

# **Variation of commercial timbers from Turkey in resistance to marine borers as assessed by marine trial and laboratory screening**

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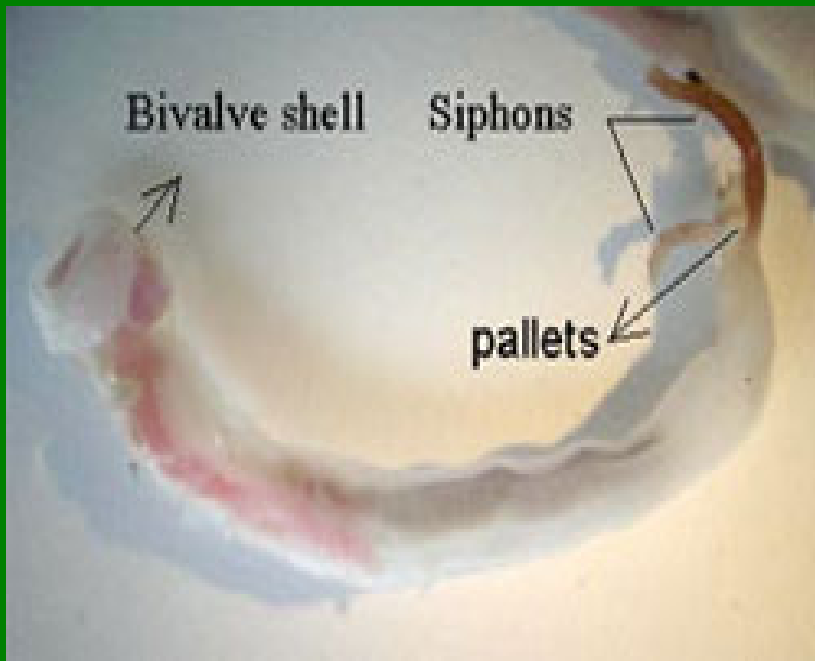
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# INTRODUCTION

- Wood is used in the marine environment for fixed structure such as groynes, wharves, jetties, dolphins and navigational posts. It is also important in many countries as a material for boat construction.
- Although microorganisms decay the surfaces of wood exposed in sea water the primary agents of attack are the marine wood boring animals, the molluscs and crustaceans.

Teredinids or shipworms are bivalve molluscs, have a world-wide distribution. Most species of teredinids appear able to both digest wood and filter feed.



- shells are small and cover only the anterior end of the animal, used as raps for boring into wood.
- The pallets can close off the burrow to protect the borer from predators and dehydration (at low tide). They are also valuable in species identification.

- In this study, the marine durability of three common Turkish timbers from the family Fagaceae were compared with *Pinus sylvestris* (Scots pine) which has been shown to be non-resistant to attack by marine borers.
- Scots pine covers 5 % of the total forest area
  - Oak : 30 %
  - Chestnut : 1.4 %
  - Beech : 8 %

- Although extensive testing of tropical timbers has been undertaken, there has been only limited testing of marine durability of temperate timbers.
- This study aimed to investigate the marine durability of these Turkish timbers.
- Testing by conventional marine exposure trial was compared with a laboratory assay.

