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Short Communication

Testing multi-lure traps for surveillance of native and alien longhorn beetles (Coleoptera, Cerambycidae) at ports of entry and in forests in Austria

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Abstract

A multi-lure approach for trapping a wide variety of Cerambycidae was tested at the Port of Vienna in 2017 and 2018, a high risk area for the introduction of invasive tree pests transported in wood packaging material. Traps were deployed in the port area and in an adjacent broadleaved forest. A second experimental site was set up in a pine forest in eastern Austria not influenced by wood imports. Blends of cerambycid pheromone compounds were tested: Blend 1 mixing four pheromone components for various Lamiinae and Spondylidinae, Blend 2 mixing four pheromone components for various Cerambycinae and Prioninae, and Blend 3 combining the eight volatiles. Additionally, the host tree kairomones ethanol and (-)-α-pinene were added as general attractants. A total of 30 cerambycid species was detected with the traps in 2017; 36 species were detected in 2018. The full blend (Blend 3 plus ethanol plus (-)-α-pinene) caught significantly more cerambycid species than the more specific Blends 1 and 2. Addition of ethanol plus (-)-α-pinene to Blend 3 significantly increased the number of trapped cerambycid individuals but not the number of species. Overall, we caught 28 cerambycid species at the Port of Vienna (11 species) and the adjacent forest (23 species) and 23 species in the pine forest. No alien cerambycid was detected in the two years. Trapping with multiple lures could be employed in surveillance programs against potentially invasive cerambycids in high risk areas for introduction.

Key words: trapping, generic lures, pheromone, invasive forest pests, tree pests

Introduction

Bark and wood boring insects frequently travel in wood packaging material. This is an important pathway for potential introduction of key tree pests such as the Asian longhorned beetle, *Anoplophora glabripennis* (Motschulsky, 1853), or the emerald ash borer, *Agrilus planipennis* Fairmaire, 1888 (EPPO 2016, 2005). Most insects intercepted on wood packaging material are Coleoptera, and among them Cerambycidae and Scolytinae are most prevalent (Meurisse et al. 2019). In 2015 and 2016, 10.2% and 19.6% of inspected consignments with wood packaging material imported into Austria from China contained living bark- or woodboring insects, especially scolytids and cerambycids (Hoch and Krehan 2017). This clearly shows that despite intensive efforts and regulations, such as the

International Standard for Phytosanitary Measures No. 15 (ISPM 15), the pathway remains of great importance. In a recent report of a trapping survey carried out in Great Britain, Inward (2019) concluded that imported wood including wood packaging material continues to be of great risk for the introduction of wood boring scolytids. The plant health regime of the European Union (Regulation (EU) 2016/2031) requests that member states carry out surveillance programs for quarantine pests. Trapping active insect stages at potential ports of entry is one part of such surveillance programs. Given the record of interceptions of cerambycids and scolytids in wood packaging material and considering the variety of species detected, trapping with generic lures would increase the chance for detection of unexpected and hence unregulated species.

Traps are an important tool for surveillance at ports of entry and in surrounding natural environments. However, trapping is rather labor intensive when many traps are used (Poland and Rassati 2019). Employing multi-lure traps allows simultaneous attraction of multiple species, thereby reducing trapping costs and efforts. Generalist lures, such as ethanol and α-pinene were successfully employed in surveys for Scolytinae in New Zealand (Brockerhoff et al. 2006) and the U.S.A. (Rabaglia et al. 2019). In a pilot study, Rassati et al. (2014) demonstrated the efficiency of traps simultaneously baited with scolytine pheromone components and host tree kairomones (i.e., multi-lure traps) for trapping bark and ambrosia beetles at entry points. Employing this trapping system in 15 ports and surrounding forests in Italy, again with a focus on Scolytinae, led to the detection of 14 alien species (Rassati et al. 2015). A trap survey using ethanol and α-pinene in Great Britain detected three recently established alien ambrosia beetles (Inward 2019).

