NORTHLAND

TOTARA

WORKING GROUP

EXAMPLES OF TOTARA SAPWOOD RESISTING ATTACK BY THE COMMON HOUSEHOLD WOOD BORER (*ANOBIUM PUNCTATUM*)

A Report Prepared by Paul Quinlan for Tāne's Tree Trust

31st January 2017

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A report prepared on behalf of the Northland Totara Working Group.

Purpose of report.

Presently, the NZ Standards NZS 3602 committee is undertaking a review of aspects of the New Zealand Building Code. To assist with that process, this report documents evidence that members of the Northland Totara Working Group can verify regarding examples where tōtara sapwood timber has shown resistance to the common household borer (*Anobium punctatum*).

Tāne's Tree Trust
Native Trees for the Future

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Executive Summary

This report comprises documentation of specific examples where untreated tōtara timber, including the sapwood component, have clearly demonstrated resistance to attack by the common household borer (*Anobium punctatum*). Accordingly, it provides details, dates and photographic evidence to substantiate the specific examples referred to in this report. These documented examples are consistent with numerous observations and anecdotes previously gathered by members of the Northland Totara Working Group.

The examples presented in this report provide compelling evidence of specific incidences where untreated tōtara sapwood timber has clearly shown natural resistance to attack by the common household borer.

In this regard, these examples demonstrate potential for untreated tōtara sapwood timber to provide reasonable service life in a variety of applications.

Introduction & Background

The Northland Totara opportunity

Totara is a prominent feature of the rural Northland pastoral landscape, typically regenerating on pastoral hill country, lower-quality pastures and along riparian margins. Because it is relatively unpalatable to grazing stock, 'farm-tōtara' regenerates so prolifically that many pastoral landowners have regarded it as a weed. However, over the last century or more substantial areas of dense second-growth tōtara-dominated stands have developed with the potential to be managed as a sustainable resource, complementing the existing pastoral farming land use[4].

Potential exists to develop a significant regional industry in Northland based on the use of timber from regenerating (and planted) tōtara on private land – 'farm-totara'[1]. Encouraging sustainable management of the resource would bring multiple benefits to the region and provide a vehicle to realise ecological, environmental, cultural, social and economic benefits. This is the vision of the Northland Totara Working Group (NTWG). Since it was formed in 2005, the group has successfully conducted many projects to progress this initiative.

Presently, the primary focus is on developing the opportunity in the Northland region. However, this opportunity could extend to private land, including Maori land, and in many other regions around New Zealand.

Under the umbrella of Tāne's Tree Trust the NTWG is represented by a wide range of stakeholders in Northland including the New Zealand Landcare Trust, landowners, New Zealand Farm Forestry Association, District and Regional councils in Northland, wood millers and processors, and representatives of the Ministry for Primary Industries.

The major objectives of the NTWG include:

- identifying gaps and supporting research into determining wood properties and potential uses of farm-grown tōtara;
- investigating the feasibility of developing a supply chain from resource to market; and
- identifying and overcoming impediments to the sustainable management of naturally-regenerating and plantation tōtara.

Timber properties

Totara is an iconic native timber tree species in New Zealand. However, traditional use and knowledge is based on timber from 'old-growth forests', i.e. trees that were often many hundreds of years old. Totara heartwood is recognised as having exceptional durability attributes (i.e. Class 1 durability – "Very Durable")[5] and consequently was widely used for house piles, framing, window joinery and farm fence-posts.

Regarding natural durability of totara from old-growth forests, Hinds and Reid (1957)[8] indicate heartwood torara is: "…of outstanding durability in ground, in harbour timbers, in the weather, in tanks and vats…"

Hinds and Reid (1957)[8] describe heartwood as even pinkish brown whereas sapwood is whitish brown. They also note for totara that **"Sapwood is durable in exterior woodwork in buildings and is notable also for non-susceptibility to *Anobium* borer attack."**

Wardle (2011)[9] states a similar claim: "The heartwood has outstanding natural durability. Along with silver pine it ranks as the most durable native timber in ground contact. It is resistant to most agents causing decay, **and even the sapwood resists attack by the house borer, *Anobium*, and will last indefinitely in outside, above ground uses**. The wood is very durable in salt water and resists attack by Toredo and shipworm more successfully than any other native species."

