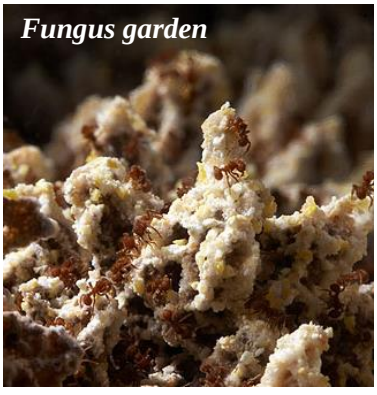
Fungi of the greening Arctic : compositional and functional shifts in response to climatic changes

Semenova, T.A.

Curriculum vitae

Tatiana A. Semenova-Nelsen was born on August 7, 1985, in Kaliningrad Moscow region, Russia. She received her secondary education in Korolev Moscow region in July 2002,where she was awarded a gold medal for excellent studies at school. In September 2002, Tatiana entered the Biological Faculty of Moscow State University, (MSU), Russia. In June 2007, she graduated from MSU and received a Specialist diploma with honors in botany and mycology. Tatiana continued her education at MSU, and obtained a Candidate of Science degree in November 11, 2011. Her main project at that time dealt with insect pathogenic fungi of the genus *Cordyceps*. In 2008-2009, Tatiana worked and studied as an exchange ERASMUS student in the University of Copenhagen, Denmark, studying fungal secreted enzymes in the system of fungus gardens, where the ants rear their symbiotic fungi for food. In 2011-2012 Tatiana was awarded a CIMO fellowship to work on the diversity and enzyme profiles of polypore fungi at The University of Helsinki, Finland. In August 2012, Tatiana started her PhD study in Leiden University and Naturalis Biodiversity Center, the Netherlands, under the supervision of Dr. József Geml. The project was focused on shifts in arctic fungal communities in response to long-term experimental climate warming – i.e. increased summer temperature and winter snow depth. The results of this work were published in international peer-reviewed journals and presented at local and international conferences. After her graduation, Tatiana intends to continue research in fungal ecology, addressing evolutionary and ecological questions by methods of biochemistry and molecular biology.

Cordyceps militaris



Fungus garden

Publications IN PEER REVIEWED JOURNALS

Semenova TA, Morgado LN, Welker JM, Walker MD, Smets E, Geml J. (2016) Compositional and functional shifts in arctic fungal communities in response to experimentally increased snow depth. Soil Biology & Biochemistry, *DOI: 10.1016/j.soilbio.2016.06.001*

Morgado LN,·**Semenova TA**, Welker JM, Walker MD, Smets E, Geml J. (2016) Long-term increase in snow depth leads to compositional changes in arctic ectomycorrhizal fungal communities. Global Change Biology, *DOI: 10.1111/gcb.13294.*

Geml J, Morgado LN, **Semenova TA,** Welker JM, Walker MD, Smets E. (2015) Long-term warming alters richness and composition of taxonomic and functional groups of arctic fungi. FEMS Microbiology Ecology: 91(8).

Popova VV, Dunaevsky YE, Domash VI, **Semenova TA,** Beliakova GA, Belozersky MA. (2015) Some properties and possible biological role of peptidase inhibitors from the entomopathogenic fungus *Tolypocladium cylindrosporum*. Archives of Microbiology. 197(8);1001-1010.

Semenova TA, Morgado LN, Welker JM, Walker MD, Smets E, Geml J. (2015) Long-term experimental warming alters community composition of ascomycetes in Alaskan moist and dry arctic tundra. Molecular Ecology, 24:424-437.

Morgado LN, **Semenova TA,** Welker JM, Walker MD, Smets E, Geml J. (2014) Summer temperature increase has distinct effects on the ectomycorrhizal fungal communities of moist tussock and dry tundra in Arcti c Alaska. Global Change Biology: 1-14.

Geml J, Gravendeel B, Neilen M, Lammers Y, Raes N, **Semenova TA**, Noordeloos ME. (2014) The contribution of DNA metabarcoding to fungal conservation: diversity assessment, habitat partitioning and mapping red -listed fungi in protected coastal Salix repens communities in the Netherlands. PLOS ONE 9:e99852.

Geml J, Pastor N, Fernandez L, Pacheco S, **Semenova TA,** Becerra AG, Wicaksono CY, Nouhra ER. (2014) Large-scale fungal diversity assessment in the Andean Yungas forests reveals strong community turnover among forest types along an altitudinal gradient. Molecular Ecology, 23:2452-2472.

Dunaevsky YE, Popova VV, **Semenova TA,** Beliakova GA, Belozersky MA. (2014) Fungal inhibitors of proteolytic enzymes: classification, properties, possible biological roles, and perspecti ve for practical use. Biochimie 101:10-20

Semenova TA, Belozersky MA, Beljakova GA, Borisov BB, Semenova SA, Dunayevsky YaE. (2011) Secreted proteinase of entomopathogenic fungus Cordyceps militaris: enzymic properties and adsorption on insect cuticle. (in Russian). Mycology and Phytopathology (Russia) 45 (1): 64-69.

Semenova TA, Belozersky MA, Beljakova GA, Borisov BB, Semenova SA, Dunayevsky YaE. (2010) Secreted proteinase of entomopathogenic fungus Cordyceps militaris: optimization of fungal culture medium and enzyme purification. (in Russian). Mycology and Phytopathology (Russia) 44 (6): 535-541.

Semenova TA, Hughes DP, Schiott M, Boomsma JJ. (2011) Evolutionary patterns of proteinase activity in attine ant fungus gardens. BMC Microbiology 11:15.