Trapping at points of entry has become an important tool for surveys of longhorn beetles. Sex and sex-aggregation pheromones as well as the attractiveness of kairomones (host tree volatiles, bark beetle pheromones) are now known for many cerambycid species (reviewed in Millar and Hanks 2017). In addition, these pheromones were shown both in North America and Europe to be very effective when used simultaneously on a trap. This is a feasible approach because pheromone components are often conserved among related cerambycid species (e.g. Hanks et al. 2012, 2018; Millar et al. 2018; Fan et al. 2019). One of the most complex blends has been recently developed and successfully tested in France (Fan et al. 2019). This blend, consisting of eight different pheromone components, detected 118 cerambycid species (including three alien species), which represent 48% of the French cerambycid fauna.

In this study we tested the application of multi-lure blends specifically designed to attract cerambycid beetles at the Port of Vienna, deploying traps on the premises of the port and in an adjacent mixed broadleaved forest. Because of the high turnover of consignments with wood packaging materials, this port is considered a high-risk area for the introduction of alien cerambycids, which may subsequently spread to the adjacent forest. An additional trapping site was established in a pine forest not influenced by imports of goods with wood packaging material in order to test the lures in a different forest type with highly different cerambycid fauna. The selection of lures was based on the experiments carried out at French ports (Fan et al. 2019). We compared blends of pheromone components of the cerambycid subfamilies Lamiinae and Spondylidinae, blends of pheromone components of Cerambycinae plus the sex pheromone of the genus *Prionus*, and the full blend of all components. Also the addition of host kairomones ethanol and α-pinene was tested. Besides testing the lures, the experiment also allowed testing the surveillance method in a busy port in practice.

Materials and methods

Sites

A first trapping site was established in the Port of Vienna (Hafen Wien): The trapping experiment was set up in two experimental sites, the premises of the port as well as an adjacent forest. Inside the port, traps were placed in open areas in the vicinity of shade trees. Care had to be taken that placement of traps would not interfere with operations in the busy port. In order to monitor potential dispersal of alien cerambycids away from the port, traps were also placed on forest edges of a directly adjacent forest or in relatively open locations inside the forest. The forest was a mature lowland riparian forest consisting of various broadleaved tree species (mostly *Populus* spp., mixed with *Aesculus hippocastanum* Linnaeus, 1753, *Tilia* spp., *Acer* spp., *Fraxinus excelsior* Linnaeus, 1753) on an old side arm of the Danube River at ca. 160 m elevation.

A second trapping site was established in the southern Vienna Basin near the town of Neunkirchen (40 km southwest of Vienna), in an even aged Austrian pine (*Pinus nigra* Arnold, 1785) forest at ca. 315 m elevation. Pine trees were approximately 60 years old, various broadleaved trees and shrubs occurred on the stand margin and in the understory. Traps were placed inside the pine stand in locations with no or very little understory.

Traps and lures

At the Port of Vienna, black multifunnel traps (12 funnels; Econex SL, Murcia, Spain) were used. Traps are Teflon-coated by the manufacturer. Based on experiences in previous experiments (Pajares et al. 2017; Fan et al. 2019), the big, teflon-coated collector cups with wire mesh bottoms designed for dry trapping were supplied with a piece of alpha-cypermethrin insecticide netting (Storanet®, BASF Pflanzenschutz, Germany). In the pine forest, black cross vane traps (Econex SL, Murcia, Spain) were used in addition to multifunnel traps. All traps were hung at 1.8 m height (top of the trap) from wooden poles.

