

### *Limnoria*

This crustacean borer occurs mainly in high salinity waters. It attacks the surface of timber, leaving a fine honeycomb structure. It is approximately 3 mm long and resembles a minute garden slater. It normally attacks piles at the tidal zone.

### *Sphaeroma*

This is another type of crustacean resembling *Limnoria*, but is up to 13 mm long. It closely resembles a garden slater and is often referred to as a 'pill bug' or 'putty bug'. It does not normally attack smooth surfaced hull planking, but tends to infest the putty or caulking in the seams. In piles it is found in the intertidal section which it honeycombs. No natural or impregnated timber is resistant to it because this borer, as is the case with *Martesia*, uses the wood for accommodation and does not devour it. However, spraying with creosote will kill them.

### Degrees of hazard

The most intensive attack occurs during the warmer months from October to April, with a peak intensity from December to February. During this period the free-swimming larvae settle on the surface and commence to bore.

Small craft which are placed in the water only occasionally, for periods of a week or less, do not require any special protection against marine borers. Any larvae settling on the surface over this period die immediately on drying. The adult shipworms which are active in planking also die if the hull is left out of water for a sufficient period. Under hot dry conditions, a period of about three days is sufficient for extermination. Under cool, damp conditions, the adult borers have been known to survive for about a month.

The high salinity type borers are invariably killed by exposure to near fresh water over a period of more than one week. The low salinity borers are killed by exposure to water of high salinity.

It is important to realise that a timber which is resistant in one locality may be quite readily attacked in another area or position (e.g. turpentine is normally resistant below low water level in Sydney Harbour, but is readily attacked by *Nausitora* at Wisemans Ferry).

### Examination for damage

All types of marine borer damage, except that of the shipworms, can be readily assessed by surface examination.

Shipworms are wormlike in appearance with the head enclosed by two white calcareous boring shells, and with two calcareous arrowlike pallets enclosing two siphons protruding from the tail. They maintain contact with the water by projection of these siphons through a small hole of about 1.5 mm diameter. These entrance holes are usually obscured by marine surface growth, mud, etc., and close examination is necessary. Occasionally the entrance hole may be indicated by the small calcareous pallets projecting from it.

The burrow of the shipworm increases in size from the entrance hole for a short length and then maintains a more or less uniform diameter. With local species the burrow, although normally considerably smaller, may be as much as 15 mm diameter and 600 mm long.

The condition of the plank can be indicated to some extent by the sound of tapping. Single isolated borers in planks usually do not warrant removal, but care should be taken to remedy any substantially damaged planks which represent a source of weakness and danger. Generally, any section which possesses numerous holes at close spacing would be suspect.

### PROTECTIVE METHODS

#### Preservative treatment by pressure impregnation

High resistance to marine borer attack (other than *Sphaeroma* and *Martesia*) may be obtained by pressure impregnation of the wood with water borne copper-chrome-arsenic salt formulations. These salts become highly fixed in the timber and are not subject to rapid leaching. Timber treated in this manner can be painted satisfactorily.

Creosote is also an efficient preservative when applied by pressure impregnation. However, due to the 'bleeding through' which occurs, its use is not recommended if the timber is to be painted. Not all timbers are suitable for treatment by this process and you are advised to seek further information in this regard.

#### Metal sheathing

Metal sheet applied as sheathing provides a well established protective measure. While copper and muntz

metal are widely used for this purpose, the application to small boats is limited by cost and additional weight. The occurrence of holes following damage permits access of marine borers to the wood and care is required to preserve the integrity of the sheathing. The sheathing should protect the hull for about 150 mm above the loaded waterline and the boat should not be allowed to lie on its side and expose the uncovered wood to the water.

The copper and muntz metal sheeting inhibits marine surface growth to some extent, but the use of anti-fouling paints is normal practice. It is generally an advantage to apply a good quality 'anti-corrosive' paint directly over the copper sheet before applying 'anti-fouling' paint.

### Painting

Most damage to painted hulls occurs in areas which have not been coated, where paint has become unduly thin or where the paint has been damaged by mechanical action.

