object of an examination in the laboratory, classified according to their sanitary state (Healthy leaves and damaged leaves). The damaged leaves are classified according to the nature of the damage: leaves attacked by phytophagus, leaves presenting necroses, brown spread spots the limb, the leaves affected by galls or cécidie. We also estimated the damaged foliar surface and classified the rate of destroyed or damaged surface.

To know the chemical composition leaves of cork oak, extracts are realized with two solvents: the pentane and the dichlorométhane (CH2Cl2), The identification of compounds was realized by coupling chromatography / spectrometry (GC / MS) in the Research laboratory on the Aromas of the INRA of Dijon (France).

The results translate an abundance of damaged sheets(leaves) and it during the period of study (on 2011, 2012 and 2013) with rates in the order 77,4 %, 73,3 % and 84,6 %.

We obtain after analysis by chromatography in gas phase various extracts of leaves show comparable profiles whatever is the type of used solvent. Hundred diverse compounds, in more or less big concentration, were able to be detected in the various extracts. The aromatic fraction consists of a volatile fraction (consisted chemical of low molecular mass) and of a not volatile fraction (consisted chemical of molecular mass superior to 200).

The percentage of the volatile fraction and that of the heavy fraction depend on the type of used solvent.

– Poster № 18 –

EVALUATING OF FOUR-YEAR LABORATORY REARINGS OF *RHIZOPHAGUS GRANDIS* GYLL. IN ORIENTAL SPRUCE FRESH LOGS

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Among the bark beetles causing significant damages with epidemic populations, the great spruce bark beetle, *Dendroctonus micans* (Kugelann) (Coleoptera: Curculionidae, Scolytinae), is well known with its effective damage in the oriental spruce, *Picea orientalis* (L.) Link, forests of Turkey. Apparently positive outcomes have been obtained in the oriental spruce forests in the course of the biological control against this, upon having the specific predator of *D. micans*, *Rhizophagus grandis* (Gyllenhal) (Coleoptera, Rhizophagidae) within the larval galleries of the destructive beetle inside fresh spruce logs under specific conditions of temperature and moisture at the laboratory environment.

In this study, having been performed in between the years 2004-2007 under average conditions of 21±1°C temperature and %75±5 relative humidity maintained in the growth medium, the number of eggs, prey depletion ratios, and death ratios in various biological stages as per the different male and female ratios of the predator were observed within the breeding logs within two successive rearing periods in the same year. Total of 35,784 *R. grandis* individuals were placed in total 353 spruce fresh logs throughout the years of the study. New egg numbers of a mature female *R. grandis* are 18.28, 18.72, 5.75 and 17.56 in average during the successive years of the study.

As per the 8 female and 4 male *R. grandis* placed in rearing logs, the number of the new eggs yielded there from was 22.71 for the first period, and 11.65 for the second period of the first year of the study. In the second year of the study, the number of the new *R. grandis* eggs yielded from the 6 females and 2 males placed in the logs for the first period was 22.13, and the same yielded from the logs placed with 8 females and 4 males was 12.28. As per the 8 female and 4 male *R. grandis* placed in growth logs, the number of the new eggs yielded there from was 20.47 for the first period, and 12.69 for the second period of the fourth year of the study. Number of the new eggs yielded from the logs being kept under the same conditions decreased significantly in the third year in comparison with the same figures from the previous years. In that year, the number of the new *R. grandis* eggs yielded from the 6 females and 2 males placed in the logs for the first period was much more than those yielded for the second period from the logs placed with same number of females. According to the biological stages, mortality ratio of *R. grandis* is 3.88% among the matures, 7.49% among the pupas, and 62.95% among the pre-pupas.