Three different blends of lures that are known to be attractive for certain cerambycids were tested: Blend 1 consisted of four pheromone components (fuscumol, fuscumol acetate, geranyl acetone, monochamol) of various Lamiinae and Spondylidinae (Sweeney et al. 2010; Pajares et al. 2010; Mitchell et al. 2011); Blend 2 consisted of three pheromone components (racemic 3-hydroxyhexan-2-one, 2-methyl-1-butanol, *anti*-hexanediol) of various Cerambycinae (Hanks et al. 2007, 2012; Millar and Hanks 2017), and prionic acid, the sex pheromone of *Prionus* spp. (Barbour et al. 2011); Blend 3 was a mix of 1 and 2. The individual compounds were purchased from ChemTica Internacional, S.A. (Heredia, Costa Rica) except prionic acid (Alpha Scents Inc.). The compounds were dissolved in isopropanol and mixed to realize the multi-lure blends. The specific proportions of each compound in the blends were defined following Fan et al. (2019): Blend 1 contained 50 mg fuscumol, 50 mg fuscumol acetate, 50 mg monochamol, and 25 mg of geranyl acetone in isopropanol to a total volume of 1 ml per lure. Blend 2 contained 50 mg 3-hydroxy-2-hexanone, 1 mg prionic acid, 50 mg 2-methyl-1-butanol, and 50 mg anti-2,3-hexanediol in isopropanol to a total volume of 1 ml per lure. Blend 3 combined blends 1 and 2. 1-ml aliquots of each blend were filled in glass vials with screw caps and stored at 4 °C until used. Additionally, the lures were combined with the host tree kairomones ethanol (5 ml) plus (-)-α-pinene (1 ml) (blend +a). Based on the results of experiments in France (Fan et al. 2019) that showed that numbers of cerambycids attracted to traps baited only with isopropanol were significantly lower than in traps baited with either of the tested blends, we did not use the isopropanol-controls in our experiment. Before being installed on the trap, the lures were poured from the vial on a cotton wad in a re-sealable poly ethylene bag (Minigrip bags, 4 cm × 6 cm × 60 µm; Dutscher, Brumath, France). These dispensers were installed in the middle of the trap.

Trapping experiments

Trapping experiments were conducted at both sites during two consecutive years. Traps were arranged in blocks in which lures were placed in randomized positions (Table 1). Distance between individual traps was at least 50 m; maximum distance between traps on one site was 1 km. The traps were checked and emptied weekly or biweekly. Lures were renewed every three weeks and trap positions were rotated at these occasions. Insects were stored dry until determination. Cerambycids were determined morphologically using keys by Harde (1966) and Klausnitzer et al. (2016). Trap catches were pooled for 3-week collection periods representing the change intervals of the lures.

Statistical analysis

Lure rotation at each 3-week collection period allowed us to consider the number of collection dates at each site as replicates. Replicates from a given

Table 1. Sites and lures used in the experiments (Lures: pheromone Blend 1 (fuscumol, fuscumol acetate, geranyl acetone, monochamol), Blend 2 (3-hydroxyhexan-2-one, 2-methyl-1-butanol, *anti*-hexanediol, prionic acid) or Blend 3 (mix of 1 and 2); +a indicates addition of ethanol and (-)-α-pinene).

Year	Site		Lure				Trap[3]	No. of blocks
2017[1]	Vienna	Port	1+a	2	3+a		M	2
		Forest	1+a	2	3+a		M	2
	Neunkirchen	Forest	1+a	2	3+a		M	2
		Forest	1+a	2	3+a		C	2
2018[2]	Vienna	Port	3	3+a			M	3
		Forest	3	3+a			M	3
	Neunkirchen	Forest	1+a	2	3	3+a	M	2
		Forest	1+a	2	3	3+a	C	2

[1] Traps active from June 1 to October 5 in Vienna, June 2 to October 6 in Neunkirchen (i.e., 6 trapping periods)
[2] Traps active from May 16 to October 10 (i.e., 7 trapping periods)
[3] Trap type: M = multi funnel, C = cross vane

date that contained no cerambycid specimens in any traps, for example due to inclement weather, were excluded from the analyses. This concerned three collections (24/08/2017 and 19/09/2018 at Vienna Port and 14/09/2017 at Vienna Forest). For the analysis, we combined the replicates involving the same lures at both sites and in both years of experiments. Consequently, we obtained 21 replicates to compare the attractiveness of Lures 1+a, 2 and 3+a, 20 replicates to compare Lures 3 and 3+a, and 7 replicates to compare the attractiveness of the four lures. Response variables were: (1) number of cerambycid individuals per trap per collection period; (2) number of cerambycid species per trap per collection period; and (3) numbers of individuals per trap per collection period of cerambycid species for which at least 100 specimens were captured.

Because the data violated normality assumption, differences between trap captures were tested using the nonparametric Friedman's *Q* test (Statistix 10®, Analytical Software, Tallahassee, FL, USA). Following a significant overall Friedman's test, pairs of treatment means were compared with the posthoc Dunn-Nemenyi multiple comparison test. Cerambycid captures realized in Neunkirchen during 2017 and 2018 were used to compare the attractiveness of cross-vane and multifunnel traps. The mean number of cerambycid individuals and mean number of cerambycid species trapped for a same lure during the same period was compared between the two trap types using a paired t-test.

