

Agrilus planipennis, *Polygraphus proximus*, and
its associated *Corinectria* spp.: approaching
threats to European ash and fir

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Part 1. Potential invasion of **Emerald Ash Borer** (EAB) to the EU

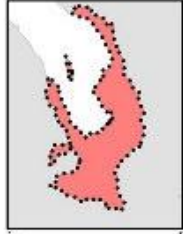
D.L. Musolin, A.V. Selikhovkin, M.G. Volkovitsh, E.Y.Peregudova,
B.G.Popovichev, M.Y. Mandelshtam, Y.N Baranchikov, K.Davydenko,
Y.Skrylnyk, O. Borysenko, N. Vysotska, A.Menkis, V.Meshkova,
R.Vasaitis

Based on four recent publications (open access)

1. **Invasive Insect Pests** of Forests and Urban Trees in Russia: Origin, Pathways, Damage, and Management. *Forests* **2022**, 13, 521. <https://doi.org/10.3390/f13040521>
2. North-Westward Expansion of the Invasive Range of **Emerald Ash Borer** (*Agrilus planipennis*) towards the EU: from Moscow to Saint Petersburg. *Forests* **2021**, 12, 502. <https://doi.org/10.3390/f12040502>
3. Invasive Populations of the **Emerald Ash Borer** (*Agrilus planipennis*) in Saint Petersburg, Russia: A Hitchhiker? *Insects* **2022**, 13, 191. <https://doi.org/10.3390/insects13020191>
4. Invasion of **Emerald Ash Borer** (*Agrilus planipennis*) and Ash Dieback Pathogen (*Hymenoscyphus fraxineus*) in Ukraine—A Concerted Action. *Forests* **2022**, 13, 789. <https://doi.org/10.3390/f13050789>



Two directions: NW & SW



0 250 500 1000 1500 2000 Km

Forests **2022**, 13, 521.

- in 2003, EAB was recorded in Moscow
- introduced by long-distance transportation of wood, most likely in 1990s' from China
- massive outbreak in the megapolis, killed most of ash trees
- spread from Moscow in all directions, forming spatially uninterrupted population
- in north-west, by 2020 closing to the boundaries of St. Petersburg Province
- continuously detected along highway Moscow - St. Petersburg, up to 170 km NW from Moscow

Tver



Photo: B. Popovichev



Turku

Helsinki

St Petersburg
Санкт-Петербург

Tallinn

Estonia

Riga

Latvia

Klaipėda

Lithuania

Gatchina
Гатчина

Kingisepp
Кингисепп

Veliky
Novgorod
Великий
Новгород

Cherepovets
Череповец

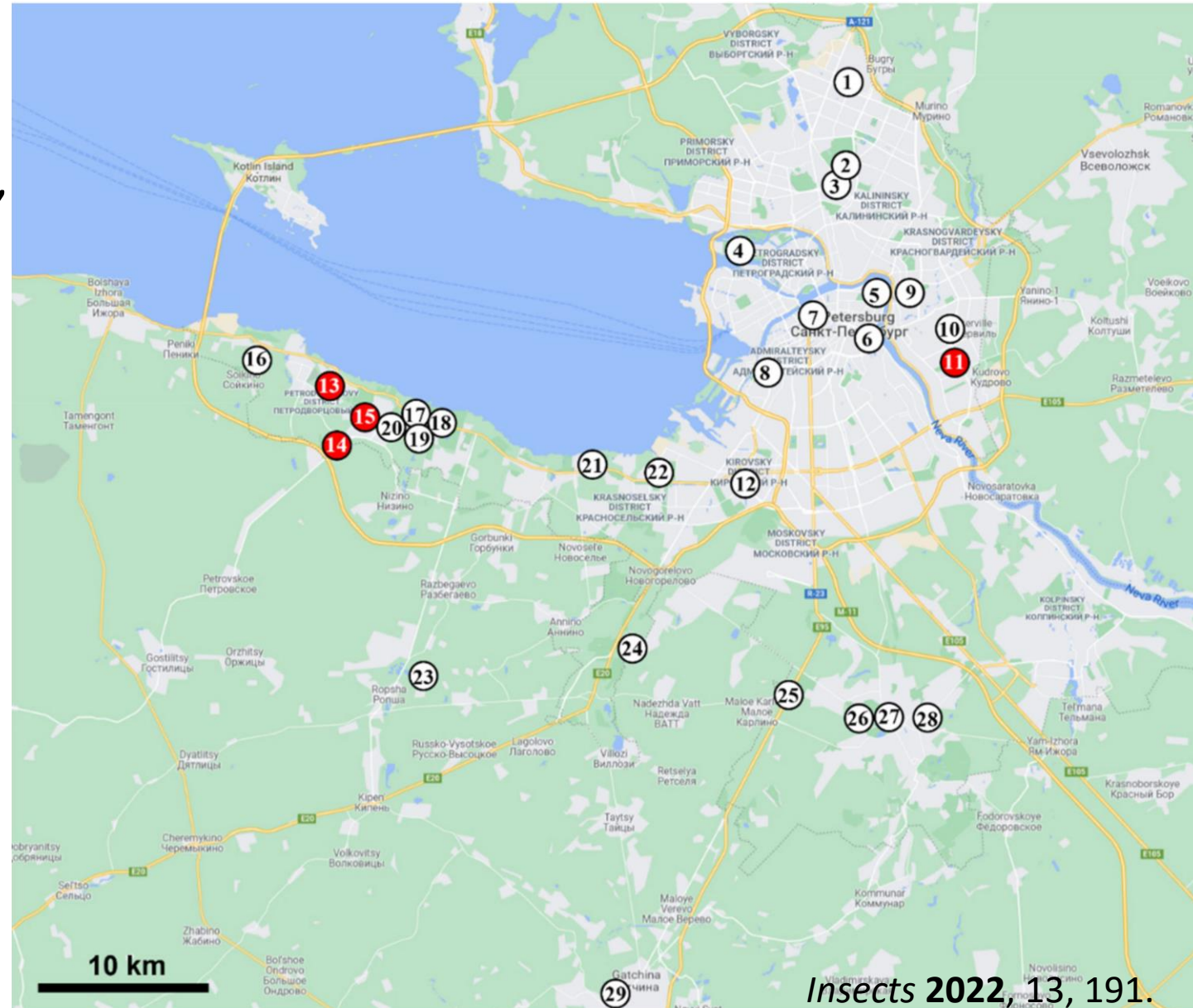
Pskov
Псков

Tver
Тверь

Moscow
Москва

Forests 2021, 12,502.

