

Port Refuge Unidentified (Cocos Keeling Islands) Inspection Report



M. McCarthy

Technical Data

Site Name: The Port Refuge unidentified wreck.

Date lost: c. Late 19th Century (1870 on)

Finder: Robert Thorn (Parks Australia).

Date of Inspection: 2/11/2004

Personnel:

OIC: M. McCarthy (Department of Maritime Archaeology, WA Maritime Museum)

A. Granger (Parks Australia)

G. Henderson (WA Maritime Museum)

W. Murray (Parks Australia)

R. Thorn (Finder, Parks Australia)

Approximate Location

c. 1Nm SE of Horsburgh Island in Port Refuge at the north west corner of the lagoon at the Cocos (Keeling) Islands

GPS. 12°05.767'S. 96°51.528'E. (Datum WGS 84)

Chart No: BA 2510: South Keeling

File No: 239/81

File Name: Cocos Island Area

Sailing Directions:

Enter the roads of *Port Refuge* which lie south of Horsburgh and Direction Islands at the north-west end of the South Keeling lagoon, Cocos (Keeling) Islands. Sight the remains of the composite barque *Phaeton* (1889) marked on the charts as a visible hazard towards the north west and proceed towards it, putting Possession Point on Horsburgh Island in line with the wreck. The Port Refuge site will be crossed or passed while on that line. Be aware of reefs and shallows en route, especially if travelling in a deep draught vessel.

Site Photographs:

Colour: Thorn Site (MADWAM Collection/ Parks Australia collection)

Video: Thorn Site (Parks Australia collection/ MADWAM Collection)

Site Conditions on inspection

Sea and Swell: Moderate seas, low swell

Surge: Low

Visibility: 20m plus

Current: Minimal

Sea-bed coverage: The wreck lies on a sand and coral bottom.

Chemical Measurements: To be assessed on a subsequent inspection. These data would include temperature, salinity, Ph, dissolved O₂, corrosion potentials.

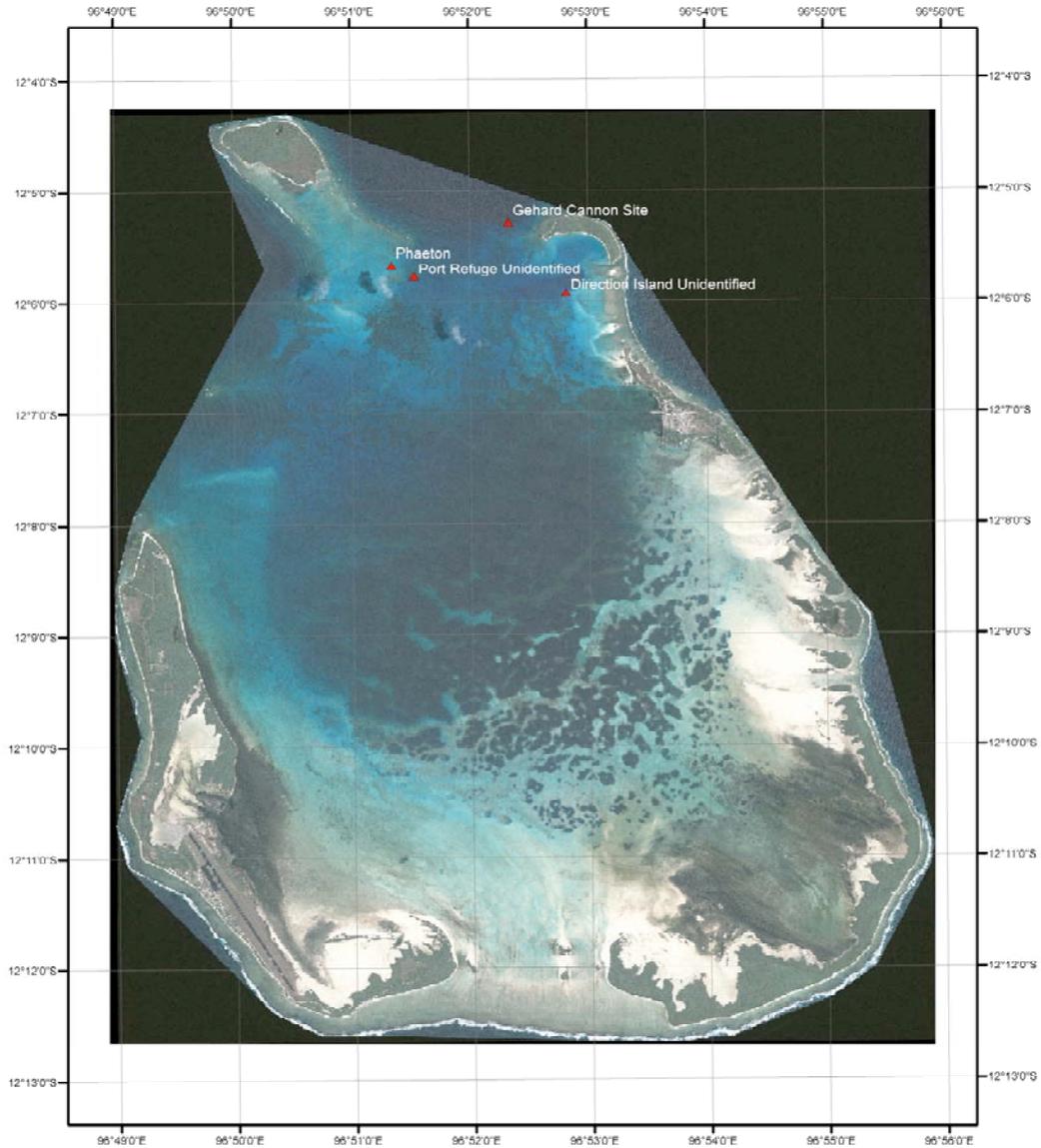
Biological Data:

