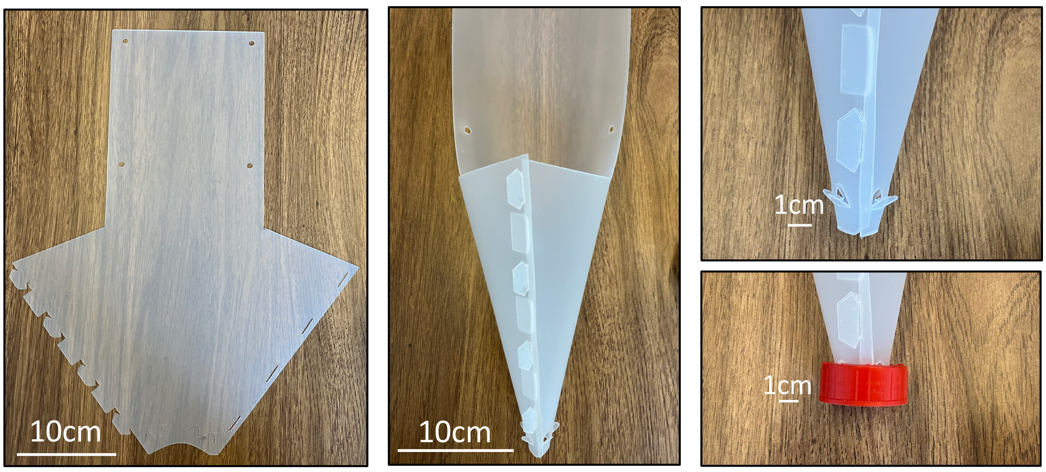
Fan-traps – Description and building instructions

Why propose a new trap model ?

Monitoring is an important component of pest management, both to prevent or mitigate outbreaks of native pests, and to check for newly introduced organisms. Surveys often rely on trapping, especially when the target species respond to semiochemicals. Many trap models are available for this purpose, but they are bulky in most cases, which raises transportation and deployment issues, and they are relatively expensive, which limits the size and accuracy of any network. To overpass these difficulties, entomologists have often used recycled material, such as modified plastic bottles, producing cheap and reliable traps but at the cost of recurrent handywork, not necessarily possible for all end-users (e.g., for national plant protection organizations). These *bottle-traps* have allowed very large surveys which would have been impossible with standard commercial traps, and we illustrate this approach with a few examples. Even though individual *bottle-traps* can be easily transported in the field (thirty of them, stacked, can fit in a backpack), they ship less easily in large numbers, because they are three-dimensional. Here we present, under a *Creative Commons* License, the blueprint of a *fan-trap*, a foldable model, laser-cut from a sheet of polypropylene, that can rapidly be produced in large numbers, occupies minimal size packaging for shipment because it is flat before being folded, and could be transported and deployed in the field with very little efforts.

Description of a *fan-trap*

A *fan-trap* (figures 1 to 3) consists in an arrow-shaped polypropylene sheet that can be folded into a funnel by fitting lugs on one side of the "arrowhead" into corresponding slots on the other side. The bottom of the funnel is inserted into a circular hole, 2.5cm in diameter, cut into the screw cap of a collecting container, either kept dry or partly filled with a preservative liquid (e. g., polypropylene glycol). The cap is maintained attached to the trap by pre-cut wedges at the bottom of the funnel, bent outwards. When visiting the traps, the containers can be unscrewed, tightly closed with unperforated caps, and replaced by fresh material. Different sizes of collection containers can be used depending on the expected catches. When folded, the traps can be attached to trees or any other support (e. g., electrical posts) with plastic ties or strings pulled through pre-cut fixation holes, or with staples. Additional fixation holes can be added to attach the lures (see supplementary information). For added performances, the traps could be painted and/or sprayed with polytetrafluoroethylene (PTFE).



Unfolded Assembled Fixation of the cap

Figure 1. An unfolded and an assembled *fan-trap*. Details of the collecting-container cap fixation.

