How *Megaplatypus mutatus* behaves inside a trunk? Studying its galleries via Computerized Axial Tomography and Digital Images Processing

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Introduction

Megaplatypus mutatus (Coleoptera: Platypodinae) is an "ambrosia beetle" therefore has a symbiotic relationship with fungi which the beetle introduces into the tree and on which the beetle adults and larvae feed. Unlike most ambrosia beetles it attacks only vigorous trees, where they bore a gallery system into the wood (Figure 1-2). The beetle is a serious problem in commercial plantations of many broadleaf tree species but is especially damaging to poplars (*Populus deltoides*) being present in South America (native) as in the area of Napoles, Italy (exotic) (Figure 3).

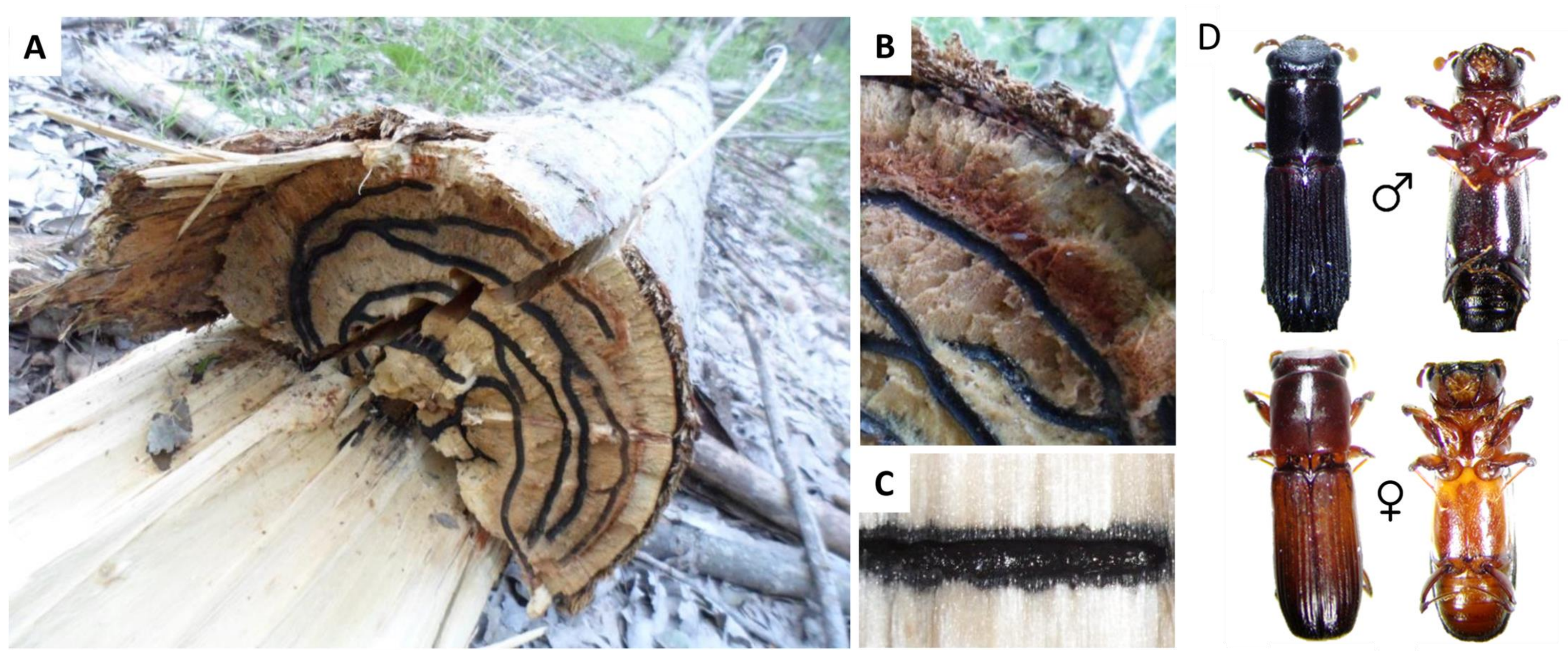


Fig. 1. *Populus deltoides* attacked by *M. mutatus*: **A**. Expose gallery under the effect of shaft break. **B**. Diameter of the gallery in relation to the breast height diameter of the affected area. **C**. Enlargement of a gallery segment. **D**. Male and Female.

