

UNIVERSITÀ  
DEGLI STUDI  
DI PADOVA

**DAFNAE**

Department of Agronomy Food  
Natural resources Animals Environment

# Innovative tools and strategies for the surveillance of *Agrilus* species and other beetles

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EPPO FAO-REUFIS BFW Conference  
'Safeguarding Forests in Europe: Emerging Risks of *Agrilus* Wood Borers (Buprestidae)'  
Vienna, 21-23 April 2026



# Traps in surveillance programs

Arrival



First-establishment



Spread



Traps in ports and surrounding areas

# Baited traps



## PROS

Easy to use

Relatively cheap

Lures available for many species

## OPEN QUESTIONS

Can we increase efficacy of available protocols by means of visual cues?

Can we use the same trap to attract multiple species?

Can we speed up the specimens identification process?

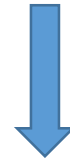
# Question 1

Can we increase efficacy of available protocols by means of visual cues?

Wood-borers exploit visual cues during their life cycle



Oviposition site location



Mate location

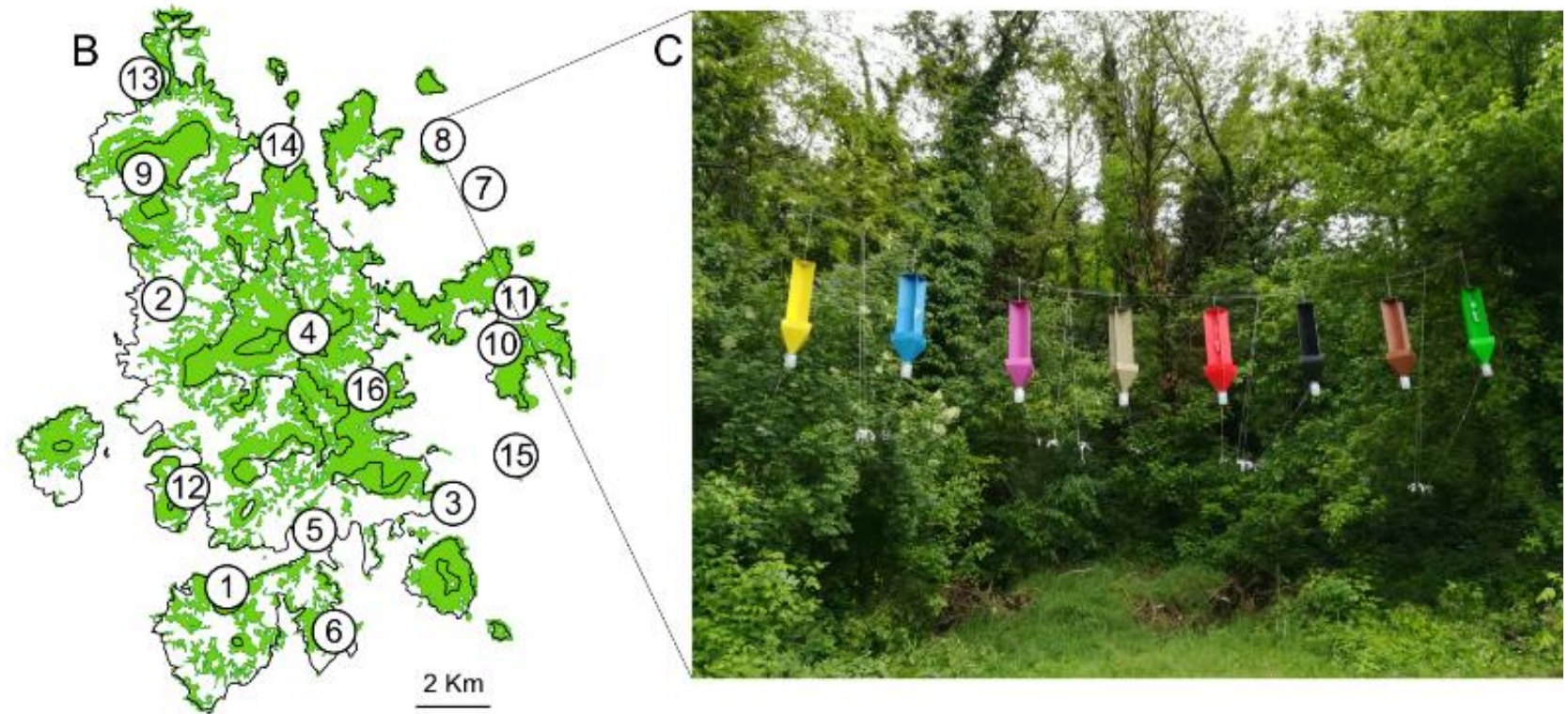


Food location



# Study 1: improving trap efficacy using colors

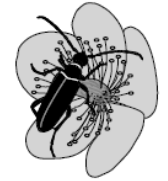
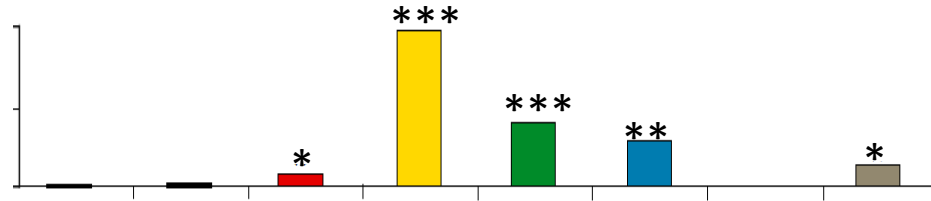
Can we improve trapping efficacy using different trap colors?



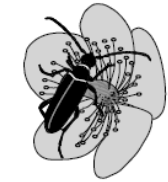
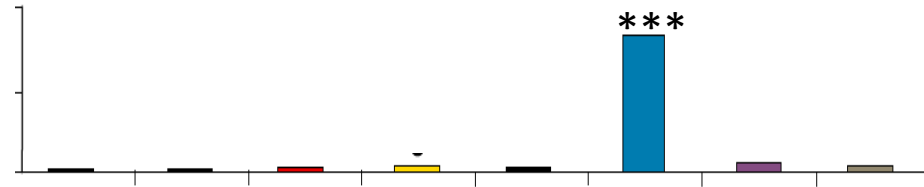
Cavaletto et al. (2021) Journal of Pest Science  
Cavaletto et al. (2020) Insects

# Exploiting trap color for longhorn beetles

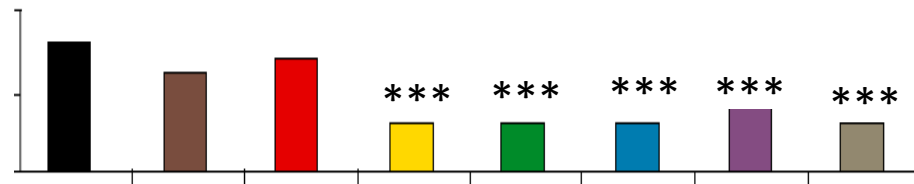
*Pachyotodes erraticus*  
(Lepturinae)



