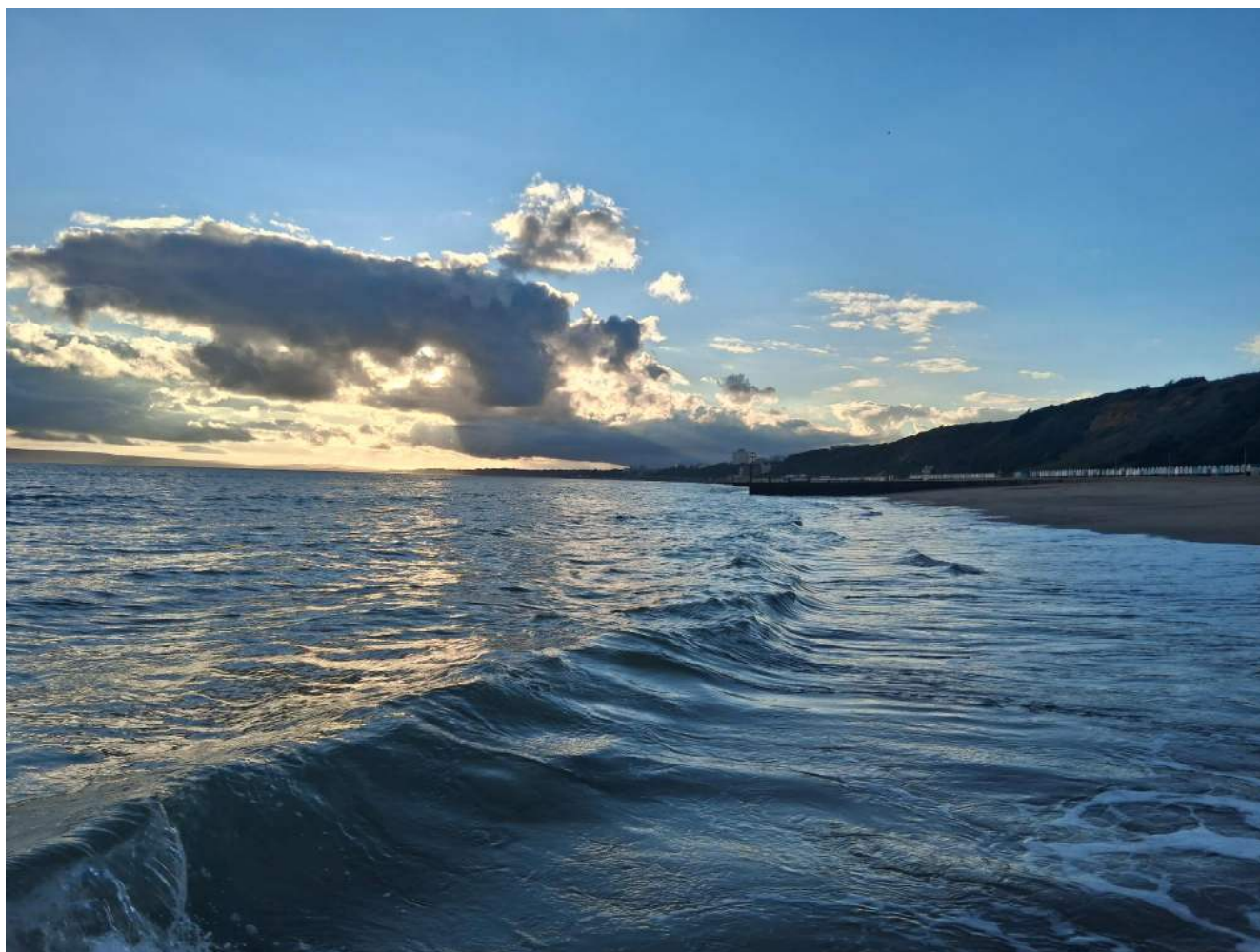




General view of Poole Bay beach with a timber groyne in the background.

BCP Council

Timber groynes

Evaluation of basralocus after 10 years in service

1286363-01 (00)

NOVEMBER 2025

RSK

CONTENTS

RSK DOCUMENT CONTROL	3
1 INTRODUCTION	4
2 PURPOSE OF INVESTIGATION	4
3 EXTENT OF INVESTIGATION	4
4 BACKGROUND	5
4.1 Procurement of timber	5
4.2 Initial assessment in 2018	5
5 METHODS	6
5.1 Referencing	6
5.2 Measurement of erosion	6
5.3 Marine borer damage	6
6 FINDINGS	8
6.1 Erosion	8
6.1.1 Groyne C36	8
6.1.2 Groyne C37	8
6.1.3 Piles: comparing performance of basralocus to greenheart	8
6.2 Marine borer attack	9
6.2.1 Groyne C36	9
6.2.2 Groyne C37: Greenheart piles and ekki planking	9
6.2.3 Groyne C30: Greenheart piles and planking	10
7.1 General comments	Error! Bookmark not defined.
7.2 Marine borer hazards in the Bay	11
7.2.1 Gribble	11
7.2.2 Shipworm	11
7.3 The performance of Basralocus	12
8 CONCLUSIONS	14

APPENDICES

APPENDIX A – PHOTOGRAPHS

RSK DOCUMENT CONTROL

Report No.: 1286363-01 (00)

Title: BCP Council
Timber groynes - Evaluation of basralocus after 10 years in service.

Client: South West Flood and Coastal
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Date: 31 October 2025

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Status: FINAL

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Signature		Signature	
Date:	31 October 2025	Date:	31 October 2025

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1 INTRODUCTION

This report has been prepared in accordance with the instructions of Mr Alan Frampton (Strategy, Policy and Environment Manager) on behalf of South West Flood and Coastal headquartered at BCP Council (the Council), Bournemouth, confirmed by the Council's purchase order reference BCP366946 issued on 23 September 2025.

RSK was instructed to undertake a performance evaluation of basralocus (*Dicorynia guianensis*) timber that had been used as piles and planking on groyne C36 in the groyne field along Bournemouth's Poole Bay ('the Bay').

2 PURPOSE OF INVESTIGATION

The purpose of the investigation was to establish the performance of basralocus after ten years in service and to compare it against greenheart (*Chlorocardium rodiei*) and ekki (*Lophita alata*) of comparable age.

The desirable service life of timber groynes, with *some* maintenance at the seaward end of the groynes, is 25 years with the piles being the life determining factor. Typically, maintenance occurs after 15 years of service and tends to be focussed on localised renewal of planks and fixings at the seaward end of the groynes at the more easterly, exposed end of the Bay.

The two objectives of this study were:

- In the absence of a defined timber Strength Class ('D' value), to confirm that estimating the strength of basralocus is a reasonable improvised alternative to resolve procurement uncertainty.
- To evaluate the likelihood that basralocus piles could deliver a 25 year service life.

3 EXTENT OF INVESTIGATION

The investigation included:

- A visual assessment of basralocus piles and planking at the seaward end of groyne C36 at low tide.
- An inspection to look for evidence of attack by marine boring organisms.
- Evaluation of erosion of selected piles.
- A comparison of observations from groyne C36 to those of groynes C37 and C30.

The inspection was carried out during a Spring Low tide period in the week commencing 6 October 2025 by Dr John Williams (Principal Consultant) for RSK with Mr Zak Bourn (Engineer) on behalf of the Council in attendance.

This report has been prepared to summarise the findings of the investigation.

4 BACKGROUND

4.1 Procurement of timber

Greenheart has been the preferred timber choice used to construct groynes along the Bay and has been used for piles and planks. In 2015, owing to procurement uncertainty over the use of greenheart, and mindful of the need to maintain momentum during the construction phase for 2015–2017, the Council procured basralocus, believed to originate from Suriname, for piles and planks to construct Groyne C36.

At that time, the long-term performance of basralocus on the UK coastline was unknown. However, research undertaken by the Environment Agency¹ indicated that basralocus had the potential for use in marine construction as it exhibited good marine borer resistance in laboratory and field trials. When exposed to marine borers in laboratory trials, test data indicated performance comparable to that of ekki, i.e. no significant difference in feeding rates was measured. Laboratory trials showed the abrasion resistance of basralocus was comparable to that of greenheart but was significantly less than that for ekki.