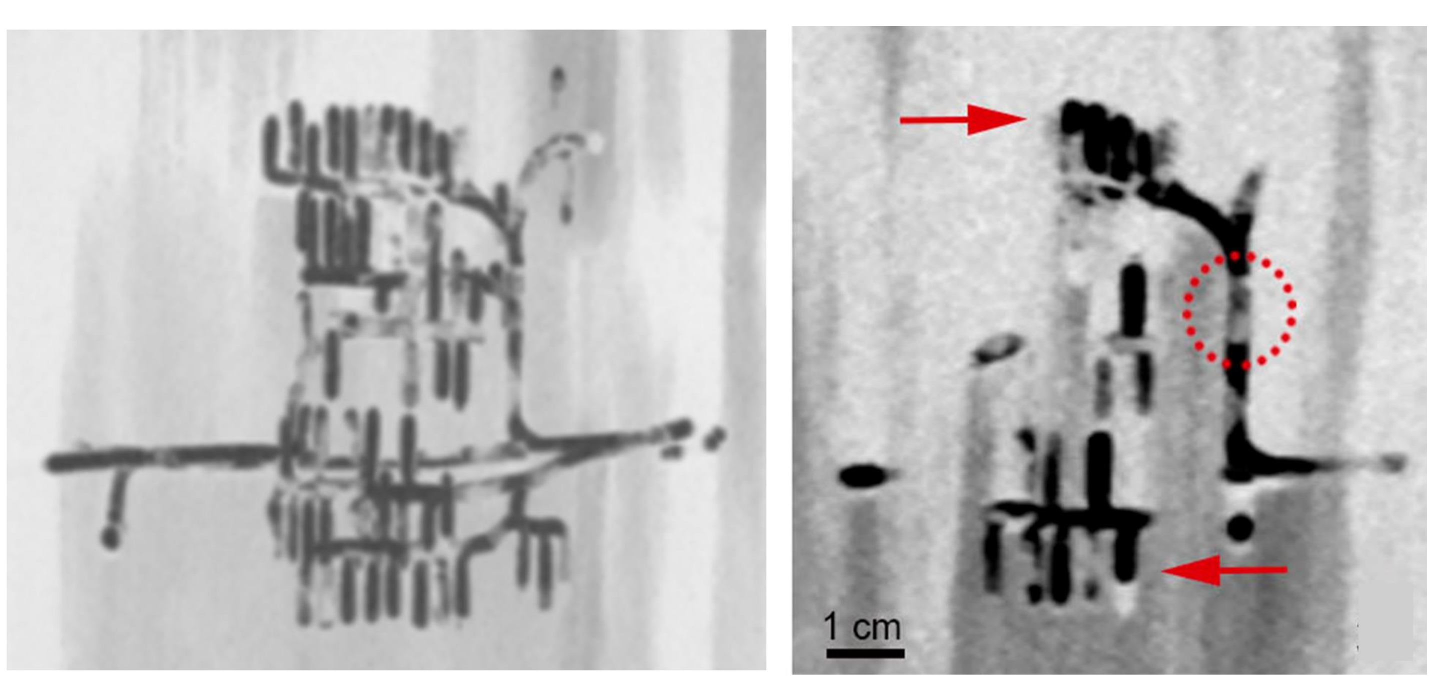