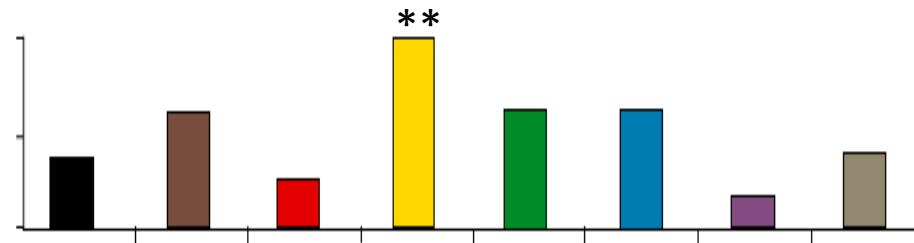
*Stictoleptura cordigera*  
(Lepturinae)



*Xylotrechus stebbingi*  
(Cerambycinae)



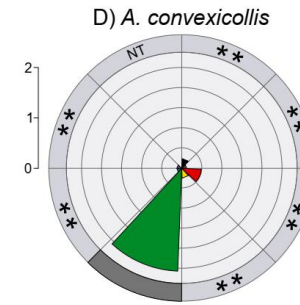
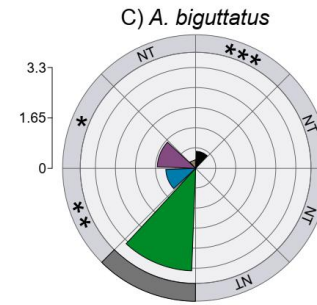
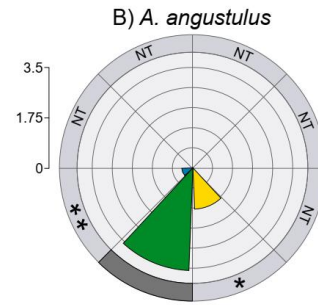
*Xylotrechus antilope*  
(Cerambycinae)



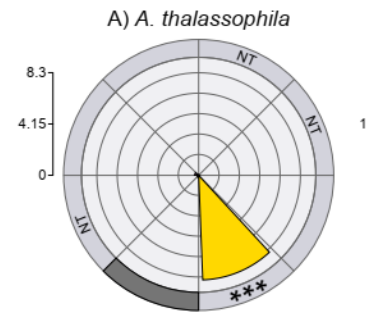
# Exploiting trap color for jewel beetles



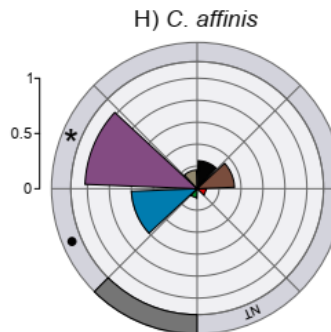
No flower visitor  
Metallic green



Flower visitor  
Metallic green

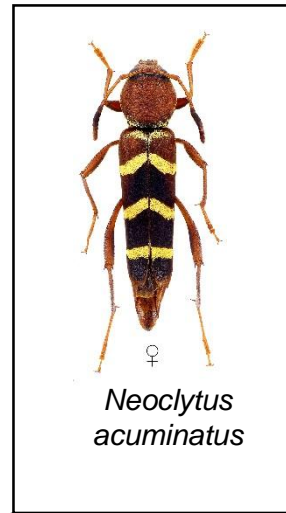


No flower visitor  
Metallic purple/brown



## Study 2: improving trap efficacy using species-specific visual cues

Can we improve trapping efficacy using species-specific visual cues?



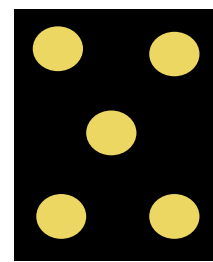
Black



Color of stripes



Color/pattern of stripes



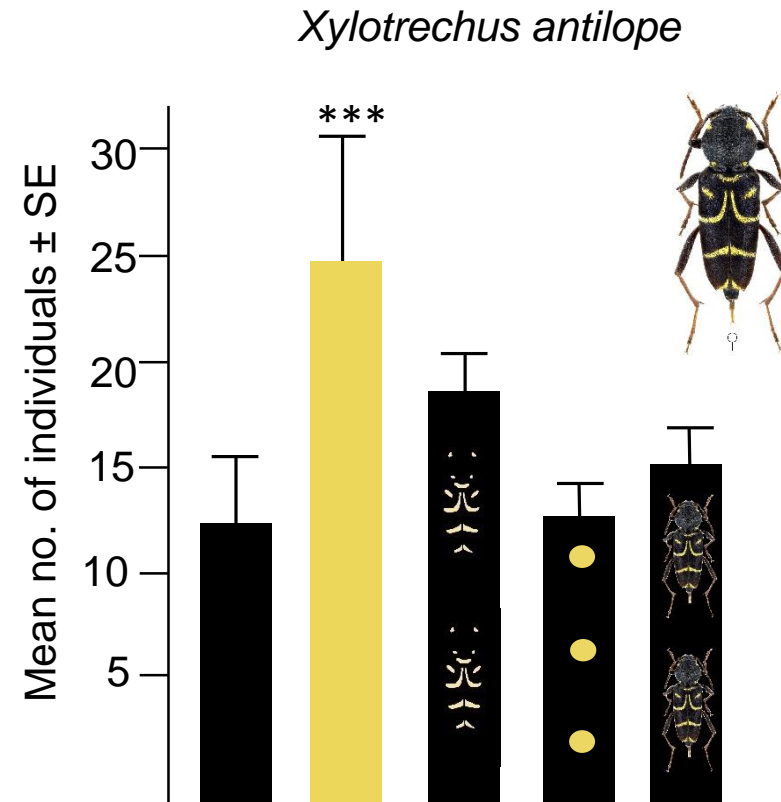
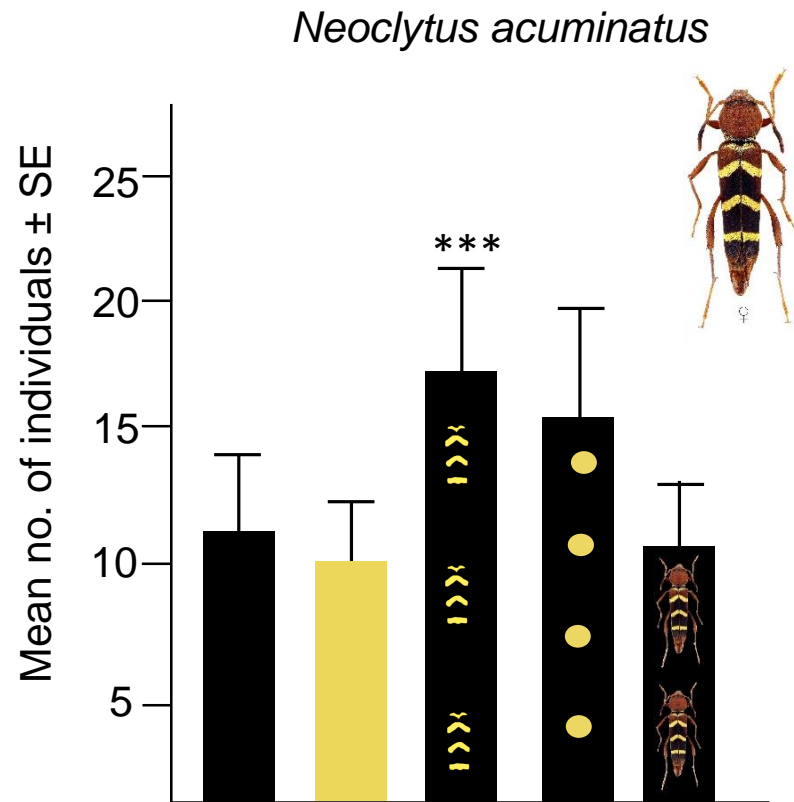
Dots of the color of stripes