The main challenge facing basralocus was that it was not recognised in BS EN 1912² and, therefore, did not have a Strength Class or 'D' value. It has long been generally accepted by engineers that a defined Strength Class in BS EN 1912 (or equivalent) is one of the most important material characteristics used to select timber for marine construction. That said, the strength class of basralocus was estimated to meet the requirements of D50; this is discussed further in **Section 7.3**.

4.2 Initial assessment in 2018

Given the lack of a published track record for the performance of basralocus in a macrotidal environment on the UK coastline, from 2015 the Council was in a unique position to test and monitor the performance of basralocus. The environment along the Bay is characterised by a narrow tidal range that amplifies the abrasion hazard presented by fine beach sediment. The Bay also has a proven marine borer hazard where gribble is present.

The use of basralocus by the Council presented an opportunity to collect evidence to evaluate its performance in a high hazard environment. The data could support the wider use of basralocus for groyne construction around the UK coastline.

A previous assessment of groyne C36 undertaken in January 2018 by RSK on behalf of the Council (unpublished records) found no evidence either to indicate the timber had been attacked by marine boring animals or to indicate structural distress in the groyne. Funding secured by the Council enabled an assessment of the basralocus on groyne C36 in October 2025.

¹ Alternative hardwood timbers for use in marine and fresh water construction, 2011, Environment Agency. Bristol.

² BS EN 1912. 2012: August 2013. Structural timber. Strength classes. Assignment of visual grades and species. BSI, London.

5 METHODS

5.1 Referencing

All piles were referenced from the king pile at the seaward end of the groyne to landward. The inspection was carried out from seaward to landward ahead of the incoming tide and was limited to the seaward end of the groynes from pile No. 1 to No. 10, on the basis that a preliminary inspection on the receding tide indicated that there was no clearly visible marine borer attack beyond pile No. 10 in the target groynes.

An annotated photographic record of observations is presented in **Appendix A** along with visual assessment ratings as described in **Table 5.1**. The target groynes, installed during a 12 month interval between 2015 and 2016, were as follows:

- Groyne C36: basralocus pile and planks
- Groyne C37: greenheart piles and ekki planks
- Groyne C30: greenheart piles and planks

The piles were inspected in the order above and the photographs in **Appendix A** reflect this order of inspection.

5.2 Measurement of erosion

Erosion was estimated by using a flexible tape measure to record the cumulative length of three accessible faces of the target piles. This was then compared to the cumulative length of three faces of the piles expected at the time of installation. Measurements were taken ca 500 mm above beach level following cleaning of marine fouling of the pile section.

The cross section of the basralocus piles on groyne C36 at the time of installation was 330 x 330 mm, giving a cumulative length of 3 no. faces of ca. 990 mm. The actual measurements were compared against 990 mm to calculate the loss of section.

A similar exercise was undertaken on greenheart piles on groynes C37, which had a cross-section size of ca 300 x 300 mm. The cross section of basralocus was increased to compensate for a predicted reduction in strength.

5.3 Marine borer damage

The piles and planks were visually assessed for damage associated with attack by the marine boring organisms 'gribble' (*Limnoriidea* spp.) and 'shipworm' (*Teredo* spp.).

Gribble are found at the surface of the timber whereas shipworm burrow into it. Shipworm siphon holes are extremely difficult to observe, especially on timber colonised by other marine organisms. Removing an edge of a pile can expose shipworm tunnels, which can rapidly increase in diameter as the larvae bore into the timber. Furthermore, tunnels are more likely to be detected in sapwood that may be present at the pile edges. In this inspection, an edge of the target piles was removed by shallow scraping with an adze along a length of ca. 500 mm at the base of the piles in order to expose the tunnels of shipworm larvae that had successfully lodged to the surface of the timber.

Marine borer attack on groyne planks was quantified using the visual assessment categories described in **Table 5.1** as guidance.

Table 5.1: Visual assessment categories used to classify the condition of the timber

Category	Extent of surface attack caused by gribble	Mechanical damage and/or abrasion
0	No attack	No damage
1	Minor: single or few galleries covering $\leq 10\%$ surface area. Cross section dimensions practically unchanged.	Handling damage caused by plant machinery.
2	Moderate: $> 10\%$ of the total surface area covered with galleries. Cross section dimensions practically unchanged.	Erosion at the edges of the component. Visible loss in section due to erosion in service.
3	Extensive: surface fully covered with galleries. Cross section dimensions reduced by ca. 10-50%.	Significant mechanical damage that results in the component failing to achieve a visual strength grade. e.g. compression failure, failure in service and/or splits through the thickness of the component.
4	Severe: Surface of the timber fully covered with galleries. $> 50\%$ of cross section lost due to gribble attack.	-

The categories in **Table 5.1** were devised for assessing timber from deconstructed groynes so their application to planks and piles on constructed groynes was subjective. Visual assessment ratings were assigned to elements presented in the photographic record in **Appendix A** and reference made to these ratings in the main body of this report. Consideration was also given to the likely service life of the groynes in relation to understanding service requirements specific to the Council and previous experience accrued by the author assessing parts of the groyne field and deconstructed groynes since 2003.

6 FINDINGS

6.1 Erosion

6.1.1 Groyne C36

The groyne planks exhibited variable performance. After 10 years' service, there was a clear pattern of erosion that had caused 'scalloping' (**Plates 9, 13 and 17**) of the planks adjacent to the landward face of the piles at the seaward end of groyne C36 (piles 1 to 10). The extent of scalloping of the planks varied and was not measured.

Minor erosion affected piles 1 (**Plate 7**), 2 (**Plate 10**) 3, 4 and 6, although considerably more erosion was observed on pile No 5 (**Plates 13 and 15**). Erosion estimates are presented in **Table 6.1**.

Table 6.1: Estimated erosion of piles on groyne C36

Pile	Cumulative length of 3 faces (mm)		Estimated section loss after 10 years (%)
	At installation	2025	
1	990	950	4
4		960	3
5		880	12
6		960	3

Although the piles identified in **Table 6.1** are in similar service conditions at the seaward end of the groyne, the substantial difference in performance of pile No. 5 indicates considerable variability in the performance of basralocus, which may be due to natural variation of the timber properties.

6.1.2 Groyne C37

Minor erosion observed on the greenheart piles at the seaward end of the groyne tended to be sapwood erosion combined with localised gribble attack of the sapwood (**Plates 26, 27, 28 and 29**). Minor scalloping indicative of erosion caused by backwash was visible on the planks adjacent to the landward face of the piles at the seaward end of the groyne. Erosion estimates are presented in **Table 6.2**. The cross section of the greenheart piles at installation was ca 300 x 300mm.

Table 6.2: Estimated erosion of piles on groyne C37

Pile	Cumulative length of 3 faces (mm)		Estimated section loss after 10 years (%)
	At installation	2025	
4	900	880	2
6		890	1

6.1.3 Piles: comparing performance of basralocus to greenheart

Even excluding the greater erosion of 12% of cross section of pile 5 on groyne 36, it can be seen that erosion of basralocus is substantially higher than that for greenheart. Direct comparison of the mean erosion of basralocus and greenheart on piles 4 and 6 is 3% to 1.5%, respectively. These data show that greenheart, over a 10 year period, was more resilient to erosion than basralocus.

6.2 Marine borer attack

6.2.1 Groyne C36

An edge was removed from piles 1 and 3 to expose about 500 mm of timber on each. There was no evidence of 'shipworm' attack in the exposed timber (**Plates 4 and 5**). However, there was damage caused by gribble at numerous positions on the groyne between piles 1 and 10, typically where the plank was in contact with the updrift and landward faces of the piles (**Plates 11, 12, 13 and 14**).

In some cases, the extent of damage could be seen at the end grains on the updrift faces of the planks. In the worst case locations, the loss of section was > 50%, which calls into question the remaining life expectancy of badly affected planks. These cases of severe damage were at the end grains of the planks (**Plates 12, 14 and 21**); however, these are the positions where the planks are fixed to the piles and failure would cause excessive stress to the remaining fixings at mid-length along the planks.

The piles at the seaward end of the groyne exhibited variable performance as shown by the range of erosion and/or gribble attack presented in **Appendix A**. This was evidence of the variable nature of basralocus, with the performance of basralocus far more variable than that of greenheart and ekki that had been previously observed in the Bay and as reported below.