In contrast to timber from old growth stands, timber from regrowth (second-growth) or farm trees, known as "farm-tōtara" has a lower proportion of heartwood than old-growth tōtara traditionally harvested in New Zealand and used for applications requiring high levels of durability. Little documentation or testing exists concerning the relative durability performance of farm-tōtara for applications that are required to comply with the NZ Building Code such as cladding and structural elements. This uncertainty has been identified as a major impediment for landowners wishing to manage, market and utilise the resource[3]. Nevertheless, timber from farm-totara has been confirmed, through practical experience as a high quality native timber with strong market interest[2].

Furthermore, anecdotal evidence suggests that timber from naturally regenerated second-growth 'farm-tōtara' trees, which included a high proportion of sapwood, has often provided a reasonable service-life in a variety of applications. Some of this practical experience was documented in the 2011 Sustainable Farming Funded project (L10/145) report titled: Existing uses and market development opportunities for naturally regenerating totara timber[2]. This NTWG project was a detailed survey that included a section on "Durability of Regenerated Totara". In that section, the survey responses from 32 different people (representing 4 different stakeholders groups with relevant experience using regenerated tōtara timber) are recorded (see questions 43-48 on pages 50-58 of that report).

Two questions were specifically about the durability of untreated tōtara sapwood in exterior and interior applications (See questions 45 & 46 and figures; 31-38). One of the conclusions stated that "*Many people considered Totara sapwood to be relatively more durable than most other sapwood timbers and to be much more resistant to the common house borer*". However, we are not aware of any laboratory testing to support those experiences.

Therefore the remainder of this report provides some evidence to substantiate that experience by documenting the practical experiences of four people with examples of tōtara sapwood resisting attack by the common household borer (*Anobium punctatum*), and including experiences with the two-tooth longhorn borer (*Ambeodontus tristis*). Hosking (1978a)[6] and Hosking (1978b)[7] provides a description, life history, ecology, and host species and impacts on timber from the larvae of these beetles for the common household borer and the two-tooth longhorn respectively.

Scope of this report

This report documents specific and verifiable experiences of three members of the Northland Totara Working Group (Geff Cookson, Michael Hayes and Paul Quinlan), and of John McGee in relation to milled tōtara sapwood timber (from farm-tōtara trees), demonstrating resistance to attack from borer, and provides photographic evidence in support.

1. Geff Cookson's Examples

A particularly convincing demonstration of borer resistance in sawn tōtara timber is provided by this first example. In the winter of 2009, (7 ½ years ago), Geff had 50m^3 of farm-totara logs felled and milled on his Northland farm property at Kawakawa. This was part of a Northland Totara Working Group project. The harvest was executed with a milling statement for scientific purposes. A pre-harvest assessment of the tōtara stands was conducted by Paul Quinlan and Owen Lewis and each tree photographed and its timber volume estimated. The trees were representative of the farm-tōtara resource. The timber comprises a mix of slab (still with the bark on) and sawn boards, and has been stored, in-fillet, in a shed on the farm for use by the NTWG for the testing of various timber attributes etc. (Refer Figures: 1 & 2).

Figures: 1 & 2 – Geff Cookson standing beside the tōtara timber stored for the last 7 ½ years in his half-round barn (with one open end).

In the same shed, since 2005, slabs of a milled kauri tree (slabs up to 83cm wide), have also been stored in-fillet (i.e. 4 years longer than the tōtara timber). Although at the time no common household borer was evident on the kauri slabs, the sapwood of the kauri has since become riddled with borer. In contrast, the tōtara slabs and sawn timber - even those with the bark still on – has remained without attack, although the infested kauri slabs remain stacked less than four metres away in the same shed.