Picture of adult beetle



# Exploiting specific visual cues for longhorn beetles

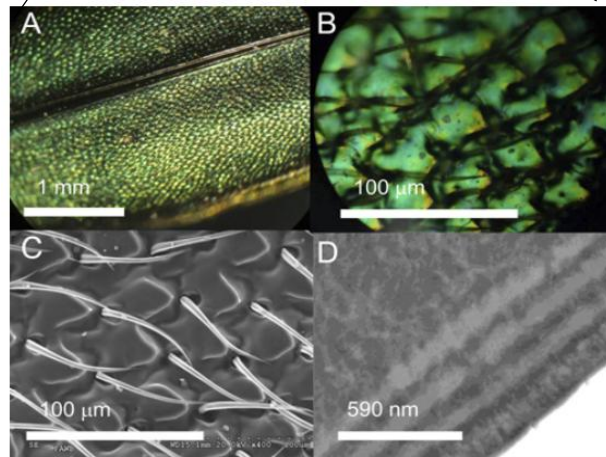
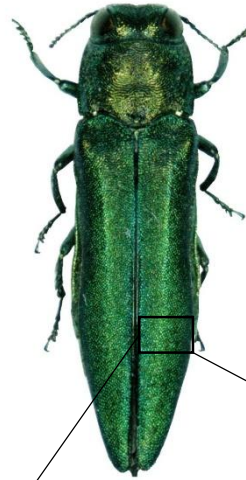


# Exploiting specific visual cues for jewel beetles?



Santer & Akanyeti (2026) Insect Science

Painting traps with a varnish having the same optical properties of *Agrius* species

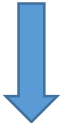


Domingue et al. (2026) PNAS

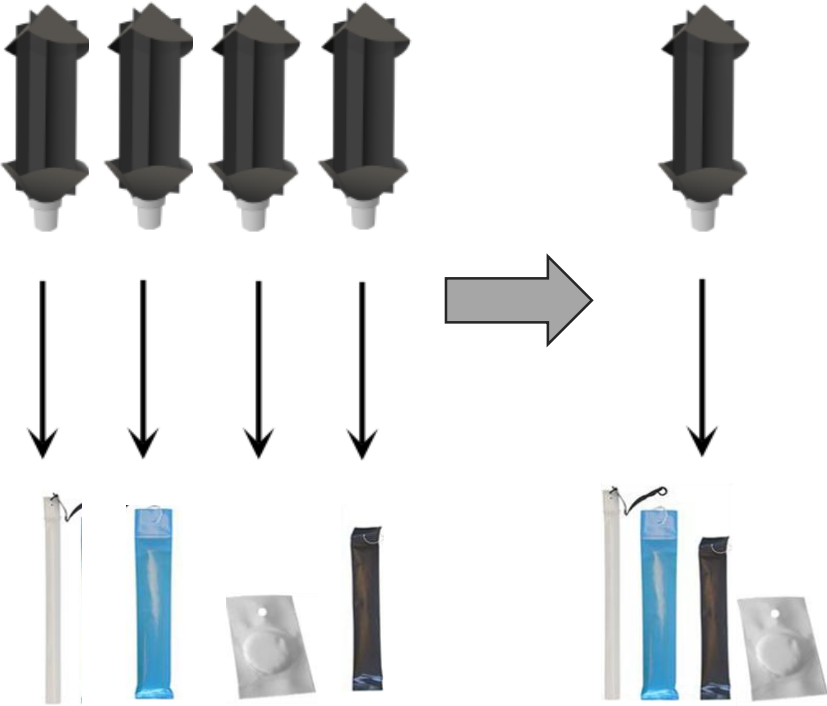


# Question 2

Can we use the same trap to attract multiple species?