In one case, pile 9 had been 'hollowed out' by gribble attack (**Plates 18 and 19**) and its remaining service life may best be described as 'short', unlikely to last another 5 years and could possibly fail during a vigorous winter storm. The comparative poor performance of this pile was an outlying observation, but indicates that the marine borer resistance of basralocus in this case was highly variable.

Damage associated with a timber borer was observed at the head of pile 5 (**Plate 20**). The elevation was too far above the mean height of the intertidal zone for it to be damage associated with shipworm. The most likely explanation is the activity of gammaridean amphipods, a sub-order of the *Crustacea* most probably exploiting previous holes made by a forest dwelling wood boring insect, possibly forest longhorn or scolytus beetle.

Beyond pile 10, there was a substantial improvement in the general appearance of the basralocus, with there being less noticeable erosion or marine borer attack where it was present.

The worst rating for the basralocus piles and planks after only 10 years' service was '4'. Overall, marine borer resistance of basralocus did not match the performance expected from previous laboratory and field trials. However, there was no evidence to indicate there had been any mechanical failure after 10 years' service, despite notably variable resistance to abrasion.

6.2.2 Groyne C37: Greenheart piles and ekki planking

Gribble attack was observed between pile 1 (king pile) and pile 6. (**Plates 26, 27, 28 and 29**). No gribble attack was observed on the ekki planks. There was also evidence of shipworm colonisation on one pile (**Plates 35 to 38**) although this was very minor and unusual for the groyne field as shipworm is not a recognised hazard limiting groyne service life in the Bay.

The worst rating for greenheart piles at the seaward end of the groyne was '2' and based on previous experience specific to the Bay, published by SCOPAC,³ it is probable that the piles and ekki planks would deliver 25 years' service life from the time of installation

6.2.3 Groyne C30: Greenheart piles and planking

Groyne C30 was subject to a visual inspection only. Some erosion was observed at the edges of the piles 1 to 10 and some erosion of the planks visible as 'scalloping' caused by backwash of waves on the plank sections adjacent to the landward face of the piles. Gribble attack was observed at the edges of the planks and piles.

Generally, the visual rating for the planks was '2' although one plank was characterised by a localised void resulting in a rating of '3' (**Plate 40**).

Based on previous experience specific to the Bay, it is probable that the piles could deliver 25 years' service life, although there may be a requirement for localised replacement of plank(s) at the seaward end of the groyne.

³ [Assessing the performance of timber groynes • The Southern Coastal Group and SCOPAC](#)

7 DISCUSSION

The marine environment is challenging for all construction materials, but timber suffers remarkably little from the effects of the salt content of seawater compared to, for example, concrete and steel. In addition, the resilience and favourable strength to weight ratio of timber, its relative ease of fabrication and repair, make it a desirable material for engineers. The material cost of timber in coastal engineering is often dwarfed by the actual construction cost; consequently, this sector of the construction industry is conservative and there is a reluctance to specify lesser used species without a proven track record. However, in this case, procurement uncertainty and a scheduled construction timetable resulted in the Council improvising and using an unproven species, basralocus, on groyne C36.

7.1 Marine borer hazards in the Bay

7.1.1 Gribble

These are crustaceans found around the UK coastline. They are ubiquitous, inhabit the surface of the timber, are fully mobile and can cause significant damage to timber groynes, particularly the sheltered parts of the groyne as observed on some of the basralocus planks illustrated in **Appendix A**.

Gribble favour the space between the pile and planks. The shelter offered by the landward face of the pile dissipates wave energy, allowing the animals to colonise these comparatively sheltered sections of the groyne. The reduction in wave energy reduces the abrasive nature of the backwash on the landward face of the pile and adjacent plank sections, which reduces the risk of abrasion. Gribble also target plank edges because the butt joints offer shelter.

Gribble damage is superficial and results in the creation of an extensive network of galleries at or just below the wood surface. The galleries tend to be 1 mm to 3 mm in diameter with regularly spaced openings to allow respiration. Gribble are generally 2 mm to 4 mm in length and are pale grey in appearance. They are just about visible to the human eye when timber is inspected *in situ* and tend to concentrate at the intertidal zone. The galleries are often exposed by erosion caused by wave action. In the case of these timber groynes, erosion exacerbates the damage caused by gribble as surviving animals will burrow into fresh timber once their galleries have been destroyed. They can cause rapid erosion of timber under favourable circumstances.

7.1.2 Shipworm

These are found along the southern parts of the UK coastline. They have a soft wormlike body with two shells or valves at the anterior end of the animal, enabling it to bore into timber, remaining in the same tunnel throughout its life. Each tunnel is discrete and the animals avoid intruding into neighbouring tunnels as they grow and excavate into the timber. The shipworm will not emerge from the timber and will continue to bore alongside its neighbours until the timber is more or less destroyed and breaks apart.

The posterior part of the animal maintains contact with the external seawater environment via a fine hole approximately 1 mm to 2 mm in diameter. This hole is the only external sign that shipworm have colonised a timber component, which makes surveying for shipworm extremely difficult *in situ*. Two siphons protrude from this hole, one for feeding

and the other for excretion and release of reproductive gametes or larvae. The animals usually line their tunnels with a calcareous secretion and removal of the surface of the timber can expose the visible calcareous tunnels that contrast strongly with surrounding timber (**Plate 38**).

Shipworm have not been previously detected in the Bay and this sighting may be considered to be rare. It demonstrates that viable shipworm are present in the Bay but, to date, are unable to successfully colonise the groyne timbers. The photographs in **Appendix A** illustrate the difficulty in detecting these organisms *in situ* unless the component has been badly infested.

7.2 The performance of Basralocus

The performance of basralocus on groyne C36 did not reflect the prediction relating to resistance to attack by marine borers. This prediction was based on laboratory experiments aimed at measuring feeding rates on candidate timber species as an indicator of resistance to attack. Performance was variable and the photographic record in **Appendix A** illustrates the inconsistent resistance to abrasion and gribble attack, with the surface of the timbers showing in places noticeable distress from the marine environment to which it has been subjected.

This variable performance in the Bay is undesirable because it is unlikely that the piles could deliver a service life of 25 years. Moreover, given the severe nature of gribble attack, it is likely that some of the planks may not achieve 15 years' service life, which is at the lower end of the service life spectrum for planks in the seaward end of groynes at the more exposed east of the Bay.

Although the mode of failure of the piles and planks is a combination of erosion and gribble attack, there was no evidence to suggest that the piles would fail due to mechanical failure. Therefore, the estimate of D50 relating to strength can be justified as a procurement decision in 2015. The estimate of D50 was based on a combination of available published ultimate strength data for basralocus from reputable sources, including the UK Building Research Establishment (BRE), French Agricultural Research Centre for International Development (CIRAD) and the Forest Research Service of the United States Department of Agriculture (USDA).

Reference also made to Hardwoods in Construction.⁴ Chapter 4 'Structural Design' describes a method where the strength properties of lesser used/known hardwood species may be estimated and states that the range of hardwoods listed in BS 5268⁵ is limited. This Standard has been withdrawn but BS 5268 was the essential document that provided the permissible strength properties of structural timber and the properties of the Strength Class system, which for hardwoods is prefixed with 'D.' The Strength Class system in BS 5268 was superseded by BS EN 338,⁶ which defined the characteristic values for timber Strength Classes. The principal advantage of both Strength Class systems was that engineers could design using a Strength Class instead of a specific species and have confidence that species identified in these Standards were supported by robust test data derived from the testing of structural size timber instead of small, clear laboratory specimens.

⁴ Hardwoods in Construction. 1991 Timber Research and Development Association, High Wycombe, UK.

⁵ BS 5268. Part 2. 1988. Code of practice for permissible stress design, materials and workmanship. BSI, UK

⁶ BS EN 338. 1995. Structural timber strength classes. BSI, UK.

However, TRADA⁷ published a route that allowed designers, particularly those based overseas without easy access to established European timber import routes, to use species not described in these Standards. This route was based on the Strength Group system which had been in use in Australia for a wide range of indigenous and imported hardwoods. The system allows a means of classifying timber that has not been fully tested using large structural sized specimens into Strength Groups. The process of grouping consists of ensuring the strength properties of the timber are equal or greater than those for the appropriate group.