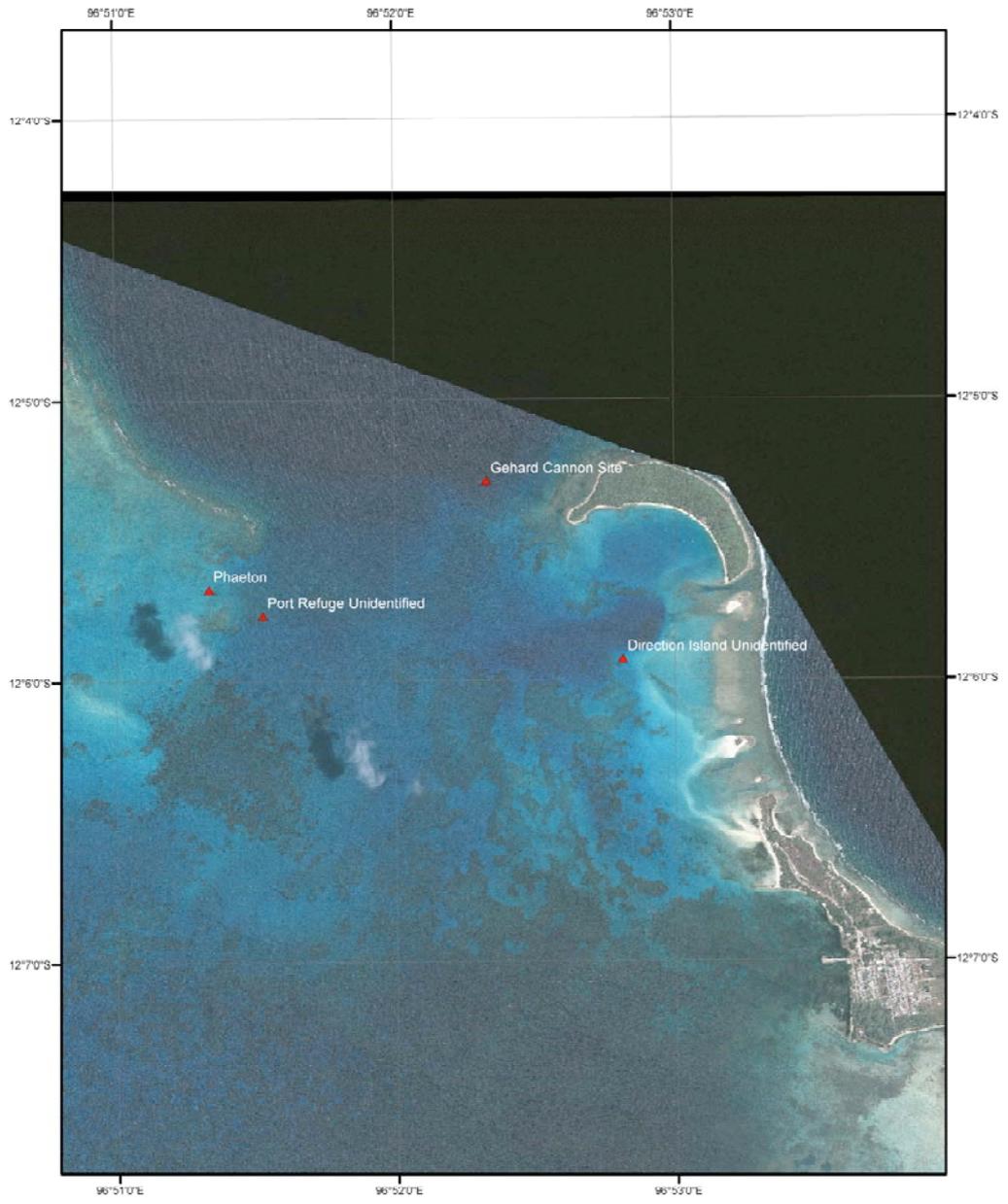
Colonising fauna: Parts of the site are heavily colonised by coral. Again these and the rate of colonisation would be assessed on a subsequent inspection.

Site Condition and Integrity:

Though in an exposed location that can be subject to moderate to heavy seas (a product of the prevailing South-East Trade Winds) and from the heavy seas and swell associated with the occasional cyclone, the wreck has reached a point of stasis in respect of the natural environment. The remaining ironwork is heavily concreted or is colonised by corals. Timbers are generally buried under coralline sediment; and the exposed fastenings (of which there are many) are all copper alloy and are all lightly coated in copper corrosion products.

Satellite photograph showing access to Site





Description of Site

Measuring 46 m long, this 'pristine', wreck lies in c.4m of water, almost upright on a sand bottom amongst coral outcrops and on an axis of 060/240°M. Crumpled sheathing is visible at the bow, which lies towards the southern end of the site. Where it is not buried, the wooden hull of this wreck has entirely disintegrated, leaving only metal work and other non-organic materials visible above the seafloor. Loose copper-alloy fastenings (mainly bolts) lie around the site and a row of nearly-vertical copper alloy keelson bolts is visible atop the degraded remains of the keelson. These are the most distinctive feature of the site and they led to its first being called the '*Peg [fastening] Wreck*', by Parks Australia staff. These bolts stretch along the length of the site and below them lie the keel, which is visible when the sand is cleared away by hand fanning.

At the forward end of the site (0m) and 11m to starboard of the line of bolts at the bow lie the remains of a heavily-degraded iron tank. Directly opposite on the other side of the bow, 12m to port, lies a capstan. A further 3m on again (at the very SE extremity of the site) lies one barrel of a windlass that has broken in two to finish with its bare axle projecting at an angle upwards towards the surface. The other half of the axle and what appears to be one of the pawl rims lies closer to the site. The other barrel is located quite some distance away, closer to the line of keel bolts and 4m aft of the bow. It has a very heavy chain comprising c. 10 inch 'D' links tightly wound around its whelps.

One end of this line of chain passes aft from the windlass to cross the centre line of the wreck at a point 10m from the bow to terminate alongside a heavily-built iron tank. This measures 5.8m (19 feet) long, by 1.8m (6 feet) wide by 0.9m (c. 3 feet) and it is lying to starboard between the 6m and 14 m mark, aft of the bow. Another line of chain—some of it cemented in a suspended state above the seafloor—snakes in an arc aft from the windlass, along the port side of the wreck, passing through a hawse pipe at a point 18m aft of the bow and c. 5m to port of the keelson. This too lies suspended above the seabed. From there the chain proceeds aft in an arc to cross the keel line 26m from the bow where it turns back parallel to the keel. From there it continues running towards the stern, terminating alongside the keelson at the 42m mark, with the last bolt at the stern visible 2 m further on.

Of the remaining visible iron-work, an iron deadwood strap lies to port forward. A second capstan lies just to starboard of the keel line 7m aft of the bow and rounded ballast (appearing like granite) was occasionally visible amongst the wreckage.

Many large copper-alloy bolts (often termed 'drift bolts' to differentiate them from equally large through bolts) lie loose on the seabed throughout the site.¹ Some of these were 42 inches (1.46m) in length by 1 and a quarter inches (c.30mm) in diameter. In the stern area on the port side copper alloy 'through bolts' measuring 30 inches (c 86cm) by 1 and a sixteenth inch diameter are also visible. Two lines of smaller bolts are visible 1.5m apart, and 1.5 m from the keel midships on the starboard side between the 24-30m mark aft. A single line of bolts is visible on the port side, a similar distance from the keel and between the 15 and 21m mark.