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– Poster № 19 –

FIRST TRIALS OF PATHOGENS CLEANSING WITH *BACILLUS AMYLOLIQUEFACIENS* AND *TRICHODERMA ATROVIRIDE* TO REMOVE OPPORTUNISTIC PATHOGENS IN TREES

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We report here an original and novative approach where biological control agents were used as endophytes in order to remove an endophytic opportunistic fungal pathogen. An initial search for endophytes in *Castanea sativa* grafting scions showed that an opportunistic pathogen fungus *Gnomoniopsis smithogilvyi* was present as the major component of the endophytic flora in chestnut tree scions. Already known in Italy and Australia as a pathogen affecting chestnuts, we described it elsewhere as the cause of canker symptoms very similar to the one caused by *Cryphonectria parasitica* on twigs and scions. Preventive biocontrol experiments were carried out with chestnut tree scions soaked overnight in a liquid suspension of *Bacillus amyloliquefaciens* strain UASWS BA1. This bacterium was then frequently found in the lower parts of scions and up to a height of 18 cm. It has been observed that when *B. amyloliquefaciens* was present, the endophytic and opportunistic pathogenic fungus *G. smithogilvyi* was not present. Conversely, the parts not colonized by the bacteria were always naturally infected by the endophytic fungus. This would indicate that the endophytic behavior of *B. amyloliquefaciens* inhibited the growth of *G. smithogilvyi* and reduced its presence in chestnut tree scions. A similar experiment, carried out with the biological control agent *Trichoderma atroviride* strain ITHEC45, led to similar observations. *T. atroviride* was frequently found in the lower parts of scions and up to a height of 27 cm. Inoculating *B. amyloliquefaciens* and *T. atroviride* as part of a preventive biocontrol treatment would allow these biological control agents (BCAs) to colonize the plant as endophytes and prevent the development of pathogens.

– Poster № 20 –

INTERACTIONS BETWEEN POPLAR AND NATIVE AND NON-NATIVE DEFOLIATING INSECTS

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The complexity of the interactions between plants and herbivorous insects is due to the fact that the interactions vary in relation to the species and to the environmental factors. We analyzed the consequences of previous defoliation on the feeding activity of *Lymantria dispar* (generalist native), *Hyphantria cunea* (generalist invasive) and *Melasoma populi* (specialist native) using poplar (*Populus nigra*) as model native plant. The aims of this study were to compare the effects of defoliations induced by native versus invasive insect species and specialist versus generalist insect species on the defoliated trees and on neighboring, non-defoliated plants.

An experiment was carried out during two years (2014 and 2015) using potted cuttings of poplar grown in field conditions. Cuttings were defoliated mechanically or with the two polyphagous insect in 2014, whereas mechanical defoliation was substituted with *M. populi* in 2015. The experiments were carried out with the same methods in the two years, although in 2015 a fertilization treatment was necessary to prevent plant dieback. The feeding activity of insects was evaluated in laboratory conditions, where disks of leaves taken from cuttings subjected to different treatments were offered to insects both in choice and no-choice trials.

The results showed differences among insect species and years. In 2014, both native and invasive generalist species showed a low feeding activity on leaves of previously defoliated plants, with similar behavior between the two species, whereas the specialist *M. populi* did not show any preference. As for of the leaves of neighboring plants, they reduced the consumption of generalist species compared with those defoliated and control, but with a high variability in the response. In 2015, on the contrary, no statistically significant differences have been detected in the feeding activity of the three species, although the native generalist showed a lower feeding activity on leaves of previously defoliated plants. It is likely that during 2015 the growth of the plants was promoted by resource availability (nutrient, light) and the plants invested more in growth than in defense, while the reverse was observed in 2014, as indicate in growth-differentiation balance hypothesis.