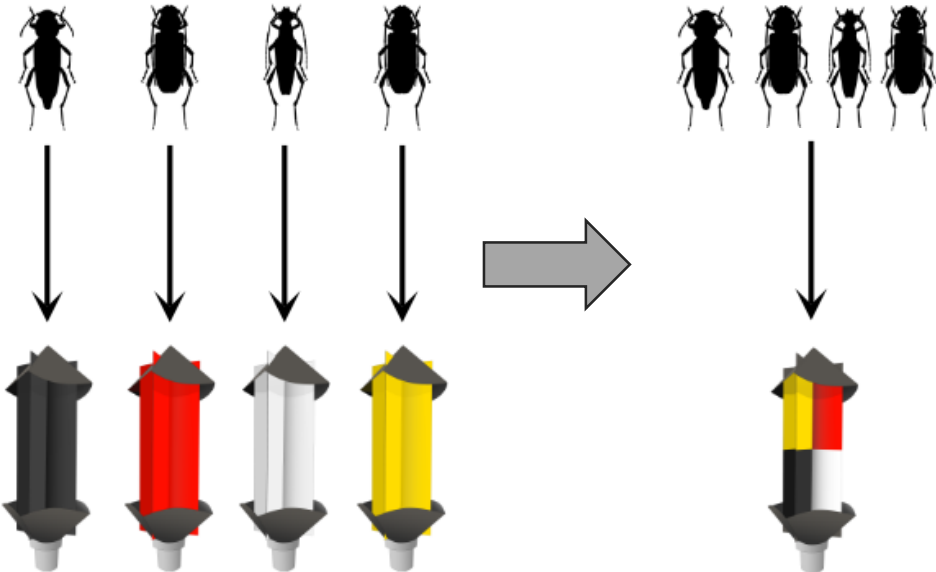


Combine multiple olfactory cues



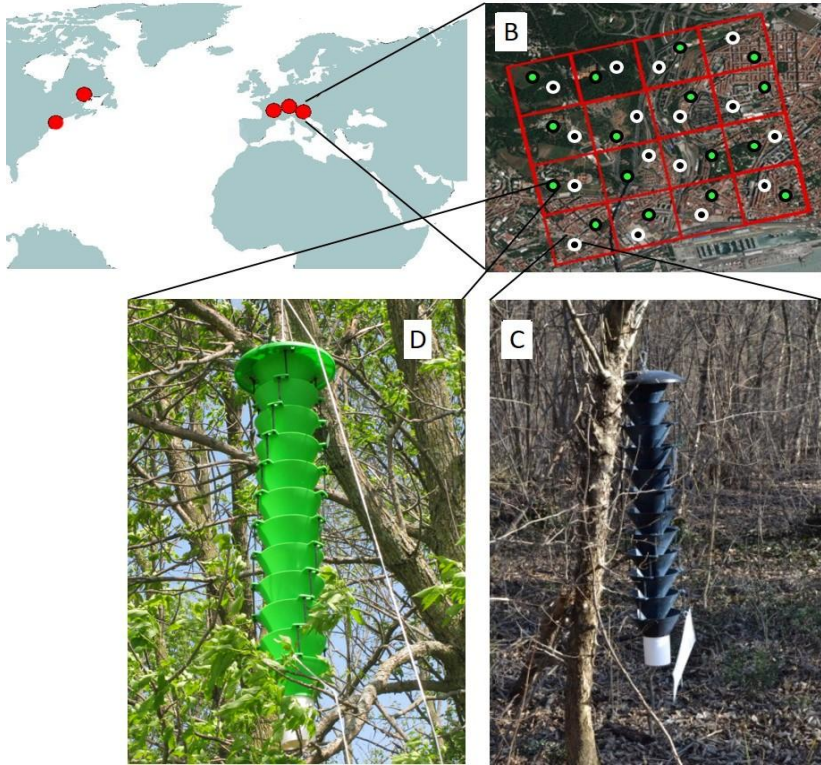
Multi-lure blends

Combine multiple visual cues



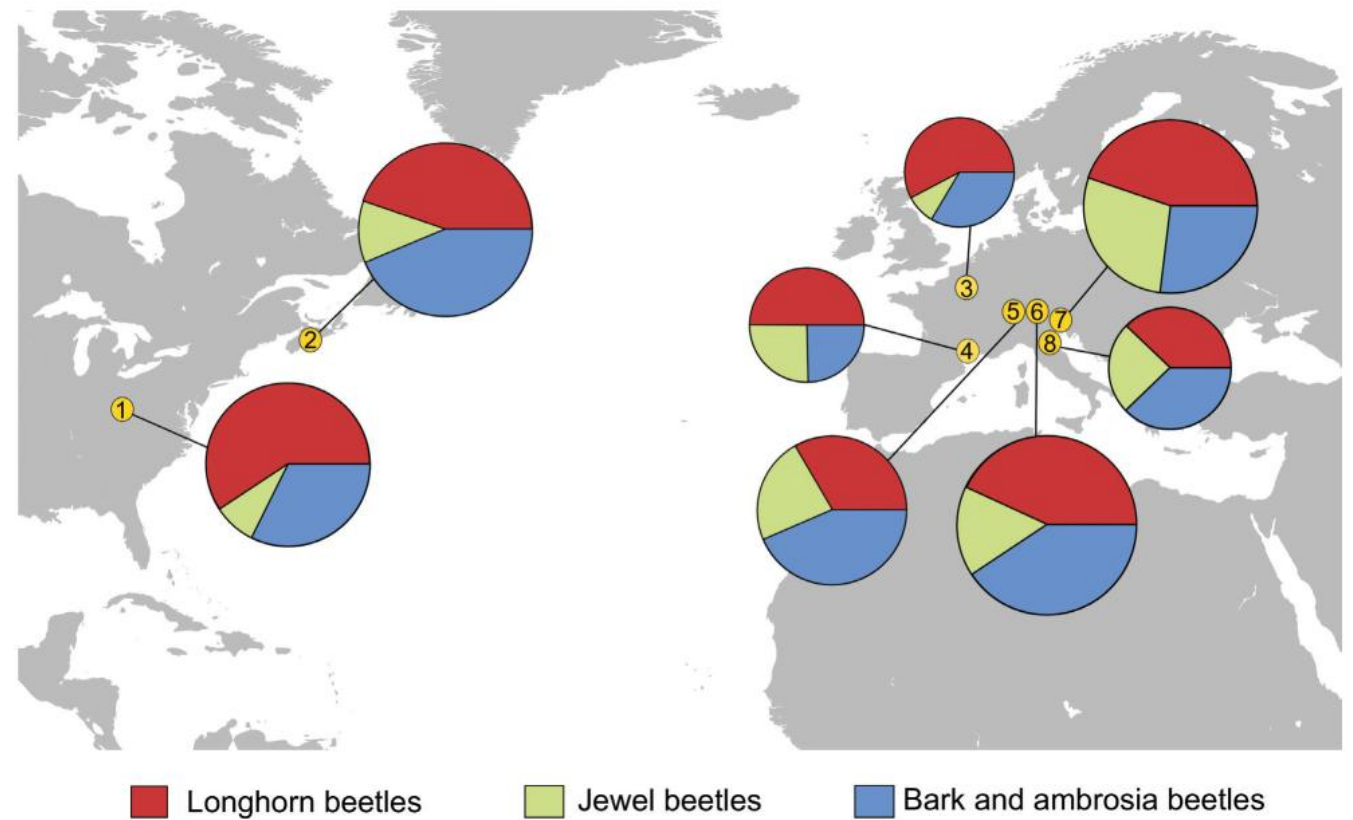
Multi-colored traps

# Multi-lure blends



16 green-canopy and 16 black-understorey MF traps per site (n=8)