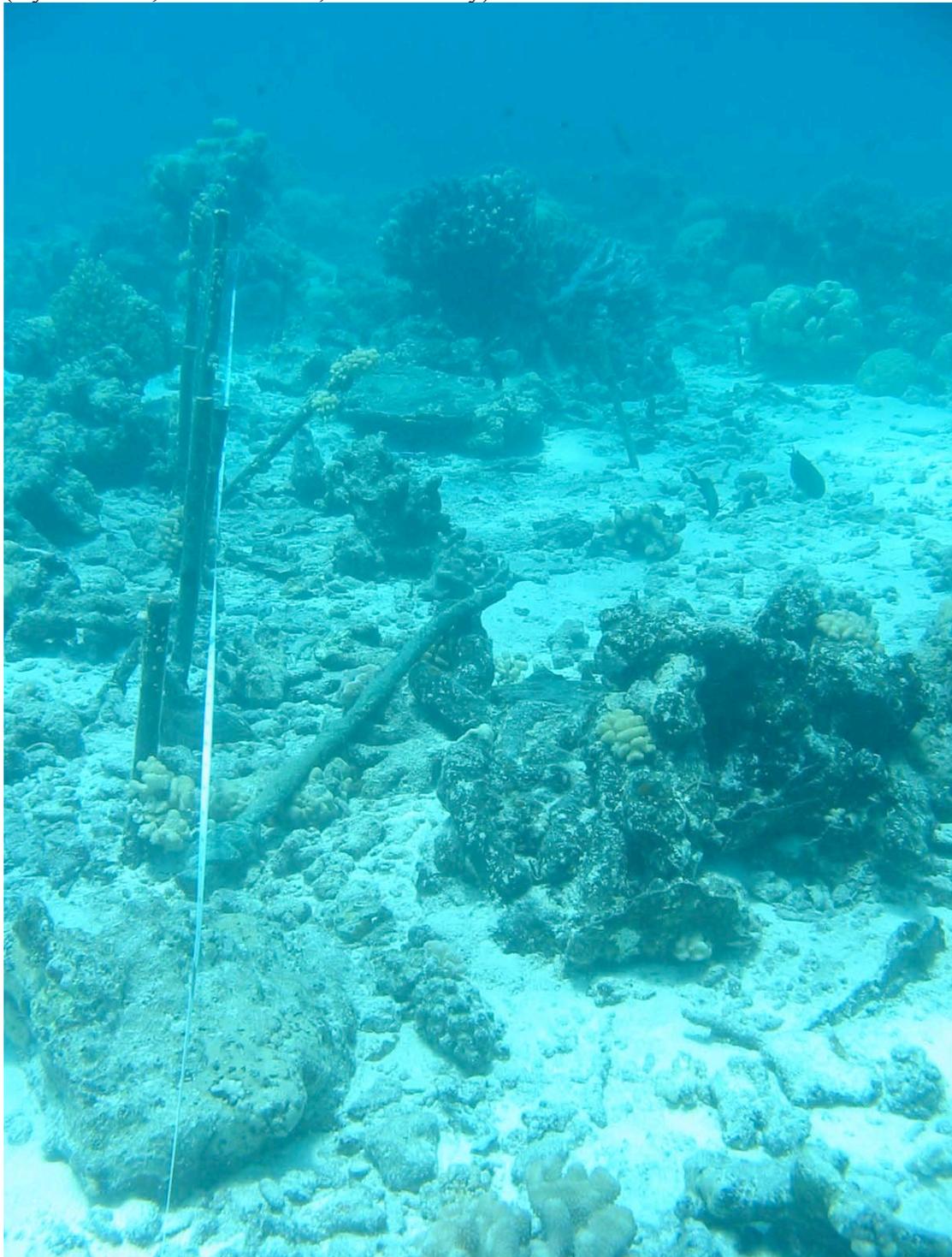
Five metres from the bow a line of round headed (one and a quarter inch diameter), square-sectioned spikes, 11 inches long were visible. These were found to protrude

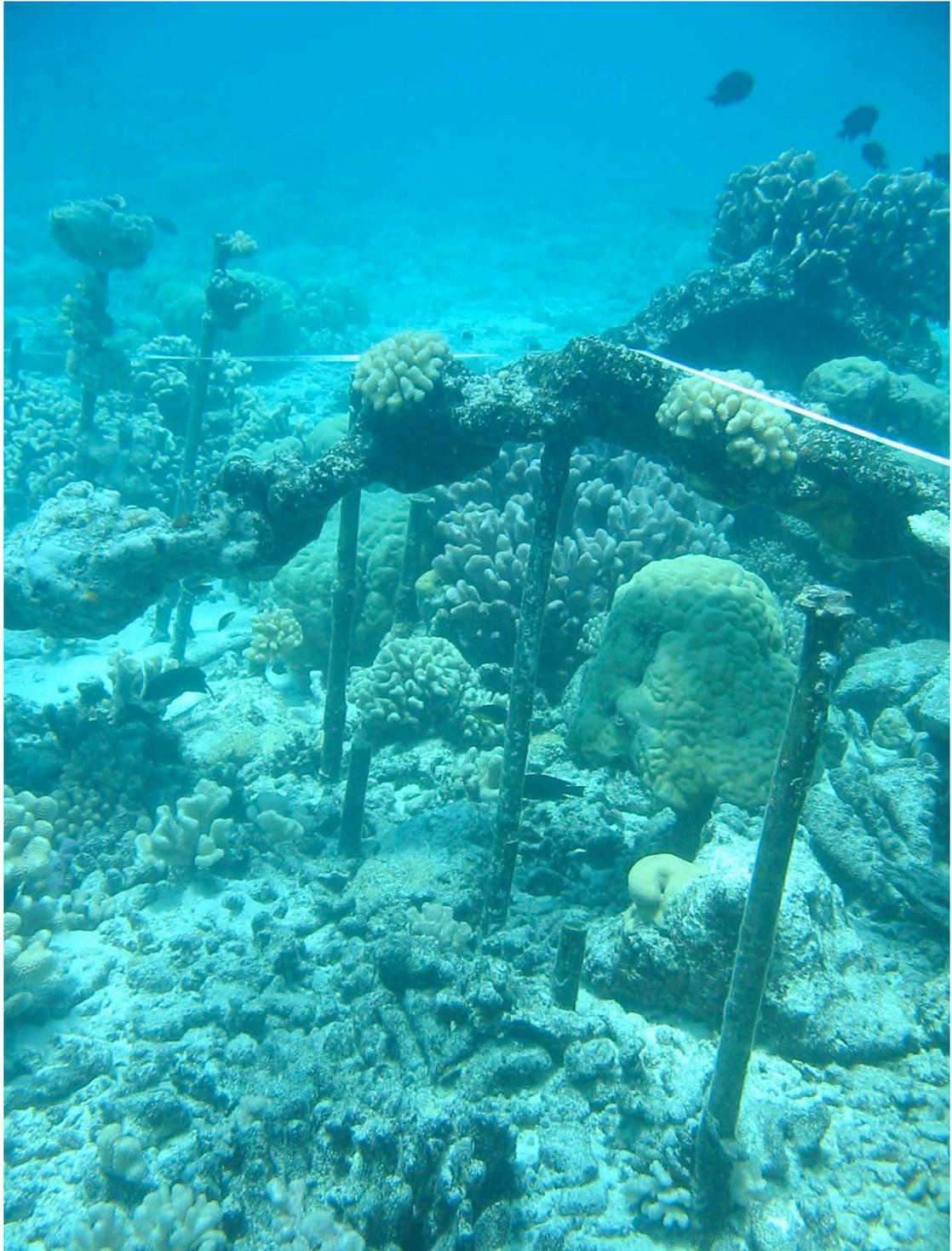
¹ A through bolt is as the name indicates, one passing through the timbers being secured. Another form of bolt are described being 'blind', or 'short' i.e. though often of great length, they do not pass right through the timbers being joined. It is now common practice to call long bolts not passing right through the timbers being fastened 'drift bolts'. (McCarthy, 1996)