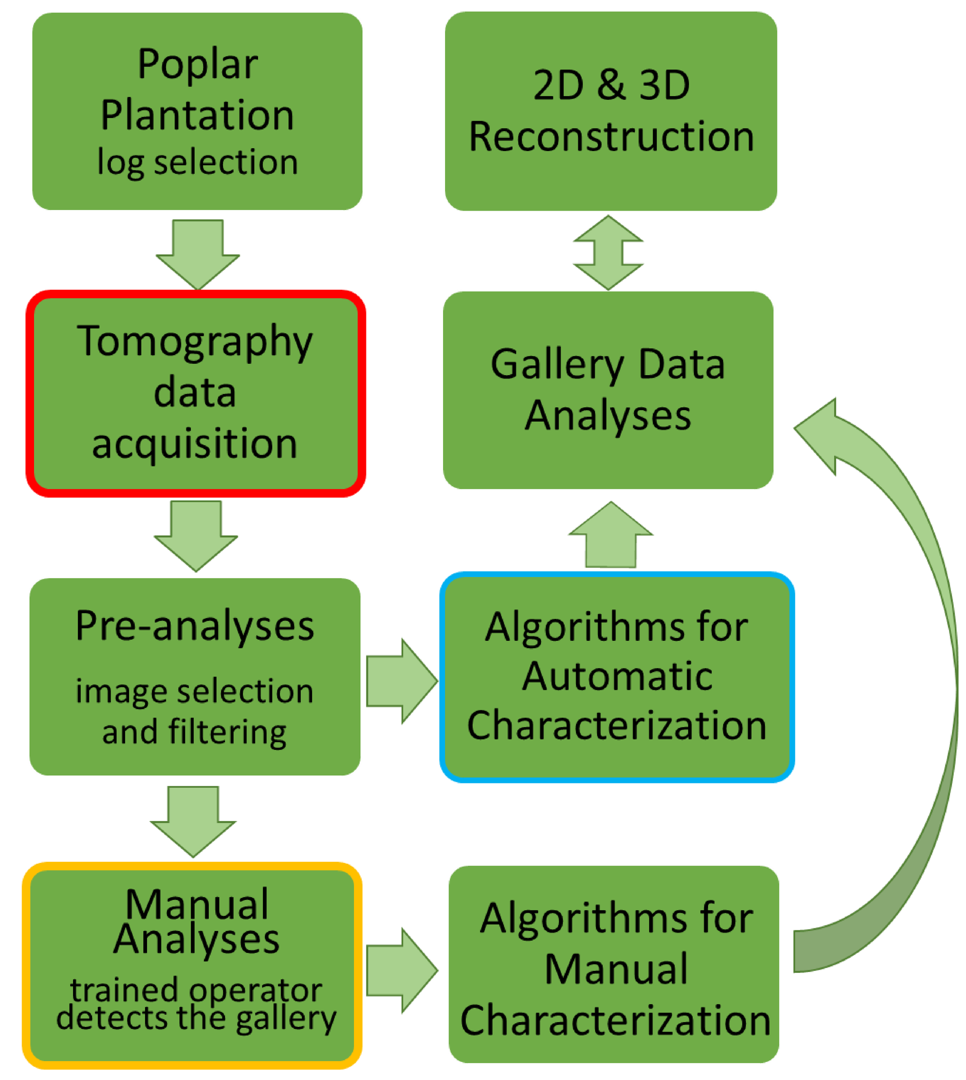