- in 2020, in St.Petersburg spatially isolated EAB population (further 520 km north-west)
- ... suggesting the invasion by "hitchhiking" transport vehicles (e.g., cars, trucks, railway)
- e.g., North America reports: can be transported by cars
- ... hidden behind flanges of the car body, on windshields or wipers
- typical St.Petersburg EAB finds along streets, roadsides, alleys, in squares and parks



Saint Petersburg



Photo: D. Musolin

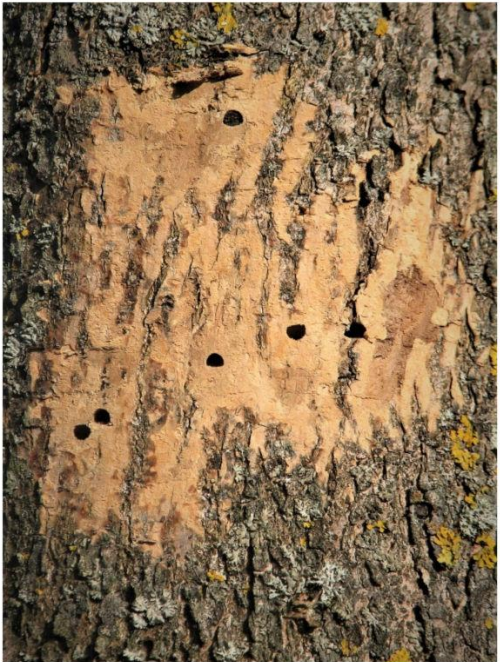
Saint Petersburg



(a)



(b)



(c)

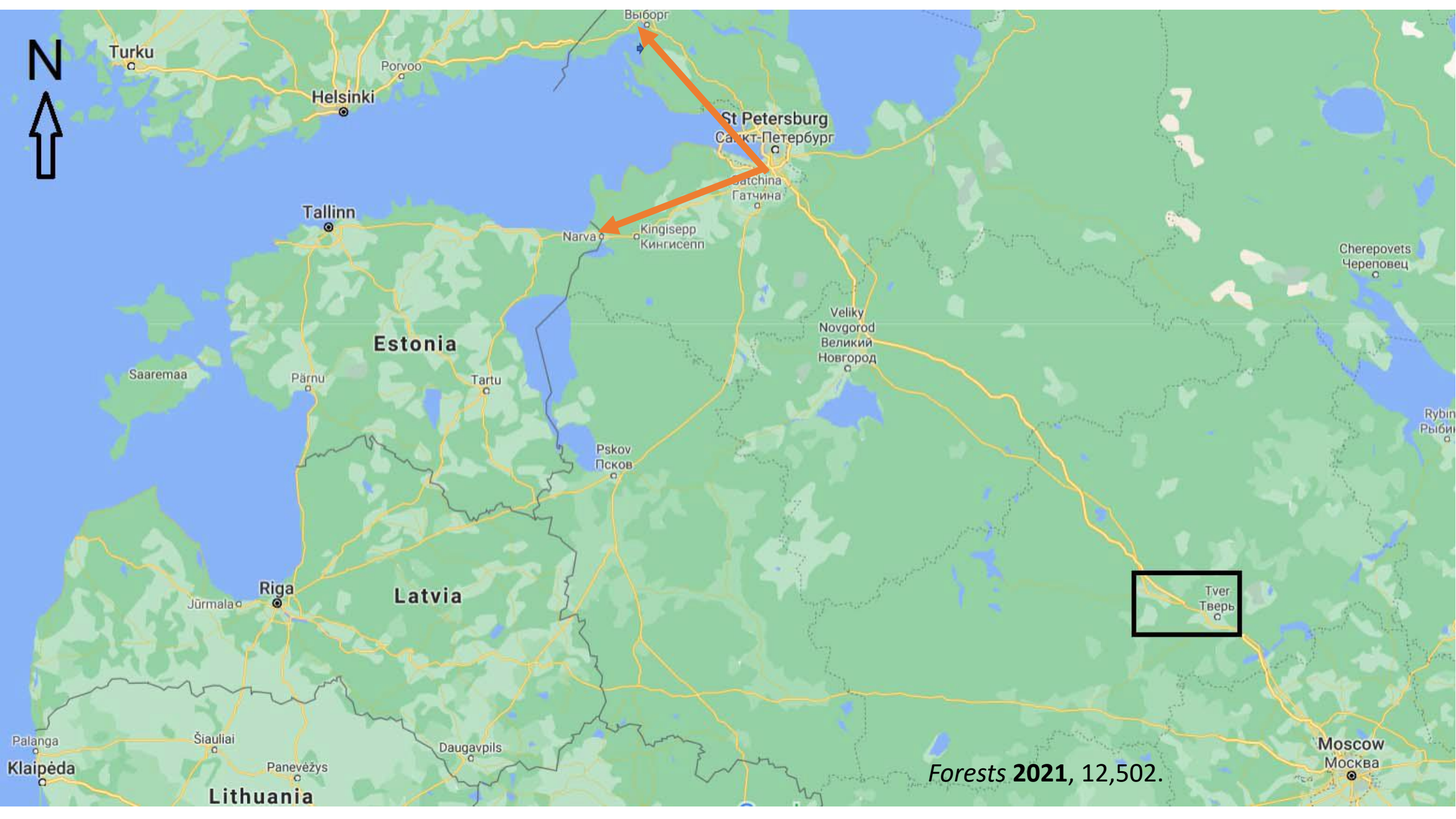


(d)

Conclusion (Saint Petersburg):

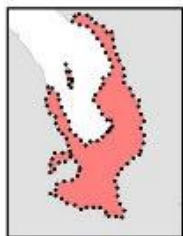
EAB invasion from St. Petersburg to northern EU is possible, due to:

- geographic proximity (< 150 km) to Estonia & Finland;
- excellent transport corridors (highways, railroads, sea).