# MATERIALS AND METHODS

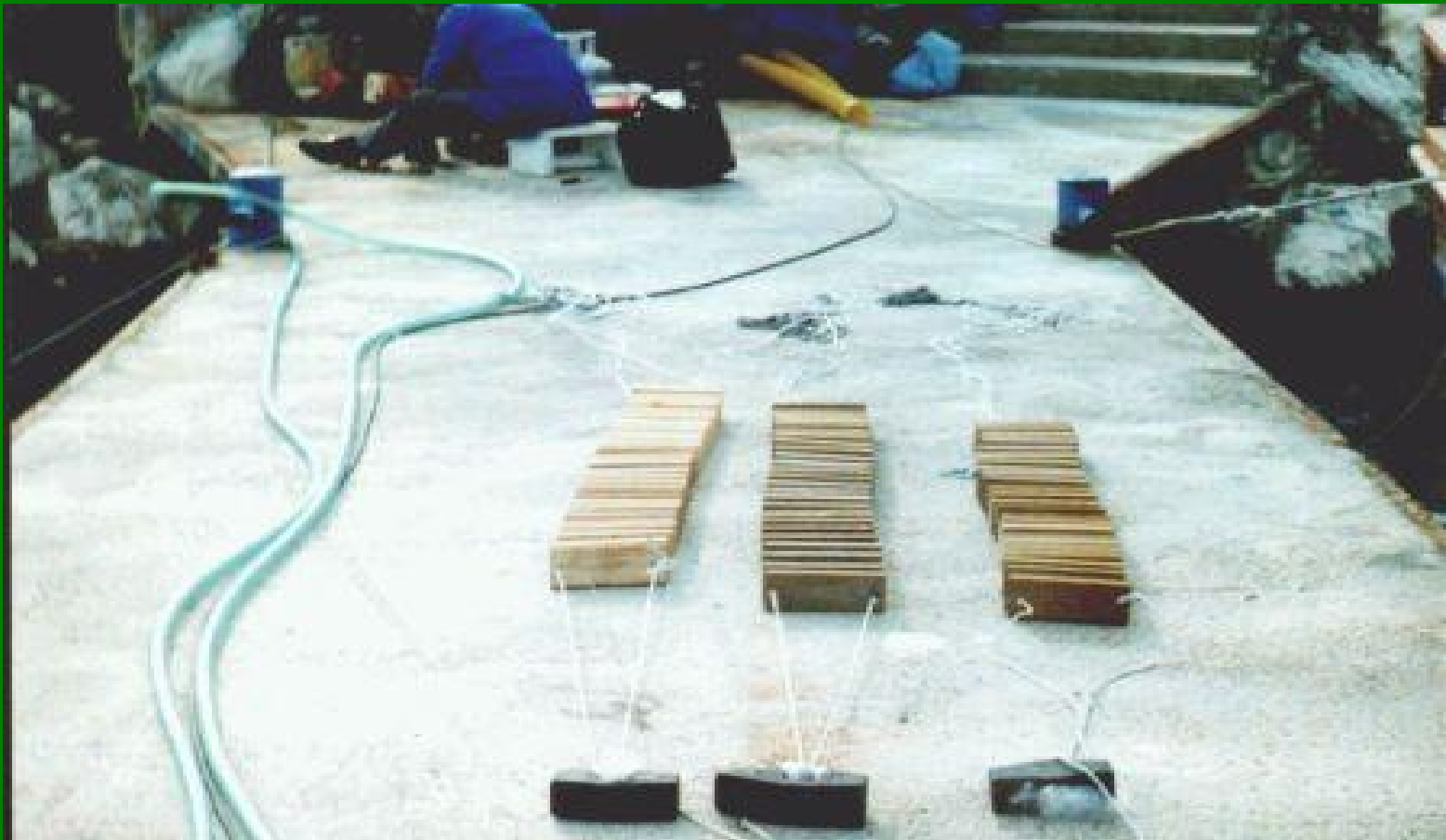
Wood species	Scientific name	Family	Oven dry density(kgm <sup>-3</sup> )
Oak	<i>Quercus petraea</i>	Fagaceae	746.0
Chestnut	<i>Castanea sativa</i>	Fagaceae	528.3
Beech	<i>Fagus orientalis</i>	Fagaceae	600.3
Scots pine heartwood	<i>Pinus sylvestris</i>	Pinaceae	528.6
Scots pine sapwood	<i>Pinus sylvestris</i>	Pinaceae	430.2

# Marine Exposure Trial

- For the marine exposure trial wood panels with dimensions 25 x 75 x 200 mm. according to EN 275 standard were prepared.



- Six replicate panels were exposed for each timber type







BLACK SEA

A  
E  
G  
E  
A  
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S  
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A

Mersin

MEDITERRANEAN SEA

- The test site was at Mersin on the Southern, Mediterranean coast of Turkey (36° 33' N, 34° 35' E). Samples were exposed to marine conditions at the harbour belonging to Institute of Marine Sciences of the Middle East Technical University between 14.02.2007 and 13.09.2007.
- The harbour is an important focus of marine biological diversity on the Mersin coast.
- In the test site water temperatures are between 15 and 31 °C, and salinities of between 34 and 39 PSU.