Blend: longhorn beetle pheromones + ethanol + alpha-pinene



From 55 to 100 species

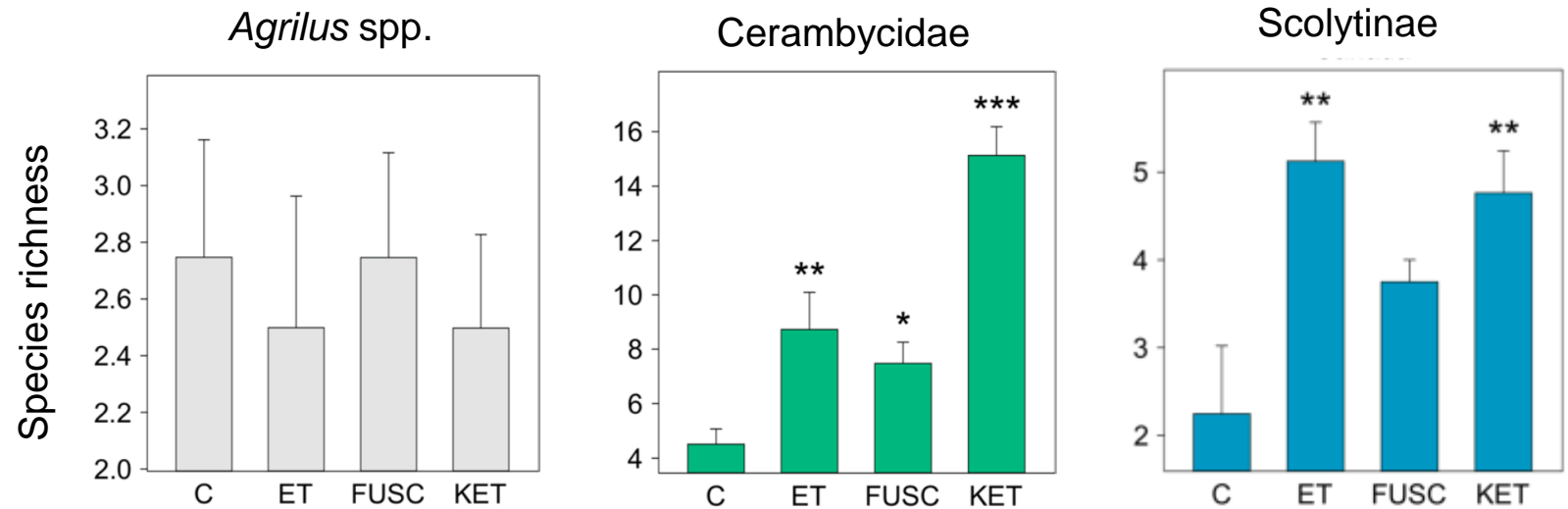
21 non-native species (14,772 specimens)

# Multi-lure blends and *Agrilus* spp.



Santoiemma et al. (2025)  
J Pest Sci

Unbaited vs. baited green-canopy multifunnel traps in multiple countries  
(C: unbaited / ET = ethanol / FUSC = fuscumol + ET / KET = kethols + ETH)



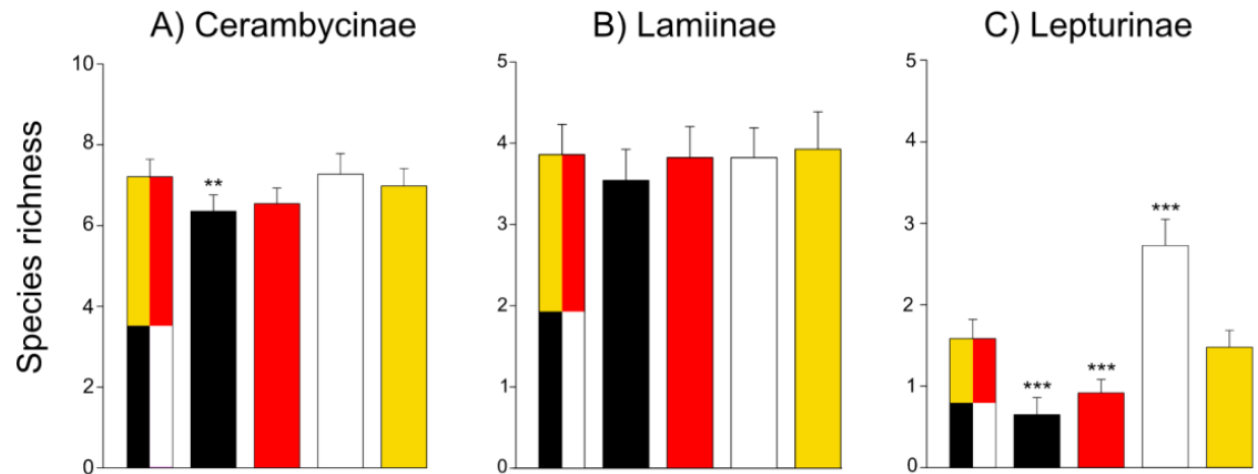
Baiting green-multifunnel traps with blends for longhorn beetles and bark and ambrosia beetles do not affect catches of *Agrilus* jewel beetles (including EAB)

# Multi-colored traps

Plain colored traps vs. multi-colored traps towards longhorn beetles in multiple countries



Besana et al. (2026)  
Forest Ecology and Management



Multi-colored traps can be used for most longhorn beetles but Lepturinae

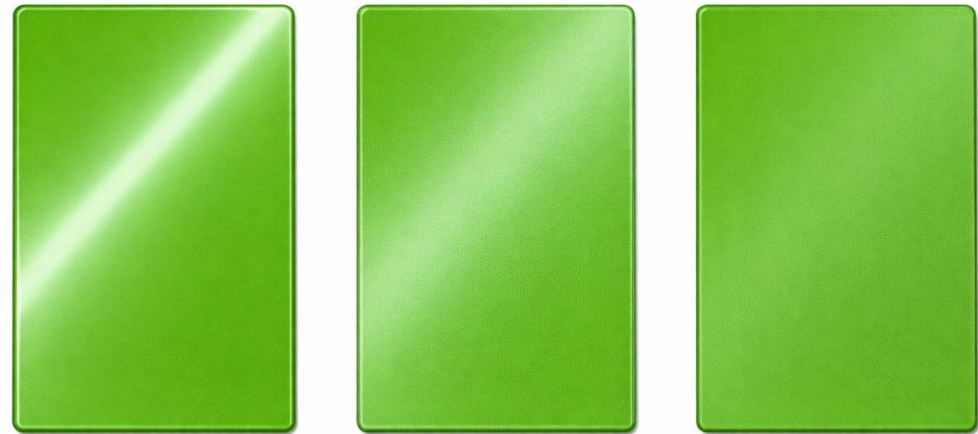
# Multi-colored traps and *Agrilus* spp.



Mainly no difference with green traps for longhorn beetles and bark and ambrosia beetles but...

...almost no *Agrilus* specimens in both treatment!

Santoiemma et al. (in preparation)



Impact of glossiness on trap captures?