– Poster № 21 –

SELECTION OF BIOLOGICAL CONTROL AGENTS AGAINST *PHYTOPHTHORA* AND *PYTHIUM* SPECIES PATHOGENIC OF FOREST TREES IN POLAND

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The oomycetes *Pythium*, and *Phytophthora* are acute pathogens of broadleaved and conifer trees, which contribute to forest dieback. Polish forest nurseries and stands are often contaminated with such pathogenic *Phytophthora* and *Pythium* species, which have high ecological and economic impacts. The present work aimed to screen a selection of fungal and bacterial biological control agents (BCAs), from diverse commercial or experimental sources, for their potential to reduce the growth of *Phytophthora* and *Pythium* species. The following pathogens, *Phytophthora alni*, *P. cactorum*, *P. cambivora*, *P. cinnamomi*, *P. citrophthora*, *P. gonapodyides*, *Pythium anandrum*, *Py. citrinum*, *Py. flevoense*, and *Py. sterilum* were exposed to BCAs. The tested bacteria were strains of *Bacillus subtilis*, *B. amyloliquefaciens*, *Cryptococcus albidus*, *Pseudomonas fluorescens*, *P. syringae*, *P. viridiflava and Streptomyces griseoviridis* as well as 12 unidentified strains isolated from Polish forest soils. The fungal species used were *Trichoderma harzianum* (5 strains), *T. asperellum*, *T. atroviride*, *Gliocladium catenulatum* and *Microsphaeropsis ocharacea*. In vitro experiments included a first round of direct confrontation or crossed co-cultures on PDA plates after which most efficient antagonists were retained for a second selection step. *In vivo* experiments involved the germination of oaks *Quercus robur* and *Q. rubra* in soil plots infected by *P. cinnamoni* with or without BCA protection (*B. amyloliquefaciens*, bacteria B12 and *T. harzianum* B33), as well as the infection of 1-year old beech seedlings *Fagus sylvatica* with *P. cambivora* in the presence or the absence of BCA protection (*B. amyloliquefaciens*, bacteria B12 and *T. harzianum B33).* The most efficient antagonists identified were *Trichoderma* spp., *G. catenulatum*, *B. amyloliquefaciens* and the soil bacteria B3 and B4. *In vivo* experiments on *Q. rubra* and *Q. robur* seedlings growing in infected soils showed a lower rate of infection and root protection effect against *P. cinnamoni* provided by *B. amyloliquefaciens*, bacteria B12 and *T. harzianum* B33. The same antagonists displayed a protective effect on *F. sylvatica* plantlets infected with *P. cambivora*.

– Poster № 22 –

CHANGES IN POPULATIONS DENSITIES OF *MELOLONTHA* SPP. (COLEOPTERA: SCARABEIDAE) IN CENTRAL POLAND STANDS UNDER DIFFERENT SYLVICULTURAL MANAGEMENT

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White grubs of European cockchafers (common European cockchafer *Melolontha melolontha* L. and forest European cockchafer *M. hippocastani* F.) cause severe damage of Polish forests, especially in plantations and nurseries. Due to their feeding on plants' roots these insects belong to soil pests affecting reforestation and afforestation. Forest protection against white grubs of *Melolontha* spp. cannot use chemicals poisoning for the environment. Still there is a lack of proper methods that would be sound for environment, as well as knowledge about biology of the insects is quite inadequate. The understanding if environmental conditions created by sylvicultural management may impact the density of *Melolontha* spp. population could help in better pest management. Life cycles of the two species last 3-5 years. Phenology of both species is very similar in Poland and a discrimination between individuals of two species is possible only on molecular level during larval instars and is easily done with the help of differences in morphology when they are adults. In Poland these species have been usually moulting once a year.

In presented work changes in populations densities of *Melolontha* spp. going in stands (central Poland) under different sylvicultural management were monitored since spring 2011 till spring 2013. The study was carried out in fresh coniferous forest in Opoczno Forest District and fresh mixed broad-leaved forest in Kozienice FD. Experimental areas in Opoczno and Kozienice FD were established, based on exposure to sun light and meteorological factors, in four treatments such as: I -well-stocked stand, II -medium-stocked stand, III-artificial gaps and IV-clear cutting area. The assessment of population density of *Melolontha* spp. was done every year in spring and autumn. Soil from 12 trial pits (100 cm x 50 cm x 70 cm) per treatment was thoroughly searched and all white grubs and adults were found.

Significant differences were found in population density of L_2 white grubs of *Melolontha* spp. depending on a kind of sylvicultural management. In fresh mixed broad-leaved forest the population density of L_2 white grubs decreased according to a growth of treatment exposure to the sun light and meteorological factors. There were significant differences between treatment I and III, I and IV and also between II and IV. In fresh coniferous forest the similar dependency was observed, but the only significant difference was between treatment I and IV. In presented paper the sylvicultural management did not influence population density of *Melolontha* ssp. adults (assessed in trial pits) and L_3 white grubs (checked only in Kozienice FD).