'Anti-fouling' paints, containing toxins such as cuprous oxide, are normally preferred for paint protection. These paints are specially designed to control marine surface growth by gradual leaching of the toxin from the paint. If the anti-fouling paint is applied directly to the wood, some deposition of toxin occurs in the wood surface and provides additional protection in the case of thin paint or slight abrasion.

More definite surface protection is provided by swabbing the wood with copper naphthenate solution or other preservative before painting. Repeated treatments with this type of preservative have given very good protection with softwood timber hulls.

An essential practice with any surface coating is to ensure that the coating is applied regularly and where abrasion has occurred, the coating is renewed. Protective strips of metal, preservative-impregnated wood, or naturally resistant wood should be attached where abrasion occurs frequently.

#### *Procedure when painting*

##### *Exterior*

If the boat is newly constructed, sand timber to a smooth surface. If the surface is of old paint in poor condition, remove all paint back to bare wood.

1. Coat all timber with copper naphthenate (or similar fungicide solution) making sure that 'runs' caused by

excess are not left. Allow two to three days' drying. Timber already treated with a fixed preservative will not require this initial coat.

2. Lightly sand. Apply a coat of primer which conforms to Australian Standard 2301-1981 *Wood primer, solvent borne, brushing*. Allow two days' drying.
3. Stop all holes, joints etc., with a suitable caulking compound. Allow drying time and sand whole surface.
4. Apply an exterior undercoat and allow 24 hours' drying.
5. Sand surfaces and coat with an exterior marine enamel. Allow at least 24 hours' drying time.
6. Sand surfaces and apply another coat of exterior marine enamel.

If anti-fouling paint is required below the waterline, omit the marine enamel and apply the anti-fouling paint over the undercoat.

Clear finishing, which is often desired by boat owners, is an inferior system to an opaque paint system. In general, clear finishes, when exposed to weather, have less than one-third of the life of good quality opaque paint systems.

##### *Interior*

Apply a coat of preservative to all bare timber.

Paint should be applied to internal surfaces of the hull, linings etc., only when required for appearance. In such cases, the procedure for exterior painting should be followed.

### Reinforced plastic sheathing

Increasing use is being made of thick coatings of chemically cured resins reinforced with glass-fibre cloth or other laminates. Care to ensure satisfactory adhesion is essential. Better adhesion is obtained on light to medium density timbers by abrasion of the surface with coarse sandpaper and by applying thin initial coats of resin.

### ELECTROCHEMICAL CORROSION OF METALS

Corrosion is essentially electrochemical. The most common examples are the rusting of iron and the corrosion of dissimilar metals when in contact in the presence of moisture. When iron comes into contact

with air, a thin, patchy film of oxide forms on it. A voltage difference exists at all times between the iron and the oxide coat and, should the surface of the iron become wet, an electric cell will be formed resulting in the formation of rust deposits. Corrosion of dissimilar metals, or bi-metallic corrosion, is a process essentially similar to the rusting of iron. When dissimilar metals are adjacent in a damp situation, moisture will provide an electrolytic link between them. When electric cells are formed in this manner the metals constitute the positive and negative poles and the severity of the corrosion depends on the voltage difference existing between dissimilar metals. The rusting of iron is a more active process in sea air than in ordinary atmospheres because moisture containing salt is a more efficient electrolyte.

### Electrochemical series

The Galvanic Table (Table 12) is very useful in predicting which metal will corrode in any bi-metallic pair and the probable severity of the corrosion. In Table 12 the metals and alloys are listed in order of the voltages they develop while freely corroding. The metal closer to the negative end of the scale (i.e. less noble) will corrode while the other will not, and the further apart on the scale the metals are the more severe will be the corrosion.

### Protective coatings

The oxide coating which rapidly forms on aluminium in the atmosphere protects it from further corrosion. By promoting this process artificially by anodizing, aluminium can be given a protective coating of pleasing appearance. However, zinc and aluminium suffer attack from the alkalis present in salt laden atmospheres, the results being rather unsightly but not usually serious unless the metal is very thin or is an unsuitable alloy.