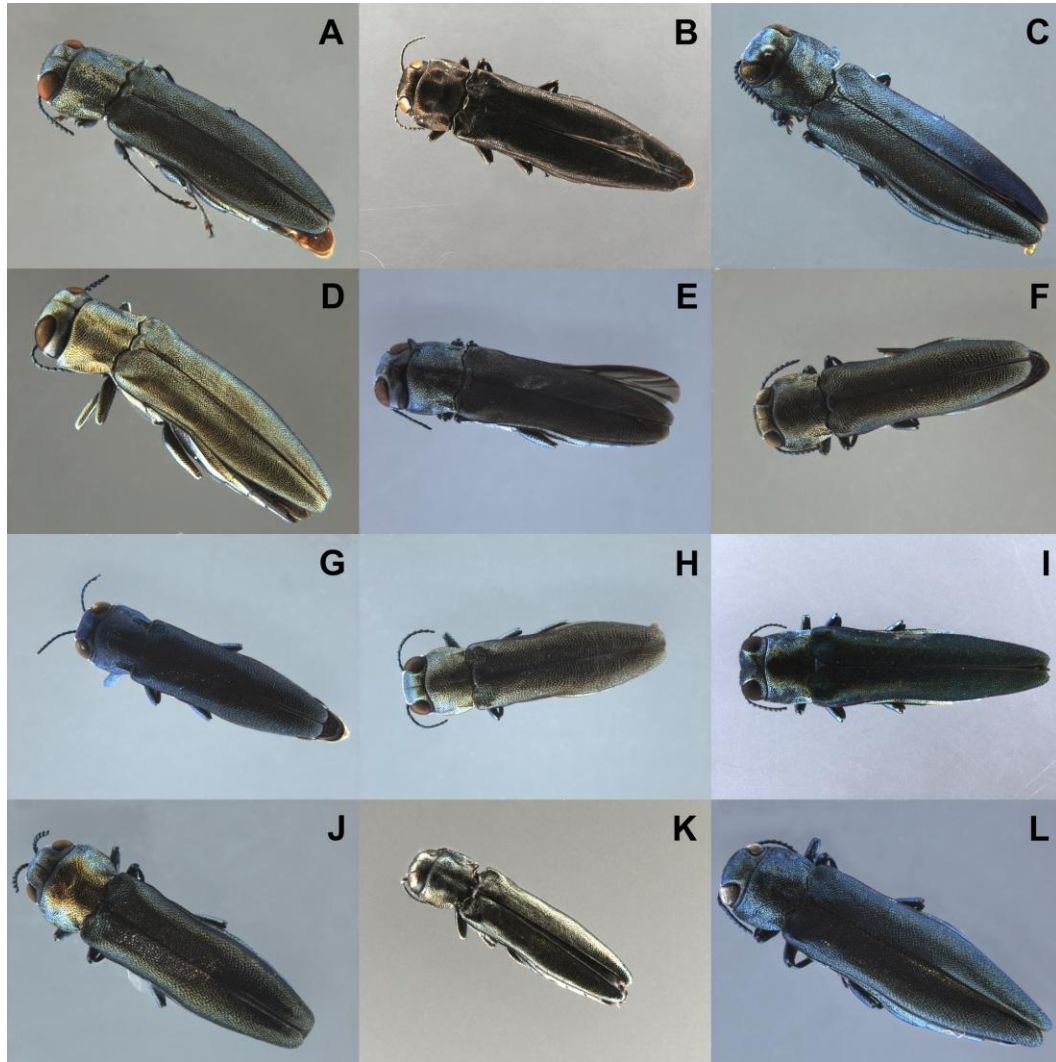
## Question 3

Can we speed up the specimens identification process?



Entomoscope is a low-cost open source photomicroscope that uses high-resolution digital imaging and allows a pre-trained CNN to accurately detect, image and classify insect specimen

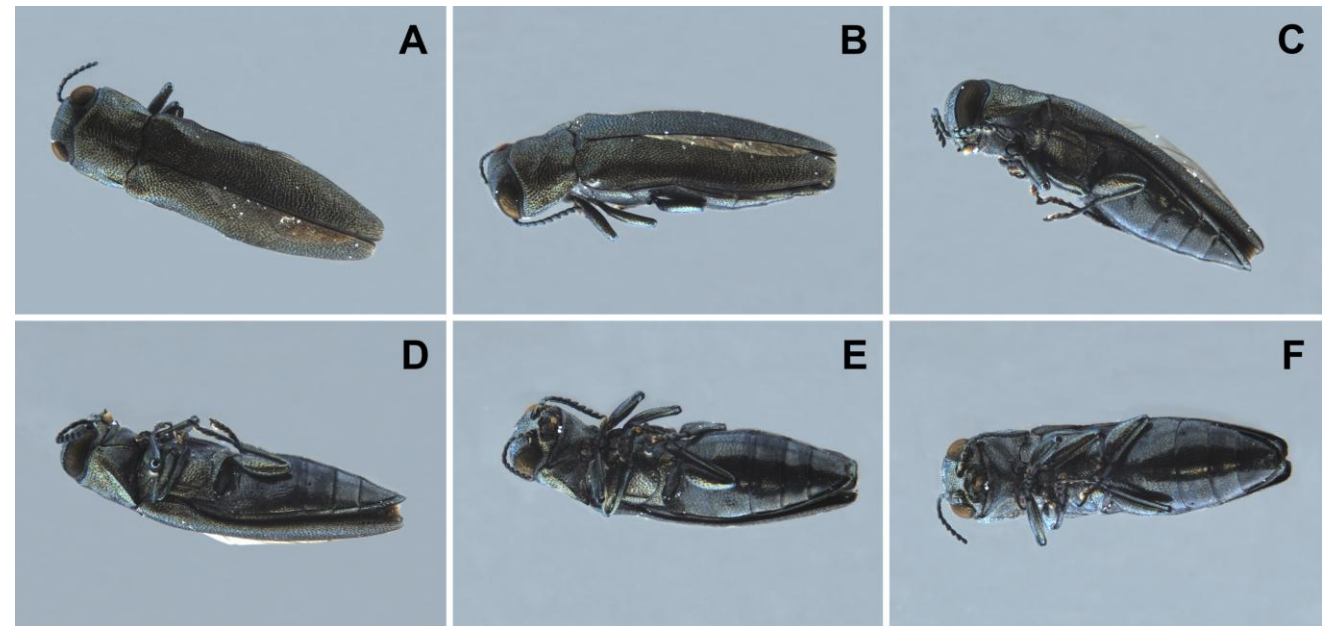
# Entomoscope and *Agrilus* spp.