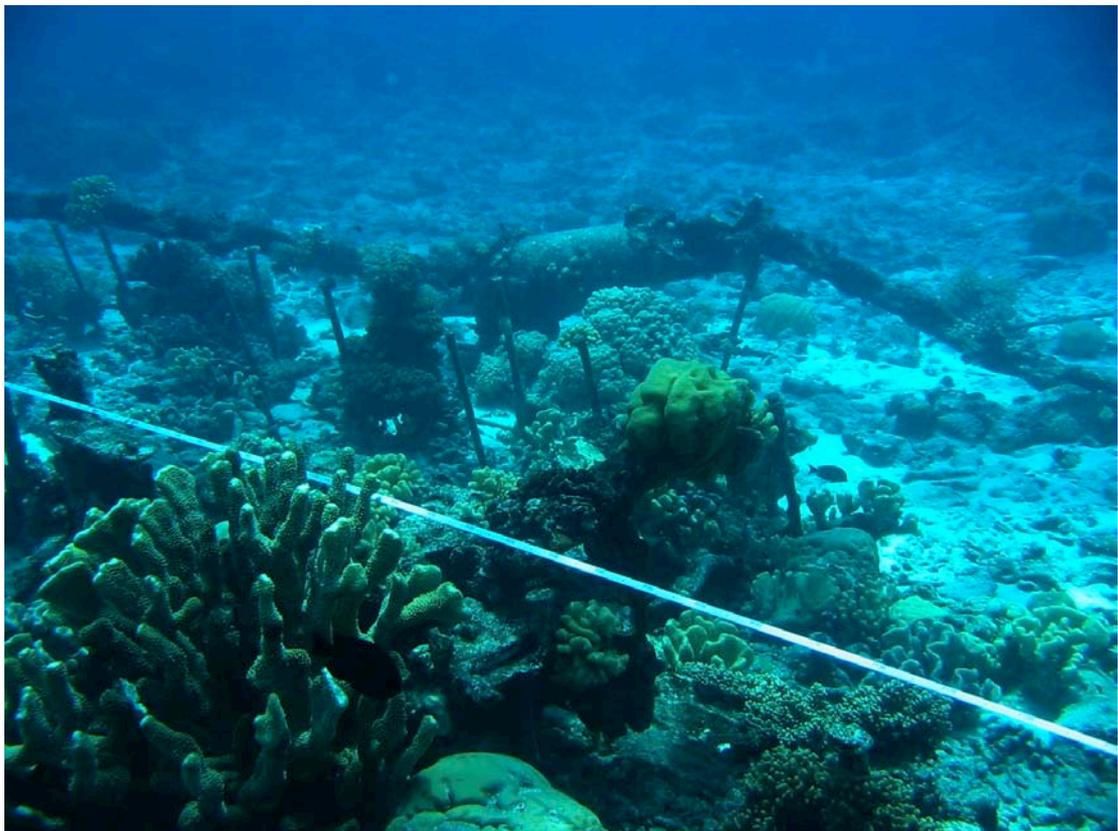
from planking (possibly the garboard strake or a nearby strake) which when hand-fanned proved to have scantlings of 9 inches wide by 4 inches thick.

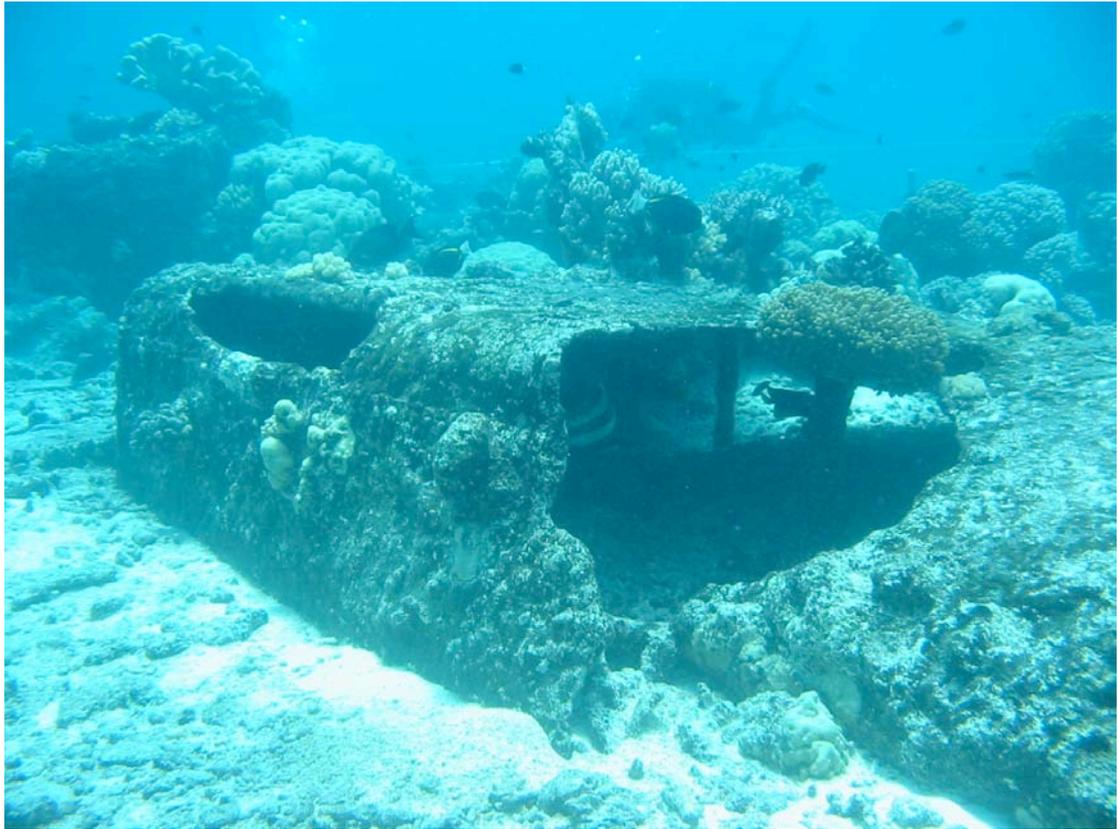
Views of the site

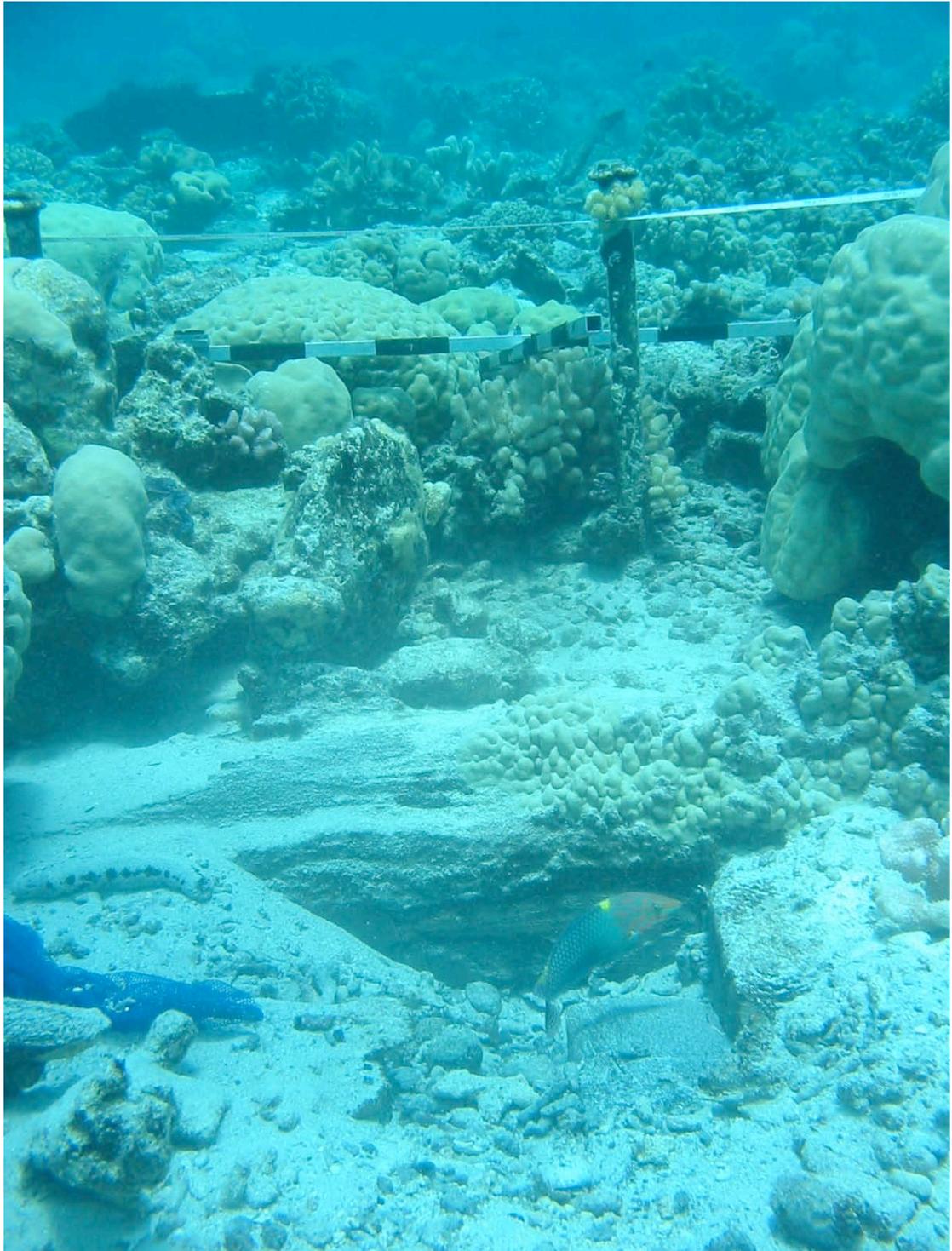
(By R. Thorn, G. Henderson, M. McCarthy)