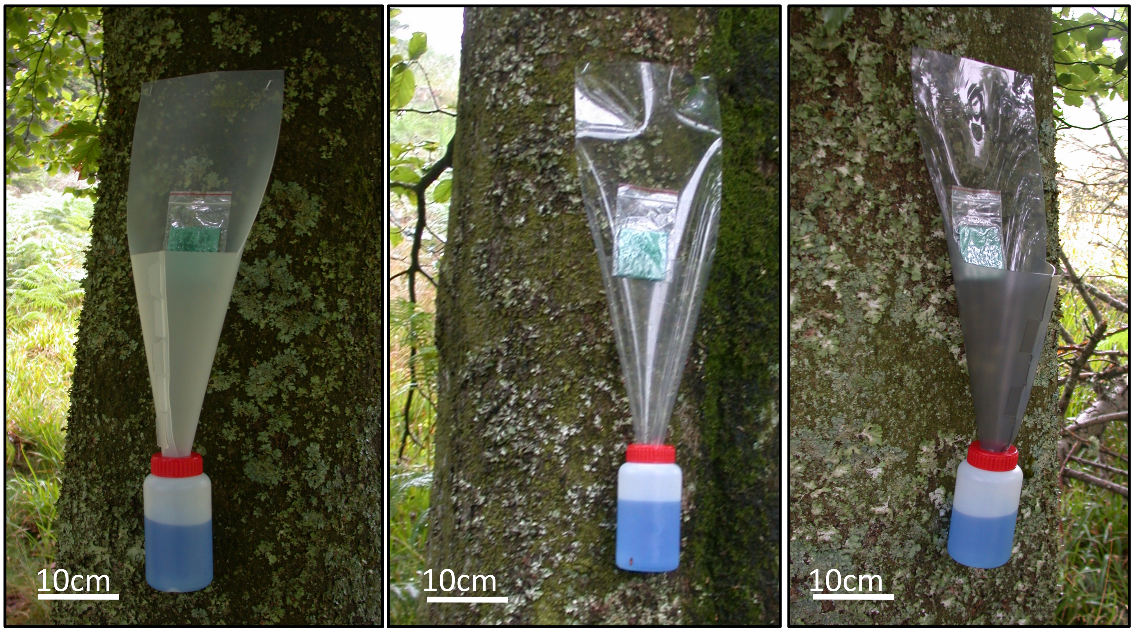


Figure 2. *Fan-traps* positioned in the field. Here they are in three colours, baited with off-the-shelf lures for *Ips typographus* and equipped with 250 ml collecting containers half-filled with polypropylene glycol