Forests 2021, 12,502.

- differently, in south-western direction main pathway for EAB expansion was all the way “continuous”
- ... either by flying from tree-to-tree (*a good flyer, median > 3 km, some up to 10 - 20 km/day: Michigan, USA*) or transport, or both?
- resulting in large continuous population, stretching for over thousand km from Moscow to Ukraine
- in 2019 invading eastern Ukraine and killing thousands of ash trees
- ... and spreading further westwards ...

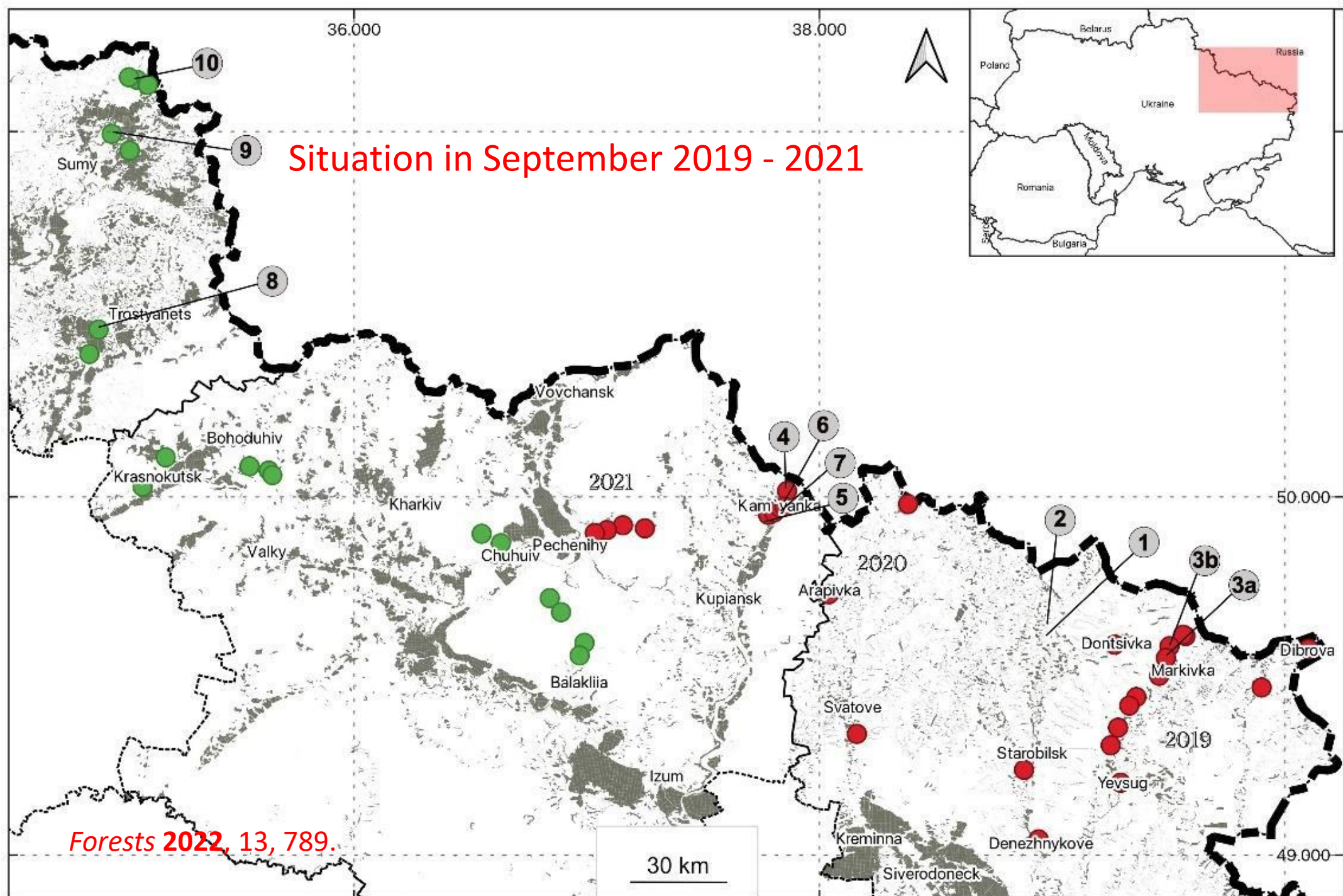


0 250 500 1 000 1 500 2 000 Km

Forests **2022**, 13, 521.