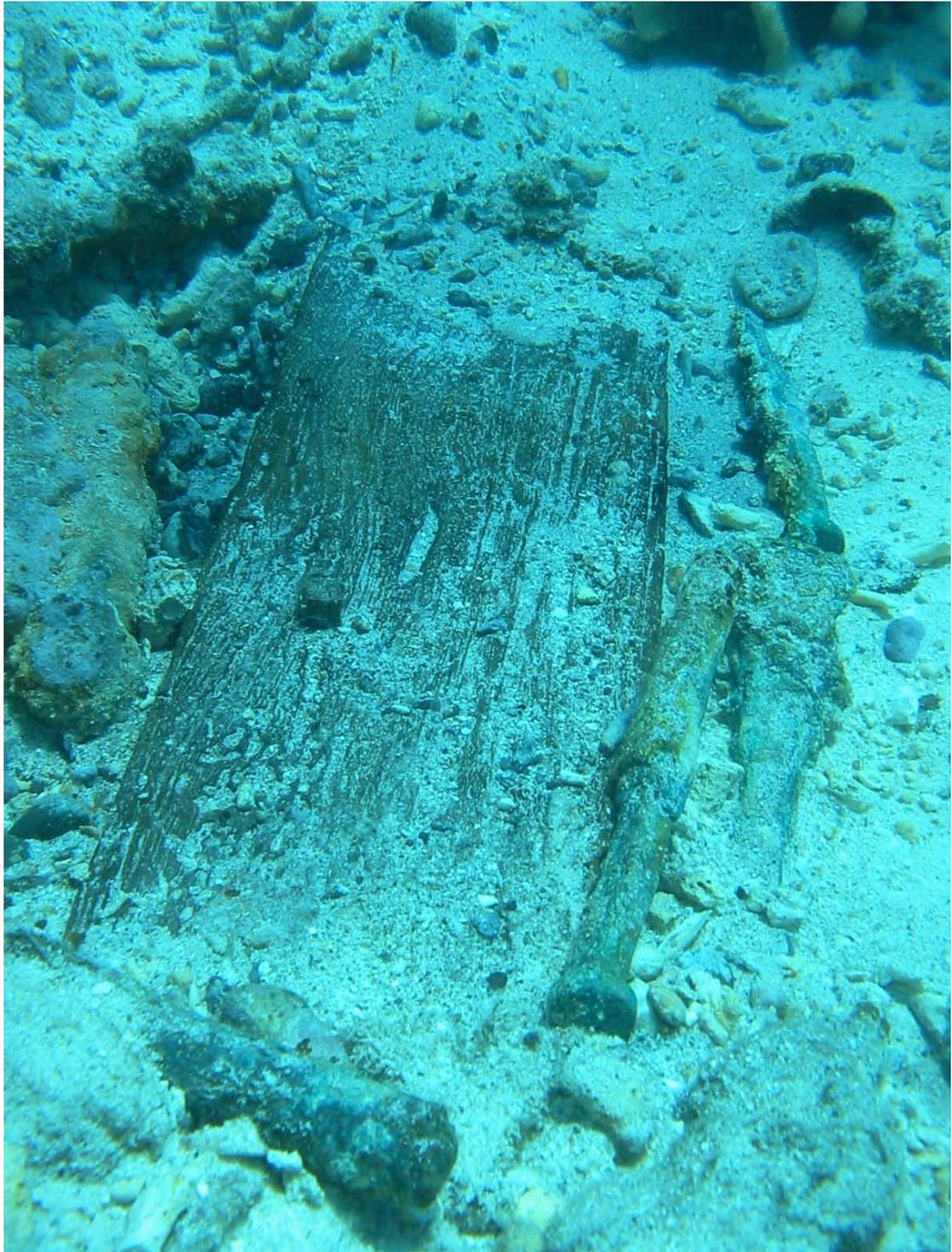


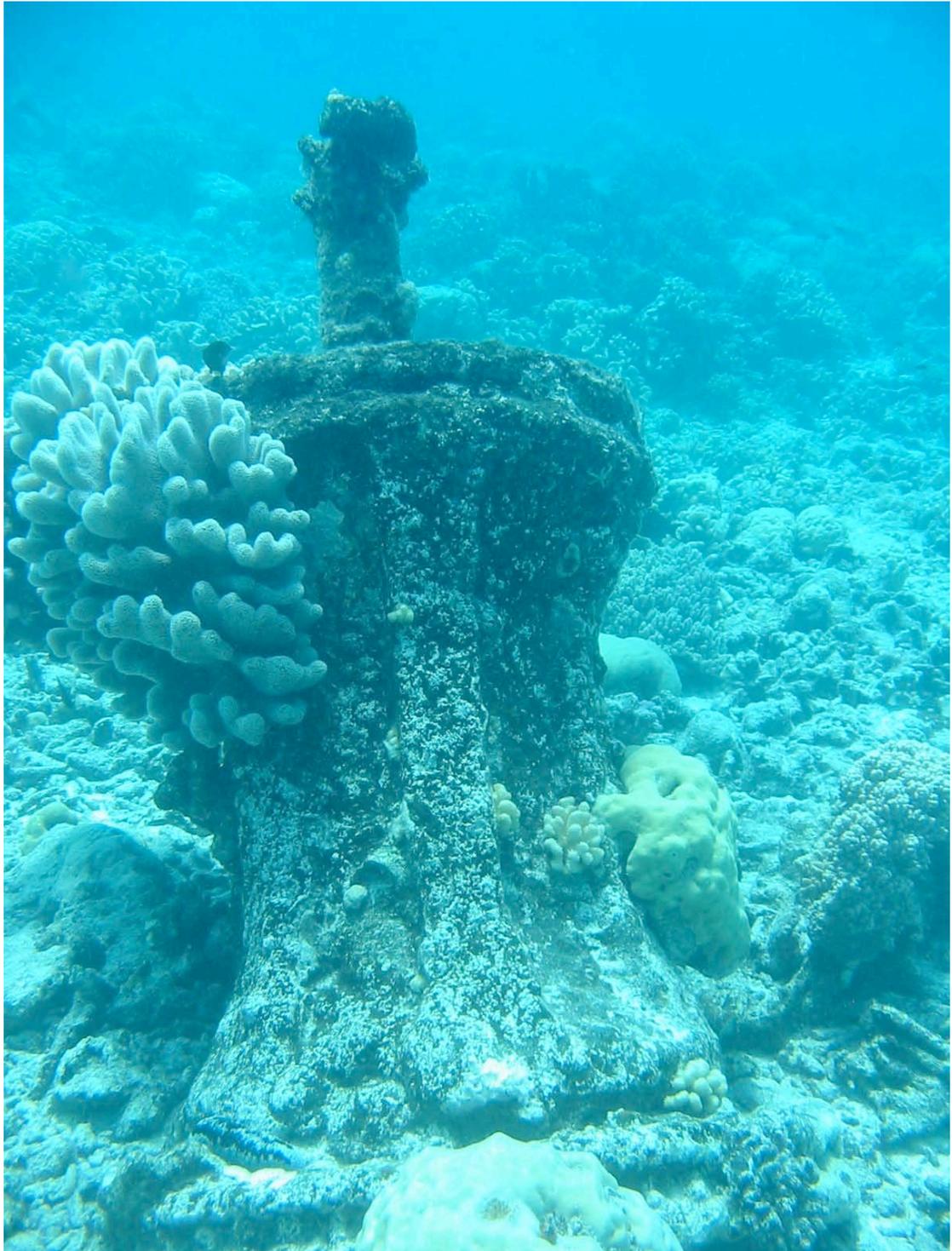












Material Raised for Identification Purposes

Metallic samples

- 1) Large blind ('drift') bolt (initial designation TW 1)
- 2) Through bolt (TW 2)
- 3) Spike (TW 3)
- 4) Bolt fragment with timber attached (TW 4)

(TW: Interim catalogue reference. Thorn Wreck).

Being stable and in no danger of disintegration, these were deposited with Parks Australia office on the Cocos (Keeling) Islands for public information and exhibition purposes.

Organic samples (timber)

- #1) Planking 41 m. from the stern just to port of the keelson
- #2) Frame 25 m from the stern, post side against the keel.
- #3) Keelson 26 m from the stern.
- #4) Timber on bolt fragment TW 4 above

Site Identification Comments

From the scantlings of the timbers, the fastening composition and sizes, the two large tanks, the chain and other indications, it is evident that the wreck is that of a c. 45-50m long late 19th century vessel (post-1870) of c 700 tons or greater. These are generally found drawing c. 14-16 feet) and the depth (c.4m) in which the wreck lies is consistent with this.

The timber samples were sent for analysis at the conservation laboratories of the Western Australian Maritime Museum and were found to be most likely

- 1) pine of the red deal type, exemplified by Scots pine (*P. sylvestris* L.), red pine (*P. resinosa* Ait.) and Austrian and Corsican pine (*P. nigra* Arnold,
- 2) white oak (*Quercus* species), species native to both Europe and North America and which cannot be differentiated microscopically (Godfrey, 2004).
(See Appendix)

While many large vessels called into the Cocos (Keeling) Islands en route other locations—some in need of repairs, others in transit, some seeking or offloading cargo—it is possible that this particular vessel called in to the islands with the intention of loading coconut products. Evidence for this remains solely with the very large tank described above that may have been storage for coconut oil. The trade was substantial and in 1880 copra exports amounted to 500 tons, for example (Bunce, 1988:133). Alternatively the ship may have been carrying extra water supplies for those on board and had two water tanks, one substantially larger than the other.

Given the axis of the wreck, with bows pointing at a bearing of 240°, it is logical to conclude that the vessel was driven ashore to its present location from a position on that bearing. Against this the anchorage at Port Refuge lies due east of the site and the anchor chain snakes aft from the broken windlass back in a north-easterly direction across the site.

There does exist indisputable evidence that the ship experienced extremely heavy seas at some stage in either the wrecking or in the ensuing disintegration process and that

these were of sufficient force to tear both the windlass (to which the chain was attached and the forepart of the ship (to which the hawse pipe was attached) apart.

A long length of chain snaking aft from the windlass around which it is tightly wound is indicative of movement either of the anchor, or of the ship as it broke up. A shorter length to starboard provides inconclusive evidence. Being from the same cable as that which is paid out over and around the windlass and through the hawse, the shorter length appears likely to have been ranged below deck, its end secured in the chain locker throughout the wrecking process.