Bearing greases, which are really sodium soaps, should not be used to lubricate or 'protect' aluminium components.

Copper alloys are more noble than most other metals and are therefore not so likely to corrode from electrochemical attack. Copper, bronze, zinc (including galvanising) or brass should not be used in association with aluminium.

### Sacrificial coatings

Corrosion will usually be restricted to the less noble metal. A common instance of sacrificial protection is where the zinc coating on galvanised iron corrodes in preference to the steel.

Steel boat hulls may be protected by attaching blocks of zinc at regular intervals along the hull below the waterline. These blocks corrode in preference to the steel and must be replaced from time to time.

**Table 12.** Galvanic series of metals and alloys.

More negative end (Base end)	Metal or alloy
	Magnesium alloys
	Zinc
	Cadmium
	Aluminium
	Aluminium alloys
	Iron and mild steel
	Stainless steels (active)
	Soft solders
	Lead
	Muntz metal
	Manganese bronze
	Naval brass
	Nickel (active)
	Nickel-chromium alloys (active)
	Copper
	Red brass
	Aluminium brasses
	Composition bronzes
	Admiralty brass
	Phosphor bronze
	Silicon bronze
	Gunmetal
	Silver solder
More positive end (Noble end)	Nickel (passive)
	Stainless steels (passive)
	Monel

**Note:** Nickels and stainless steels have varying positions in the scale according to their composition and the state of the coating of oxide films.

### Electrical systems

Fully insulated electrical systems with double pole switches are desirable, but where of necessity earthed, a negative earth is to be preferred. The use of lead-covered cables is inadvisable. Wiring should not be run through bilges.

The setting up of undue resistance in wiring or at terminals must be avoided (e.g. the use of too small a cable, or dirty or loose connections). Such conditions give rise to a voltage drop over a part of the system which may in turn cause a potential difference between underwater metal parts. Defective insulation on the live side of a circuit may apply battery voltage to otherwise isolated metal parts.

If wires to electrical fittings are inadvertently cross-connected the fittings may still operate satisfactorily but heavy leakage of current may occur. Such leakage does not necessarily require a metallic path but may flow for long distances through wet wood.

Failure of the battery to hold a charge properly is a common indication of leakage. It does not necessarily mean that the battery is worn out.

Screws and nails should, where possible, be of the same metal as the item to be fixed. This is very important in regard to the fixing of sheathing or other metal parts below the waterline as unseen corrosion may take place rapidly.

'Nail sickness' is a term used to describe the action of acids, present in many timbers, on a nail or screw which has been driven into the timber. Assisted by moisture, the acid can corrode the nail or screw and this in turn may cause chemical deterioration of the timber surrounding the nail. The nett result of this is that the nail or screw will eventually fall out or fail to hold. The possibility of nail sickness occurring may be reduced by using galvanised, silicon-bronze, monel or copper nails and screws and by keeping the timber as dry as possible, e.g. by painting or sealing with bitumen or caulking materials.

Where two different metals have to be used close together, they may be separated by a thin layer of bitumen or other suitable electrically isolating material, but regular careful inspection should be made to ensure that corrosion is not taking place.

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## TERMS AND DEFINITIONS

This short list is appended as a useful guide to potential boat builders. A more comprehensive list is contained in Standards Australia AS01-1964: *Glossary of terms used in timber standards*.

### Timber Terms

**Backsawn:** Sawn so that the wide face of the piece is a tangential plane to the growth rings.

**Batten:** A piece of sawn or dressed timber of rectangular cross-section, usually between 19 mm and 40 mm thick, and between 25 mm and 75 mm wide.

**Beam:** A structural timber, supported at two or more points along its length.

**Board:** A relatively thin piece of sawn or dressed timber, of width greater than thickness.

**Bow:** A curvature from the plane of the wide face in the direction of the length.

**Cover strip:** From 10 mm to 20 mm thick and various widths, used to cover joints to prevent entry of rain or to improve the appearance of the joints.

