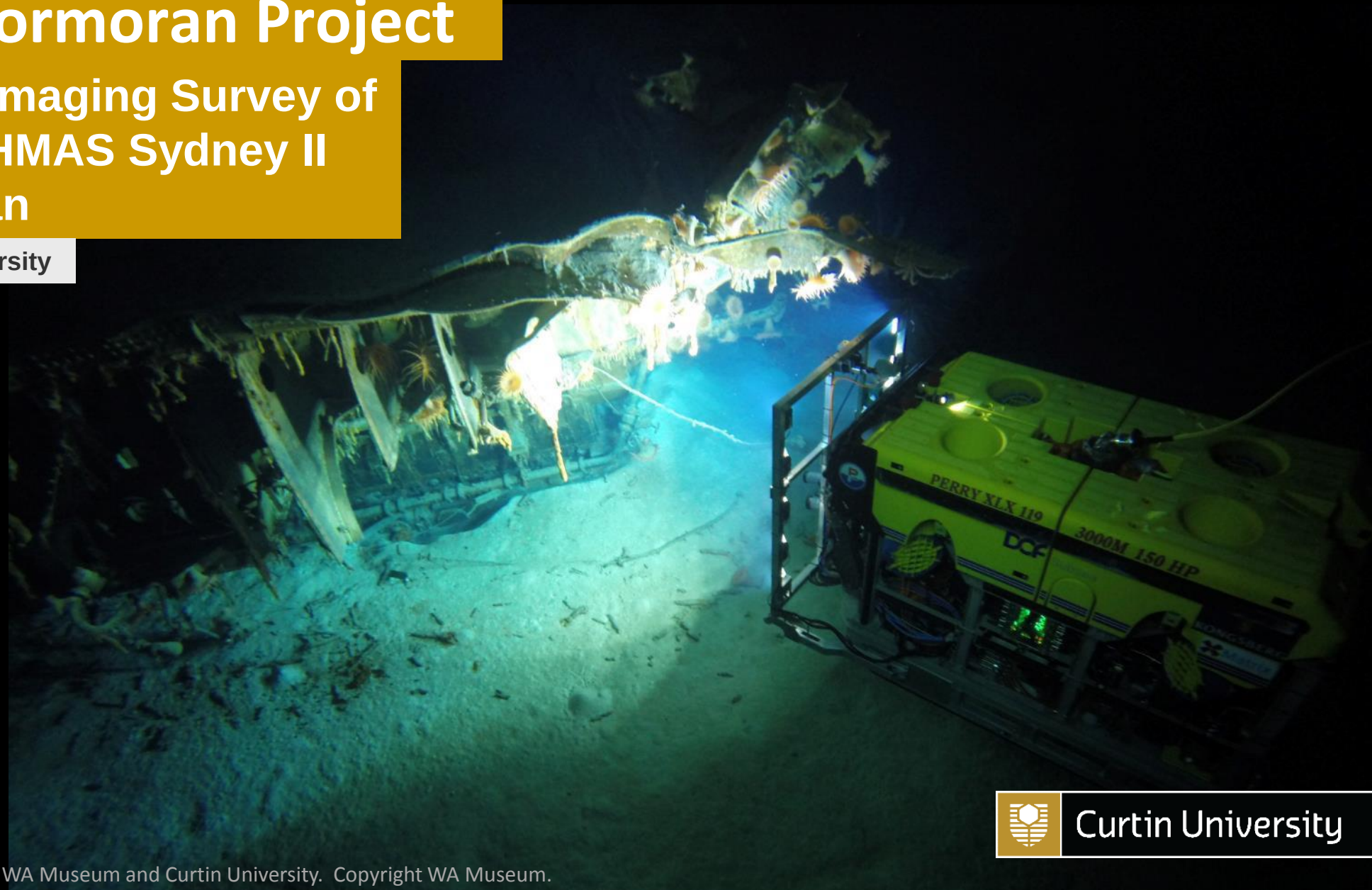
The Sydney-Kormoran Project

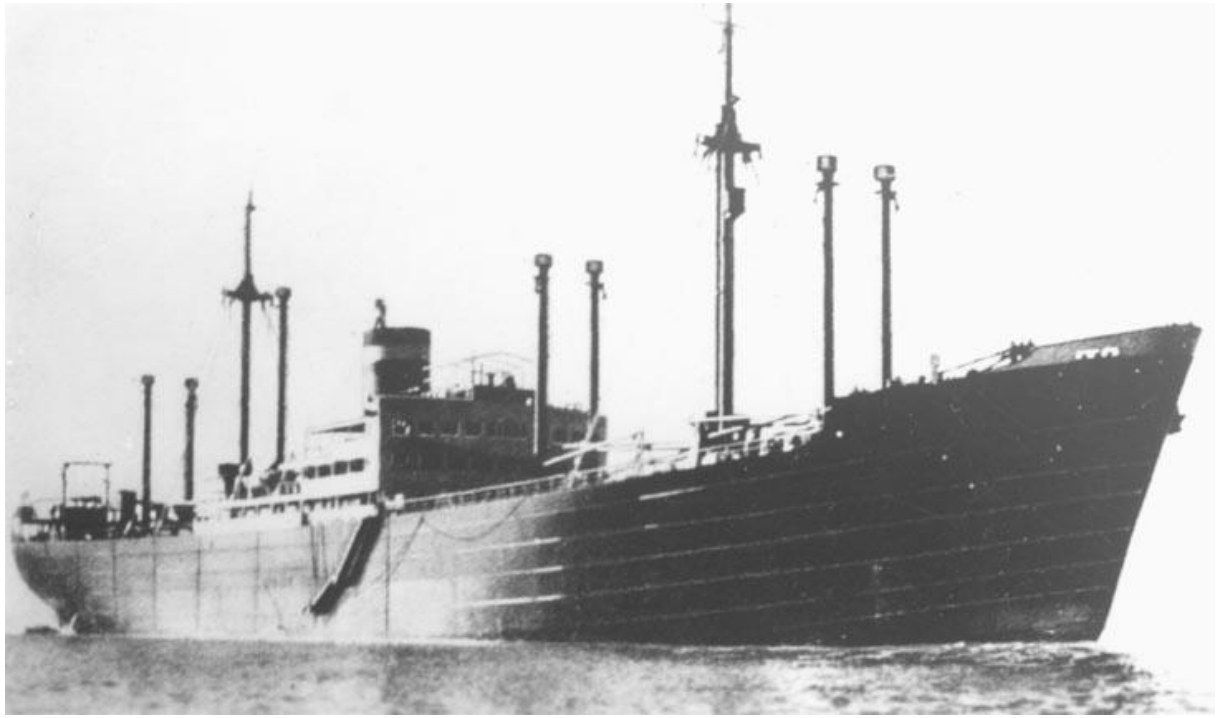
Conducting a 3D Imaging Survey of the WWII wrecks HMAS Sydney II and HSK Kormoran