# Laboratory Assay

- In laboratory assay, feeding rate of individual *Limnoria quadripunctata* was assessed by measuring faecal pellet production



Limnoria are small (1-4 mm long) crustaceans that bore into wood for food. Limnoria have a world-wide distribution from cool to warm waters

- Sticks measuring 20 x 4.5 x 2.4 mm were prepared from each of the wood types in the marine trial plus beech (*Fagus orientalis*).
- Prior to experimentation, the sticks were leached in sea water for one week, with a change of water 3 days.



- Faecal pellets produced by the animals feeding on the sticks were counted every three days over a period of fifteen days.
- Each time interval, a record was also made of animals that had moulted and those that had died.



# RESULTS

For the marine trial, ratings of the wood samples were determined according to EN 275 standard.

<b>Rating</b>	<b>Description</b>
<b>0</b>	<b>No trace attack</b>
<b>1</b>	<b>Light attack ; 15 %</b>
<b>2</b>	<b>Moderate attack ; 25 %</b>
<b>3</b>	<b>Heavy attack ; 25 - 50 %</b>
<b>4</b>	<b>Destroyed attack ; &gt; 50 %</b>

## Mean ratings of the wood panels exposed to marine borers

<b>Wood species</b>	<b>Type</b>	<b>Rating</b>
Pinus	sapwood	4.0
Pinus	heartwood	4.0
Quercus	heartwood	2.8
Castanea	heartwood	2.3

After the marine trial broken panels are shown;

## Scots pine sapwood-3





## Scots pine sapwood-5



## Scots pine heartwood-1



# Scots pine heartwood-6



## Oak (Quercus petrae) - 2



# Oak (Quercus petrae) - 5



## Oak (Quercus petrae) - 6



# Chestnut (*Castanea sativa*) - 1



## Chestnut (*Castanea sativa*) - 2





## Chestnut (*Castanea sativa*) - 3



- In the marine trial, both sapwood and heartwood of Scots pine were totally riddled by teredinids, so the ratings were 4.
- Attack on Oak was moderate, ranging between ratings 2 and 3, where as rating for Chestnut ranged from 1 (slight) to 3