CONFERENCE PRESENTATIONS (*2013-Present*)

Geml J, Morgado LN, **Semenova TA**, Pastor N, Nouhra ER (2016). A comparison of altitudinal distribution patterns of fungi in Borneo and in the Andes using DNA metabarcoding. Brazilian Mycological Congress, October 2016 (Oral presentation).

Geml J, Pastor N, Morgado LN, **Semenova T**, Nouhra ER (2015). Mycota of understudied biodiversity hotspots –DNA metabarcoding reveals hyperdiverse communities and strong habitat partitioning along altitudinal gradients in Borneo and in the Andes. DNA Barcoding – The gold standard for species recognition. Utrecht, the Netherlands. (Oral presentation)

Geml J, Morgado LN, **Semenova TA**, Smets E, Walker MD, Welker JM (2015). Peek into the future – long-term warming and increased snow depth alter richness and composition of taxonomic and functional groups of arctic fungi. Symposium Netherlands Polar Programme: Polar tipping points – identifying rapid changes in the polar regions.The Hague, the Netherlands. (Oral presentation)

Semenova TA, Morgado LN, Welker JM, Walker MD, Smets E, Geml J (2015). Climate warming increases arctic winter precipitation – how fungi respond to increased snow depth. Symposium Netherlands Polar Programme: Polar tipping points – identifying rapid changes in the polar regions. The Hague, the Netherlands. (Poster presentation)

Semenova TA, Morgado LN, Welker JM, Walker MD, Smets E, Geml J (2015). Ascomycete fungal communities reorganize in response to long-term summer and winter climate warming in moist and dry tundra of Arctic Alaska. XVII Congress of European Mycologists. Madeira, Portugal. (Oral presentation)

Geml J, Morgado LN, **Semenova TA**, Smets E, Walker MD, Welker JM (2015). Long-term warming and increased snow depth alter richness and composition of taxonomic and functional groups of arctic fungi. 21st International Tundra Experiment meeting: Integrating Arctic Plant and Microbial Ecology.Uppsala, Sweden. (Oral presentation)

Morgado LN, **Semenova TA**, Smets E, Walker MD, Welker JM, Geml J (2015). Compositional shifts in arctic ectomycorrhizal fungal community in response to long-term

increased snow depth in Northern Alaska. Ecology of soil microorganisms 2015 –microbes as important drivers of soil processes. Prague, Czech Republic. (Poster presentation)

Morgado LN, **Semenova TA**, Welker JM, Walker MD, Geml J (2015). Compositional shifts in ectomycorrhizal fungal community in response to long-term snow depth manipulations. Netherlands Annual Ecological Meeting. Lunteren, The Netherlands. (Oral presentation)

Semenova TA, Morgado LN, Welker JM, Walker MD, Smets E, Geml J (2015). Climate warming alters comunities of soil ascomycetes in arctic Alaskan tundra. Netherlands Annual Ecological Meeting. Lunteren, The Netherlands. (Oral presentation).

Semenova TA, Morgado LN, Welker JM, Walker MD, Smets E, Geml J (2015). Why does the dry arctic tundra remain unaffected by climate warming? Netherlands Annual Ecological Meeting. Lunteren, The Netherlands. (Poster presentation)

Morgado LN, **Semenova TA**, Welker JM, Walker MD, Smets E, Geml J (2014). The effect of long-term warming on arctic fungal communities. Netherlands Annual Ecological Meeting. Lunteren, The Netherlands. (Oral presentation)

Morgado LN, **Semenova TA**, Welker JM, Walker MD, Geml J. (2014). What can 1,000,000 sequences tell us about climatic changes and ectomycorrhizal (ECM) fungal communities? Netherlands Annual Ecological Meeting. Lunteren, The Netherlands. (Poster presentation)

Semenova TA, Morgado LN, Welker JM, Walker MD, Smets E, Geml J (2014). Global warming changes soil ascomycetous fungal communities in the arctic tundra. Netherlands Annual Ecological Meeting. Lunteren, The Netherlands. (Poster presentation)

Morgado LN, **Semenova TA**, Welker JM, Walker MD, Smets E, Geml J (2014). Long-term experimental warming have distinct effects in the ectomycorrhizal fungal communities of moist tussock and dry tundra in the Arctic Alaska. The 10th International Mycological Congress. Bangkok, Thailand. (Oral presentation)

Morgado LN, **Semenova TA**, Welker JM, Walker MD, Smets E, Geml J (2014). Linking local-scale diversity changes in ectomycorrhizal fungal communities with functional traits: a case study from long-term warming experiments in Arctic Alaska. The 10th International Mycological Congress. Bangkok, Thailand. (Poster presentation)

Semenova TA, Morgado LN, Welker JM, Walker MD, Smets E, Geml J (2014). Ascomycetous fungal communities respond to experimental warming in the mesic and dry arctic tundra. The 10th International Mycological Congress. Bangkok, Thailand. (Oral presentation)

Morgado LN, **Semenova TA**, Taylor DL, Geml J (2013). Biodiversity and habitat partitioning of arctic ectomycorrhizal fungi and their role in vegetation change due to climate change. Netherlands Annual Ecological Meeting. Lunteren, The Netherlands. (Poster presentation)

Morgado LN, **Semenova TA**, Welker JM, Geml J (2013). The effect of climate change on the composition of arctic soil fungal communities. Netherlands Annual Ecological Meeting. Lunteren, The Netherlands. (Oral presentation)

Geml J, Morgado LN, **Semenova TA** (2013). High-throughput DNA sequencing provides first insights into the fungal diversity of lowland rainforests and montane cloud forests in Borneo. 9th Flora Malesiana Symposium. Bogor, Indonesia. (Oral presentation)

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