Dr Andrew Woods, Curtin University

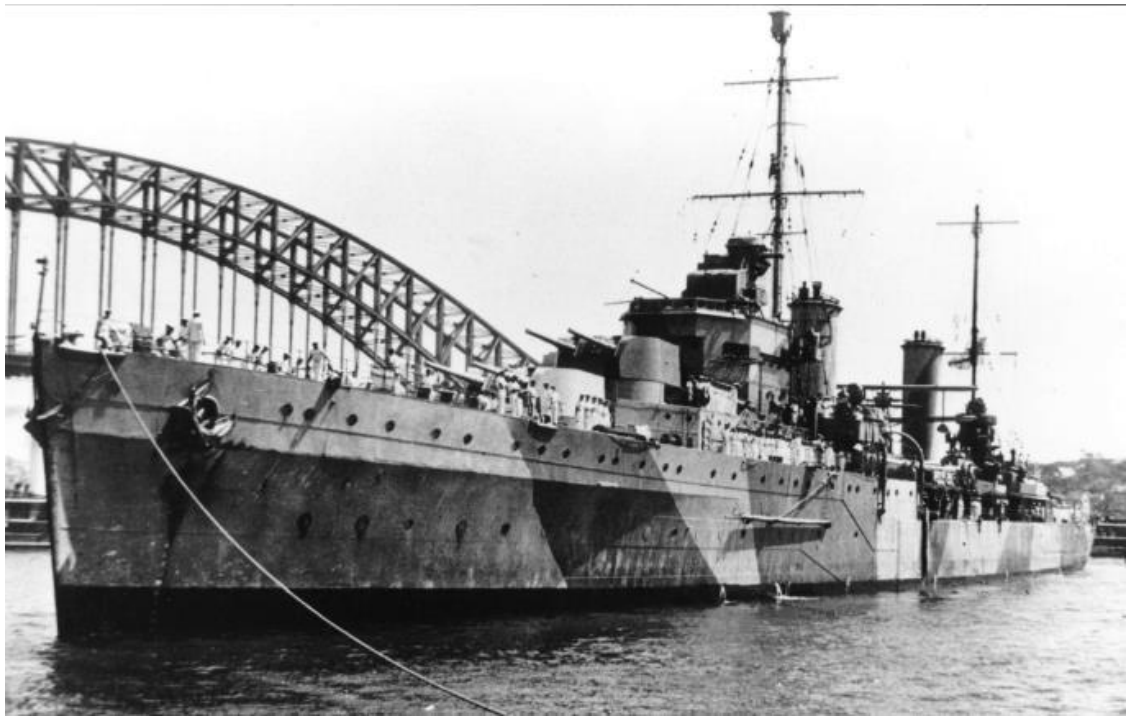


Curtin University

An unlikely encounter

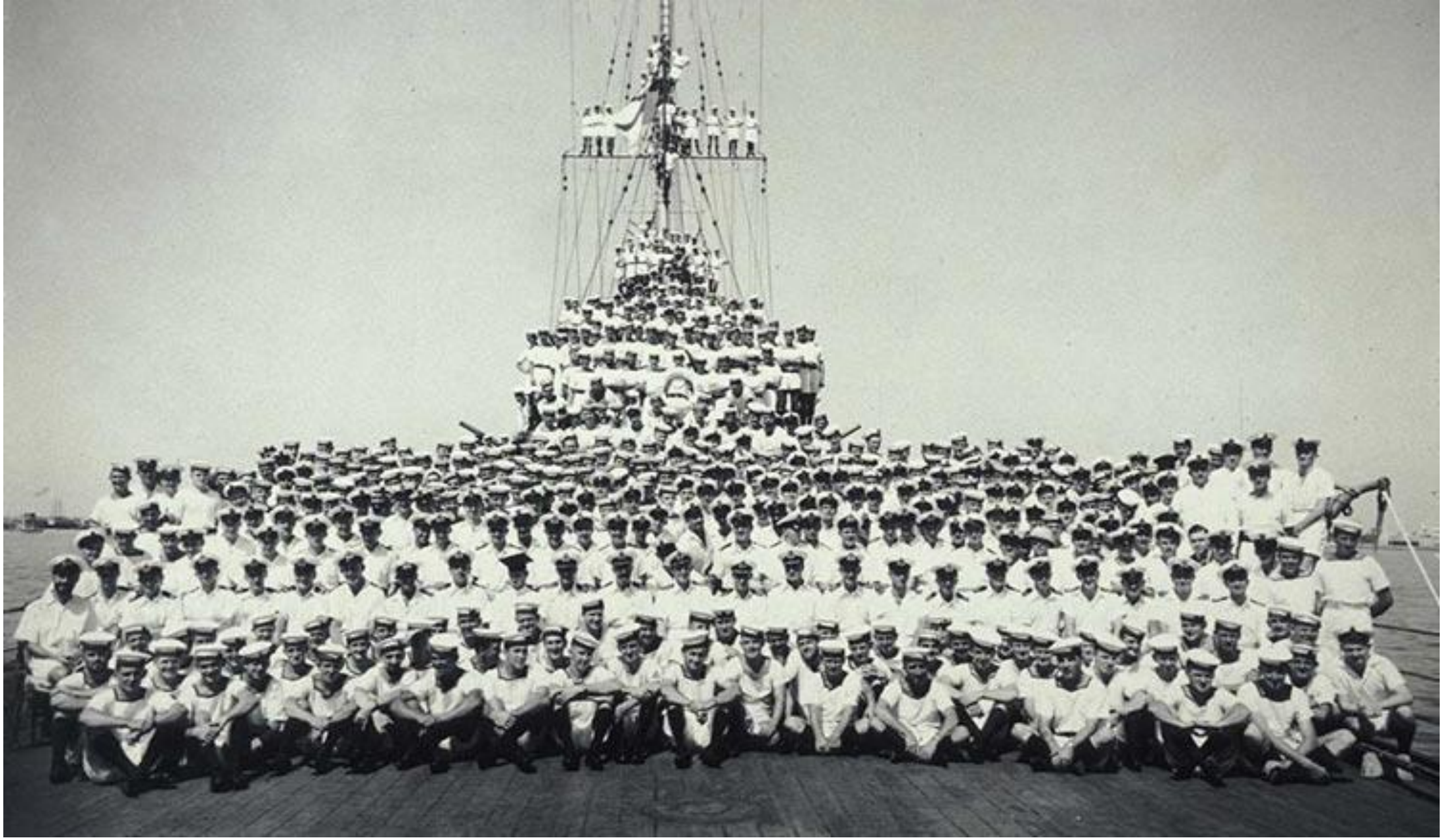