Results

A total of 30 cerambycid species was detected with the traps in 2017 (962 individuals were trapped); 36 species were detected in 2018 (2174 individuals trapped). Overall 44 species were detected over the two years.

Trap catches at Port of Vienna and in adjacent broadleaved forests

In 2017, a total of 39 cerambycid specimens representing 6 species were caught on the premises of the Port of Vienna. A higher number of 61 specimens representing 15 species was caught in the adjacent broadleaved forest. Overall, 17 species were detected in the traps. In 2018, the numbers of cerambycid specimens and species detected in traps were higher than in 2017, with 135 specimens and 11 species captured at the port and 241 specimens and 16 species captured in the adjacent forest. A total of 21 cerambycid species were trapped in 2018. Ten species were trapped in both years (Supplementary material Table S1). *Phymatodes testaceus* (Linnaeus, 1758) was the most abundant species, both on the premises of the port and in the adjacent forest. Also, *Rusticoclytus rusticus* (Linnaeus, 1758) was trapped frequently in both areas. *Leiopus linnei* Wallin, Ný́lander & Kvamme, 2009 was abundant in the forest, whereas *Hylotrupes bajulus* (Linnaeus, 1758) and *Chlorophorus varius* (Müller, 1766) were trapped only on the port premises. No alien cerambycid species was trapped.

Trap catches in pine forest Neunkirchen

In 2017, a total of 923 cerambycid individuals representing 19 species were caught in Neunkirchen. Like in Vienna, trap catches were higher in 2018; a total of 2113 cerambycid individuals representing 21 species were caught (Table S2). Corresponding to the completely different habitat and host plant species the species composition differed from the one in Vienna; only 7 species were found both in Vienna and Neunkirchen. In the pine forest, *Spondylis buprestoides* (Linnaeus, 1758) was the most abundant species followed by *Arhopalus rusticus* (Linnaeus, 1758) (both subfamily Spondylidinae). Also, *Monochamus* spp. (subfamily Lamiinae), particularly *M. galloprovinicalis* (Olivier, 1795), were trapped in high numbers. *Phymatodes testaceus* was the most abundant Cerambycinae.

Comparison between the lures

Cerambycid total captures per lure at a same trapping period did not differ significantly between the two trap types (multifunnel and cross vane traps) at Neunkirchen (paired t-test: $t = -0.57$, df = 45, P = 0.572). Similarly, no difference was observed between the two trap types for the number of cerambycid species trapped by each lure at the same period (paired t-test: $t = -0.56$, df = 45, P = 0.577). These results allowed combining the data obtained from the two trap types in further analyses.

In experiments comparing Lures 1+a, 2, and 3+a, the full blend 3+a and Lure 1+a captured cerambycid individuals in significantly higher numbers per trap and collection period than Lure 2 ($Q_{2,21} = 12.87$; $P = 0.005$). Traps baited with Lure 3+a caught, on the average, significantly more cerambycid species per period than those baited with Lures 1+a and 2 ($Q_{2,21} = 14.56$; $P = 0.001$) (Figure 1). The supplementation of Lure 3 with ethanol and α-pinene (i.e., Lure 3+a), resulted in significantly higher catches of individuals compared to Lure 3 alone ($Q_{1,20} = 9.00$; P = 0,003). However,