**Dressed:** Planed smooth, straight and square.

**DAR:** Dressed all round.

**DBF:** Dressed both faces.

**DD:** Double dressed or dressed both faces.

**D<sub>1</sub>F<sub>1</sub>E:** Dressed one face and one edge.

**D<sub>2</sub>E:** Dressed two edges.

**D<sub>1</sub>E:** Dressed one edge.

**Flitch:** A large segment of log with saw cuts on at least two surfaces.

**Growth rings:** Rings visible on the transverse or cross-section of a trunk or branch which mark a cycle of growth.

**Lagging:** Timber, of small section, used to cover the surface of a jig or mould.

**Milled timber:** Timber which has been passed through a machine to shape it to a desired profile.

**Nominal sizes:** The named size, or ordered size, which may vary from the actual size of the piece because of variations due to sawing, shrinkage and dressing and the tolerances allowed on these operations.

**Plank:** A piece of timber sawn or dressed to rectangular section 40 to 75 mm thick and more than 150 mm wide.

**Quarter sawn:** Sawn so that the wide face of the piece is a radial plane of the log. Trade practice in Australia is to class timber as quarter sawn when the average inclination of its growth rings to its wide face is over 45°.

**Rough sawn:** Surface condition of wood as it leaves the saw.

**Round timber:** Items such as piles, poles and posts utilized in the natural form of the tree.

**Scantling:** Timber of rectangular cross-section and of dimensions used in construction. Usually 35 to 100 mm thick and up to 150 mm wide.

**Scarf joint:** A joint made by bonding together two matching bevelled ends or edges.

**Spring:** Curvature from the plane of the edge, or narrow face, in the direction of the length.

**Surfaced:** Planed or dressed on one or more faces.

**Timber:** Wood in a form suitable for construction or manufacturing purposes.

**Veneer:** A thin piece of wood produced by rotary peeling or slicing:

- (a) Rotary cut: cut from a log by turning the log on a lathe against a knife.
- (b) Sliced: produced from a flitch by slicing with a knife.

**Wane:** The original underbark surface with or without the bark.

**Want:** The absence of wood other than wane from corner or edge of a piece.

**Warp:** Any variation from a flat surface. It may consist of bow, spring, twist or any combination of these.

### Terms Used in Boatbuilding

**Abaft** - Behind

**Accommodation plan** - The drawing showing the interior layout of a vessel.

**Aft** - Astern, or towards the stern.

**Ahead** - Forward, or in front.

**Amidships** - The central portion of any boat, or neither to port nor starboard.

**Anti-fouling paint** - A specially prepared paint containing various chemicals which discourage the attachment of marine growth to a vessel's hull.

**Apron** - A strengthening timber placed behind the stem.

**Astern** - Behind.

**Athwart** - Across, from side to side

**Ballast** - Weight, usually lead or iron, added to a vessel low down either internally or externally to provide stability.

**Beam** - The maximum width of a vessel. Also a timber laid athwartships to support the decking; this is known as a deck beam.

**Bearers** - Longitudinal supports for an engine.

**Berth** - A sleeping place or bed aboard a vessel. Also refers to a place at a jetty where a vessel may moor.

**Bilge** - The lower part of any hull. Can refer to either inside or outside.

**Bilge keel** - A rubbing strip, usually fixed to the bilge of dinghies and small boats to stop chafe to the planking.

**Bits** - Posts fitted in the foredeck to take the aft end of a bowsprit, which are also used for making fast an anchor warp or chain.

**Body plan** - A drawing showing the shape of various sections of a boat if it were cut athwartships.

**Bollard** - A wooden or iron post on a ship or quay for securing ropes to.

**Boom** - A horizontal spar to which the foot of a sail is set.

**Bow** - The front of a vessel.

**Bowsprit** - A spar projecting beyond the bow from which a jib is set.

**Breasthook** - A knee, either wood or metal which is fastened to longitudinal members such as stringers, deck shelves, etc., and to the stem, thus tying them together strongly.