Fig. 2. Tomographic images of pupal chambers structure. Red marks show larvae.

Materials and Methods



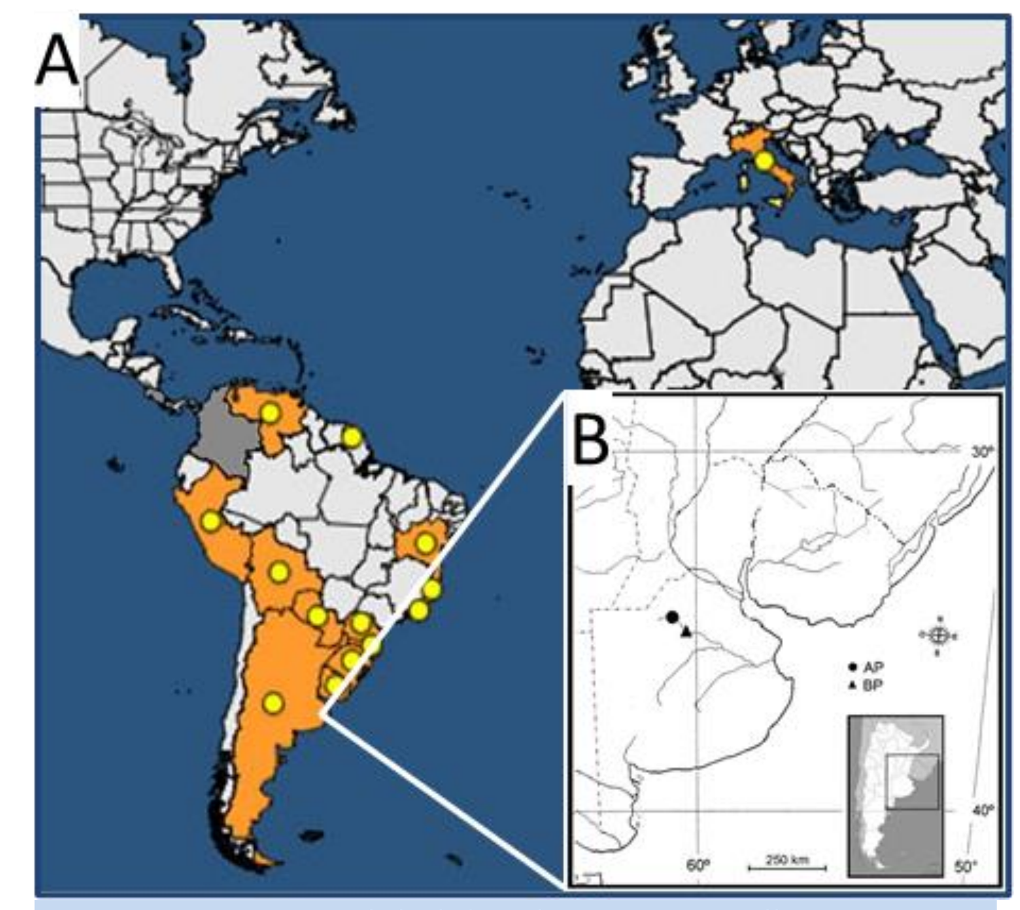


Fig. 3A. *M. mutatus* global distribution; **3B**. Collection sites at Province of Buenos Aires.

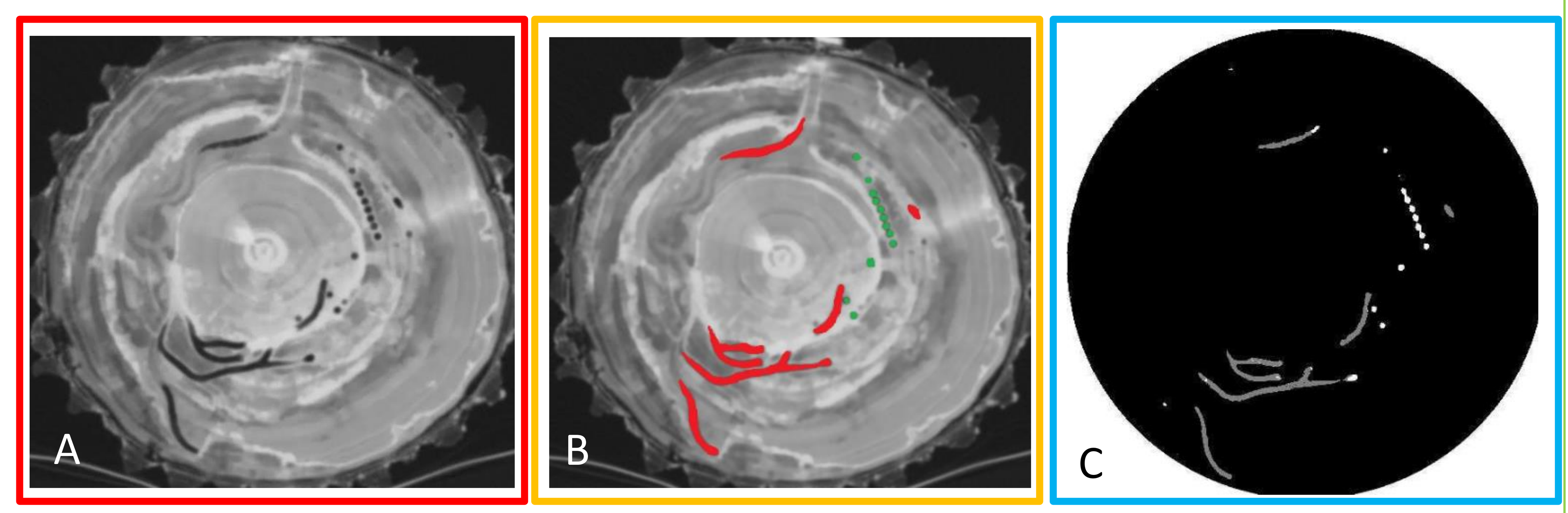


Fig. 4A. Tomographic image from an attacked tree, tunnels shown in black; **4B.** Manual analyses performed by a trained operator (Red: tunnels, Green Pupal chambers). **4C**. Automatic algorithm detects the tunnels shown in gray and pupal chambers in white.