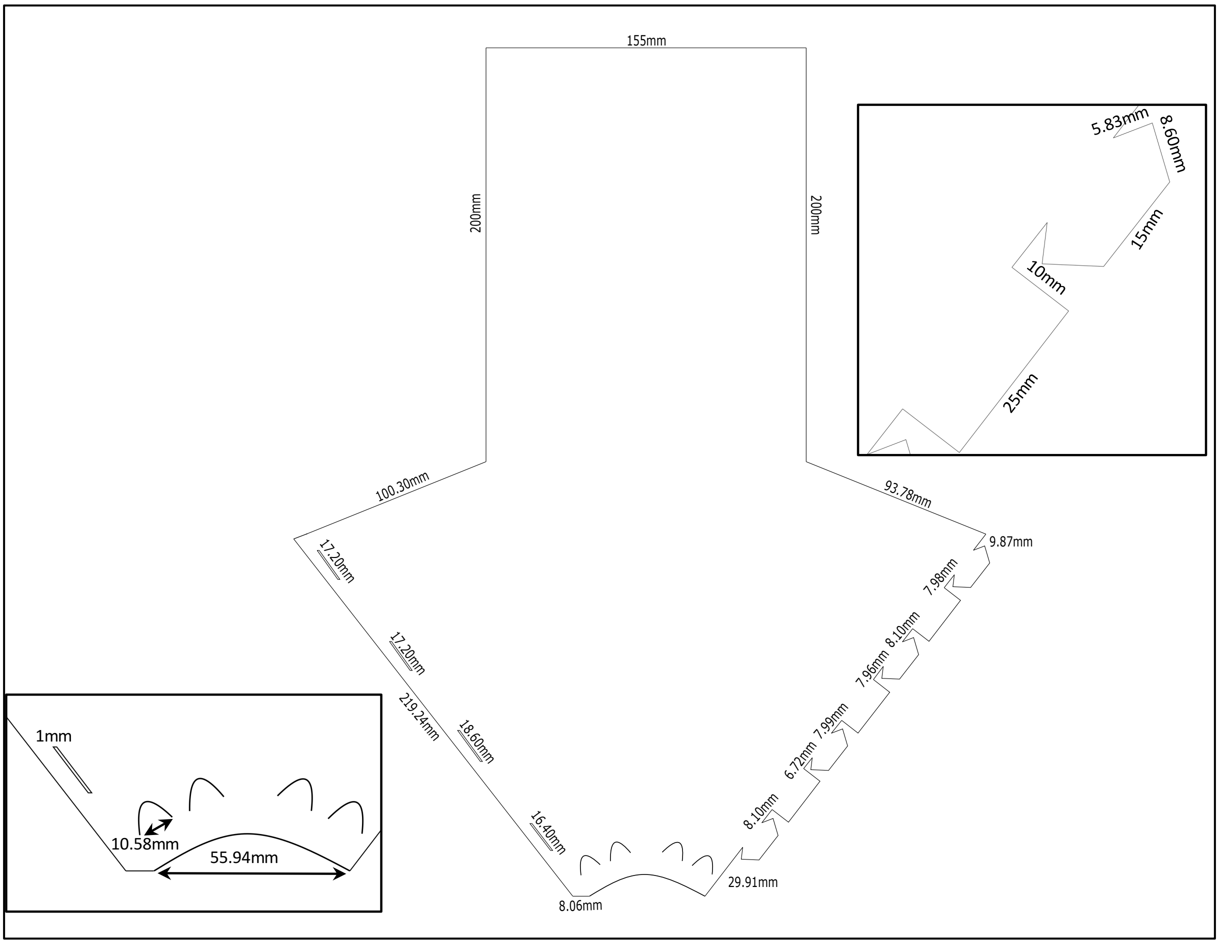


Figure 3. Blueprint of the *Fan-trap*

Our own experience

The main part of the fan-trap, the "arrow part", was cut out of a polypropylene sheet (65 x 100 cm and 0.8 mm thick) using a Metaquip MQ1590 laser machine implemented with the RDWorks 8.0 system. The laser machine used has a working area of 150 x 90 cm, a laser power of 130 W, a cutting speed of up to 600 mm/sec with a positional accuracy of 0.01 mm.

To cut the 0.8 mm thick polypropylene sheet, the settings were: a speed of 60 mm/sec, a minimum and maximum power of 25 W and 50 W, respectively. The minimum power should always be half the maximum power to avoid burning the polypropylene when the laser is temporarily stationary, e.g., when cutting corners.
Previous tests have shown that a thicker sheet (maximum 1 mm) could work just as well with these plans but the settings will need to be adjusted. Also, our personal observation has shown that lens wear could also affect the settings.
The costs involved (material and manpower) were as follows: 5,33 € for one polypropylene sheet (65 x 100 cm and 0.8 mm thick), out of which five traps were cut (cost per unit: 1.07 €). Fifteen sheets (= 75 *fan-traps*) could be processed within one hour. Counting a 30 €/h charge for manpower, the handling cost per trap was 0.4 €. The total cost per trap was thus 1.47 €, to which a modest FabLab fee (50 €/year) should be added, as well as the time for setting up the laser cutter each day (15 min, 7.5 €). So, each of the *fan-traps* we produced cost less than 2 €.

Possibilities for changes

The design can be easily modified with any conventional drawing software. In the present case, the open-source software, Inkscape 1.1 (https://inkscape.org/) was used. Figure 3 shows all the measurements of the fan-trap, but the scale is maintained in the blueprint files.
Three types of drawings are included here, one without fixation holes (Figure 4 and picture Fantrap1.svg) and two with various fixations (Figure 4 and pictures Fantrap2.svg and Fantrap3.svg). To maximise the trap production, an open-source nesting software such as Deepnest (https://deepnest.io/) can be used (see Figure 5 and picture Fantrap3nested.ai). The software will set as many traps as possible according to the size of the plate and merge the contact line to facilitate cutting.