An inspection on the 18th January 2017, revealed no single observation of borer attack on any of the tōtara. This example clearly demonstrates tōtara timber, even tōtara sapwood timber, showing resistance to borer (See figures; 3- 5 below).

Figure: 3 – Totara slab and sawn boards stored in-fillet at the back of the shed. Slabs of kauri (grey-coloured) stored on right-hand side of the shed in foreground.

Figure: 4 – An example of kauri slab (in the top half of the photo) with sapwood riddled with the common household borer (small round holes) and the two-tooth longhorn borer (larger elliptical holes), in contrast a board of tōtara sapwood with the bark on it (in lower half of photo), without any sign of borer attack, despite being stored in close proximity to the kauri for over 7 ½ years.

Figure: 5 – No evidence of borer damage was observed on any of the tōtara slabs or sawn lumber stored for over 7 ½ years in the same shed as the kauri slabs that were infested with borer.

Experience with performance in-use

In addition to the above example, Geff Cookson also has experience with untreated farm-tōtara timber used for sub-floor framing in two houses on the family farm where he still lives. He remembers his father having the tōtara trees on the farm felled and milled specifically to build the houses on the farm. Geff describes the trees as being 'farm-tōtara trees' (i.e. relatively small diameter trees which he indicated as being up to around 70cm diameter). One house was built in 1953, the other in 1962. Both used untreated farm-tōtara timber for the subfloor framing (piles on concrete footings, bracing and floor joists).

As part of this investigation, an inspection of the subfloor framing was made on the 17th January 2017. This found that although the nails and wire had mostly rusted out, the timber was in excellent condition. The only single timber defect observed was a small incidence of what is presumed to be dry-rot on an angle brace between two joists of the older house. The affected area is approximately 18cm long, 8cm wide, and 3 cm deep. It does not appear to be proportionally large enough to compromise the structural service of the timber member. No other timber defects, or incidence of borer attack, were observed in the untreated subfloor framing of either house. The untreated tōtara timber has provided excellent structural service in the subfloor framing of both houses for well over 50 years (51 & 63 years respectively).

From the careful inspection of the subfloor timber members, it appears that the builders have selected timber that is largely heartwood timber for the purpose. Some 'coloured-grade' timber was also observed, which is presumed to indicate pieces of timber that include a transition between heartwood and sapwood (See figures: 6-8). However, only two examples were observed that could be confidently identified as definitely comprising sapwood. One involved bark encasement (See figure: 8), the other was obvious wane (a proportion of the natural round outside surface of the tree under the bark) on an angle brace between two joists (See figure: 9). From this, it can be stated that, although predominantly heartwood, certainly the

subfloor framing also comprises a small proportion of untreated tōtara sapwood. Importantly, no evidence of borer (or other defects) was observed in these pieces of timber. Therefore, these examples demonstrate excellent structural service from untreated tōtara timber, including from some pieces that contain a portion of untreated tōtara sapwood.

Figures: 6 & 7- Untreated tōtara subfloor framing of houses built in 1953 & 1962. No evidence of borer was observed. N.B. – the distinct colour variation on the same piece of timber (– notably the angled brace in the right-hand image) presumably indicates a transition zone from heartwood to sapwood timber.

Figure: 8 – Bark encasement on one of the timber joists is presumably associated with a portion of sapwood content on this piece of timber. No evidence of borer was observed.

Figure: 9 – Obvious incidence of wane indicates the definite presence of sapwood on this piece of timber (in service since 1953). No evidence of borer was observed.

In summary the examples documented above include the following:

- No incidence of any borer observed in untreated tōtara timber (comprising heartwood and sapwood lumber and slabs with the bark on) that has been stored in a shed, for over 7 ½ years, immediately adjacent to kauri slabs that are riddled with both household & two-tooth longhorn borer.