- HSK Kormoran
- Merchant vessel converted to an armed raider



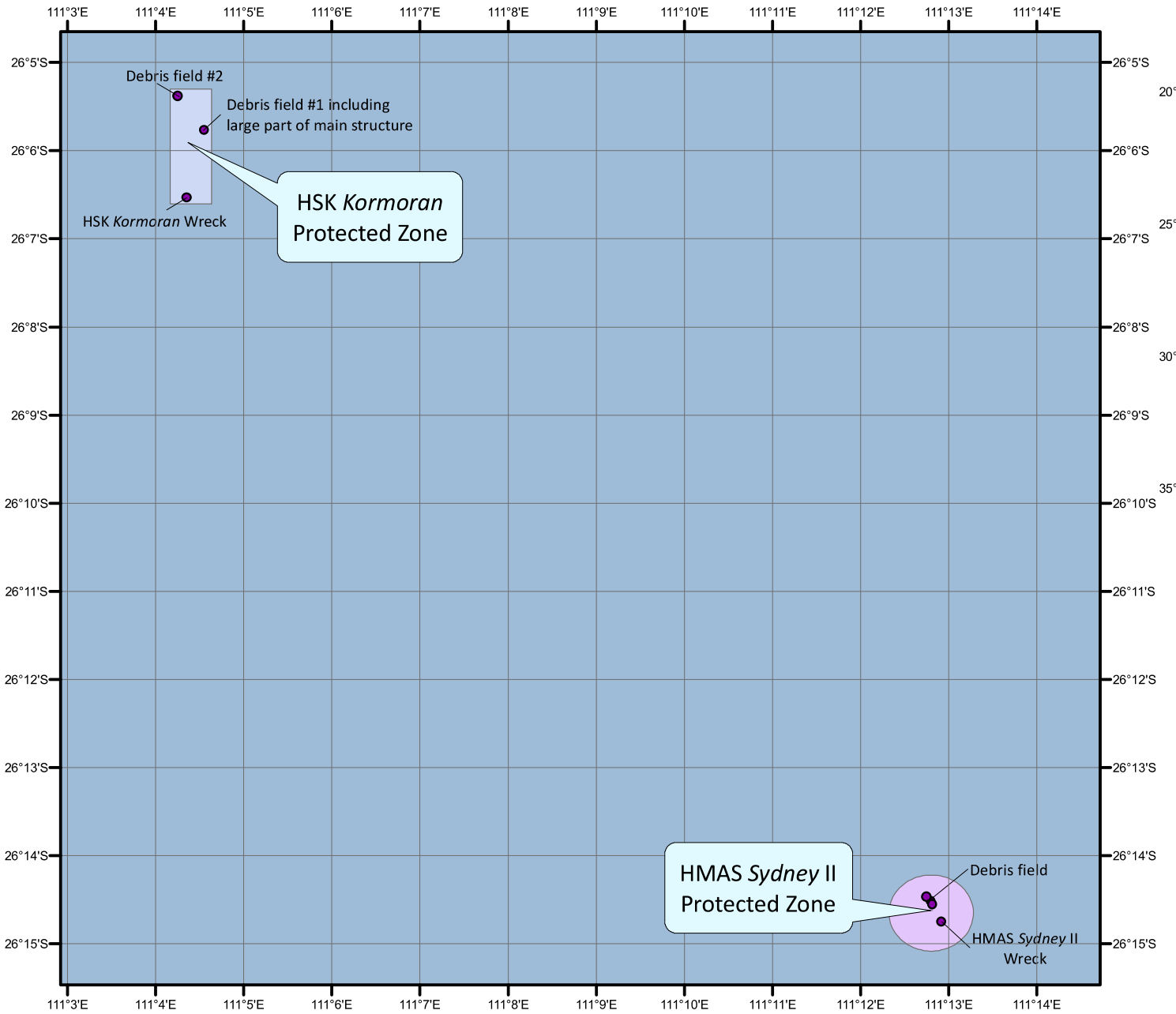
- HMAS Sydney II
- modified Leander-class light cruiser