From the evidence provided by the longer length of chain, a case exists where the ship first grounded, bilged and settled on the seabed in a cyclone or storm, with an anchor set, bows first pointing to the north-east. From its state, it appears that the windlass broke at some juncture, apparently to go over the side in pieces. Then the ship swung back around onto the chains as the wind changed direction when the storm abated, or as the eye passed over. Against this relatively common scene is an almost unique situation (in this author's experience) where for much of its length the chain (including the hawse-pipe) remains suspended above the seabed. Here it is evident that the chain lay on timbers and that its links became cemented in place by corrosion products and marine growth as the timbers slowly disintegrated beneath it. This contrasts with a situation where in a wind change, a ship rides (or is driven) back on its chain and/or anchors such that they lie below the hull timbers.

While accepting that the ground tackle (anchors and chain) and the windlass were subject to extreme forces during or soon after the wrecking process (as evidenced by the broken windlass and the dislocated hawse-pipe), in attempting to explain the anomaly, it remains equally possible that during the post-wrecking salvage of the vessel, the anchor was fished off the seabed by a salvage craft and (with the chain still attached) was hoisted back aboard the wreck using the fore, main or mizzen yards as a crane—a common process. While the anchor was recovered and taken off the site, clearly much of the chain was not. It could have been left ranged along the deck, to collapse downward on top of the floors and keelson as the ship disintegrated. The reasons for salvaging anchors, yet leaving the chain, are not immediately apparent. Perhaps, in contrast to anchors which are prized for use as moorings, chain may have been in abundant supply on the Cocos islands, or more likely, it was entangled in the wreckage. Alternatively, it was too large and too heavy with 10 inch links to be needed in much quantity, or to prove of use on risers linking mooring anchors and chain to a buoy on the surface.

The challenge then arises at this point to find a vessel whose characteristics and circumstances of loss fit these remains and the possible circumstances outlined above.

Site Identification Issues

Of immediate interest in the light of the evidence above, are the *Robert Portner*, an American schooner wrecked in the atoll by 'mishandling by her crew' in 1878 (Gibson-Hill, 1948:155), and a barque purporting to be the Italian *Luigi Raffo* that

was wrecked at the islands in February 1892. It's crew assimilated for a while, and produced children, before outstaying their welcome and being 'deported' as outlined below (Gibson-Hill, 1947:165).

The *Robert Portner* appears to be one of the very large three-masted schooners that became quite common throughout the world in the late 19th century. This particular vessel appears named after an American brewer who came to be based near Washington and who got his start during the Civil War. He went on to make beer in such quantities he was shipping it elsewhere on the coast and later became known as one of Virginia's most popular business leaders (Gaines, 2002). The American three and four-masted schooners are regularly found named after prominent people and a listing for *Robert Portner* appears in Merchant Vessels, US, for the year 1877. It carried the Official Number 110299, was sloop rigged, of 631.51 gross tons and was home-ported in New York. Given that another American schooner *J.M. Colman*, launched in 1888, was smaller at 472 gross tons, and 448 net tons and was 157 ft. long, 37 ft. in breadth, 11.3 ft. deep, and that another *Alex T. Brown* built in 1903 was 654 tons net and 788 tons gross and was 180 feet long by 40 feet wide and drew 14 feet, it is evident that *Robert Portner* would have been in the range between these two vessels.