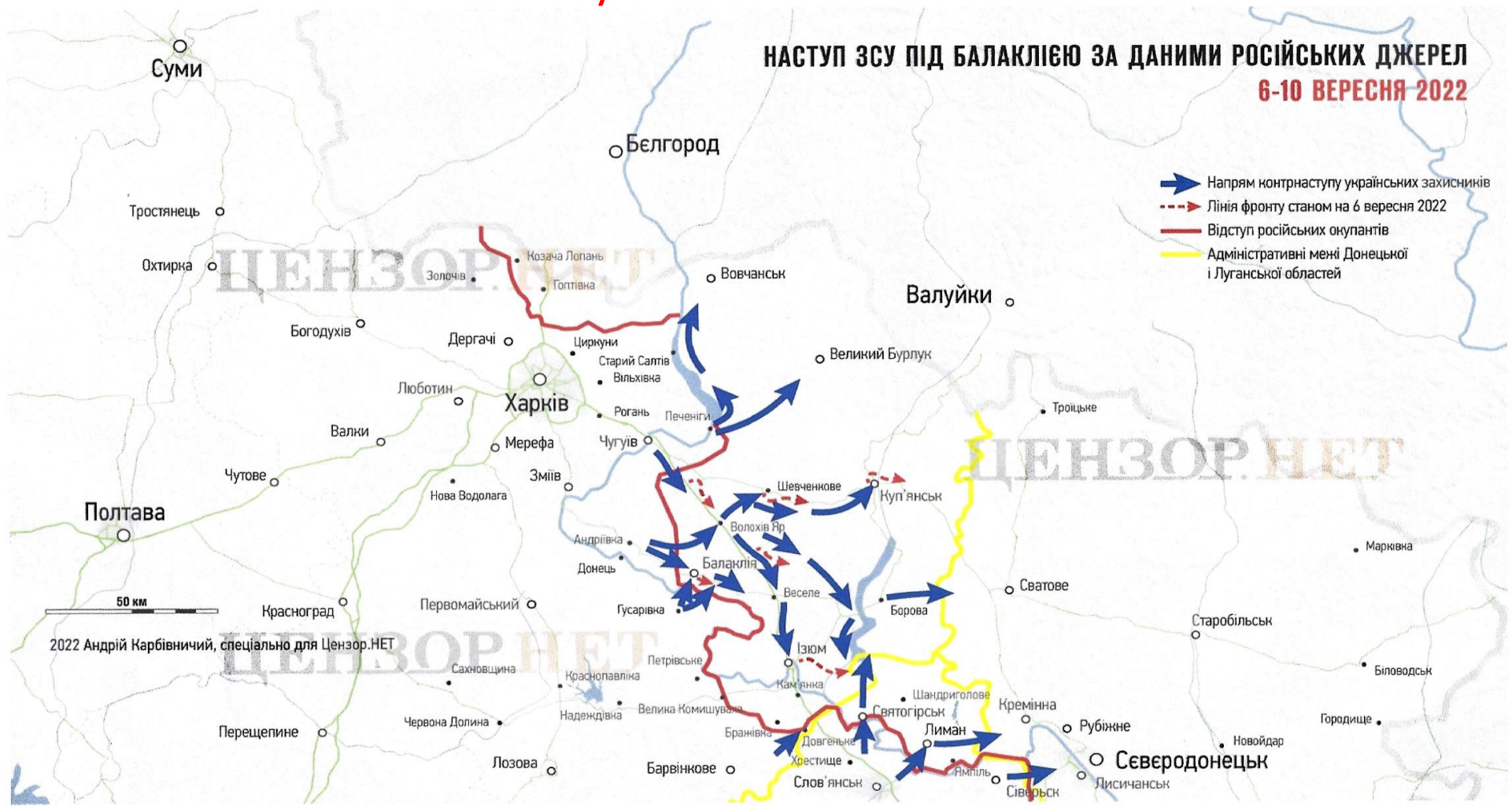


Photo: Y. Baranchikov



Situation in the very same area in September 2022: offensive of Ukrainian army: retreat of the invader

1 / 1



Conclusions (Ukraine)

- EAB has a large potential for further spread towards the EU
- ash common in field protection belts, along roads and railways
- due to war, nobody will bother with control
- the climate is suitable
- in Ukraine ash is also threatened by the ash dieback (ADB)
- the infestation by EAB combined with ADB can be more lethal than either of them alone, and it is indeed ...

The indication:

Ash that shows more resistance to ADB could be more prone to EAB, and *vice versa*

(value for ongoing numerous & extensive breeding programs for resistance against ADB?)

Reference:

4. Invasion of **Emerald Ash Borer** (*Agrilus planipennis*) and Ash Dieback Pathogen (*Hymenoscyphus fraxineus*) in Ukraine—A Concerted Action. *Forests* 2022, 13, 789.

Our ongoing work (material from St.Petersburg & Ukraine)

- Populations of EAB (100s of adults & larvae)
- Genetic markers for combined tolerance to both EAB & ADB (buds & leaves)
- Microorganisms associated with EAB