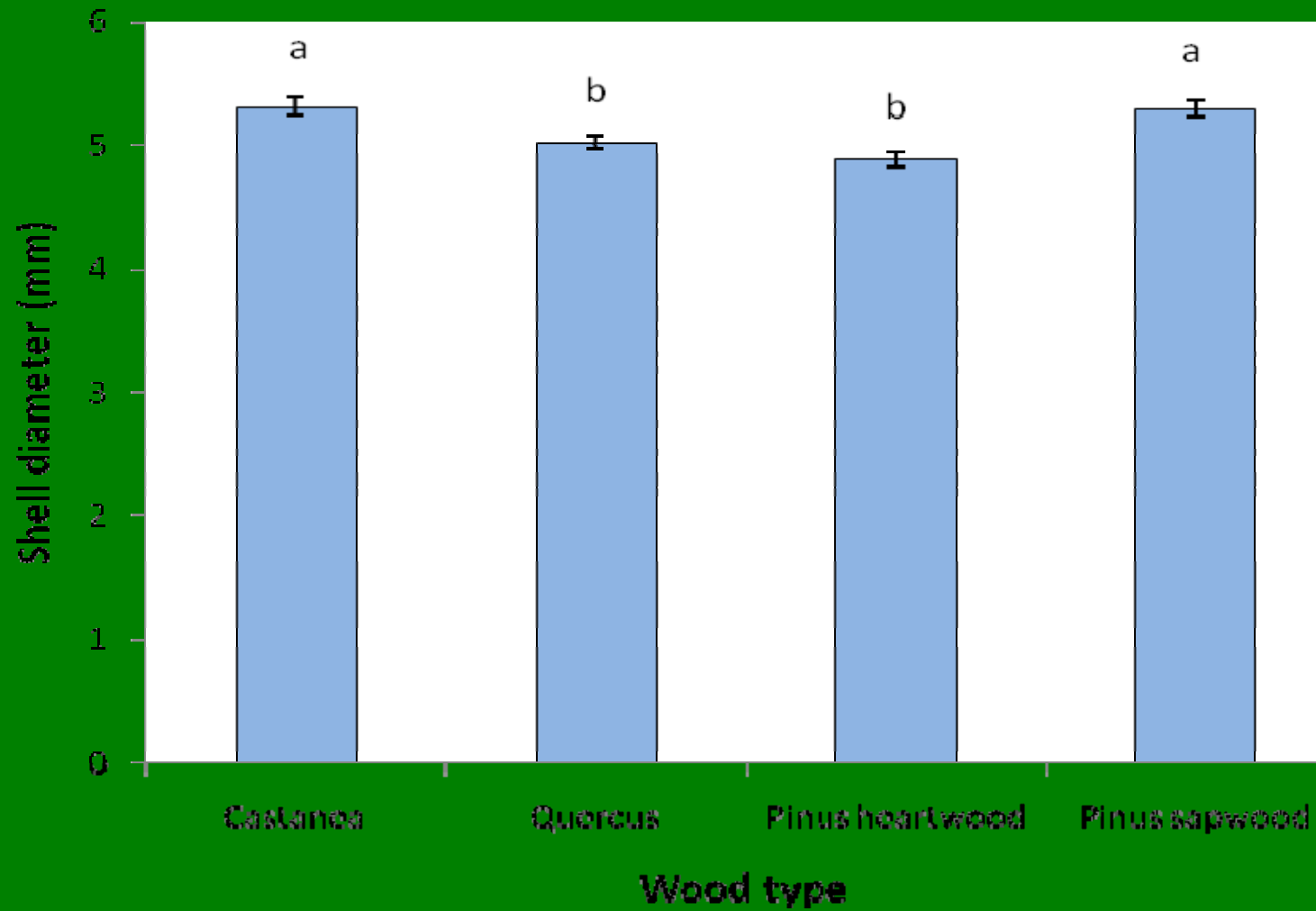
*Teredo navalis*, wood boring animals was dominant in all the wood samples tested in marine trial.