13 species used to train the algorithm, including *A. planipennis* and *A. anxius*

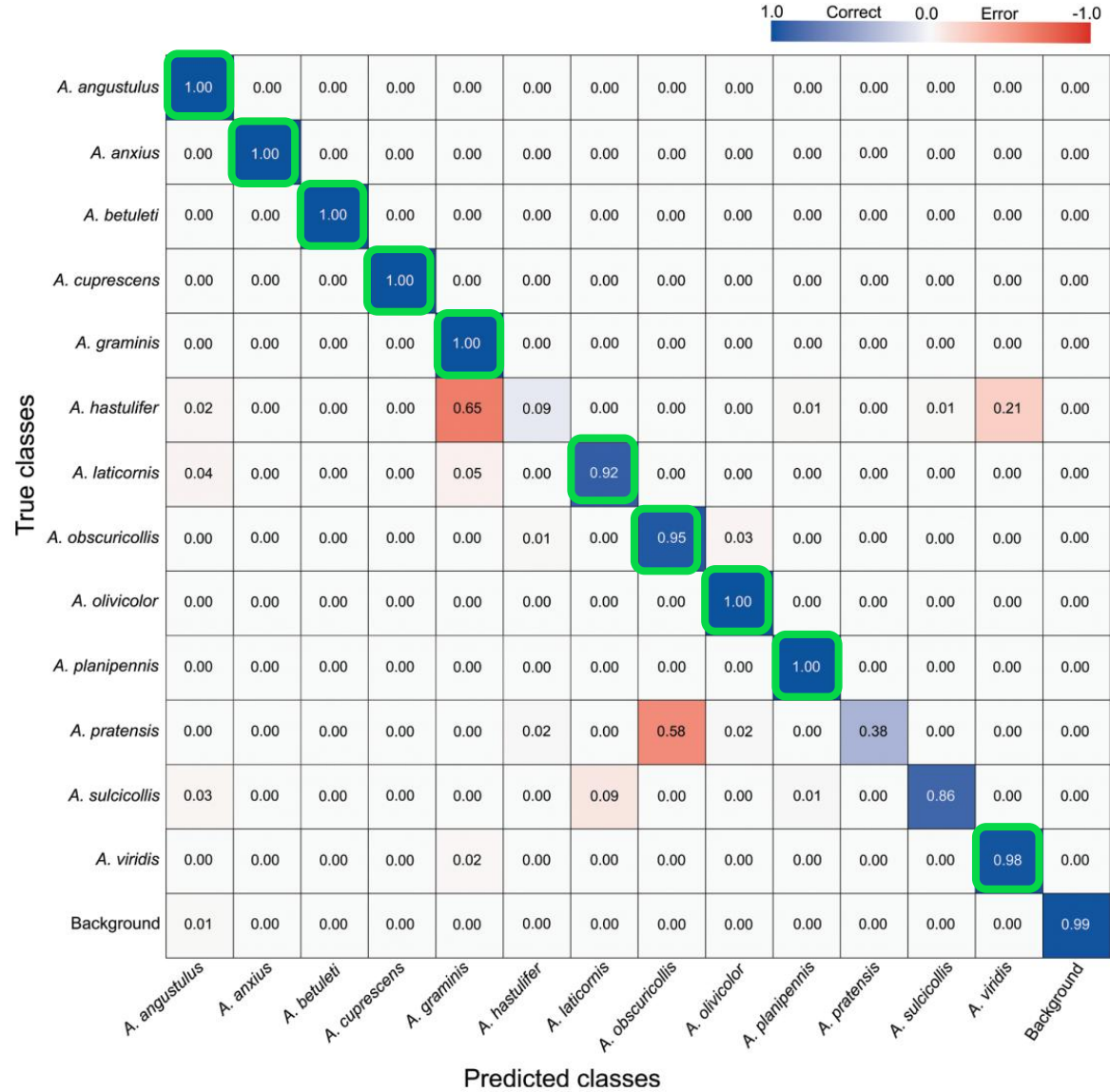
Specimens collected in green-multifunnel traps and kept in ethanol

Training based on 50-150 pictures per species from different angles



# Entomoscope and *Agrilus* spp.

Is the trained algorithm able to correctly identify specimens belonging to the species on which the training was based on?



Seven species with 100% accuracy

Ten species with more than 90% accuracy

# Entomoscope and *Agrilus* spp.

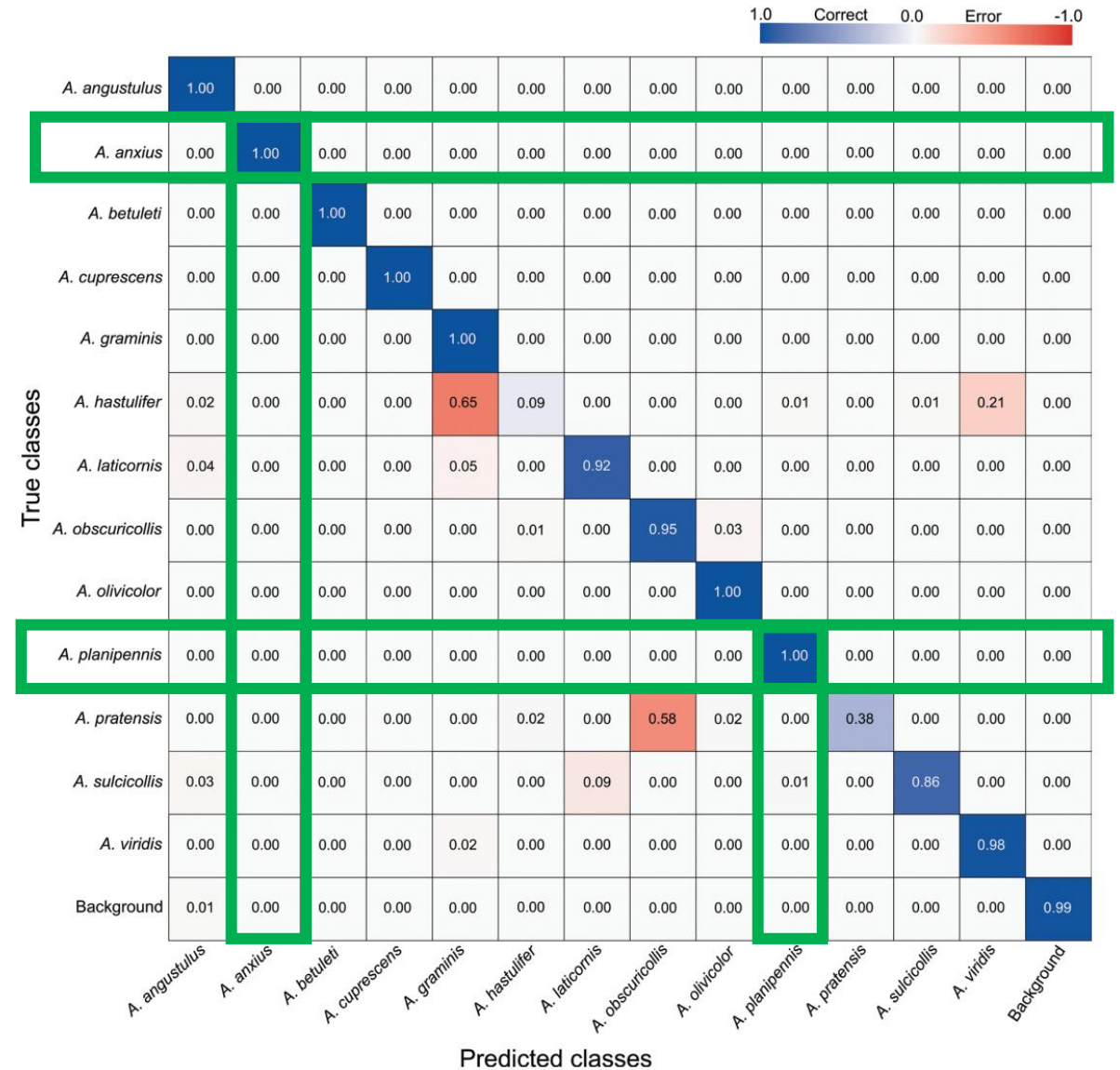
Is the trained algorithm able to correctly separate *Agrilus planipennis* and *Agrilus anxius* from EU-native species?