**Bridge deck** - The decking which separates the cockpit from the main cabin.

**Brightwork** - Woodwork on a yacht which is finished with varnish.

**Bulkhead** - A partition below decks which separates one section from another. Used commonly to give extra strength to a vessel.

**Bulwarks** - A continuation of the planking, often above the deck to prevent the loss of gear or people overboard.

**Bumpkin** - A spar which extends beyond the stern to which a standing backstay is attached.

**Bunkboard** - A canvas or timber bulwark fitted so as a sleeping person will not be thrown out of a bunk by the vessel's motion.

**Buoyancy tanks** - Airtight compartments in small vessels to give added buoyancy in case of the vessel becoming water-logged.

**Butt** - The squared end of a piece of timber. Planks are butted when the squared ends are placed together.

**Camber** - The amount or curve athwartships in a deck.

**Carline** - Fore and aft members which support the cabin sides or cockpit and to which the deck and cabin top beams are secured.

**Carvel** - A method of planking where the planks are fitted to lie alongside each other, presenting a smooth exterior finish.

**Cat rig** - A sail rig which has one mast right for'ard and only one sail.

**Caulk** - To fill the seams between planks with caulking cotton so as to make them leakproof.

**Centreboard** - A central keel which can be raised or lowered at will.

**Chine** - The angle formed where the topsides meet the bottom in a V bottom or hard chine boat. Also refers to the longitudinal timber which runs fore and aft at this point.

**Cleat** - A fitting to which a line may be easily fastened.

**Clench** - Term used when referring to copper nails which are turned back into the timber.

**Clinker (or clincher)** - Type of construction where hull planking overlaps.

**Coach house** - The raised cabin of a boat.

**Coach roof** - The roof of the coach house designed to give extra height below.

**Coaming** - The raised sides of a hatch or cockpit.

**Cockpit** - The well, usually placed aft, from which a yacht is steered.

**Covering board** - The plank running around the outer edge of a deck.

**Deadwood** - The strengthening piece which joins the keel to the sternpost.

**Displacement** - The actual weight of the vessel.

**Doghuse (or dodger)** - The raised cabin aft which gives added headroom or protects the helmsman.

**Draught (draft)** - The depth of water necessary to float a vessel.

**Drift** - A tool used for driving plank fastenings home.

**Dry rot** - The term 'dry rot' is not really correct; all decay results from damp conditions.

**False keel** - A piece added to the main keel often used to fair in with the ballast keel.

**Fastenings** - Nails, screws, bolts etc., which are used to hold components together.

**Fiddle** - A removable strip of wood, which when in place prevents crockery etc., from falling off a cabin table, shelf etc.

**Flare** - The outwards curve of a vessel's sides above the waterline.

**Floor timber** - A transverse piece of either metal or wood which is fastened to the planking and timbers and to the keel, tying the construction together strongly.

**Forecastle** - The accommodation in the bow.

**Forefoot** - The section of bow between the waterline and the keel.

**Forepeak** - That section below deck which is right in the bow. A very cramped space used for stowing anchors, warps etc.

**Frame** - A large rib of a boat which is usually laminated, sawn or of metal, used particularly in plywood construction.

**Freeboard** - the height of a vessel's side above the waterline.

**Gaff** - The spar to which the head of a quadrilateral sail is set.

**Garboard (or garboard strake)** - The plank which lies adjacent to the keel on each side. Often said to be the most difficult to fasten, yet the most important.

**Graving** - Taking the boat from water to repair.

**Gunwale** - The upper edge of the topsides on a boat.

**Hack knee** - A knee bracket cut out of a solid piece of timber about 30 mm thick.

**Half beam** - A partial deck beam or one that does not extend the full width of the boat.

**Half breadth plan** - The drawing showing the shape of waterlines and level lines.

**Hatch** - A deck opening usually covered by a hinged lid.

**Headroom** - The height of the cabin roof from the cabin sole.

**Heel** - The lower end of a mast or the aft end of the keel.

**Helm** - The wheel or tiller by which a boat is steered.

**Horn timber** - The fore and aft timber between the stern post and transom

**Jogged frame** - A section is cut away to take transverse members.

**Keel** - The back bone of a boat upon which the rest is built.

**Keelson** - Inside the planking, above the keel, but separate from the keel.

**King plank** - The centre plank of decking.

**Knee** - A shaped piece of timber, preferably with the grain running with the shape, which is used to tie together such parts as deck to topsides, cabin roof to cabin sides etc., now replaced by plywood.