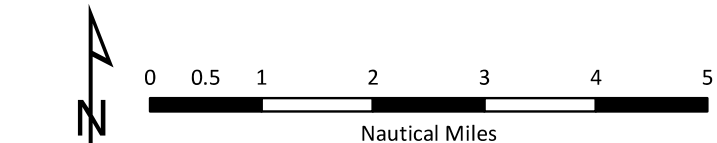
- 19 November 1941 – in the midst of World War II
- The two vessels encounter each other and a short battle results in the sinking of both vessels

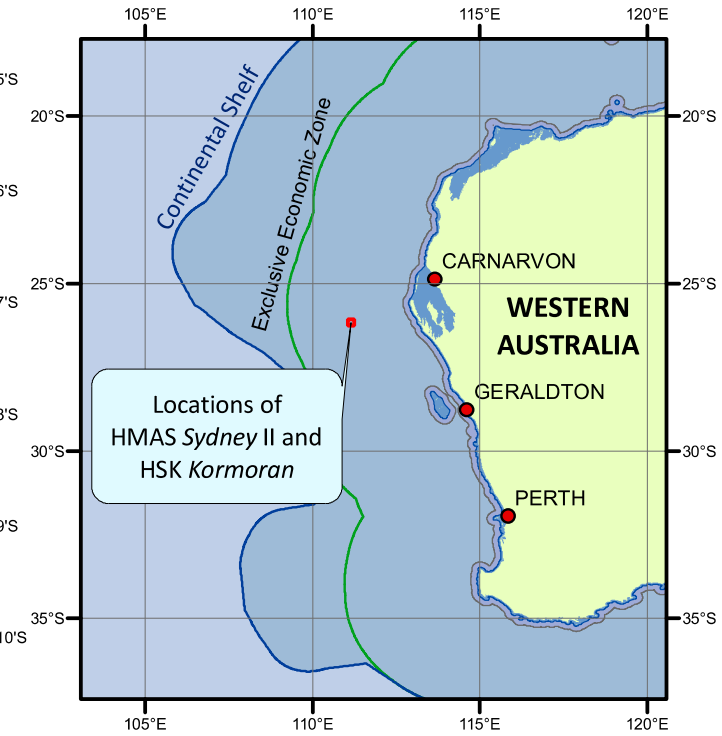


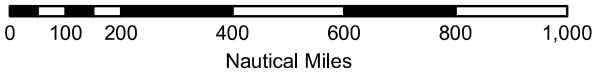
Crew of the HMAS Sydney II

- 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.