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– Poster № 23 –

THE EXPERIMENTS WITH ATTRACTANTS IN BAITED PITFALL TRAPS FOR CONTROL OF *PISSODES CASTANEUS*

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Small banded pine weevil *Pissodes castaneus* (De Geer.) is one of the most dangerous pests of Scots pine *Pinus sylvestris* L. plantations and thickets infested by root fungi and/or damaged by game and other insect species or weakened by abiotic factors. It is a species commonly found in Europe and North Africa as well as South America. In Poland, the area of its occurrence fluctuates within a few thousand hectares per year. At present there are no effective methods to protect stands against this species, besides pulling and burning trees colonized by the pest.

The aim of the studies carried out in 2011-2013 was the search for chemical compounds that attract *P. castaneus* beetles and the development of traps to catch them.

The olfactory tests were performed to determine the reactions of beetles to the smell of fresh pine twigs and 2 compounds: grandisol i grandisal, described as aggregation pheromones in the 70s of the last century. The newly hatched beetles that were feeding on pine twigs or not were used in the tests. While in the field experiments the catches of beetles to the different types of traps (in the shape of cross, white or green bucket and pipe) hung on trees or laid on the soil surface were investigated. All traps contained α-pinene, ethanol, grandisol and grandisal as the attractants.

The olfactory studies have shown that more than 60% of not feeding beetles were attracted by grandisol and grandisal. But in the group of beetles that were feeding before the experiment, half of them were attracted by the smell of fresh pine twigs. The results showed the need to use 4-component attractant containing α-pinene, ethanol, grandisol and grandisal in the traps. Under the field conditions most of *P. castaneus* beetles (to several dozen individuals/trap) were found in green bucket traps. There were no beetles in the traps laid on the soil surface.

The results are the basis for further work related to the development of commercial formulations of attractants that can be used in the protection of young forests against *P. castaneus.*

The research was founded by the General Directory of State Forests in Poland, project no. BLP 362.

– POSTER № 24 –

INFLUENCE OF ECOLOGICAL FACTORS ON THE FORMATION OF NEMATODE FAUNA OF BARK BEETLES (*COLEOPTERA*: *SCOLITIDAE*)

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Bark beetles (Coleoptera: Scolytidae) are more harmful among the pests in Georgia. Formation of nematode fauna of bark beetles is affected by both abiotic and biotic factors, i.e. their effect on nematodes is complex.

In order to establish the influence of abiotic factors, such as temperature and humidity, on the composition and quantitative changes in nematode fauna the experiments were carried out under natural conditions.

Influence of temperature on host-beetle in respect of quantitative dynamics of nematodes was studied on typographer bark beetles (*Ips typographus*). "Decoy-trees" populated with bark beetles used in experiments were at first placed at the forest edge in sunlight where maximal temperature was 30-35 ºC. After a certain period of time the tree was replaced into the forest heart, where the maximal temperature was 24-26 ºC. In 2-3 weeks study of egg and larvae galleries (wormhole dust) of host-beetle showed that quantity of nematodes was more on decoy-tree in the forest heart than at the edge of the forest.

This fact shows that environmental conditions for vitality and more activity of nematodes are better in the forest heart.

Another important ecological factor is humidity. We have studied the effect of humidity on larger shothole borer (*Scolytus mali*). During experiment an apple-tree populated with larger shothole borer beetles was used as decoy for beetles.

The quantity of nematodes in egg and larvae galleries (wormhole dust) was controlled simultaneously under various humidity conditions.

We studied wormhole dust on the decoy-tree at the sunny side where the humidity was 48-50%, and at the shady side near the ground, where the humidity was 78-80%. In the first case ecto- and endoparasites of specific and transition groups (*Bursaphelenchus, Goodeyus, Stictylus, Sychnotylenchus, Parasitorhabditis*) were found in the wormhole dust made by larger shothole borer. Nematodes of nonspecific group were not detected here. In the second case, when humidity was rather high, ecto- and endoparasites of specific group completely disappear, nematodes of transition group were left in single examples, but nematodes of nonspecific group were reproduced.

Thus, changes in humidity causes nematode change in species composition and their quantity. Quantity of nonspecific nematodes increases with the increase of humidity due to the fact that they live in saprobe habitat.

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