**Knightheads** - Timbers supporting the bowsprit and giving additional support to the planking just abaft the stem.

**Laminated** - Made up of thin strips glued together.

**Lands** - The ledgers which overlap in clincher planking.

**Lap strake** - A method of sheeting a boat.

**Lee board** - Used to increase the height of the side.

**Level lines** - Lines drawn at regular intervals on a lines plan which are parallel to and above the L.W.L.

**Limber holes** - Holes drilled in floor and frames to allow bilge water to run to the lowest part so it may be pumped out. Drainage holes between the sheeting and the ribs.

**L.O.A.** - Length over all, or the extreme length.

**Locker** - Boating term for cupboard.

**Lofting the plans** - Laying down the lines or drawing the plan of the boat full size on the floor.

**L.W.L.** - The length of a boat measured in a straight line at the waterline where she floats.

**Mast step** - The timber on which the mast is stepped.

**Oakum** - Fibrous material used for caulking.

**Offsets** - Measurements supplied with a plan which enable the builder to lay the boat out to full size.

**Overhang** - That part of a hull which extends beyond the extremities of the L.W.L.

**Partners** - A strong wood framework to support a mast as it passes through the deck.

**Pay** - To put pitch in the joints and seams of the boat.

**Plant stealers** - Short plans used to make up the total length.

**Port** - The left-hand side of a boat when looking forward.

**Praam** - Refers to a dinghy which has a transom at both ends.

**Pulpit** - Strong safety rail fitted around the bow.

**Rabbit (rebate)** - A groove cut in the stem, keel etc., to receive the edge of a plank.

**Rail** - A narrow plank fitted to the top of a bulwark. Often finished bright for effect.

**Reverse sheet** - A deck line which in elevation is higher amidships than at either end.

**Ribband** - A light, flexible timber used in fairing the hull shape. (A fairing batten).

**Riser** - A fore and aft timber which supports the thwarts in a dinghy.

**Rove** - Cup-shaped copper washer used in boat building to rivet copper nails.

**Samson post** - A strong post in the foredeck to which anchor or mooring chains are secured. May also be placed after for towing etc.

**Scarf** - A long diagonal joint between two pieces of timber.

**Scupper** - Drain hole in bulwark which allows water on deck to drain overboard.

*Sheer* - The shape of the vessel at deck level when viewed from one side.

*Sheer strake* - The top plank on each side.

*Shelf* - The longitudinal member which supports the outer end of deck beams.

*Skeg* - An extension beneath the hull which protects the propeller, also called a shoe.

*Sole* - The cabin floor.

*Spall* - A supporting secondary timber.

*Spline* - A thin wedge-shaped piece of wood which is glued between planks in place of caulking.

*Starboard* - The right-hand side of a vessel when facing for'ard.

*Stem* - The most for'ard timber in the hull to which the for'ard end of planks are fastened.

*Stopper* - A plug.

*Stopping* - Material for filling gap.

*Stopwater* - A softwood plug which is driven across a joint which cannot be caulked.

*Stringer* - A longitudinal strengthener fastened to the frames or timber.

*Strakes* - The boards used to plank the hull of a boat. Usually comparatively thin in relation to width.

*Taffrail* - A raised rail around the stern.

*Tingle* - A patch repairing a hole in the hull.

*Topside* - The sides of the hull above the waterline.

*Transom* - The single board etc., used to make up the stern.

*Trenail (or trunnel)* - A wooden 'nail', not often seen today.

*Tumble home* - The opposite of flair, i.e., the inwards curve of the topsides from the waterline, or some place.

*Wale* - A horizontal protecting strip.

*Wet rot* - Fungal attack or wood decay.

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