Robert Portner could then be considered to fit the physical evidence at the *Port Refuge Unidentified* site. Unless artefactual material is found to support an American connection, this link can only be considered tentative, however.

There are, for example, a number of pertinent issues raised in the accounts of the other vessel under consideration, the *Luigi Raffo*. It appears mentioned in C.A. Gibson-Hill's '*Notes on the Cocos-Keeling Islands*' (1947) and in the journalist Gavin Souter's unpublished history for the Clunies-Ross family. In the latter work mention is made of the wreck occurring during a gale from the north-east, and of two subsequent cyclones, each expected to have impacted on the site. In one instance descriptions are made of the inordinately rough seas and the changing wind direction. In the other the strength of the seas during cyclones is clearly apparent. Further the *Luigi Raffo* case is doubly important in any attempt to identify the *Port Refuge Unidentified*, for it attests to the sheer impossibility of adequately accounting for all the wrecks on the islands. In this case the ship in question appears to have been stolen and it also appears not to be the real *Luigi Raffo* at all!

Bad luck continued to haunt the small community with the arrival [in 1892] of the *Luigi Raffo*, an Italian Barque. She was en route from Java to Antwerp and arrived with sprung planks and leaking seriously. Soon after she had dropped anchor, a strong swell arose from the north-east and drove her onto the rocks, wrecking her. The eighteen crewmen were taken ashore. They proved to be a troublesome and argumentative lot, becoming such a nuisance that it was decided to ship them out. The JGC *Ross*, with a Norwegian captain and a crew of eight Islanders, took them aboard. She was to take them to Batavia, but she never arrived there. It was later learnt that a ship named *Luigi Raffo* was lying in Genoa at the time of her supposed wreck on Cocos. This suggests that the Italians had hijacked and disguised the ship they came in and that they had done the same thing to the JGC *Ross*, putting her captain and Cocos crew overboard. The loss to the community of the schooner and nine good men was a heavy one . . . to top it off 1894 saw the return of severe cyclonic weather. . .

. . . On 27 November 1909, the most severe cyclone ever recorded passed directly over Cocos. A falling barometer gave warning of its approach, but the precautions taken were of little effect against its fury. Tuan Tinggi said in his report on it: "The

preparations came to naught. At about 6 in the evening the cyclone was on top of us and by 11 that night the centre passed over our islands. After that we had a lull for about half an hour then came the final blast which carried away and finished everything. Scarcely a single thing withstood its fury - seawater carrying sand with it passed through the tower of my house which is 50 ft high." That night the wind was "howling like a thousand wolves let loose". Branches of trees flew through the air like feathers. Lumps of coral as big as cannon balls crashed into the brick wall around Oceania House, blowing several gaps in it. (*From Souter, ND*)

Of additional interest, in his article on the Islands C.A. Gibson-Hill (1947:183) notes that a large number of rats got ashore from the *Robert Portner* to eventually spread over all the Cocos, bar Pulo Luar (Horsburgh Island) and presumably the North Island.

Site Identification: conclusion

Against the identification of this site as *Robert Portner* (1878), rats do not appear on Pulo Luar. This island is closest to the site and immediately down-wind of it in the conditions that normally prevail. Nonetheless, the *Port Refuge Unidentified* could be the *Robert Portner* and the rats that are reputed to have come from it could have transferred to the islands via salvage vessels before the ship broke up. Equally, if the *Luigi Raffo* story is correct, this particular wreck could be any one of many large ships stolen and re-named throughout the world during the course of the late 19th century.

As a result, unless archival research or further archaeological investigations provide a better clue, the identity of the *Port Refuge Unidentified* wreck will remain a mystery, with *Robert Portner*, and the vessel purporting to be *Luigi Raffo* but two possibilities. Recommendations for further work at the site are made in that context.

Wreck Site History

(i) Contemporary Salvage:

The lack of anchors, the relatively few planking spikes (compared with the larger bolts that secured heavy timbers), the very few frame bolts, the lack of rudder hangings (normally bronze pintles and gudgeons), the depth of water, the normally-benign conditions, the easy accessibility of the site and the presence of a large labour force with which to effect salvage at nearby Home Island after the mid 19th Century, all attest to the possibility that the site was heavily salvaged soon after it was wrecked. That the Clunies-Ross family and their labour-force prized shipwreck materials and even stored them for the purposes of a ship-building and repair facility they had established by the mid 19th century adds further to this conclusion.

In one instance a wrecked American whaler was totally dismantled and the timbers numbered in readiness for use on the next shipbuilding or repair job. In other cases the Islanders built vessels of excellent quality, one even receiving an A1 classification from Lloyds (Souter, G., ND). Clearly a sophisticated shipbuilding, ship-repair and ship-breaking capacity existed near the Home Island settlement, less than 3 nautical miles from the place where this wreck occurred.

As a result all accessible and useful materials are expected to have been recovered from this site (and any other easily accessible wreck on the Cocos Islands) within a few years of its loss.

(ii) When found in modern times and by whom

The wreck was found by Mr Robert Thorn of Parks Australia on April 3 2003. At the time of finding he was searching for the remains of the WWII Catalina *JX 435*.

(ii) Modern Salvage

Indications are that after the wreck was heavily salvaged in the 19th century and possibly later, and that after the passing of a number of cyclones, the wreck was lost to living memory, or was not considered likely to be an on-going source of useful materials.

(iii) Casual Diver interference, if any

The location of the wreck has remained confidential since it was located by Mr Thorn.

(iv) Modern diver use, if any

Tour operators are keen to locate the site and to add it to their list of shallow dives and attractive sites. Some may have recently done so.

Assessment of Site Significance

(i) Archaeological: The remains are those of a large late 19th century wooden-hulled sailing vessel of either American or European origin. They have not been disturbed in recent times and as a result many of the fastenings and some fittings, fixtures and machinery still lie in-situ. The wreck is easily accessible, and it lies in shallow and normally very benign conditions. As such this wreck represents an almost unique opportunity for archaeologists to access a site of this nature and to study site formations processes unaffected by modern diving activities.

(ii) Technological

The wreck is a well-preserved example of the late 19th Century ocean-going sailing ship type, with heavy chain, tanks, windlass, winches, fastenings and timbers remaining on site. These are available for comparative studies.

(iii) Scientific

The wreck provides a useful opportunity to monitor the site formation processes at work in a warm water corraline environment and also to examine the rate of colonisation of artificial structures by coral.

(iv) Educational

Given its normally benign, easily accessible and very shallow environment, this wreck provides a very useful tool for the Island Schools and for visiting groups seeking to access an historic, and in this case ‘mysterious’, wreck for academic purposes.

(v) Recreational/Tourist

The benign, easily accessible and very shallow environment combine with the normally excellent visibility to render this site of great potential for charter operators as a second dive, (following decompression or deep dives), for snorkellers and for visitors travelling in the glass-bottomed boat facility.

(vi) Cultural

This wreck has tangible links to the period when the islands were both a haven and a hazard for ocean-going sailing ships. It also has links to the period when a boat-building, wrecking and ship repair facility existed under the supervision of the Clunies-Ross family. The wreck possibly has ties to the now-defunct copra industry in the islands.

Ancestors of the Cocos(Keeling) 'Malays' living on Home Island are certain to have been involved in the salvage of this vessel.