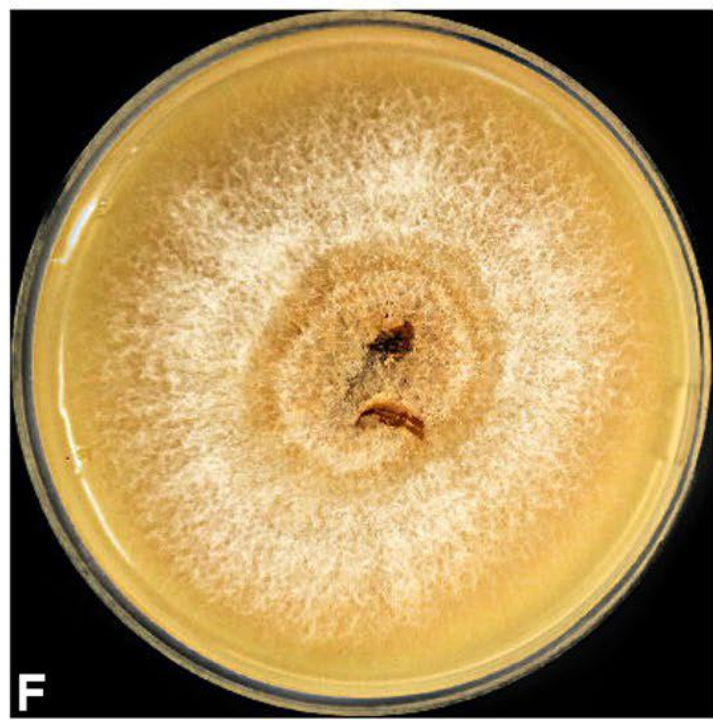
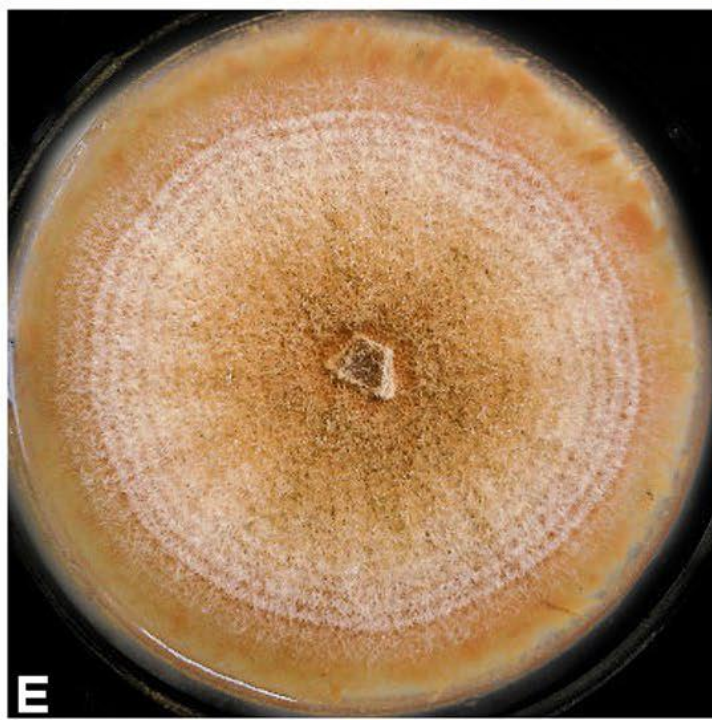
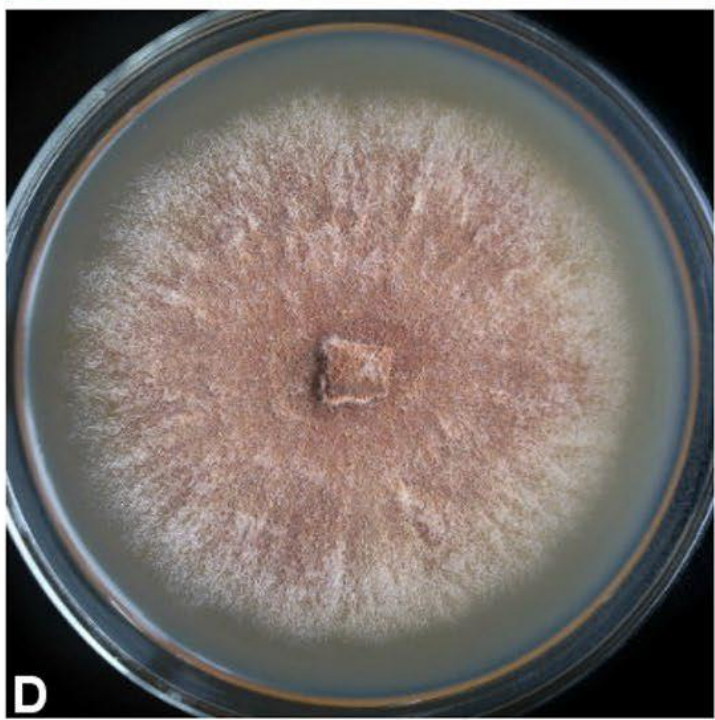
Part 2. Occurrence and pathogenicity of *Corinectria* spp. – an emerging