*Agrilus planipennis* correctly identified 100% of times



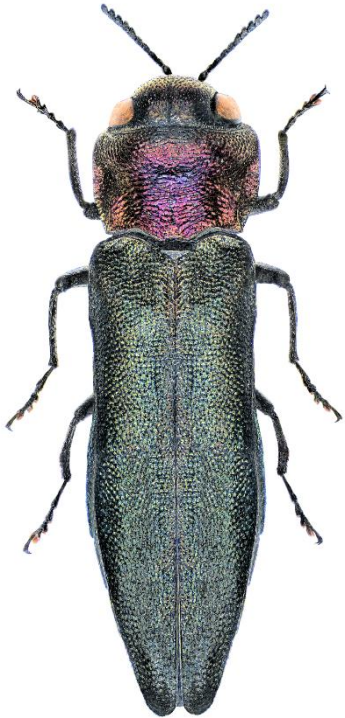
*Agrilus anxius* correctly identified 100% of times



# Entomoscope and *Agrilus* spp.

Is the trained algorithm able to correctly separate EU-native *Agrilus* species?

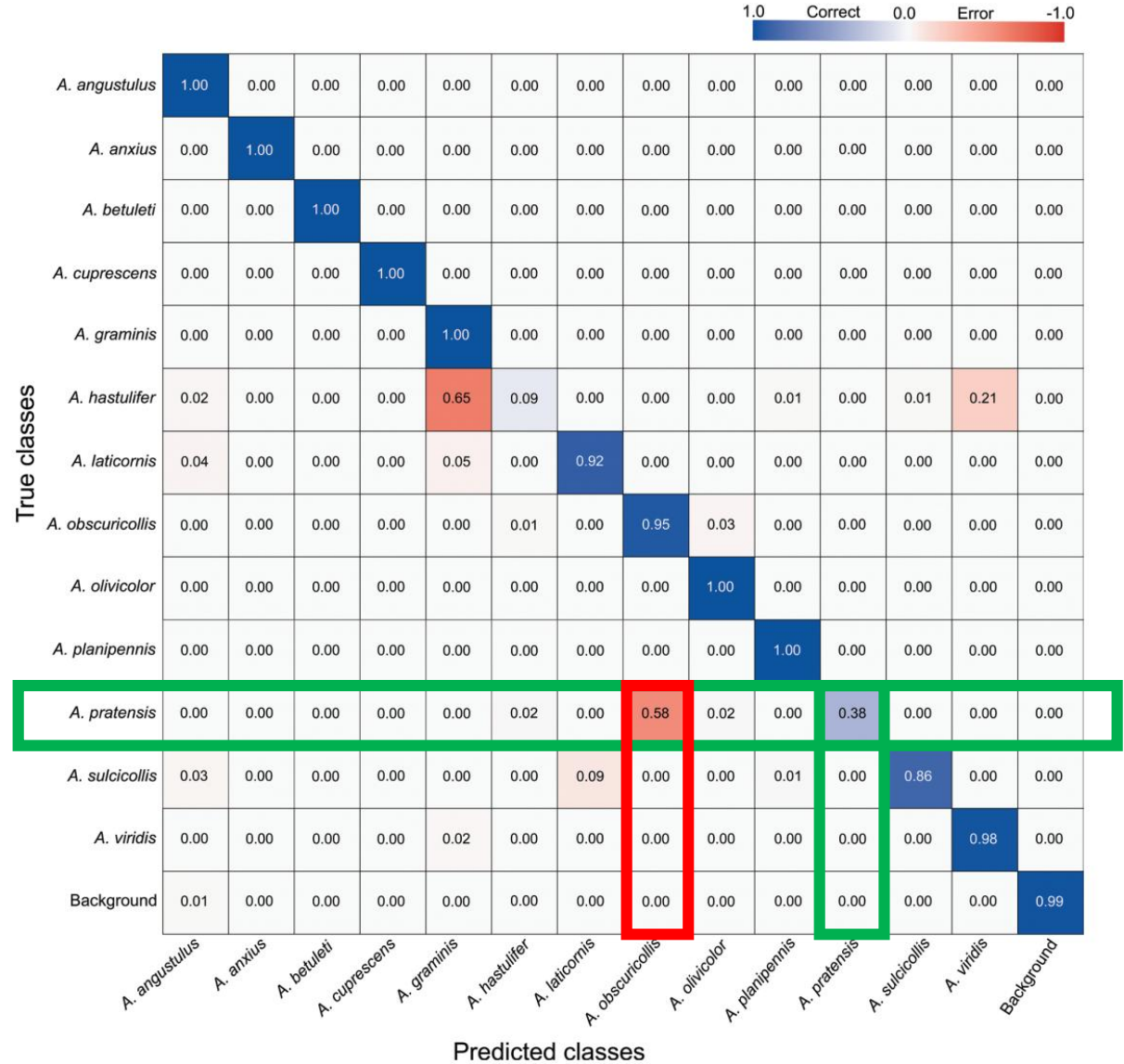
Not always (2 problematic species: *A. hastulifer* and *A. pratensis*)



*Agrilus pratensis*



*Agrilus obscuricollis*



# Entomoscope and *Agrilus* spp.

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Is the trained algorithm able to correctly recognize species not included in the training process?



*Agrilus biguttatus*



*Agrilus convexicollis*

*A. biguttatus* and *A. convexicollis* were correctly assigned to the class «Unknown» 100% of times

# Improving surveillance efficacy

Incorporating species-specific or generic visual cues on baited traps and exploiting AI-based technologies to identify specimens can help to improve surveillance efficacy



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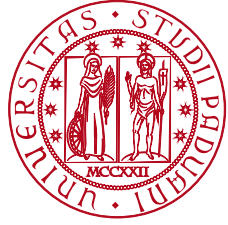
# Acknowledgments

## Funding agencies



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DI PADOVA**

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## Colleagues and collaborators



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Giacomo Cavaletto



Valerio Caruso



Giacomo Santoiemma