Syphons of the teredinid are shown on the surface of the wood panel under the stereo microscope.



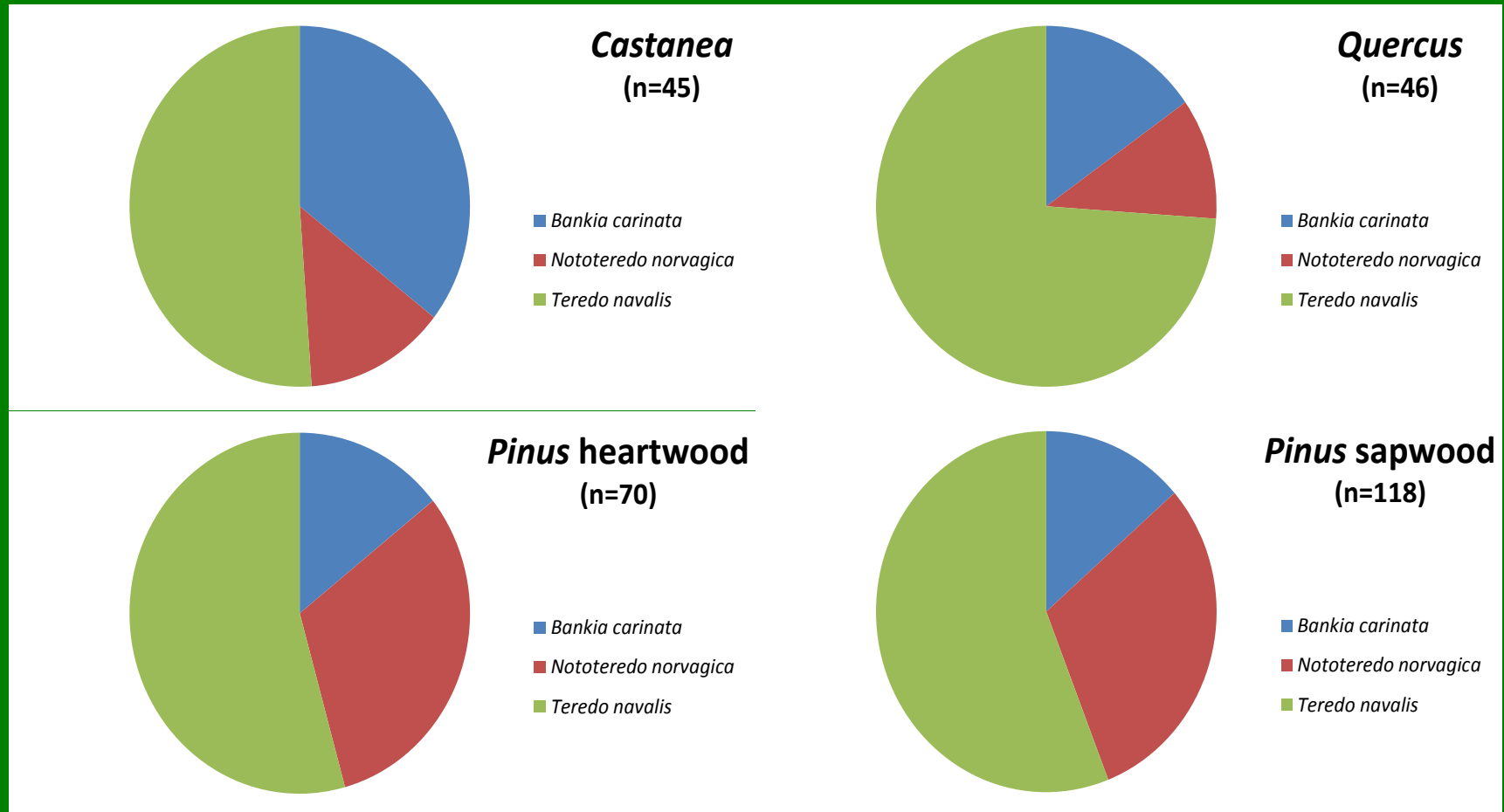
## Shell size;



