The Sydney-Kormoran Project

Conducting a 3D Imaging Survey of the WWII wrecks HMAS Sydney II and HSK Kormoran

Dr Andrew Woods, Curtin University

Image courtesy of WA Museum and Curtin University. Copyright WA Museum.
An unlikely encounter

• HSK Kormoran
  • Merchant vessel converted to an armed raider

• HMAS Sydney II
  • modified Leander-class light cruiser

• 19 November 1941 – in the midst of World War II
• The two vessels encounter each other and a short battle results in the sinking of both vessels
Crew of the HMAS Sydney II

• All 645 crew of the Sydney perished. Of the 380 men on-board Kormoran, 318 survived.
• Nearly 70 years of controversy and rumour ensued until the wrecks were discovered in 2008 by the Finding Sydney Foundation.
**HSK Kormoran Protected Zone**

**Debris field #2**

**Debris field #1 including large part of main structure**

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**HMAS Sydney II and HSK Kormoran**

Data points sourced from:
"Final report The Search to find and identify the wrecks of HMAS Sydney II and HSK Kormoran"
Australian Maritime Boundary data and Geodata Topographic 1:5M, 1:2.5M
(c) Geoscience Australia


Datum: Geocentric Datum of Australia 1994 (GDA94)
HSK Kormoran site survey (2008)

ENGINE? (with anchor in plating)

STERN (disintegrated)

BOW
HMAS Sydney site survey (2008)

Near S10:
- Searchlight
- 12ft rangefinder
- Rack depth charges (3)
- 44gal drum

Near S9:
- Tyres (fenders)?
- Plane wreckage
- Boat anchor

DCT

HACS

HACS base

Funnel

4-in. gun (stbd 1)

Catapult

Torpedo tubes (4)

Torpedo tubes (4)

Two boats

Boat cradle

Boat

Pieces of debris

NOTE:
DCT = Direction Control Tower
HACS = High Angle Control Station
'Cross-talk' is a phenomenon where an object on one side of the image appears directly opposite the real object.

ROV analysis of sidescan sonar images. HMAS SYDNEY wreck and debris field.

The hull of the HMAS SYDNEY, with stern to the north, can clearly be seen as the dark image. The shadow (in white) gives a better indication of the vertical relief.
2008 Expedition

• Successfully located the two wrecks
• Collected ~1500 images and ~40 hrs video
• Results informed the Cole Commission of Enquiry which ruled on the loss of the two vessels

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2015 Expedition:

• 4 years of preparation
• DOF Subsea Vessel
• 2 work-class ROVs (Triton XLX)
• Custom lighting and camera system
• Multi-beam sonar
• Science sampling

Core Project Team:
Andrew Hutchison, Andrew Woods,
Tim Eastwood, Joshua Hollick, etc
### 2015 HMAS Sydney (II) and HSK Kormoran expedition

**Major Project Partners**

- Government of Western Australia Museum
- Curtin University
- DCF Subsea
- [Australian Government's Community Heritage Program](https://www.environment.gov.au) (Funded by the Australian Government’s Department of the Environment)

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#### Premier Partners

- Australian National Maritime Museum
- GMA Garnet Group
- [Western Australian Museum](https://www.wamartour.org.au)

#### Major Partners

- Kongsberg
- Lotterywest
- [Friends of the Western Australian Museum Inc.](https://www.friendswa.org.au)

#### Supporting Partners

- Australian Maritime Logistics
- Stevenson Logistics
- Matrix
- Teledyne Bowtech
- IFAP
- Ashtead Technology

#### Member Partners

- BHAGWAN
- RTS
- [Medvet](https://www.medvet.com.au)
- toxfree
- DSM
- [Oil Equipment](https://www.oilequipment.com.au)
- SubC Imaging
- Seatonics
- OccMedic
- JOYCER
- [RSL (NSW)](https://www.rsl.org.au)
- [Crew of Skandi Protector](https://www.skandiprotector.com)
- Maritime Union of Australia

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**Supporters**

Specialist Offshore Services | Altronics | Doyalson Wyee RSL (NSW) | Crew of Skandi Protector | Maritime Union of Australia
Each of the two ROVs were equipped with a custom 3D imaging system:

- x10 Underwater LED lights
- + tonnes of underwater cables
- And a special mounting frame
Lighting and Camera system control room aboard Skandi Protector
2015 Expedition Results

- Two ROVs, 4 days, 24 hour ops, rotating 12 hour shifts
- Surveyed both wreck hulls and debris fields
- Carefully coordinated movement of the two ROVs – sometimes working together, sometimes working separately
- Seven digital still cameras on each ROV capturing photos every 5 sec
- Collected:
  - ~500,000 images, and
  - ~300 hrs HD video - much of that 3DHD
  - ~50 terabytes of data
Sydney-Kormoran Expedition 2015 – HMAS Sydney (II) damaged ‘B’ turret

Image courtesy of WA Museum and Curtin University. Copyright WA Museum.
ROV inspecting HMAS Sydney (II)'s torn-off bow section

Image courtesy of WA Museum and Curtin University. Copyright WA Museum.
HMAS Sydney (II) Carley float on ocean floor

Image courtesy of WA Museum and Curtin University. Copyright WA Museum.
Why so many images?

3D Reconstruction:
Generating 3D models from a series of 2D photographs

Images courtesy Curtin University and WA Museum. © WA Museum
3D Reconstruction

- aka: 3D Photogrammetry, Structure from Motion
- Primarily based on still images but may also use video data to provide more coverage
- Good coverage and lots of angles are important for high-quality models
3D Reconstruction Technique

1. Find feature points in images
2. Match features between images
3. Determine camera locations (bundle adjustment)
4. Generate dense point cloud
5. Generate mesh
6. Use images to texture the mesh

Images courtesy Curtin University and WA Museum. © WA Museum
Relevance to AUVs?

- 3D Reconstruction can be applied to images collected from a range of different sources – including AUVs.

Ship-related debris on the sea floor, including an anchor. Source: ATSB, photo by Fugro.
Where from here?

• Lots of data processing using 3D reconstruction software on the Pawsey Supercomputers to generate 3D models of items from the debris field and hopefully the full main wreck hulls

• Museum exhibitions at WA Museum and partner institutions

• Documentary feature produced by Prospero Productions

• Research outputs – processing of science samples (rusticles, sediment, water, etc)
Questions?

“[The team] have pulled off something fantastic, singular in the history of Australian maritime archaeology”

Andy Viduka, Assistant Director Maritime Heritage, Department of the Environment, Australian Government.

DOF Subsea ROV inspecting HSK Kormoran engine room wreckage
Image courtesy Curtin University and WA Museum. © WA Museum