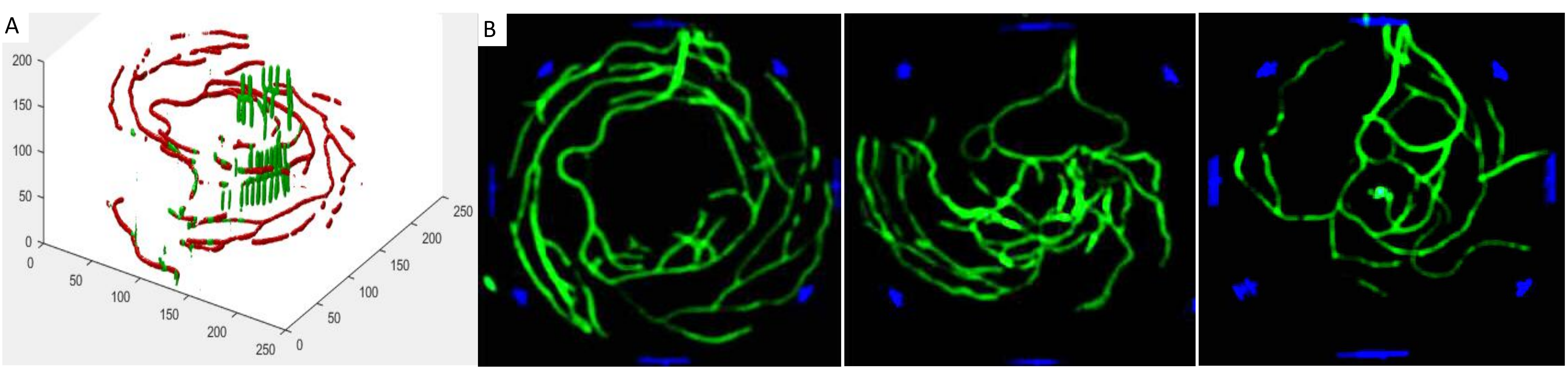


Fig. 5. Gallery representation obtained with automated algorithms. **A**. Preliminary recognition; **B**. Final representation of three different galleries. Green represent the galleries. Blue lines shows the outer bark limit.

TREE ID	N° PUPAL CHAMBER	SUCCESSFUL GALLERIES	NON-SUCCESSFUL GALLERIES	GALLERIES VOLUME (AUTOMATIC ALGORITHM CM^3)	GALLERIES LENGTH (AUTOMATIC ALGORITHM CM)	PUPAL CHAMBER VOLUME (AUTOMATIC ALGORITHM CM^3)
0	80	1	1	7,79	95,05	4,7
3	40	1	7	4,61	105,53	2,39
7	100	1	1	4.05	44,38	2.97
10	44	2	2	8,02	97,89	4,69
17	8	1	0	1,82	39,26	0,68

Table 1. Data of the most representative galleries analyzed.

Results and Discussion

Data obtained in this study suggest that:

- The *ad-hoc* algorithms represent a fundamental tool to analyze large amounts of information such as tomographic data. These algorithms showed excellent accuracy without being time-consuming and with an efficient recognition and recovery of tunings qualities (Fig. 4-5, Table 1).
- Tunnels never develop through the central cylinder of the trunk nor the developing branches and, more importantly, never do so through the active xylem (except for the initial tunnel initiated by the male). This observation suggests that, among other factors, water circulation across the outer sections might be involved in the gallery topology modulation (Ceriani-Nakamurakare et al. 2016).
- Our results suggest that the number of pupal chambers is less than the number of adults recovered in the emerging stage (data not shown). Therefore suggesting that in particular conditions, pupal chambers are used more than once. These findings raise multiple questions such as: What adaptive advantages could be detected in individuals who do not spend energy to build their pupal chamber? What triggers this behavior? Is there any unknown hierarchy system? Or there could be an intraspecific competition?