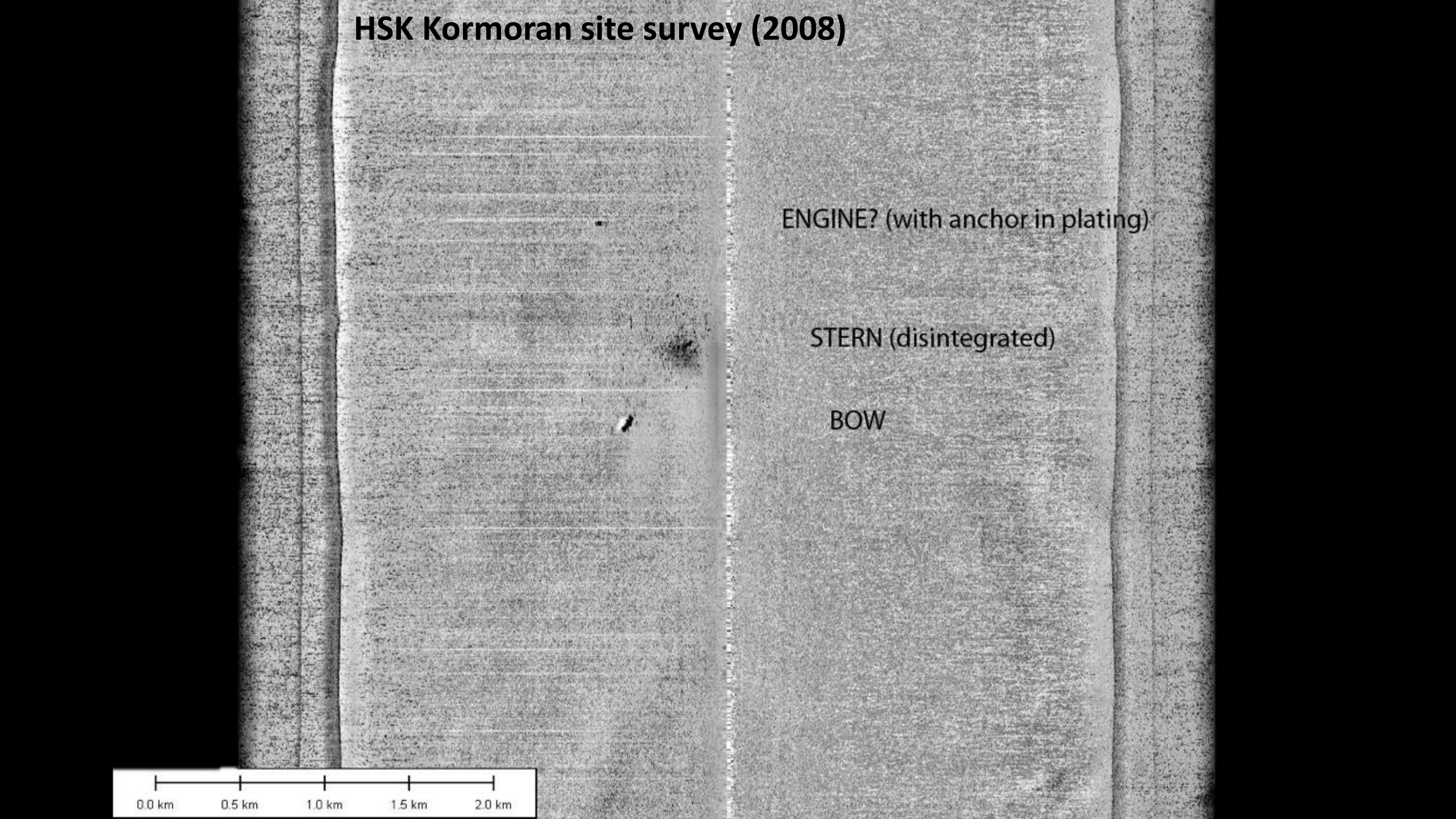
HMAS *Sydney* II and HSK *Kormoran*

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

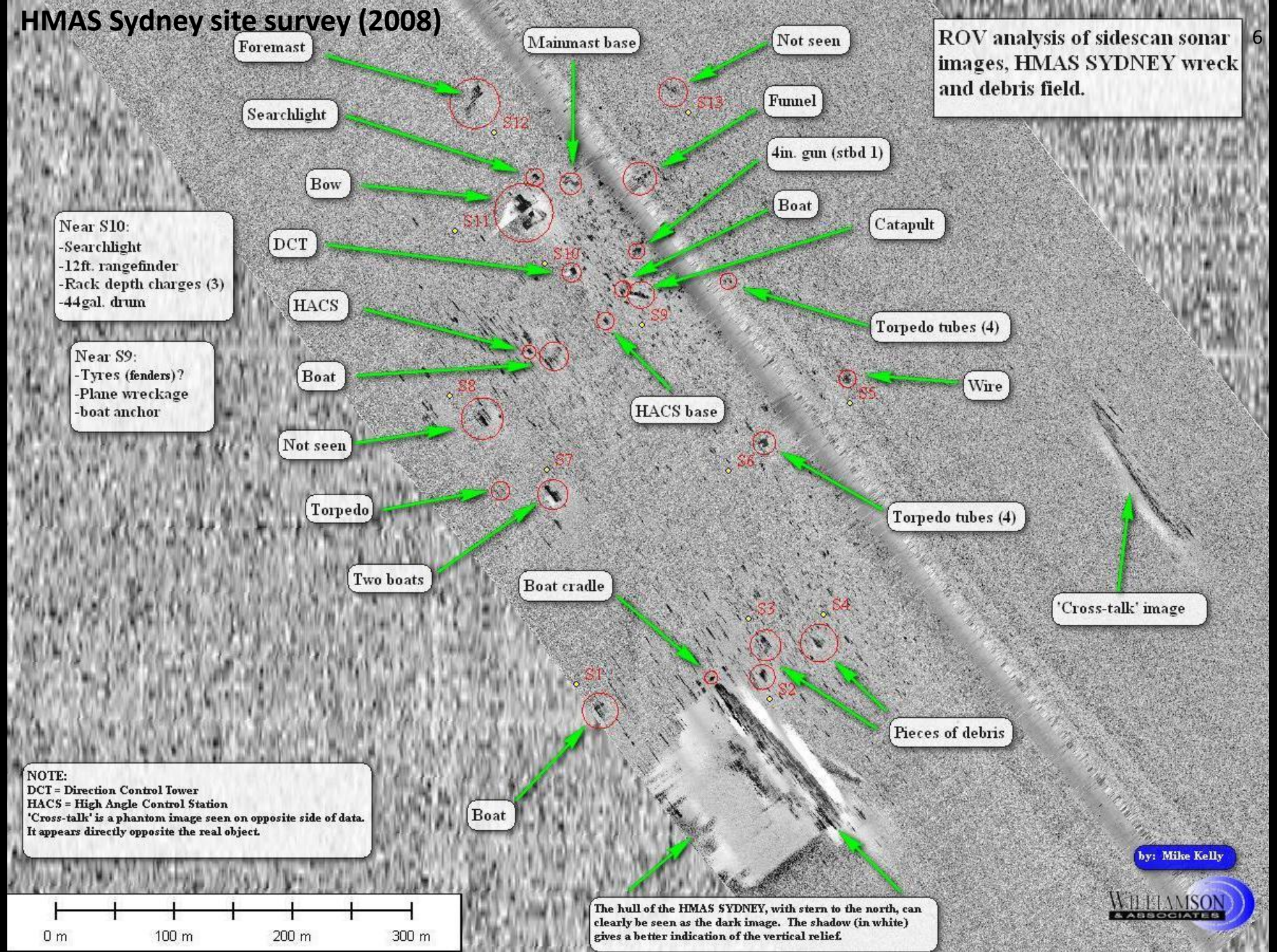
Map produced by
Environment Research and Information Branch
Australian Government Department of the Environment, Water, Heritage and the Arts
J.Longworth, October 2008