In the TRADA publication, Hardwoods in Construction, basralocus is included in Strength Group S3. This assumes that the timber can be visually strength graded to exclude significant strength reducing features such as large knots and slope of grain. According to TRADA, Strength Group S3 is equivalent to Strength Class SC7 in BS 5268: 1998. The older 'SC' stress class values in BS 5268:1998 were replaced with D deciduous (hardwood) values in later versions of the Standard. Whilst the 'SC' and 'D' values were not exactly comparable, they were broadly similar. Even though they were derived under different methodologies, a reliable approximate comparison can be made by considering the material safety factors used in the later editions of BS 5268 by dividing the SC values by the appropriate safety factor to estimate corresponding D value. This was the basis for estimating the D50 Strength Class for basralocus.

⁷ Timber Research and Development Association.

8 CONCLUSIONS

- There was no evidence of structural failure of the basralocus piles on groyne C36. Therefore the assumption that basralocus met the requirements for Strength Class D50 was reasonable,
- The performance of basralocus after 10 years' exposure on groyne C36 was variable.
- Severe gribble attack was observed on a number of planks in the sheltered parts of the downdrift face of the groyne.
- Severe gribble attack was observed on pile 9.
- 12% section loss was recorded on pile 5 due to a combination of erosion and gribble attack. Section loss on other piles ranged from 3% to 5%.
- The erosion rates on the basralocus were double those recorded on comparable greenheart piles.
- Overall, the inconsistent performance of basralocus in terms of its resistance to attack by the marine borer gribble makes it an unsuitable choice for Poole Bay.
- It is unlikely that the piles at the seaward end of groyne C36 will deliver 15 years' service life, let alone the pile design life of 25 years.
- It is advisable to replace the seaward end of the groyne back to pile 10, and to replace with a combination of greenheart piles and ekki planking for maximum performance.

APPENDIX A – PHOTOGRAPHS

This appendix contains 29 pages, including this one

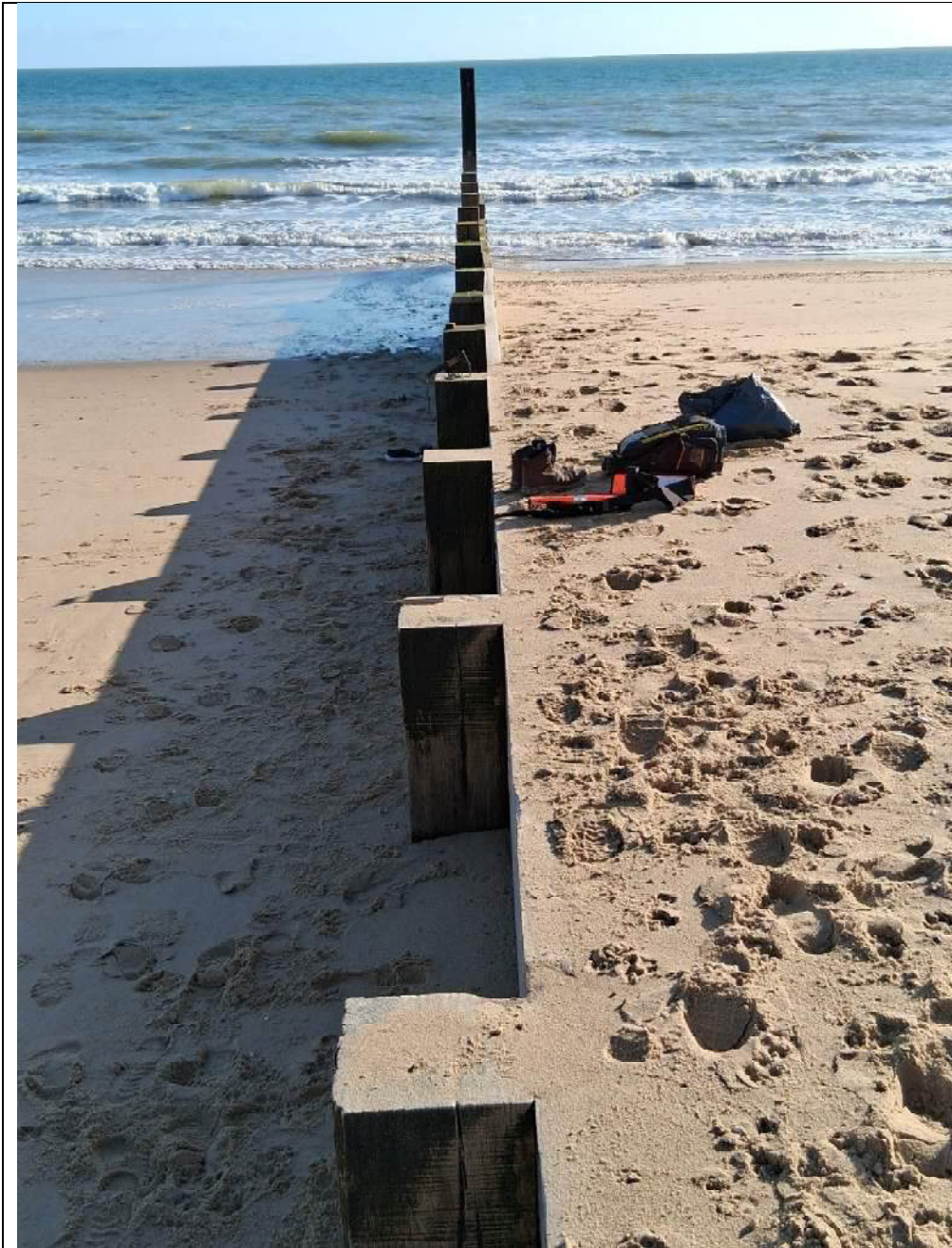


Plate 1 - Groyne C36. General appearance looking along the line of the piles. There was no evidence of movement away from the vertical, which indicated that none of the piles at the seaward end of the groyne had suffered mechanical failure below the beach level.



Plate 2 - Groyne C36. General appearance viewed from the downdrift side, illustrating the difference in beach levels between updrift/downdrift faces of the groyne



Plate 3 - Groyne 36: Removal of pile edge to examine the timber characteristics to confirm the piles comprised basralocus. This was also confirmed by measuring the cross section, which exceeded the standard 300 x 300 mm pile section for greenheart piles. A larger 330 x 330 mm cross section was selected to counter the reduction in strength of basralocus (D50 est.) when compared in greenheart (D70).