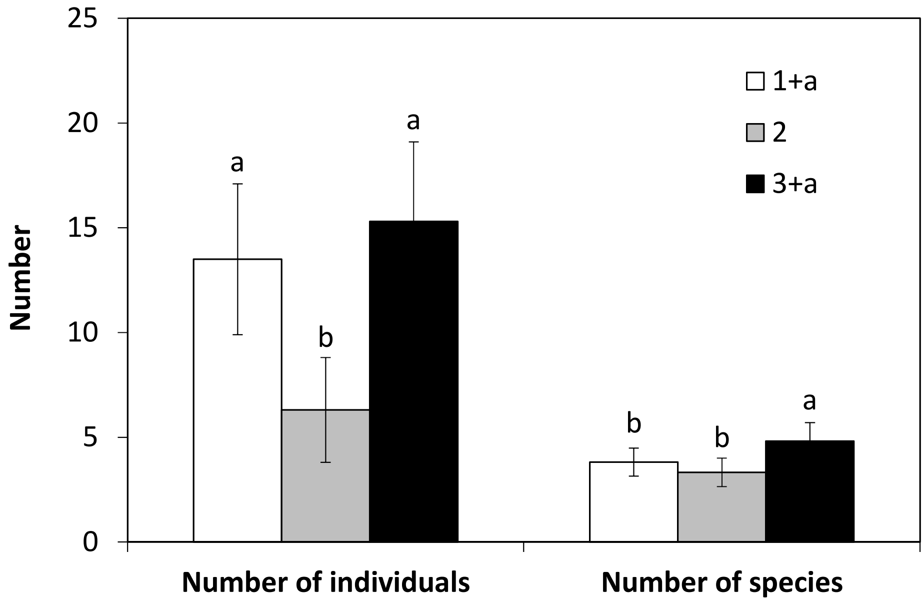

Figure 1. Mean number (± SE) of cerambycid individuals and cerambycid species per trap and trapping period caught with Lures 1+a, 2, and 3+a. Different letters indicate significant differences between means according to Friedman's Q test followed up by Dunn-Nemenyi multiple comparison test.

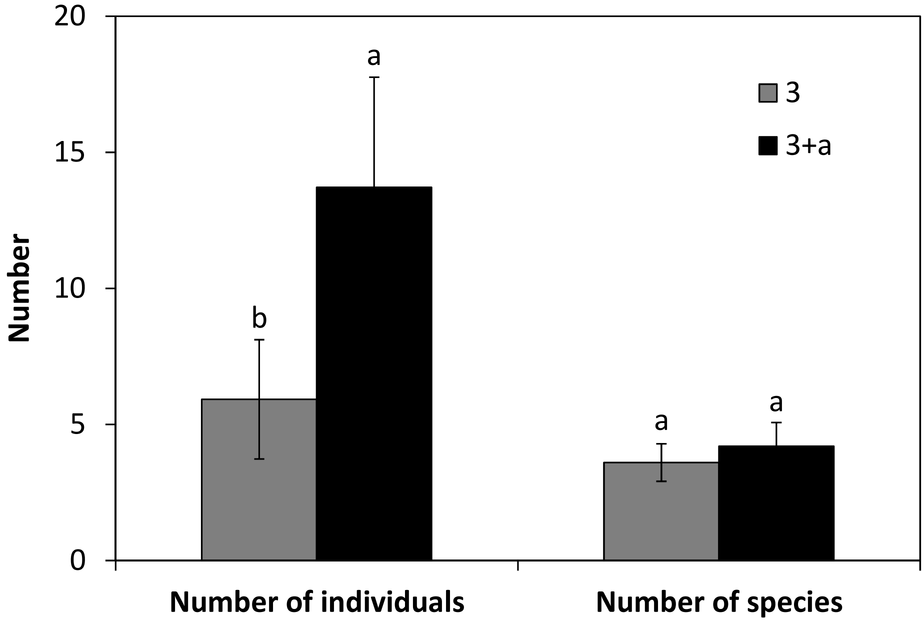

Figure 2. Mean number (± SE) of cerambycid individuals and cerambycid species per trap and trapping period caught with Lures 3 and 3+a. Different letters indicate significant differences between means according to Friedman's Q test.

the total number of cerambycid species trapped per period did not differ among the two lures ($Q_{1,20}$ = 1.00; P = 0,317) (Figure 2). Only 7 replicates were available to compare the attractiveness of the 4 lures. Traps baited with Lures 3+a captured significantly more cerambycid individuals per period (28.03 ± 7.73) than those baited with Lures 2 (11.57 ± 6.90) and 3 (10.24 ± 5.06), while the captures by traps baited with Lure 1+a (25.60 ± 8.05) were not significantly different from either 3+a, 2 and 3 ($Q_{3,6}$ = 9.28; P = 0.026). The number of trapped species was significantly higher in traps baited with Lure 3+a (6.57 ± 1.99), Lure 1+a (5.57 ± 1.25), and Lure 3 (5.14 ± 1.26) than in traps baited with Lure 2 (4.29 ± 1.21) ($Q_{3,6}$ = 9.45; P = 0.024).