- Excellent structural service provided by untreated farm-tōtara timber comprising heartwood, transition and some sapwood used in the subfloor framing of two houses built on the farm (1953 & 1962) with no sign of borer.

2. Michael Hayes' Example

Michael Hayes of Kaeo, has had very similar experiences to Geff Cookson concerning untreated farm-tōtara timber resisting attack by the common household borer. This includes tōtara sapwood.

Totara logs were felled in the autumn of 2011 but lay on the ground where they were felled, until extracted to be milled at the end of the following summer March 2012 (i.e. well over 6 months). The timber has been stored in-fillet and partially covered by tin (although somewhat dislodged by livestock rubbing on the stack) since it was milled (See figure: 10). The timber includes boards that are cut to the natural wane and some even include bark on some edges (See figure: 11). This confirms that many of the boards comprise a significant portion of sapwood.

The tōtara timber has not been preservative treated. No evidence of any borer attack was observed, despite the fact that a stack of taraire timber that was milled at the same time and has been similarly stacked, less than 25 metres away, in the same paddock, shows definite signs of borer damage (See figure: 12). Even more compelling is that the taraire had been sprayed with a mixture of "Clear Metalex" (Zinc Naphthenate 60% (Zinc as metal 8%)) & thinned with mineral turpentine, but the tōtara had no such treatments applied.

As with the Cookson example, no evidence of borer in the tōtara timber was observed although other timber species in close proximity have been affected. As Michael says: "*If totara was susceptible to borer, it would have had some by now*".

Figure: 10 – Michael Hayes next to a filleted stack of farm-tōtara timber in a paddock.

Figure: 11 – No incidence of borer was observed in the stack of untreated tōtara timber, which includes boards that clearly comprise a high proportion of sapwood timber.

Figure: 12 – In contrast to the tōtara, an adjacent stack of taraire timber, milled at the same time, has been damaged by the common household borer (*Anobium punctatum*), despite being sprayed with Clear-*Metalex* & Turps.

Nevertheless, Michael Hayes, like Geff Cookson, has occasionally seen borer in tōtara timber. Mostly this has been incidence of the two-tooth longhorn borer, which has probably affected the damaged live trees or has tunnelled under the bark of green logs before the wood was milled and dried. This experience is consistent with many other anecdotal accounts. It appears that the two-toothed longhorn borer ceases to be a problem once the timber is air-dry (or if the bark is removed from green logs).

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3. Paul Quinlan's Examples

Since 2008 I have had experience with the milling and storing of tōtara timber from the property in Kaeo, Northland. Previous to that I have had similar experiences to Geff Cookson regarding the resistance of tōtara slab wood in contrast to two slabs of kauri sapwood. The respective slabs were stored standing and leaning directly against one another inside an unlined shed. Eventually the two kauri slabs were discarded due to borer and dry-rot, (so are no longer available to photograph), but the tōtara slab remains in the shed without damage.

However, numerous other examples are present on the property to provide verifiable evidence of examples where untreated tōtara sapwood has been stored without being affected by the common household borer. Several examples are documented in the photographs and captions below.

Figures: 13 & 14– Flitches from a farm-tōtara tree milled in 2008 have been used to weigh down roofing iron that covers a stack of the filleted timber stored outside under a Leyland cypress hedge for over 8 years now. No evidence of the common household borer has been observed (See figures: 15).

Figure: 15 – Even under the bark that had just been removed no evidence of borer damage was observed on the sapwood timber of the flitches that have been stored outside since milled in 2008 (i.e. over 8 years ago).

Figures: 16 & 17 – 'Coloured' pieces of totara timber (i.e. ones that are part sapwood/ part heartwood), were deliberately used in August 2009 as a performance trial of untreated tōtara in

exterior above ground situations. They form the weather shield hoods above the windows and door (and the support blocks). The lower drip-edges of the weather hoods comprise sapwood, the upper edges against the exterior walls are the darker heartwood. The colour transition is faintly visible on the end-grain in the above photograph. The interface with the wall was filled with clear silicone sealer and the timber painted liberally with two coats of a timber preservative oil (Red ENZ, Natural Timber Finish and Preservative). The three weather hoods are still in good condition now after more than 7 years' service without any maintenance or recoating.