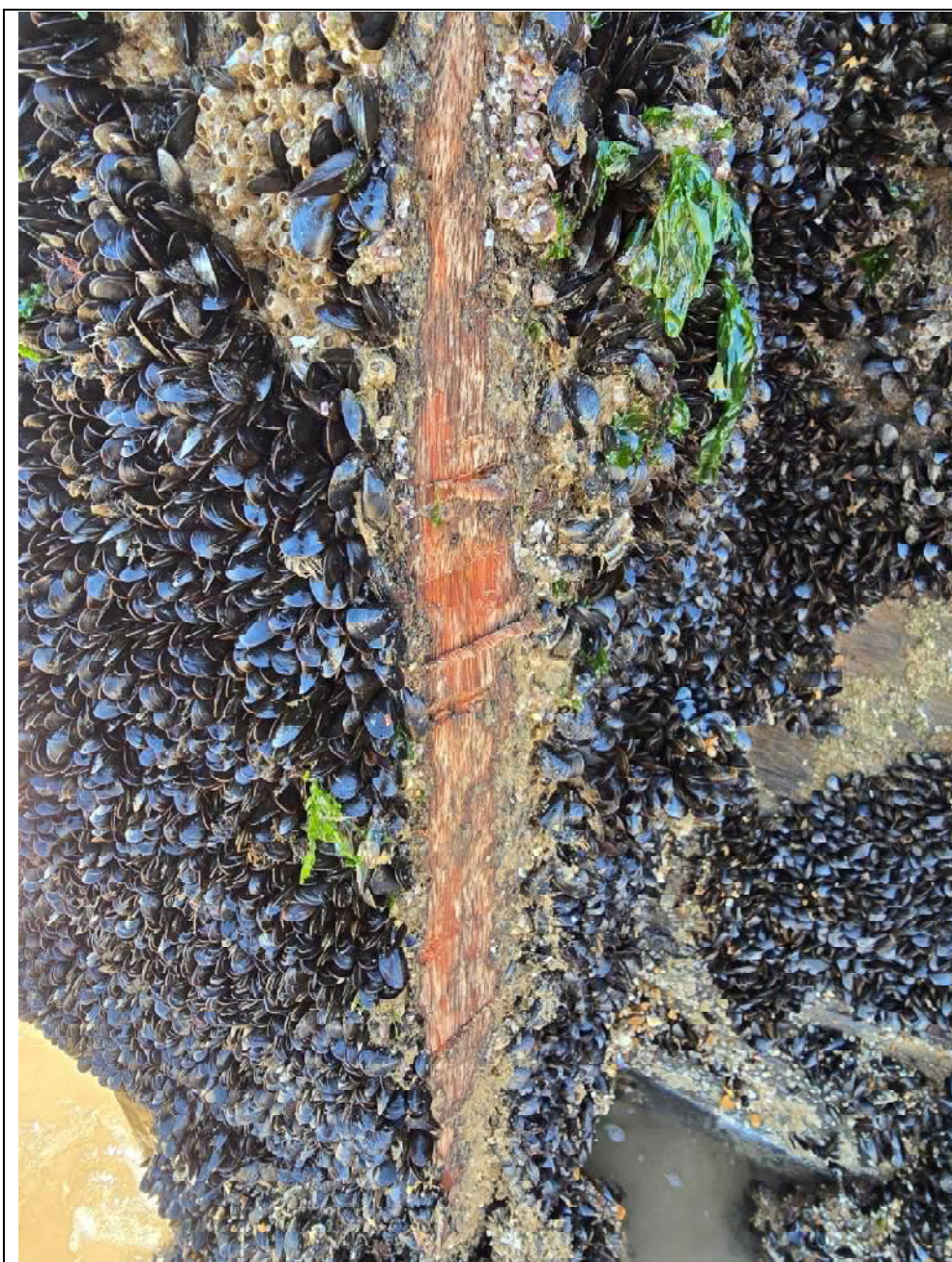


Plate 4 - Groyne 36. Pile 1 (King pile) No evidence of shipworm.



Plate 5 - Groyne 36. Pile 2. No evidence of shipworm.



Plate 6 - Groyne C36. Typical pattern consistent with gribble attack showing galleries just below the surface that are eroded away by wave action. Striking the surface of the plank shows the galleries are shallow (indicated). The visual assessment rating for this plank (**Table 5.1**) was '2', although the image focusses on a small part of the plank.

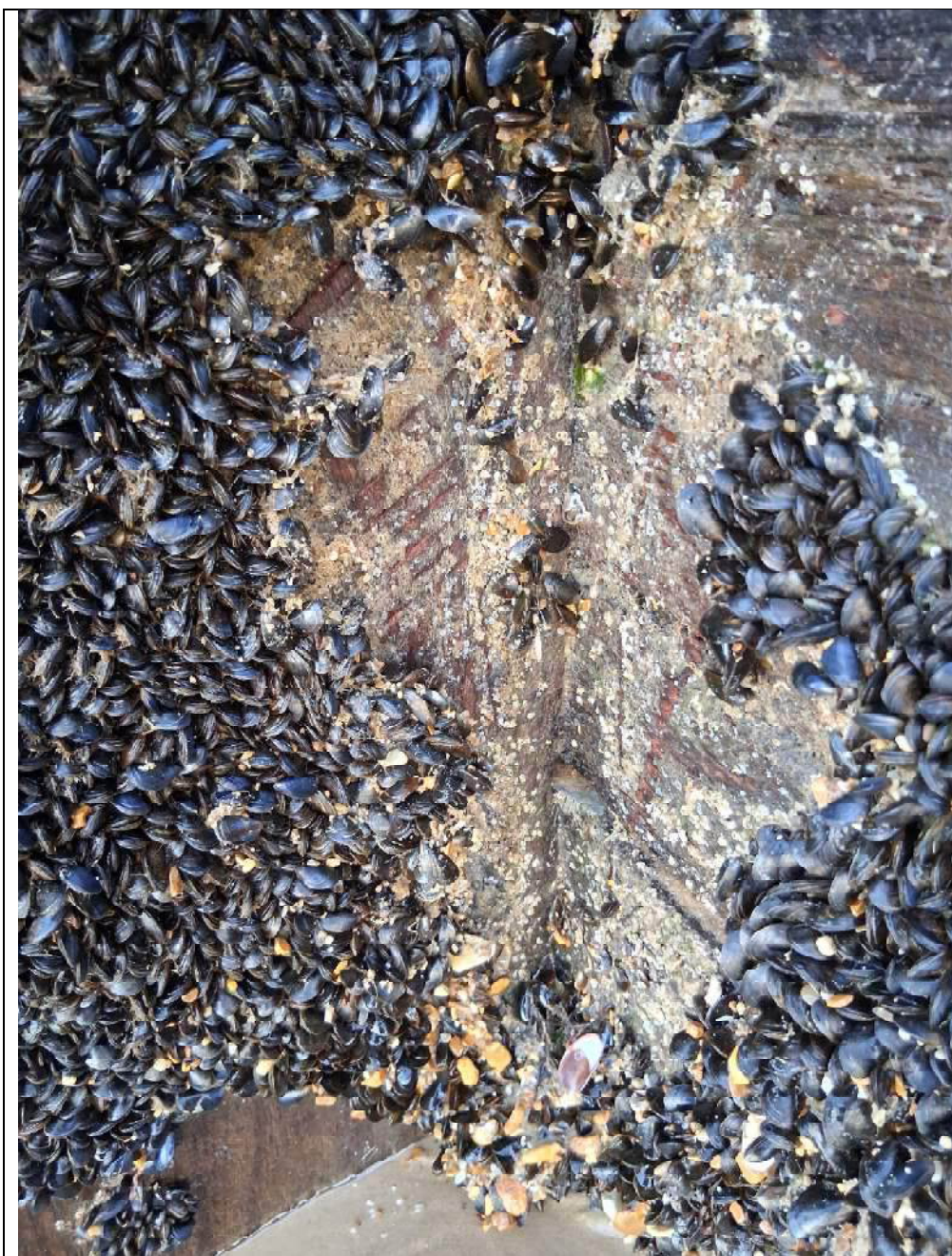


Plate 7 - Groyne 36. Scraping away of marine fouling to expose the connection between the king pile (Pile 1) and adjacent planking on the more sheltered landward face of the pile where gribble colonisation is most likely in the intertidal zone. In this location, there was no sign of gribble attack, no damage was observed and the visual assessment rating is '0' (**Table 5.1**).



Plate 8 - Groyne C36. Erosion of the face of a plank in the intertidal zone. The plank has suffered some erosion as indicated by the knife. The arrow shows a combination of grazing behaviour and subsequent erosion. Visual assessment rating '2'.



Plate 9 - Groyne C36. Typical 'scalloped' appearance of a plank caused by backwash of sediment as indicated by the knife. The faint pitted appearance (indicated) suggests erosion has exposed and eroded gribble galleries. The visual assessment rating is '2'.