Datum:
Geocentric Datum of Australia 1994 (GDA94)

HSK Kormoran site survey (2008)



HMAS Sydney site survey (2008)



2008 Expedition

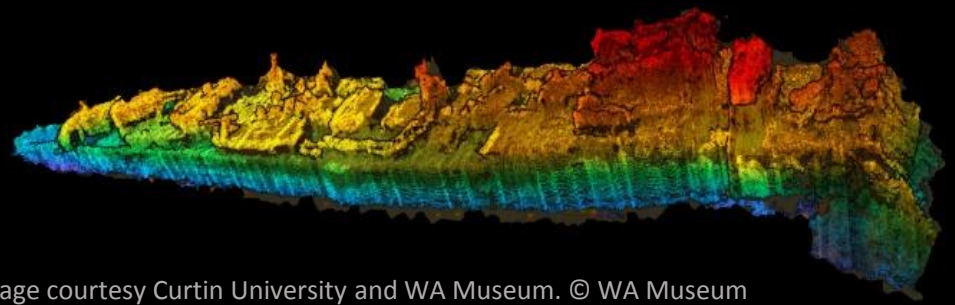
- Successfully located the two wrecks
- Collected ~1500 images and ~40 hrs video
- Results informed the Cole Commission of Enquiry which ruled on the loss of the two vessels

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

Skandi Protector

Core Project Team:
Andrew Hutchison, Andrew Woods,
Tim Eastwood, Joshua Hollick, etc



Multi-beam image courtesy Curtin University and WA Museum. © WA Museum

2015 HMAS Sydney (II) and HSK Kormoran expedition

Major Project Partners

Government of Western Australia | Western Australian Museum | Curtin University | DCF Subsea | Australian Government Department of the Environment

Funded by the Australian Government's your Community Heritage Program

Premier Partners

GMA Garnet | GMA Garnet Group – when your abrasive matters! | Western Australian Museum Foundation | minderoo | Høgskolen i Ålesund – Aalesund University College