Figure: 18 – Untreated tōtara timber rails milled in 2008 and used in service outside since 2009 (i.e. 7 years so far). N.B. - many boards have wane and will therefore include a portion of sapwood. Although not expected to be durable in this exposed exterior application, no evidence of borer or rot/deterioration is yet evident.

Numerous other examples of untreated tōtara timber that has been milled and stored since 2008, in and around sheds where the common household borer is present (and is affecting pieces of timber from other species) could be documented. However, the author considers that above examples should suffice to demonstrate the natural resistance of tōtara sapwood timber to borer.

Other experiences include examples of interior furniture made of tōtara sapwood timber that are located in rooms where minor borer infestations still exist in pieces of oak furniture, pine architraves and door jams, yet the tōtara furniture has not been affected.

4. John McGee's Examples

Figure: 19 - John McGee stands by a 'lean-to' addition to a shed on Robert Hayes' property on Omaunu Road in Kaeo. In 1968 John and the (late) former owner, Jim Leslie, cut and delivered two tōtara trees for use as beams in the lean-to construction.

The final examples demonstrate the structural use and performance of untreated pole tōtara (i.e. small diameter tōtara trees – down to 160mm small end diameter).

John McGee recalls felling two skinny but straight tōtara trees from the bush along the Tairaire Road, with Jim Leslie. He also transported them (on a K model Bedford) to Jim's farm at Kaeo, for use as beams in a 'lean-to' extension to Jim's shed. Bill Bramley was the local self-taught carpenter who built the addition. A book on the history of the Bramley family in Kaeo (Bramley, G. 2009)[10], notes (on page 171) that Bill left the district in 1971 to live in Tauranga. However, diary entries by John McGee's late mother Gwen, help pinpoint Thursday the 10th October, 1968 as the day that John helped to lift the beams into place (See figure: 20 below). A highlighted photocopy of the diary entry reads: "*John 2hrs with B Bramley for Jim.*" This means the untreated tōtara beams have been installed and in service now for over 48 years.

The tōtara trees were cut and used green. John cut the branches flush with an axe and the bark and was removed. The beams have been partly square-sided with the skilful use of an axe (John think's Bill Bramley did that), but for much of the length the natural round of the tree's wood immediately under the bark remains. This natural round surface, and just under, is certainly sapwood. One beam forms the lintel above the doors and the other supports the roof rafters under the mid-point of their spans. The tōtara beams are 8.57metres long and span at least 8.37m. The lintel has other boards fixed to it therefore its diameter could not be accurately measured although the natural round surfaces indicate that it was clearly a relatively small diameter tree. In contrast, the tōtara support beam located under the mid-span of the rafters, is fully exposed and could be more accurately measured, although the rough 'squaring' of two faces of the last 2metres near the larger end, means that the large end diameter could only be estimated (at 30cm), based on the remaining half to two-thirds of the natural round of the tree. The small end diameter was accurately measured at 160mm.

The rest of the shed addition is made from various timbers that appear to be mostly kauri. Amongst the items stored in the shed, are some kauri slabs. Robert Hayes says the sapwood of the kauri has some borer damage. House borer holes were also observed in the nogs of the framing (thought to be kauri sapwood), directly on top of which the large end of the mid rafter tōtara beam rests (See figure: 23).