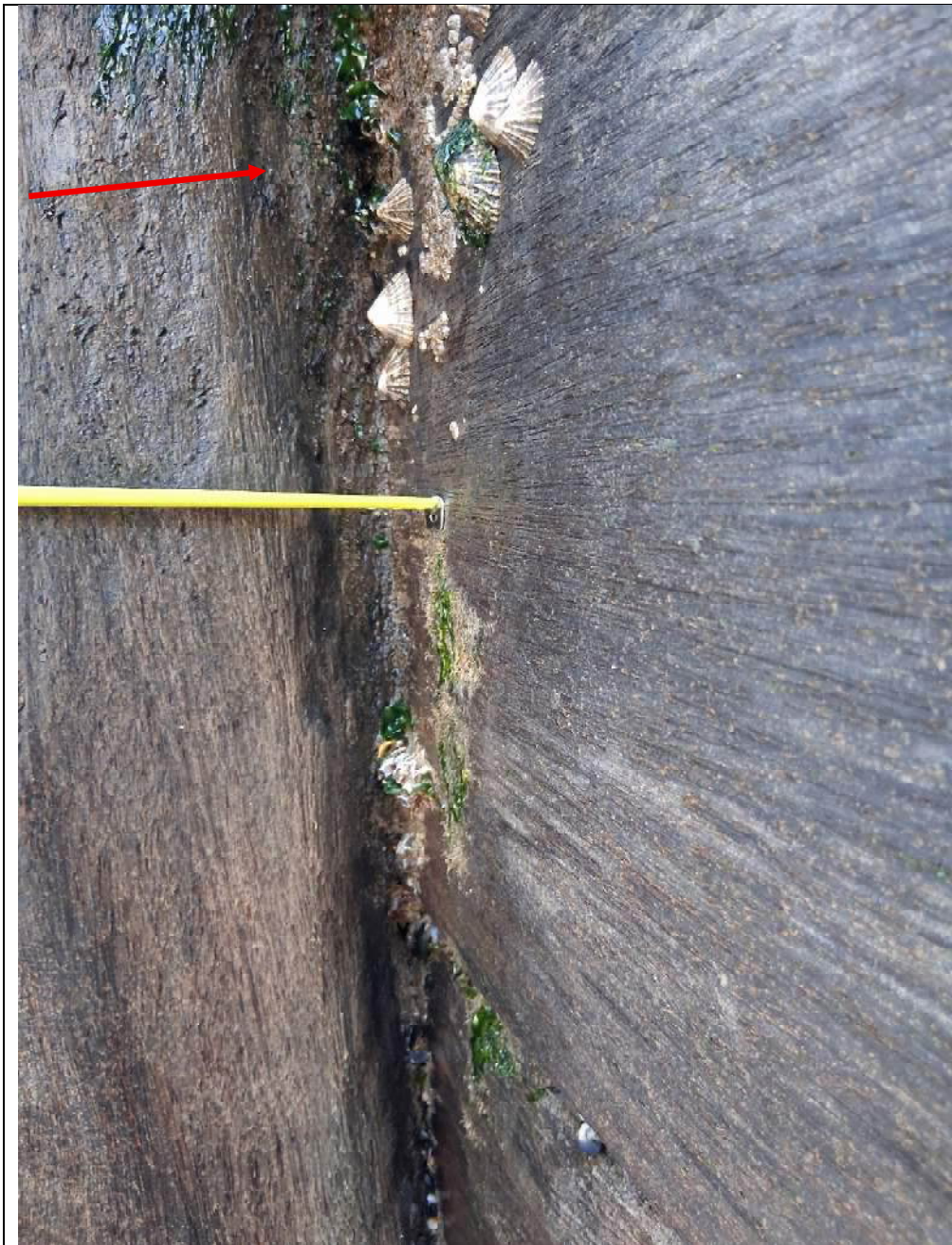


Plate 10 - Groyne C36. An example of erosion observed on the landward face of pile 2 caused by backwash of sediment abrading the pile surface. This action can create refugia for gribble, which can then attack the timber as just discernible at the eroded pile edge (indicated) that has exposed galleries. The visual assessment rating is '1'.



Plate 11 - Groyne C36. An example of erosion observed on the landward face of a pile caused by backwash of sediment abrading the pile surface. This action can create refugia for gribble, which in this case (indicated) has colonised a sheltered part of the groyne and started to attack the plank. The visual assessment rating is '3'.



Plate 12 - Groyne C36. An close-up image of gribble attack showing the typical appearance of the exposed galleries at the boundary of the surface of the plank and the 'gribble zone' (indicated). The visual assessment rating is '3'.

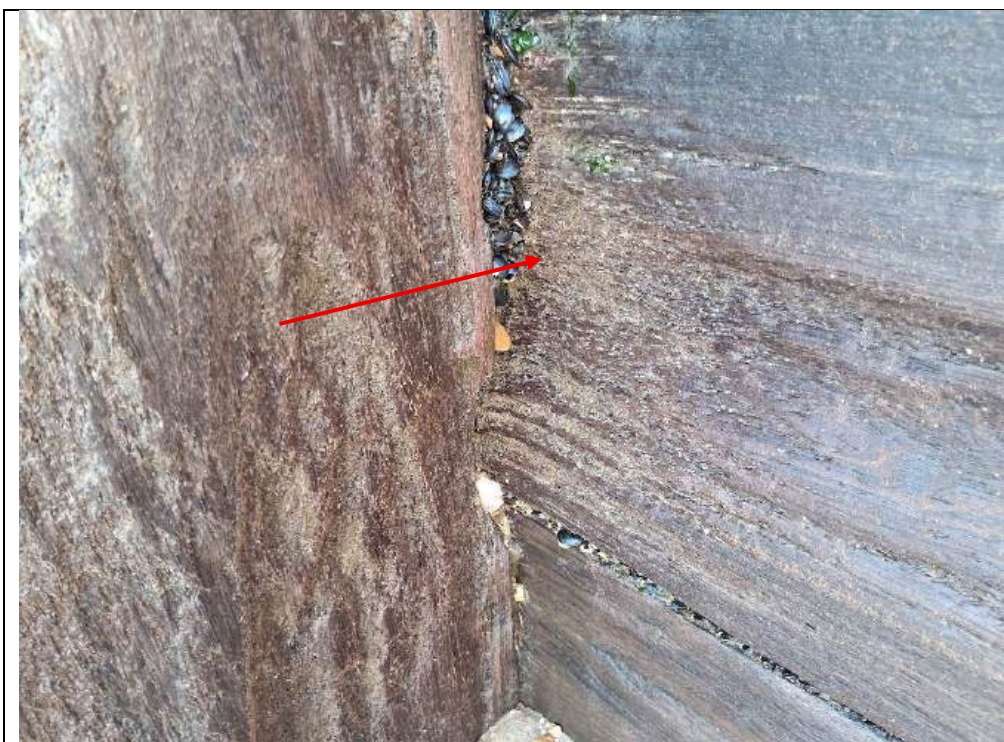


Plate 13 - Groyne C36. General appearance of an eroded plank in the backwash zone where abrasion has exposed gribble galleries (indicated) and caused erosion of the surface of the pile. Although localised, the visual assessment rating for the plank is '2'. Also note the eroded surface of pile 5.



Plate 14 - Groyne C36. A close-up image of gribble attack showing the typical appearance of the exposed galleries in the backwash zone adjacent to the landward face of pile 5. Note the extension of the measuring tape through a gap between the pile and plank indicating loss of section of both, caused predominantly by gribble attack and exacerbated by erosion. Although localised, the visual assessment rating for the plank is '3'.



Plate 15 - Groyne C36. Gribble attack and abrasion observed on pile 5 and the plank adjacent to the landward face of the pile (indicated). This image highlights the variable performance of basralocus in the intertidal zone. The general grazing pattern over the pile, particularly the landward face results in a visual assessment rating of '3'.



Plate 16 - Groyne C36. A wider-angle view of **Plate 15** illustrating section loss caused by a combination of gribble attack and erosion (visual assessment rating '2') and an unusual pattern of erosion in the plank below (indicated), which has not been caused by gribble attack. This pattern may have been caused by erosion of pockets of lower density timber or of soft rot pockets. This image shows the variable nature of basralocus.



Plate 17 - Groyne C36: Loss of section of a plank adjacent to the seaward face of a pile. This loss has been caused by a combination of gribble attack and subsequent erosion.



Plate 18 - Groyne C36. Pile 9. Substantial internal 'hollowing out' damage to a basralocus pile caused by gribble attack. This pile is at risk of failure; visual assessment rating '4'.



Plate 19 - Groyne C36. Close up of the cavity of pile 9 shown in **Plate 18** illustrating the 'hollowing out' of the pile.