Major Partners

Kongsberg | Lotterywest supported | friends of the Western Australian Museum Inc

Supporting Partners

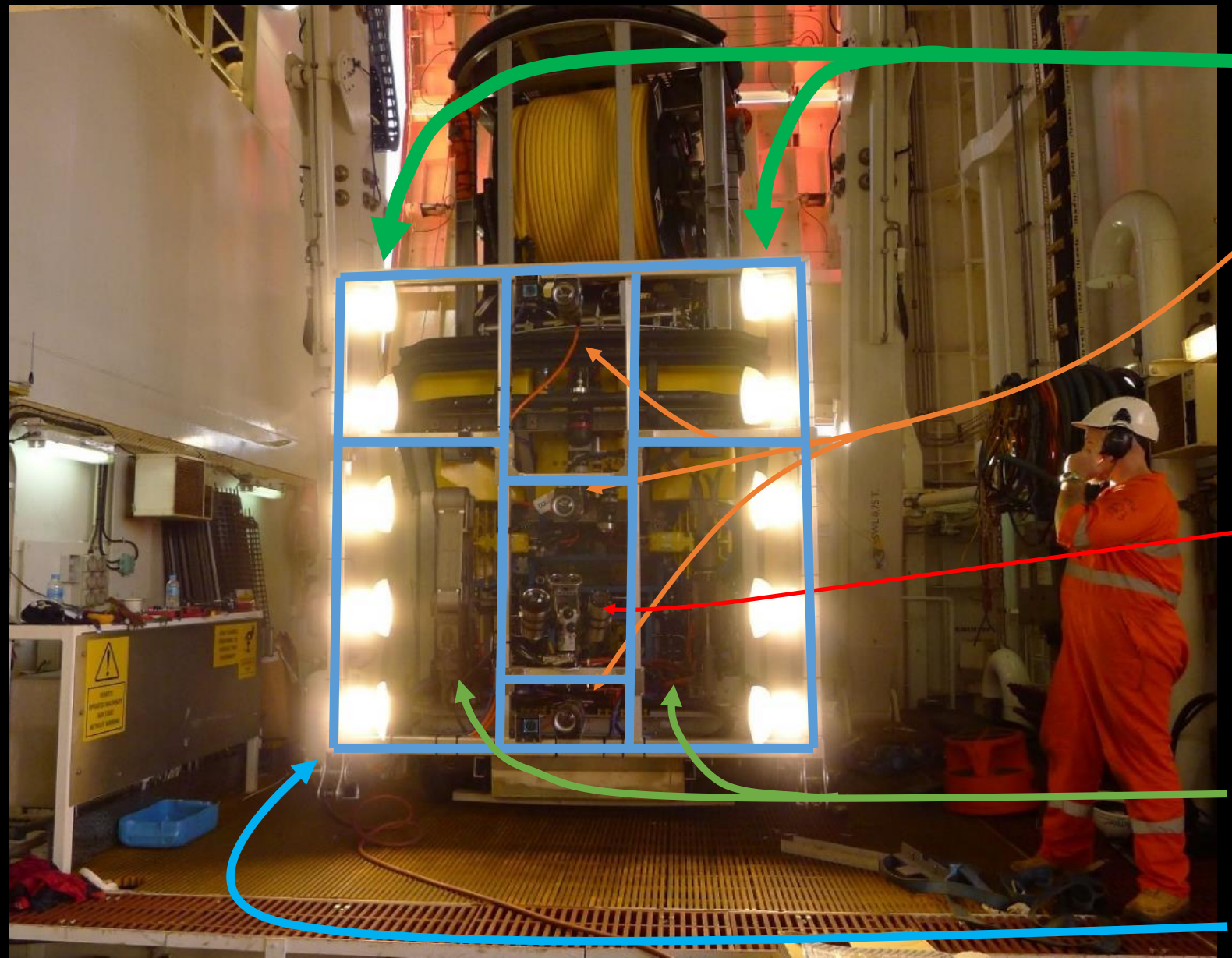
Australian National Maritime Museum | Stevenson Logistics | Matrix Composites & Engineering Ltd | Teledyne Bowtech – Everywhereyoulook™ | IFAP – Safer Healthier Workplaces | Ashtead Technology – The number one independent provider of subsea electronic and survey equipment, sales and services | 30

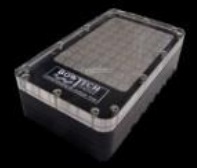
Member Partners

Bhagwan Marine | rts www.rts.as | Medvet. Industry Health & Safety Testing, Training & Prevention | toxfree | dsm | Subsea Energy Australia | SubC Imaging | seatronics | OccMedic Corporate & Industrial Health | Joyce JK | Oil Equipment