- Mean shell size varied by less than 10 % between wood types.
- However, shells found in *Quercus* and in *Pinus* heartwood were significantly smaller than those found in *Castanea* or *Pinus* sapwood.

# Pallets ;

In all wood types examined, the teredinid *Teredo navalis* was the dominant species, with over half of all pallets belonging to animals of this species.



Proportion of species of teredinid wood borers in panels of a range of commercial Turkish wood types exposed at Mersin, southern Turkey.



*Teredo navalis*

In the study, Pallets of *Teredo navalis*, *Nototeredo norvagica* and *Bankia carinata* were identified.



*Nototeredo norvaciga*



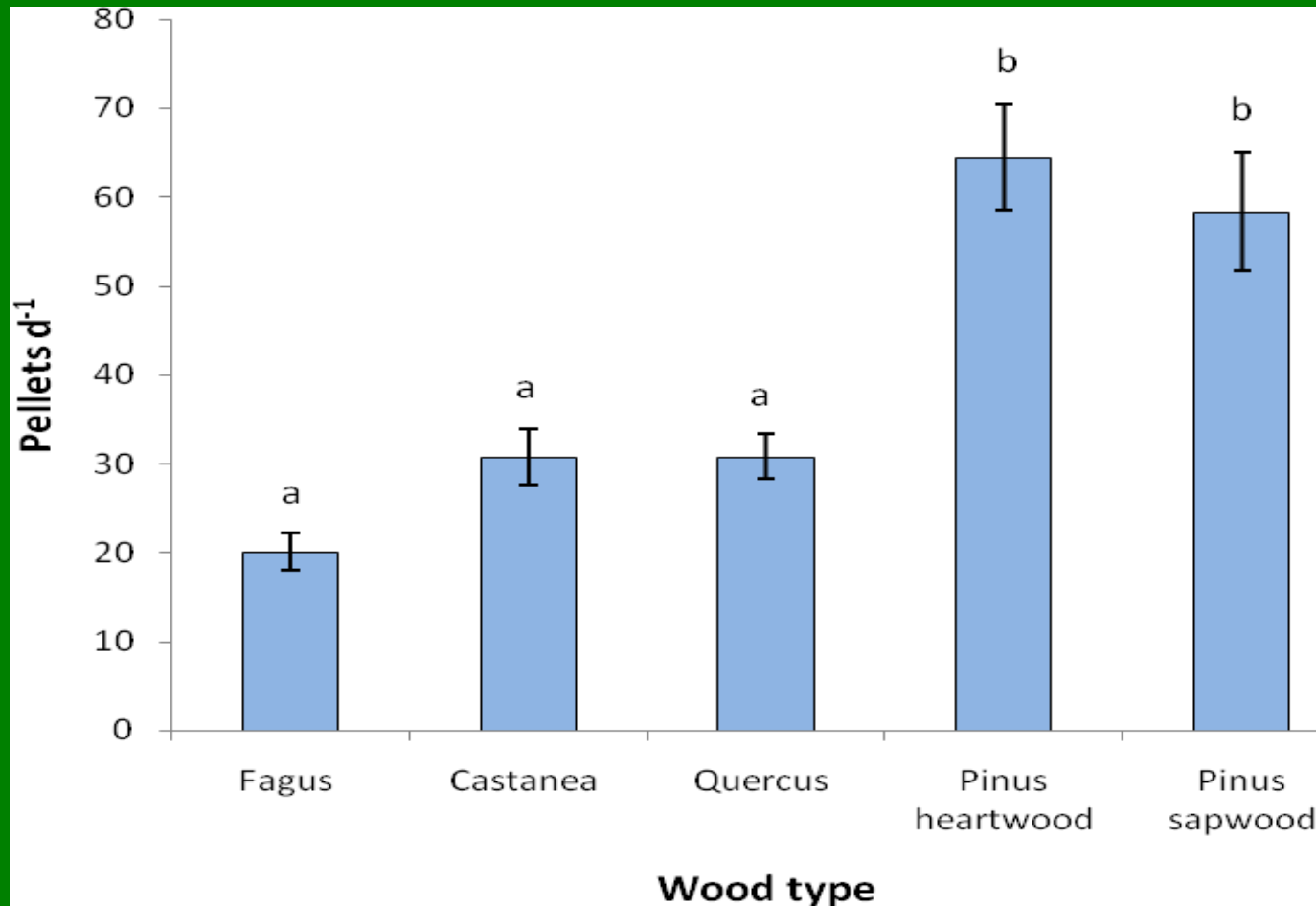
*Bankia carinata*





- The wood boring amphibod *Chelura terebrans* was found, but only on two of the panels of *Castanea*.