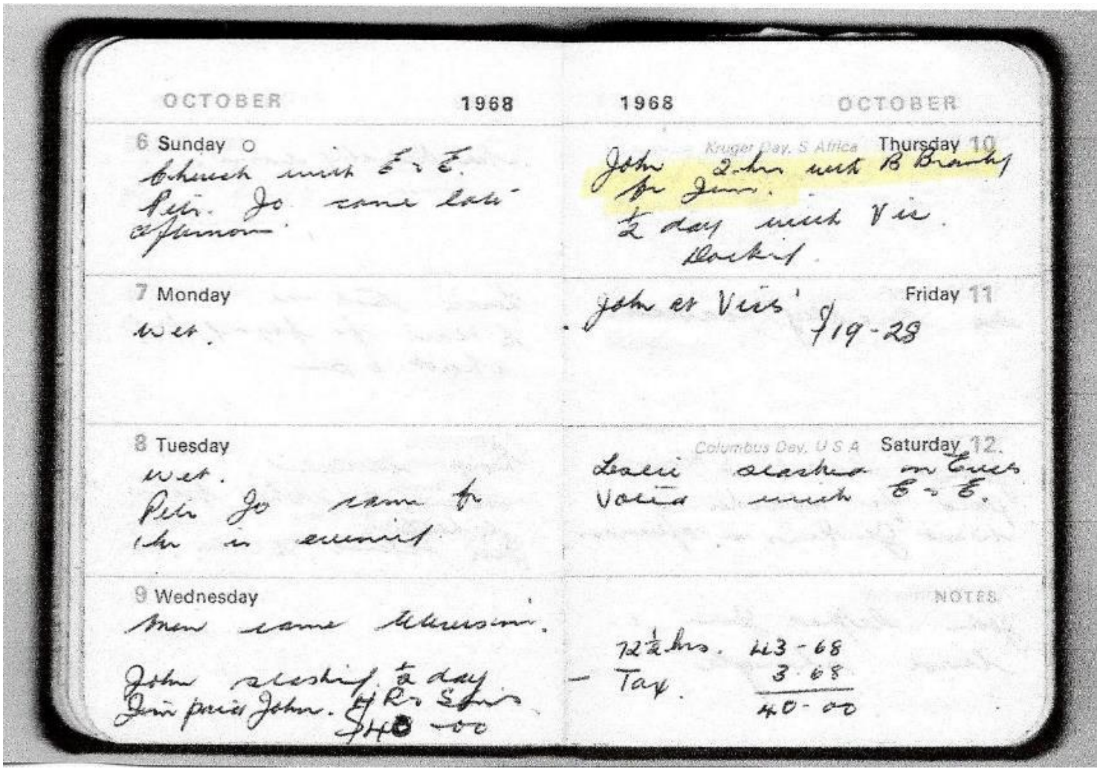
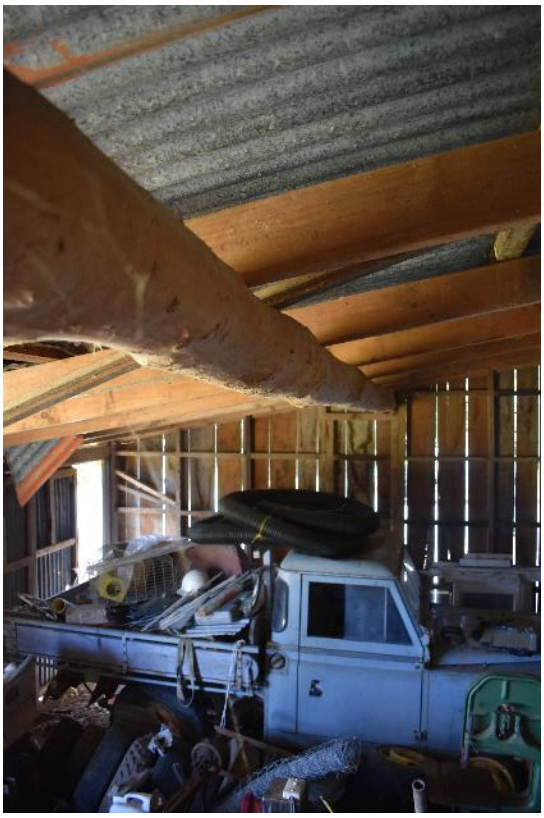


Figure: - 20 Gwen McGee's diary entry that pinpoints the installation date for the untreated green tōtara beams as being the 10th October 1968.