canker disease of *Abies sibirica* in central Siberia

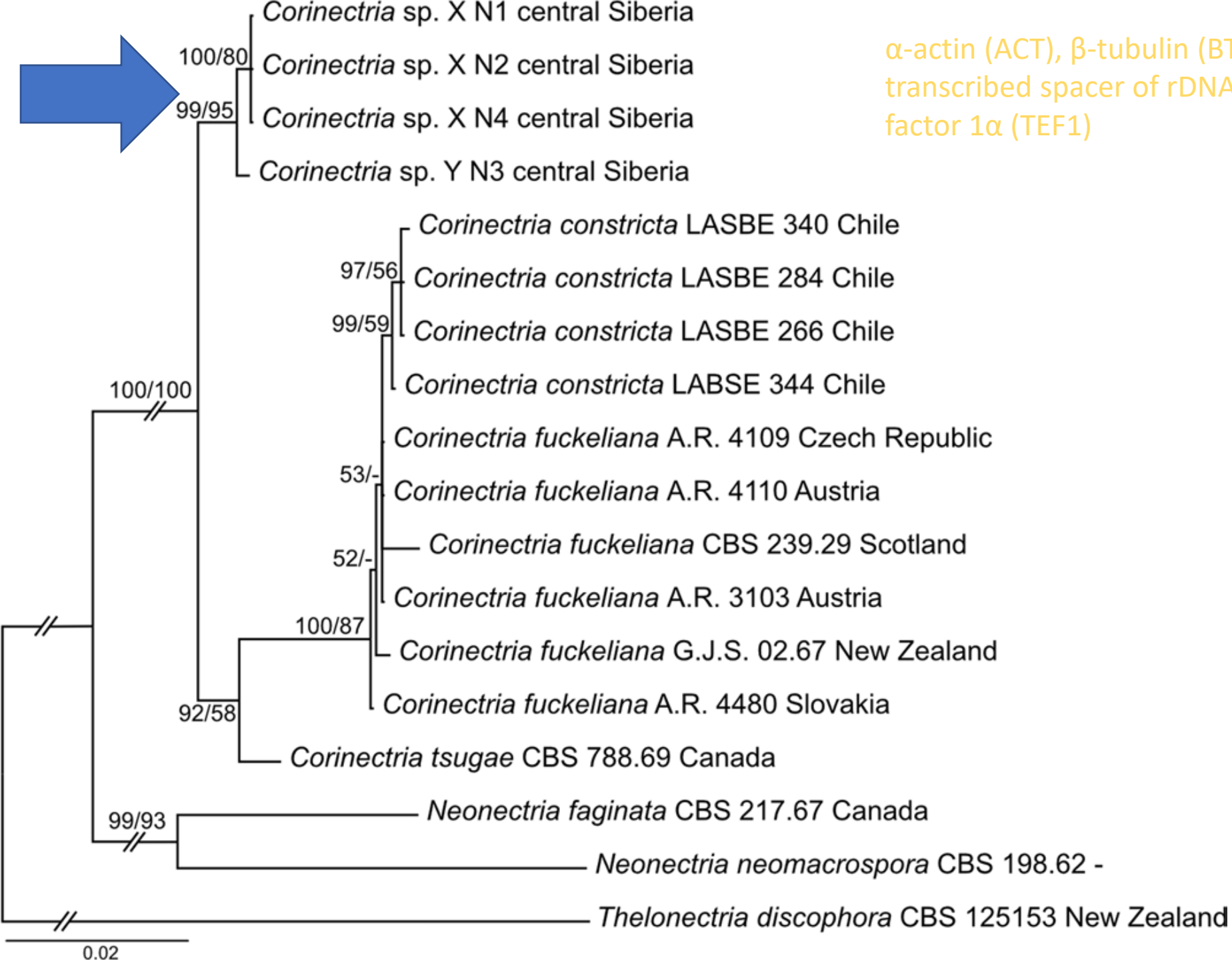
I.N . Pavlov, R. Vasaitis, Y.A. Litovka, J. Stenlid, L. Jankovsky,
A.A.Timofeev, A. Menkis