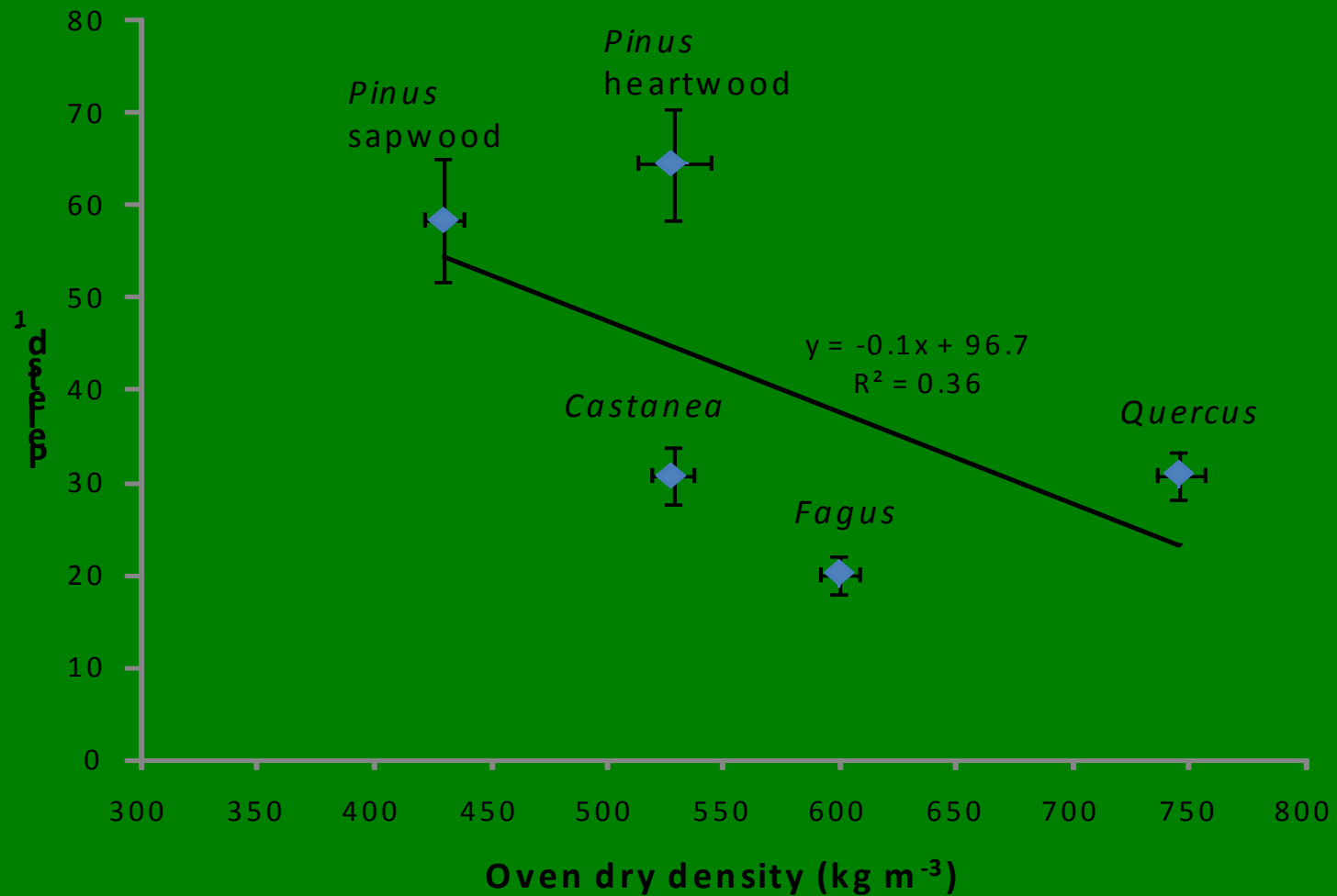
In the laboratory assay with *Limnoria quadripunctata*, feeding rates as measured by faecal pellet production over a 15 day period.



Effect of wood type on rate of feeding of *Limnoria quadripunctata* as measured by faecal pellet production.

- Feeding rates as measured by faecal pellet production were significantly lower on all members of the Fagaceae tested (*Fagus*, *Quercus* and *Castanea*) than on either heartwood or sapwood of Scots pine.
- The differences between the species of Fagaceae were however not significant.
- Feeding rates on the Fagaceae were about half of that on *Pinus*.

For the wood species tested, there was not a strong relationship between density and feeding rate as measured by pellet production.



- For the wood species tested, there was not a strong relationship between density and feeding rate as measured by pellet production, though the trend was for less pellet production at higher densities.
- It was notable that two wood types *Pinus sylvestris* and *Castanea sativa* heartwood have similar densities. However, feeding rate on *Castanea* was less than half of on *pinus*.

# CONCLUSIONS

- Both Scots pine sapwood and heartwood showed poor performance comparing to Oak and Chestnut samples in marine trial as well as in laboratory assay. Besides, there was no difference between sapwood and heartwood of Scots pine samples regarding in resistance to marine borers.
- The first result was also evidenced from the recruiting shells which were found in the pine samples more than Oak and Chestnut.
- In the laboratory assay, difference in feeding rate on different timbers with *L. Quadripunctata* could be due to differences in hardness, or presence of extractives with toxic or antifeedant effects.

- As the samples of Pinus heartwood and Castanea tested had similar densities, the marked differences in feeding rate on these two timbers is likely to be due to extractives.
- The test site at Mersin (South of Turkey) the diversity of borers and the high water temperature gives this site rapid rate of biodegradation. Despite the short exposure period (7 months) meaningful differences between the durability of different timbers can be detected.
- The correlation between performance in the marine trial and in the laboratory assay is quite close.

**THANK YOU FOR YOUR ATTENTION**