Management considerations

Natural Forces: The wreck lies on a sand bottom in 4m of water in a warm-water coralline environment. It can be subject to the effects of wave action in heavy seas and very occasionally (in cyclonic conditions) to very heavy seas and swell. In those circumstances sediments might move, alternately revealing and burying parts of the site. In those circumstances any exposed timbers would be at risk.

Present and future Human forces: While presently there is little evidence of interference (the wreck being known to few other than Parks Australia staff), the site is at great potential risk from inadvertent damage by anchors dragging through it as the wind increases and the seas lift, during the course of a dive (apparently a common occurrence in this part of the lagoon). Divers wanting to souvenir some of the myriad of loose attractive copper alloy fastenings that abound will also prove a threat to the integrity of the site once its location becomes generally known.

Projected site stability in view of the above: This wreck will need be carefully managed in respect of future visitation by divers and in the anchoring of their boats. Unless these issues are very carefully and stringently attended to, the wreck will quickly be damaged, losing its quite unique appearance and 'untouched' status. This will serve to reduce both its value to archaeologists and historians and its appeal to recreational divers and visitors in the glass bottomed boat facility.

Recommendations & Management Proposals

- 1) Lying in Commonwealth waters, having significance under the terms of the criteria listed above, being virtually untouched in recent times, the wreck should be protected under the terms of the *Commonwealth Historic Shipwrecks Act*. The wreck is certainly well over 75 years-old and it can be protected on that score alone.
- 2) A management strategy, allowing self-regulated visitation by Cocos charter operators, should be developed. This, of necessity, would be effected in concert with staff of Parks Australia who found the site, who frequent the nearby waters and who know the Islands and the attitudes of their inhabitants well. Local tourist operators and government instrumentalities, such as the police and customs, would also need be involved, given their policing roles in the islands.
- 3) Should they prove willing, and after suitable training, staff of Parks Australia and other interested water-borne staff of the various government instrumentalities could become recognised as inspectors under the terms of the Commonwealth Historic Shipwrecks Act. This would allow them to act in respect of this site, in respect of the others in the South Keeling, of the famous SMS *Emden* (1914) and in regards those yet to be located others in the North Keeling. A course of this nature could be effected using staff of the Department of Maritime Archaeology at the Western Australian Maritime Museum.
- 4) Once protective mechanisms are in place and the wreck has become accepted as an integral part of the cultural heritage by all stakeholders, the site could be marked with interpretive materials set in plinths fixed below water. These would advise visitors of the significance of the site and of its importance to the people of the islands and to the tourist industry on which they have come to increasingly rely. Similar above water signage could be erected near the island boat ramps. Pioneered at Rottnest Island in Western Australia in 1980, these facilities are now commonplace and have proved their worth. There are many examples of best practice from which to choose.
- 5) In the absence of a suitable mooring facility near the site, a safe mooring zone adjacent should be chosen and it should be clearly marked with buoys that could also display information about the site and about its protected status.
- 6) A wreck map and information pamphlets on this and on other maritime sites in the region could be produced, subject to a survey of needs amongst Island stakeholders. Again there are many examples of best practice in this matter.
- 7) A comprehensive re-examination, re-measuring and re-assessment of the wreck, together with a minimal-disturbance surface search of the site could be conducted with a view to gleaning further evidence towards a satisfactory identification of the site.
- 8) A series of minimal-disturbance test excavations could be conducted at selected places with a view to gleaning further evidence towards a satisfactory identification of the site.

Acknowledgements

The author would like to acknowledge the field and technical assistance from: Dr I. Godfrey, A. Granger, J. Green, G. Henderson, W. Murray and R. Thorn.

References

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Appendix

Report Wood Identification Cocos Island 2004

Dr M. McCarthy supplied six wood samples for identification with a view to determining their provenance. These samples, obtained during a trip to Cocos Island in 2004, were given the simple codes #1-6 and are described below [where relevant to the Port Refuge unidentified site].

The transverse surface of each sample was polished to a 1200-grit finish prior to low power microscopic examination. Where necessary the radial longitudinal surfaces were cut with a scalpel to reveal features on these surfaces under high power microscopic examination.

#1 Plank at 41 m [from stern] – Peg Wreck [Port Refuge unidentified]:

Transverse surface:

The sample is a highly degraded softwood which was very soft and difficult to polish or to cut without damaging structural features. Identifiable features were as follows:

- Resin canals are numerous
- There is a sharp transition between the less dense early wood and the denser latewood

The presence of resin canals indicates that the sample belongs to one of 4 broad wood types – *Pinus* (pine), *Picea* (spruce), *Larix* (larch) or *Pseudotsuga* (Douglas fir) species.

Radial longitudinal surface:

The highly degraded nature of the surface made it extremely difficult to get a good section that would allow definitive identification. After cutting numerous sections, on balance, it appears that the wood contains the following features:

- Ray tracheids are dentate containing small bordered pits
 - Ray parenchyma are smooth-walled with predominantly large simple pits in the cross-field region. Small simple pits (x3) were observed in one cross-field region.
- There is a contradiction between the macroscopic observation that the transition between the early and latewood is sharp and the microscopic observation of large simple pits in the cross-field region.

The macroscopic observations and the isolated observation of 3 simple pits indicate that the wood could belong to pines of the Southern Yellow Pine group - exemplified by pitch pine (*Pinus rigida*), longleaf pine (*P. palustris* Mill.), slash pine (*P. caribaea* Morelet and *P. elliottii* Engelm.) and loblolly pine (*P. taeda* L.). However the majority of the microscopic features, identified in the most solid section of the piece of wood, indicate that the wood is more likely to be a pine of the red deal type, exemplified by Scots pine (*P. sylvestris* L.), red pine (*P. resinosa* Ait.) and Austrian and Corsican pine (*P. nigra* Arnold).

Pines of the red deal type occur naturally in both Europe and North America

#2 Frame at 25 m [from stern] – Peg Wreck:

This sample is a very degraded and mushy hardwood with few features that could be easily discernible after either polishing or slicing. Identifiable features are listed below:

Transverse surface:

- Rays are wider than pores and of 2 distinct widths

- Ring porous arrangement
- Tyloses are not visible
- Absence of a uniform gradation of pore size across the growth rings.

The wood is likely to be white oak (*Quercus* species), a species that is native to both Europe and North America. American and European species cannot be differentiated microscopically.

#3 Keelson at 26m [from stern] – Peg Wreck:

The sample is a softwood in solid condition that contains large amounts of iron corrosion products and other materials.

Transverse surface:

- Resin canals are present
- There is a more gradual transition between the less dense early wood and the denser latewood than evident in sample #1.

Radial longitudinal surface:

While the good condition of the wood allowed good sections to be cut, the presence of very large amounts of iron corrosion products and other ‘black’ inclusions inhibited observations of cross-field regions.

- Ray tracheids are dentate
- Ray parenchyma are smooth-walled and appear to contain large simple pits in the cross-field regions. Some of the cross-field regions contained 2 simple pits.

On the basis of the above features the wood is most likely to be a pine of the red deal type – see sample #1 for details of typical species and provenance.

#5 Wood around fastening at 12 m [from stern] – Peg Wreck:

This piece of wood was in very good condition and contained substantial amounts of copper corrosion products.

Transverse surface:

- Rays are wider than pores and of 2 distinct widths
- Ring porous arrangement
- Tyloses are present
- Soft tissue surrounds the pores

This wood is clearly a sample of white oak (*Quercus* species), having either a European or North American provenance.

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