Species that could be analyzed individually because they were trapped in sufficient numbers revealed preferences for specific lures. *Phymatodes testaceus* (Cerambycinae) was trapped significantly more often with Lure 3+a and Lure 2 (6.04 ± 3.66 and 4.46 ± 2.09 specimens, respectively) than with Lure 1+a (0.06 ± 0.04) ($Q_{2,12}$ = 16.50; P = 0.000). By contrast, catches of *S. buprestoides* (Spondylidinae) were significantly higher with Lure 1+a and Lure 3+a (10.59 ± 3.09 and 9.80 ± 2.87, respectively) than Lure 2 (0.70 ± 0.27) ($Q_{2,10}$ = 14.00; P = 0.000). *Monochamus galloprovincialis* (Lamiinae) also showed higher mean captures with Lure 1+a and Lure 3+a (4.42 ± 0.80 and 2.58 ± 0.51, respectively) than with Lure 2 (1.09 ± 0.36) ($Q_{2,10}$ = 14.86; P = 0.000). This was also the case for *A. rusticus* (Spondylidinae) (8.53 ± 1.88 specimens trapped with Lure 1+a and 7.00 ± 2.81 with Lure 3+a *vs*. 1.58 ± 0.49 with Lure 2; $Q_{2,9}$ = 17.90; P = 0.000) and *Acanthoderes clavipes* (Schrank, 1781) (Lamiinae) (1.08 ± 0.40 specimens trapped with Lure 1+a and 0.90 ± 0.26 with Lure 3+a *vs*. 0.03 ± 0.03 with Lure 2; $Q_{2,9}$ = 10.72; P = 0.005). In our experiments, no significant differences between lures were observed for *R. rusticus* (Cerambycinae) and *L. linnei* (Lamiinae).

Discussion

The full blend of pheromones and kairomones (Lure 3+a) caught significantly more Cerambycid species than the more specific Lure 1+a and Lure 2 and significantly more Cerambycid individuals than Lure 2 in our experiment. This demonstrates that combination of the two blends that are attractive for either Lamiinae and Spondylidinae or Cerambycinae and *Prionus* is a feasible option to trap a broad spectrum of species in single traps. Multi-lure trapping of cerambycids has been successfully used in many experiments in North America and Europe. Partial inhibition due to pheromones of other species occurred only in a few species (Hanks et al. 2012, 2018; Millar et al. 2018). The study in French ports and forests showed that the combination of two four-component lures (same blends as in the present study) on one trap resulted in a significant increase in species and specimens compared to each blend individual. No apparent antagonistic effects occurred (Fan et al. 2019). Also, our experiment gave no indications for such negative effect. Species specific analysis (performed in cases were sufficient individuals were trapped) indicated preferences towards the blends consisting of pheromones known to be attractive for the respective subfamily. This was highly significant for *P. testaceus* (Cerambycinae). Only 2 specimens were caught with Lure 1+a, while a total of 297 specimens were caught with Lure 2 over the two years. *Spondylis buprestoides* and *A. rusticus* (Spondylidinae) as well as *M. galloprovincialis* (Lamiinae) showed a significant preference for Lure 1+a. The blend included monochamol, the pheromone of *M. galloprovincialis* (Pajares et al. 2010) and fuscumol that is a pheromone for *A. rusticus* (Žunič-Kosi et al. 2019). However, there was no significant difference between catches with the specific lure and the full blend in Lure 3+a for any of these species.

The addition of ethanol and (-)-α-pinene to the pheromone blend led to a significant increase in the number of trapped specimens. The number of species did not increase. The increase in numbers of caught specimens was mostly due to abundant species such as *S. buprestoides*, *A. rusticus*, or *M. galloprovincialis*. Kairomones have been shown to increase attractiveness of the generic pheromone monochamol for the latter species (Pajares et al. 2010, 2017). A synergizing effect of ethanol in combination with pheromones was also shown for several American cerambycids (Miller et al. 2010; Handley et al. 2015). A similar increase in the mean catch of *P. testaceus* in the Russian Far East and France, respectively, was achieved when ethanol was combined with 3-hydroxyhexan-2-one (Sweeney et al. 2014; Fan et al. 2019).