Scientific Reports | (2020) 10:5597 | <https://doi.org/10.1038/s41598-020-62566-y>

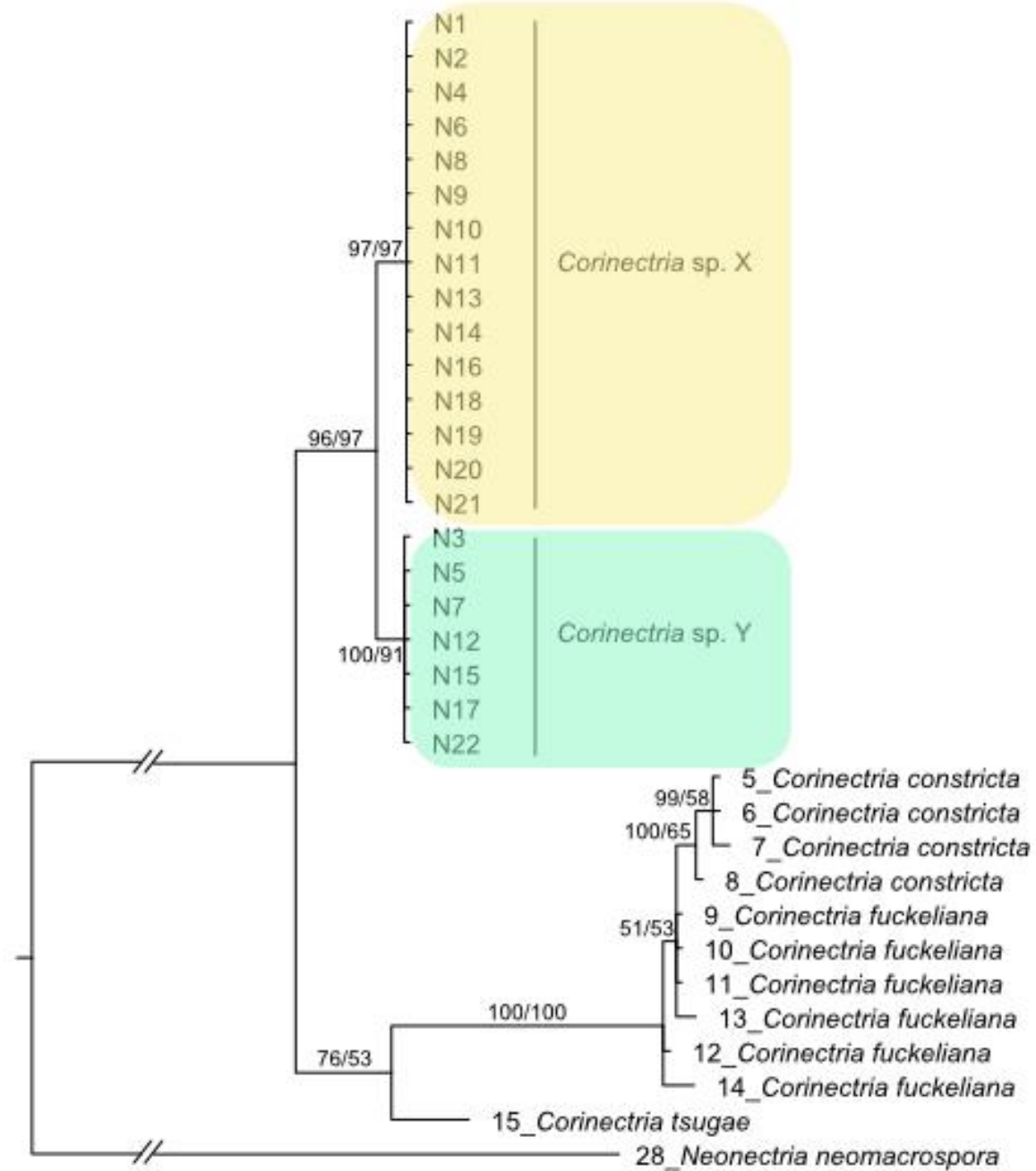
www.nature.com/scientificreports

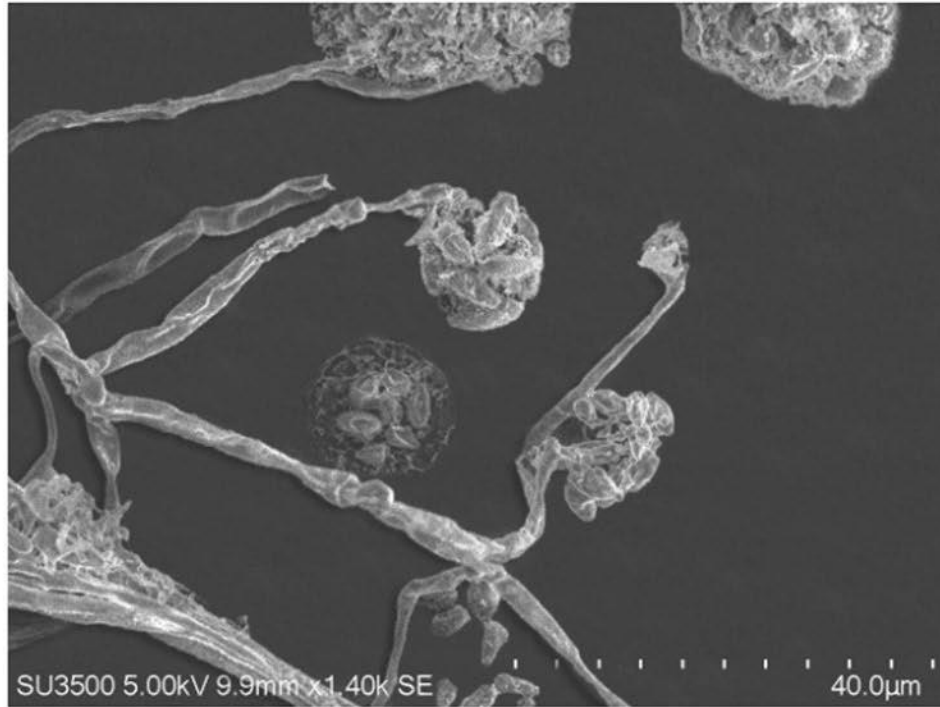
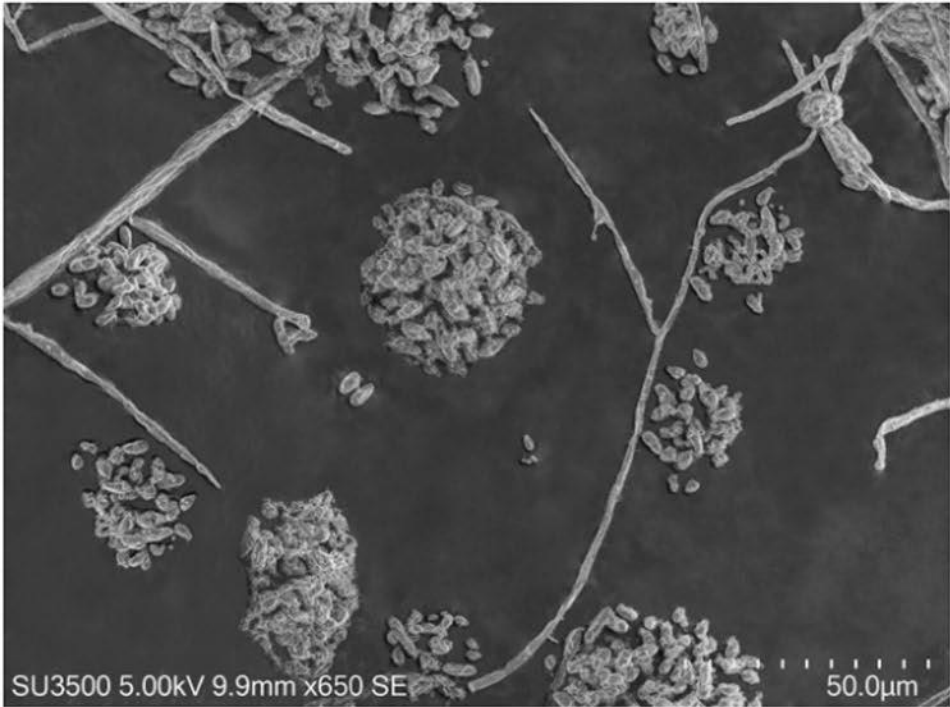






α -actin (ACT), β -tubulin (BTUB), the complete internal transcribed spacer of rDNA (ITS) and translation elongation factor 1 α (TEF1)