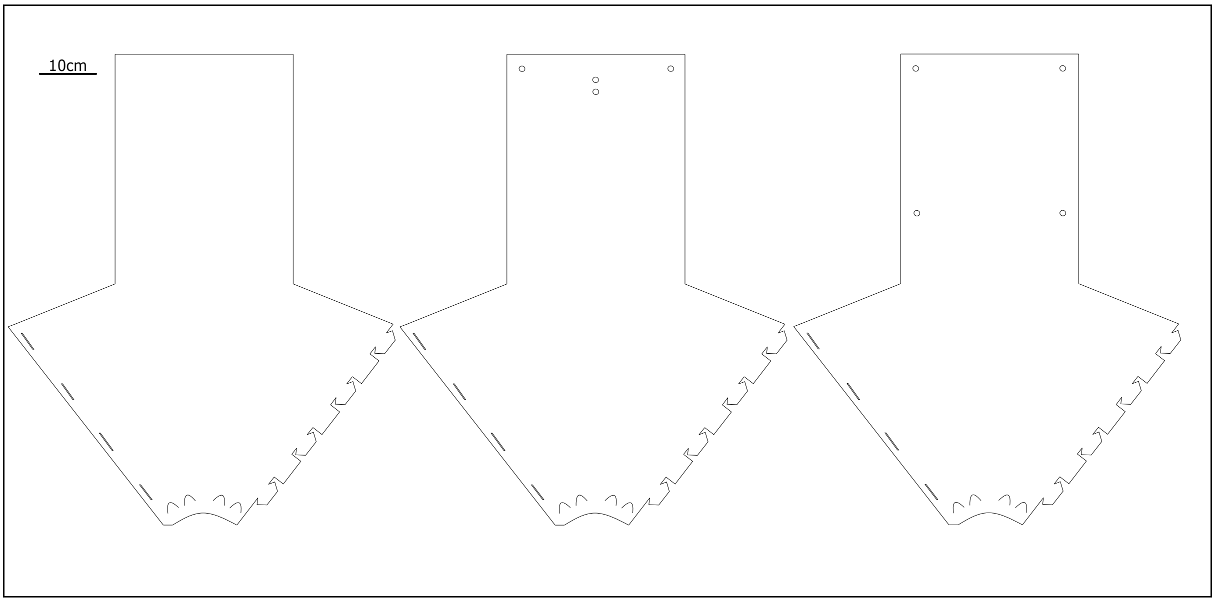


Figure 4. Blueprint of *Fan-traps* with various fixation holes

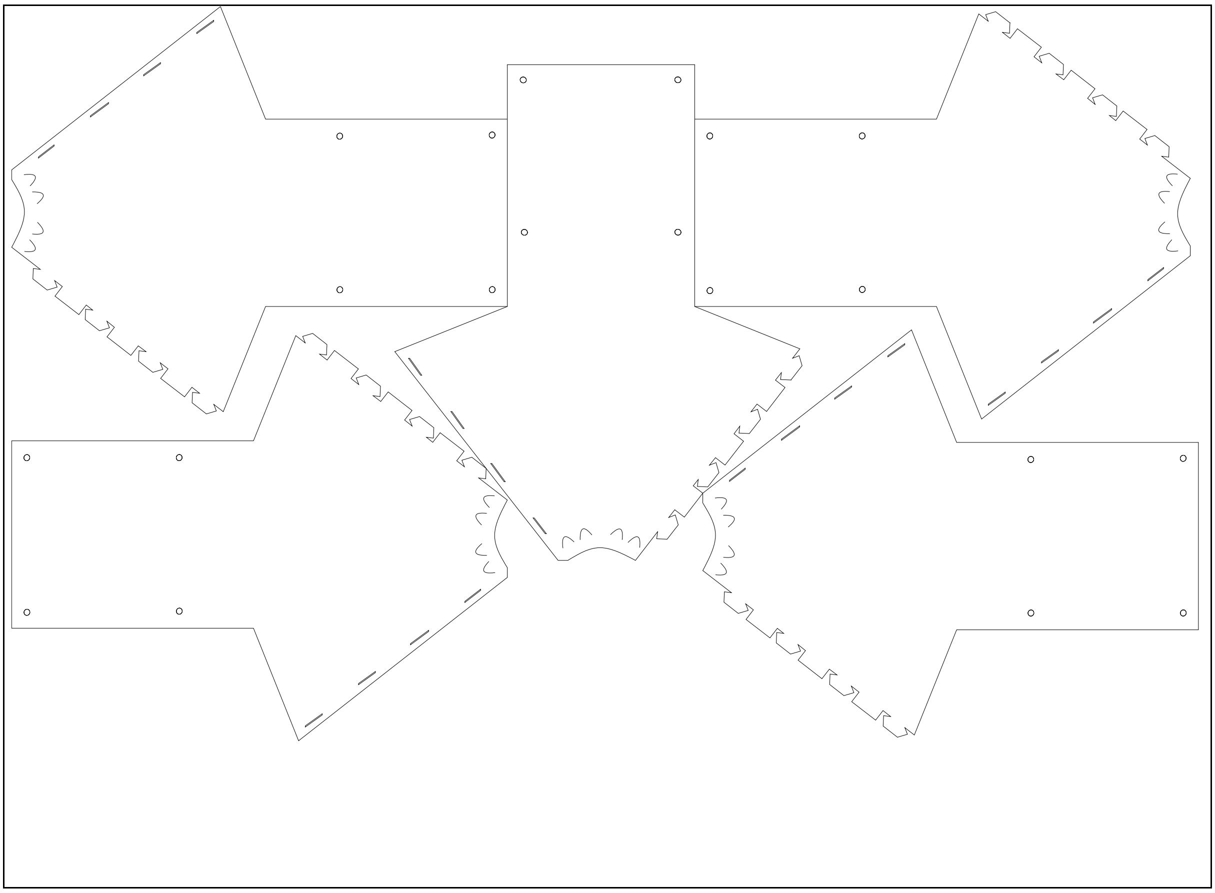


Figure 5. Blueprint of nested *Fan-traps* as designed with Deepnest