It is of interest to compare the species composition in the traps with faunistic data to evaluate the detection efficacy of the method. Combining both years, our study detected a total of 28 cerambycid species in Vienna (port and adjacent forest). The updated list of Cerambycidae for the 2nd District of Vienna, where our study site is located, contains 57 species (W. Howorka *personal communication*). Hence, multi-lure trapping recorded more than half of the cerambycid fauna in this district in just two trapping seasons and a rather limited area. This illustrates that the method could also be very useful for faunistic studies. Species richness and abundance was higher in the adjacent forest than on the port premises, which likely corresponds to the availability of suitable habitats for cerambycids. Some species, such as *Clytus arietis* (Linnaeus, 1758), *Mesosa curculionoides* (Linnaeus, 1761), and *Aegosoma scabricorne* (Scopoli, 1763) were trapped only in the adjacent forest, likely due to the occurrence of suitable breeding material in area. On the other hand, *C. varius* and *H. bajulus* were trapped only in the port. The latter develops in dry wood and does not need bark for establishment (Klausnitzer et al. 2016). It can therefore be supported by unused wood packaging material or dunnage that is present at the port. *Chlorophorus varius* develops in dying or dry, sun-exposed branches (Klausnitzer et al. 2016) and might be more prevalent on trees in the open areas of the port.

Given the good representation of the native cerambycid fauna, we conclude that multi-lure trapping will also be feasible for surveillance for alien cerambycids of similar taxa in high risk as well as natural areas. No alien cerambycids were caught in Vienna and Neunkirchen. In a study at 17 ports and adjacent forests from 2014 to 2017, three alien species were detected, two of which had never been recorded in Europe before (Fan et al. 2019). On the other hand, as Rassati et al. (2018) pointed out, native species present on ports may be able to infest outgoing shipments. From this perspective, the presence of 21 cerambycid species in the port of

Vienna and the adjacent forest, and 10 species directly in the port (six of these trapped in both years) is of interest. For most species this will be relevant if a substantial amount of round wood in bark is shipped from the port, which is not the case in Vienna. But species that can infest dry wood, such as *H. bajulus*, may be able to infest wood packaging material of outgoing shipments.

Multi-lure trapping could reduce the number of traps deployed in surveillance programs in high risk areas for the introduction of alien pests. This can help save costs, since trap maintenance is very labor intensive. Moreover, finding suitable positions for traps on busy sites like the premises of ports or importers can be difficult. Traps must not interfere with the regular operations on the sites and the risk for traps to be damaged should be minimized. Therefore, using the few suitable spots for covering a maximum of possible species is clearly an advantage. Since the catch of cerambycid species in traps baited with the full blend was significantly higher than the catch of species in traps baited with the two more specific blends individually, multi-lure trapping provides the option to cover a comparable species number in one trap instead of two. Since host tree kairomones ethanol and (-)-α-pinene have been shown to been useful for surveillance of bark and ambrosia beetles (Brockerhoff et al. 2006; Miller and Rabaglia 2009; Rassati et al. 2015; Inward 2019) multi-lure traps using the full blend (Lure 3+a) could be an interesting option for trapping Scolytinae and Cerambycidae together. Our study showed that trapping on such busy points-of-entry like the Port of Vienna can be done when administration and workers of the port are well informed and are willing to comply. During the two years, not a single trapping period was lost due to damage or blocking of a trap in the port. We conclude that integration of this approach into the surveys carried out by plant protection organizations would contribute to increase the chance for early detection of invasive wood boring insect pests.

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Ethics and permits

Permits to carry out experiments in the two forest sites and in the port were obtained from owners/managers and the authorities, respectively. We thank MA 22 of the City of Vienna and the Forest Service of the Province of Lower Austria for their interest in our study and assistance in selecting the locations. All applicable guidelines for the use of animals were followed. No studies involving human participants were performed.

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Supplementary material

The following supplementary material is available for this article:

Table S1. Cerambycid species trapped in the Port of Vienna and in the adjacent broadleaved forest.
Table S2. Cerambycid species trapped in the pine forest near Neunkirchen.

This material is available as part of online article from:
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