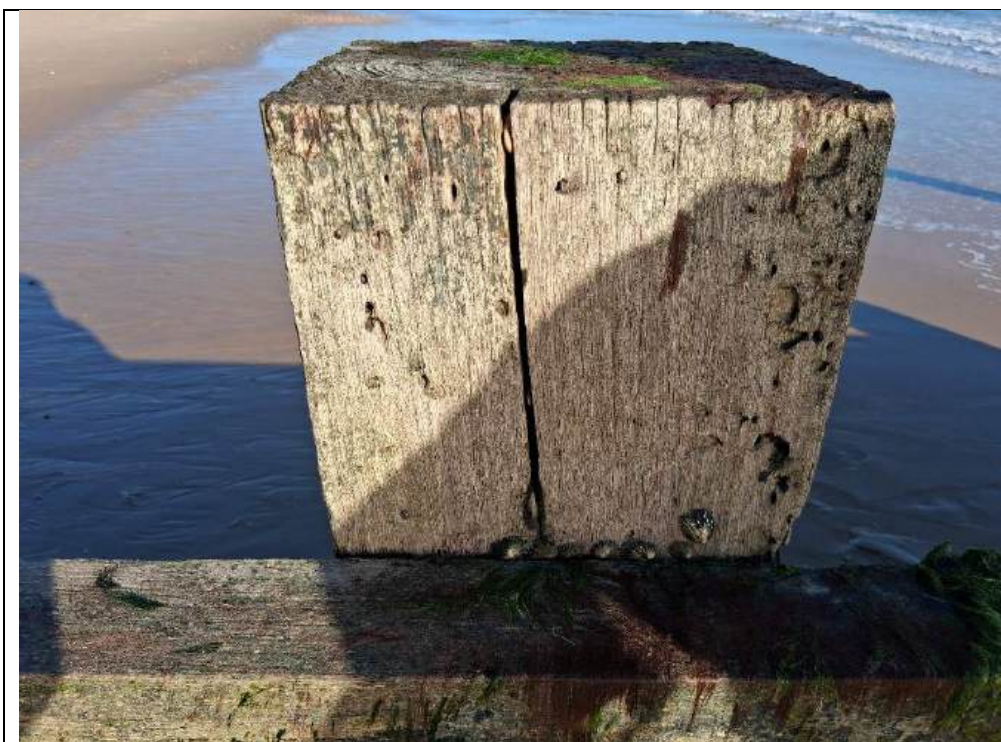


Plate 20 - Groyne C36. Pitting observed at the head of pile 5 at the upper end of the intertidal zone. This is probably caused by a gammaridean amphipod, a sub-order of the *Crustacea*, exploiting previous holes made by a forest dwelling wood boring insect, possibly forest longhorn or scolytus beetle.

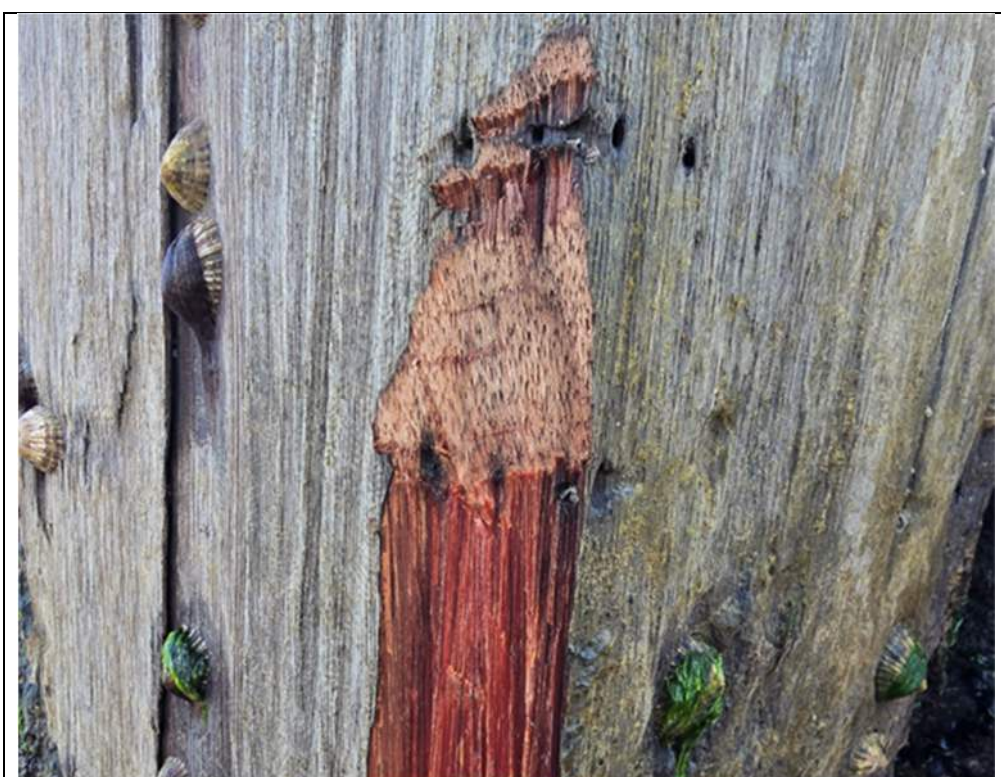


Plate 21 - Groyne C36. Pitting observed on pile 5. The edge of the pile was removed to expose the tunnels.



Plate 22 - Groyne C36, pile 5. Breaking open the timber exposed an animal dwelling in the tunnel, most likely a gammaridean amphipod, a small shrimp-like crustacean.



Plate 23 - Groyne C36. Evidence of gribble damage to the end grain of adjacent planks (indicated) on the updrift face of the groyne where the planks are fixed to pile 5. Damage was typically seen on the more sheltered downdrift face. The loss of section within the plank results in a visual assessment rating of '4'.

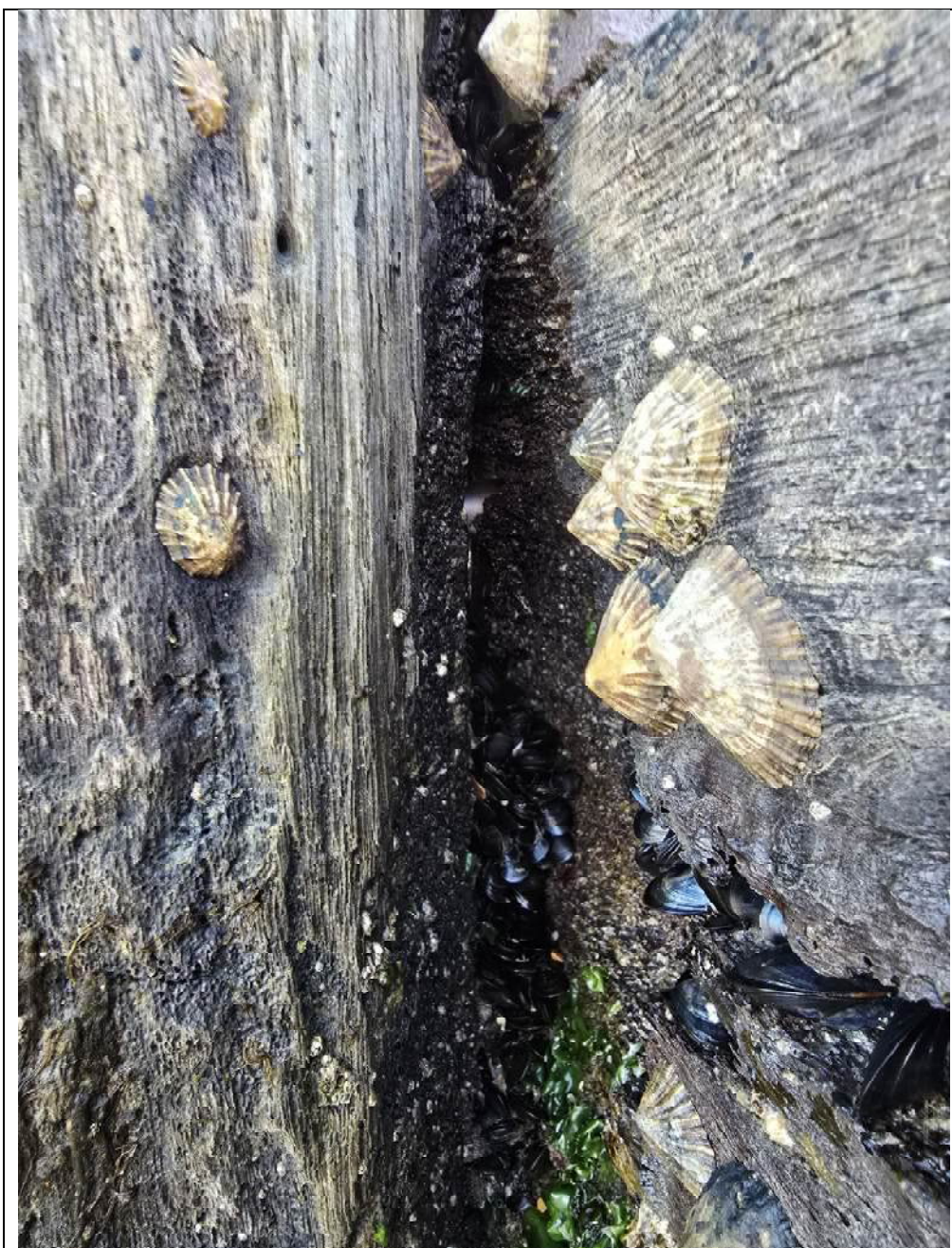


Plate 24 - Groyne C36, pile 5 showing the damage to a plank on the downdrift elevation. The loss of section of the plank results in a visual assessment rating of '4'.