Figure: 21 The 8.57m long beam (under the rafters) has provided the mid-span rafter support since Oct. 1968, is an untreated tōtara pole, mostly still in the round form, but partly flat-sided (by axe) on top and near the butt end. The small end diameter is 160mm and the large end diameter is estimated at <30cm. The beam had the bark removed and was used green. Although borer is present in other timbers in the shed, no borer attack was observed at all in this (or the other) tōtara beam.

Figure: 21 – The small end of the beam has a diameter of 160mm and immediately abuts a rotting board of the exterior cladding. No borer or rot is evident in any part of the untreated tōtara beam. It has been in services for over 48 years.



Figures: 22 & 23 – View to the large (butt) end of the 8.57m long tōtara beam, which rests on a piece of framing timber with house borer exit holes. However, no borer or rot is evident in any part of the untreated tōtara beam (N.B. the smooth natural round surface of the timber under the bark).

This example, with verifiable dates and photographs, demonstrates over 48 years of excellent structural performance by small diameter tōtara trees used in an unlined internal situation that is not directly exposed to weather (except by failing exterior cladding – which is not totara). Moreover, despite *Anobium spp*. borer and also rot being present on the immediately adjoining timbers, and in other items stored within the shed, no evidence of any borer attack (including the two-tooth longhorn), rot or other defect was observed on either of the two tōtara beams that were inspected on the 30th January 2017.

Conclusions

Practical experience is that milled farm-tōtara timber (including the sapwood) is highly resistant to the common household borer (*Anobium punctatum*). Evidence to substantiate this is documented with the verifiable and photographed examples above.

Certainly, incidences of the larger two-tooth longhorn borer (*Ambeodontus tristis*) holes were evident in the bark of some of the tōtara slabs at the Hayes and Quinlan properties. This probably reflects the fact that, in contrast to the Cookson and McGee examples, the felled logs lay on the ground for over half a year before being extracted and milled. It appears that problems with the two-tooth longhorn borer may occur in and just under the bark of logs that are left lying for some time until milled. However, the once green timber is sawn and starts to dry, the problem ceases. Hosking (1978b) indicates that the larvae of the two-toothed longhorn beetle occurs in timber that has been infested in the forest or mill yard; it is generally confined to material in damp, poorly ventilated locations.

Performance of these documented examples should (and can) be monitored again in the future. However, the results of this investigation are consistent with previous surveys of peoples' experiences. These observations are also consistent with the unequivocal statement from Hinds and Reid (1957) that the sapwood "…is notable for non-susceptibility to *Anobium* borer attack." Hosking (1978a) indicates three species commonly attacked by the common household borer "…are *Dacrycarpus dacrydioides* (kahikatea), because of its superior nutritional properties, *Dacrydium cupressinum* (rimu), and *Pinus radiata* (radiata pine) owing to their extensive availability."

Given the evidence provided above it is therefore reasonable to conclude that untreated farm-tōtara timber, (including the sapwood), has very high natural resistance to attack from the common household borer and has demonstrably provided excellent service and performance in many situations.

The specific examples documented in this report provide compelling evidence in this respect.

Dr Gordon Hosking, Forest Entomologist, retired Senior Scientist Forest Research Institute, and former Senior Technical Advisor MAF Biosecurity, has peer reviewed this report and offers the following comments... ***"Although these examples are not controlled scientific trials, given the compelling evidence of Geff Cookson's example in particular, and supported with the other examples illustrated, very sound conclusions can be drawn. With this sort of evidence available, in my capacity as an applied entomologist who has worked in this area, I would not recommend any further trials or evidence necessary to demonstrate resistance."*** (pers. comm. Dr Gordon Hosking, Forest Entomologist, 26th January 2017).

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