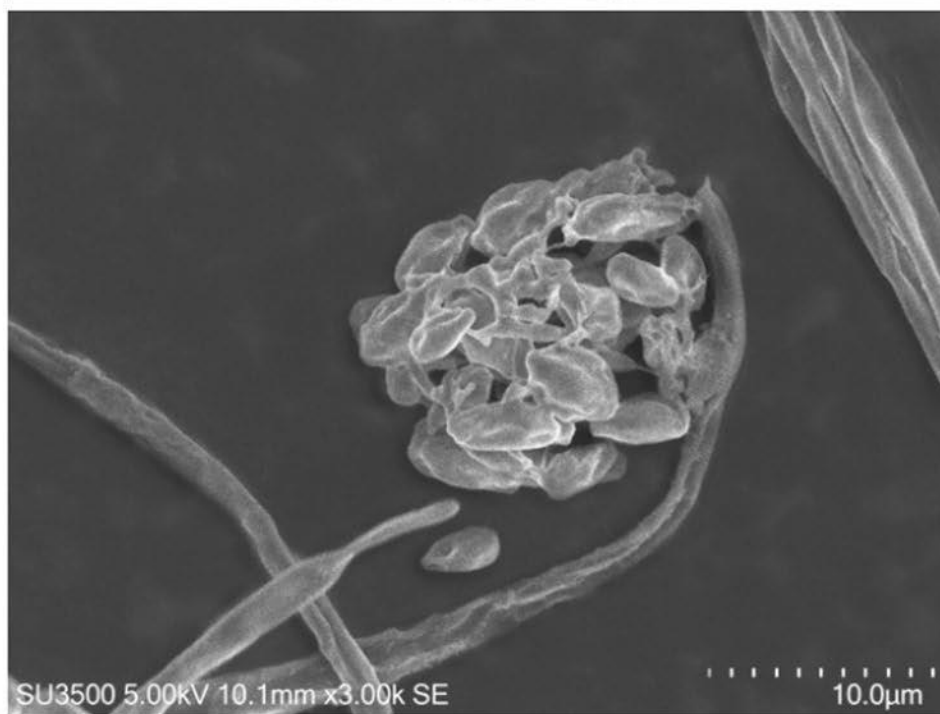
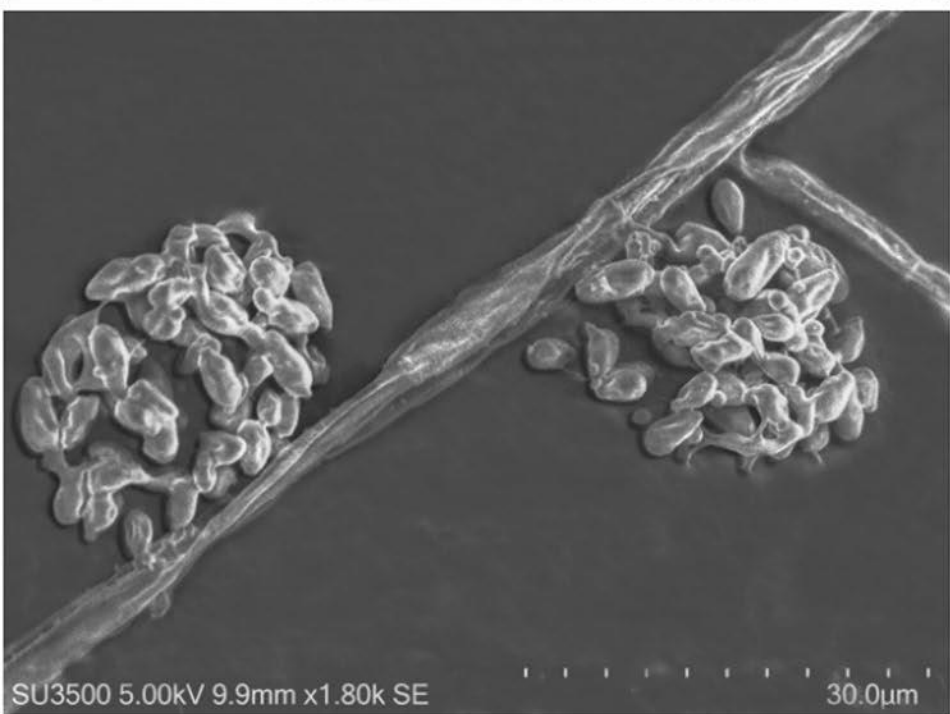




Currently being described:

X – *Corinectria sibirica*

Y – *Corinectria abietina*



Menkis *et al.* in prep.

Pathogenicity tests – *Abies sibirica* saplings



Figure 5. Extent of necrosis in cambial zone beyond inoculation wounds after the removal of an inoculation chip. Right bottom picture shows control. Diameter at wounding/inoculation point approx. 10 mm.

Pathogenicity tests – *Picea abies* seeds



Figure 6. Seeds of *Picea abies* after 14 days, a-priori soaked in cultural filtrate, and placed to germinate in sterile 9 cm Petri plates with moist filter paper. A picture on the right shows control.

... at that time, all tests were made with two strains of *Corinectria* sp. X

Pathogenicity tests. Part 2.
After eight weeks of inoculation

Treatments

2 strains of *Corinectria* sp. X

2 strains of *Corinectria* sp. Y

2 strains of *Corinectria fuckeliana*

Control



Pinus



Picea

Dieback caused by
Corinectria fuckeliana



Larix



Pseudotsuga



Abies lasiocarpa (Balsamea)

Dieback caused by
Corinectria sp. X & Y

(Menkis *et al.* in prep.)

Part 3. *Polygraphus proximus*

D. Musolin, I. Kerchev, I. Pavlov, M. Mandelshtam, A. Selikhovkin,
A. Menkis, R. Vasaitis

1. **Invasive Insect Pests** of Forests and Urban Trees in Russia: Origin, Pathways, Damage, and Management. *Forests* **2022**, 13, 521.

<https://doi.org/10.3390/f13040521>



- native to Far East, where develops on several fir species
- in 2006 *recorded* in Moscow, 2008 in west-, 2009 in central Siberia
- to Siberia, arrival estimated mid-1970s (central), early 2000s (west)
- introduced by long-distance transportation of unbarked timber
- in Siberia, mass infestations on *Abies sibirica*
- in Moscow, attacked almost 100% of different species of fir
- most prone species from the sections Balsamea and Grandis, less from the section Abies (e.g., European *A. alba* & *A. nordmanniana*)
- *Picea abies* can also be attacked, although not preferred
- currently moving west (St. Petersburg)



0 250 500 1 000 1 500 2 000 Km

- in Siberia, *Corinectria* canker (Part 2) is often associated with the attacks by *Polygraphus proximus*
- the question: can Siberian *Corinectria* spp. be vectored by *P. proximus*?
- in order to answer, analyses of fungal DNA have been done on a number of adult beetles, collected in central Siberia (*ITS2 of nuclear rDNA: forward primer fITS9, reverse ITS4, with unique barcoded primers; Ihrmark et al. 2012*)
- and the answer is ...

... yes, it can: *Corinectria sp. X* has been regularly detected in bodies of *P. proximus* beetles

That's all
Thank you!