Plate 25 - Groyne 37. Seaward end of the groyne showing piles 1 to 4. Note the contrast between the paler greenheart piles and darked ekki planks.

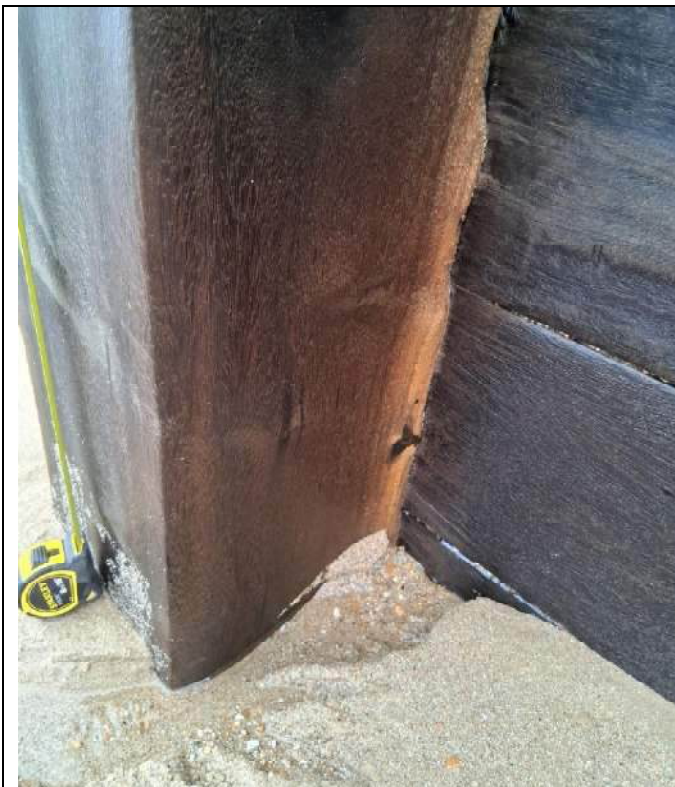


Plate 26 - Groyne 37. Contrast between a greenheart pile and ekki planking. The pale edge of the greenheart coincident with the ekki planks appears to be slightly eroded and may be a sign of less durable sapwood that can be present on large cross section greenheart piles.



Plate 27 - Groyne 37. Contrast between a greenheart pile and ekki planking. The pale edge of the greenheart coincident with the ekki planks appears to be slightly eroded and may be a sign of less durable sapwood which can be present on large cross section greenheart piles. The knot (indicated) in the darker heartwood causing distortion in the colouration of the pile reinforces the assertion that the paler wood comprises sapwood. There has been some erosion of the landward face as indicated by the barnacles lodged onto the timber (indicated).



Plate 28 - Groyne 37. Gribble attack at the edge of a greenheart pile on the seaward face. The damage is limited to the paler timber, which may be less resistant sapwood. The localised nature of the damage and minor loss of section at the edge of the pile results in a visual assessment rating of '2'.



Plate 29 - Groyne 37. A close-up image of **Plate 28** showing the gribble favouring to colonise and damage the greenheart (indicated) and not attacking the ekki.



Plate 30 - Groyne 37. Close-up image of gribble attack at the edge of a greenheart pile on the more sheltered landward face. Note the contrast between the greenheart and darker ekki, which has not been attacked by gribble. The localised damage and minor loss of section at the edge of the pile results in a visual assessment rating of '2'



Plate 31 - Groyne 37. Slight loss of section at the edge of pile 1 on the landward face (indicated) caused by gribble attack. There was no equivalent damage on the adjacent ekki planks. The localised nature of the damage and minor loss of section at the edge of the pile results in a visual assessment rating of '2'.



Plate 32 - Groyne 37. Galleries characteristic of gribble attack on pile 1 (indicated).



Plate 33 - Groyne 37. An example of assessment for shipworm attack by removing the edge (indicated) of pile 4 to a length of ca. 500 mm in order to expose shipworm tunnels (photograph taken whilst work was in progress).

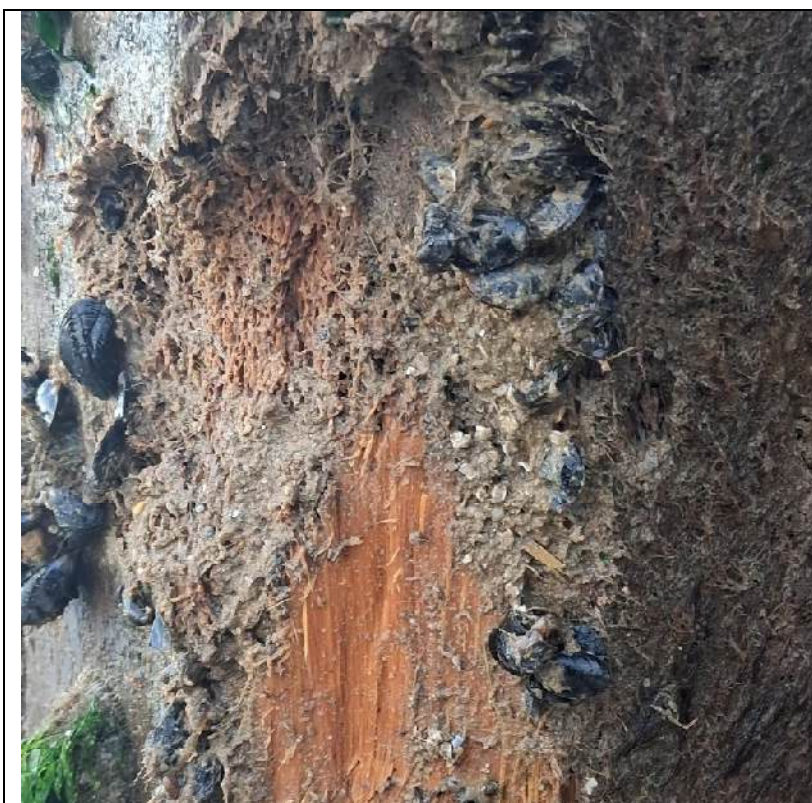


Plate 34 - Groyne 37. Localised gribble attack on pile 4 has developed in part of the pile where there was section loss, possibly due to mechanical damage. Removal of the edge of the pile indicated that the gribble attack was limited to the surface. The localised nature of the damage and minor loss of section at the edge of the pile results in a visual assessment rating of '2'.



Plate 35 - Groyne 37. Shipworm tunnel exposed by abrasion of the surface of pile 4.



Plate 36 - Groyne 37. Scraping away the surface layer of timber on pile 4 around a suspected shipworm siphon revealed the calcareous lined tunnel of a juvenile shipworm (indicated).



Plate 37 - Groyne 37, pile 4. Suspected shipworm siphons (indicated) and the likely exposure of the calcareous lining of a shipworm tunnel (yellow arrow). The localised nature of the damage and minor loss of section at the edge of the pile results in a visual assessment rating of '2'.



Plate 38 - Groyne 37, pile 4. The yellow arrow indicates a shipworm tunnel. The red arrows indicate part-formed tunnels as a consequence of the larvae failing to lodge into the timber. The localised nature of the damage and minor loss of section at the edge of the pile results in a visual assessment rating of '2'.



Plate 39 - Groyne 30. General appearance of the greenheart piles and planks with some minor scalloping observed on the down-drift elevation (indicated).



Plate 40 - Groyne 30. Localised voiding of a plank. The most likely explanation is gribble attack of a softer part of a plank, which may have been caused by a pocket of incipient decay in the tree. Some gribble colonisation was observed (indicated). The localised nature of the damage and minor loss of section at the edge of the plank results in a visual assessment rating of '3'.



Plate 41 - Groyne 30. Gribble attack observed at the edge of a plank (indicated). The localised nature of the damage and minor loss of section at the edge of the plank results in a visual assessment rating of '2'.



Plate 42 - Groyne 30. Gribble attack observed at the edge of a plank adjacent to a pile on the seaward elevation (indicated). The localised nature of the damage and minor loss of section at the edge of the plank results in a visual assessment rating of '2'.