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

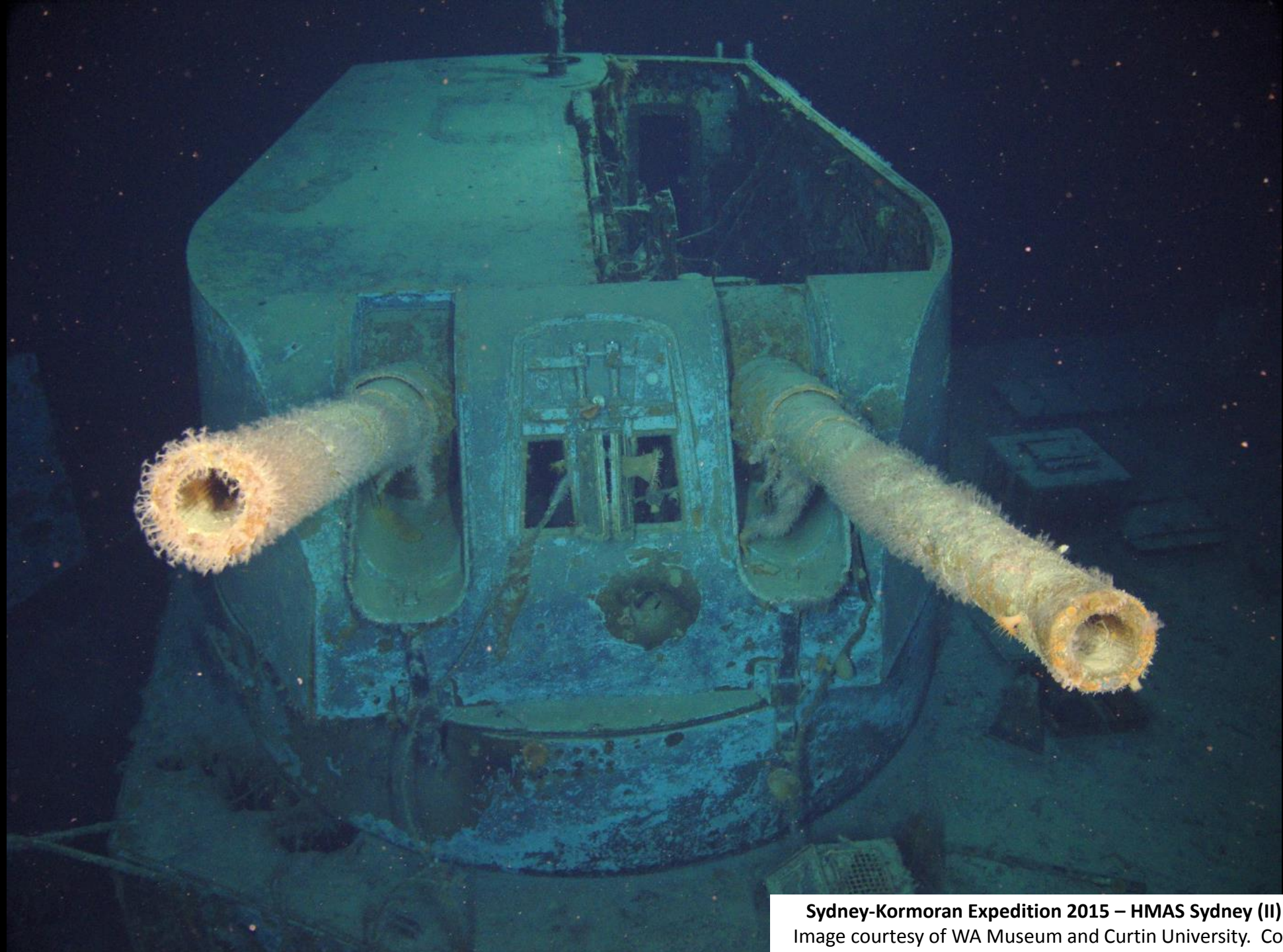
And a special mounting frame

Lighting and Camera system control room aboard Skandi Protector

Expedition Crew

2015 Expedition Results

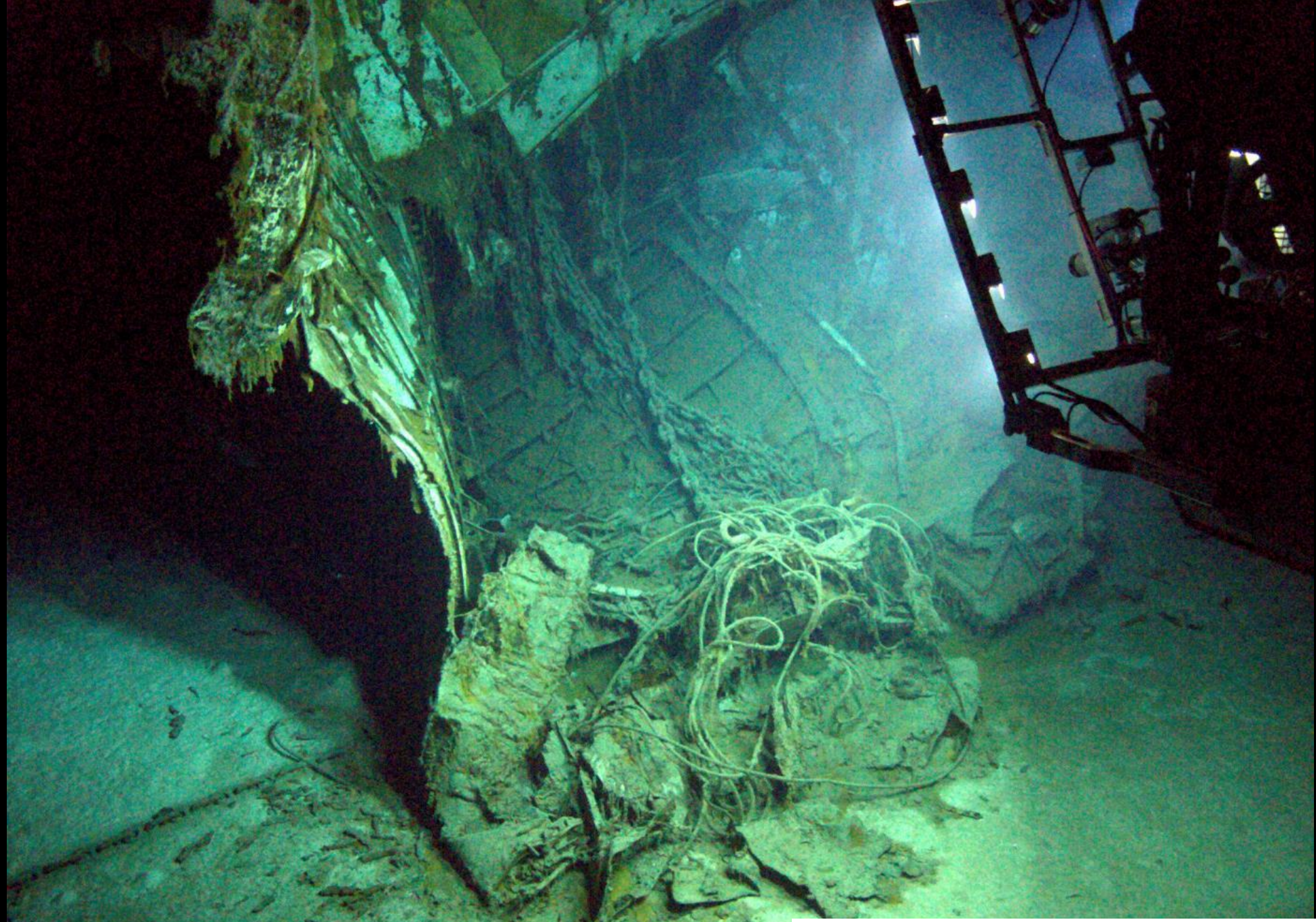
- Two ROVs, 4 days, 24 hour ops, rotating 12 hour shifts
- Surveyed both wreck hulls and debris fields
- Carefully coordinated movement of the two ROVs – sometimes working together, sometimes working separately
- Seven digital still cameras on each ROV capturing photos every 5 sec
- Collected:
  - ~500,000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



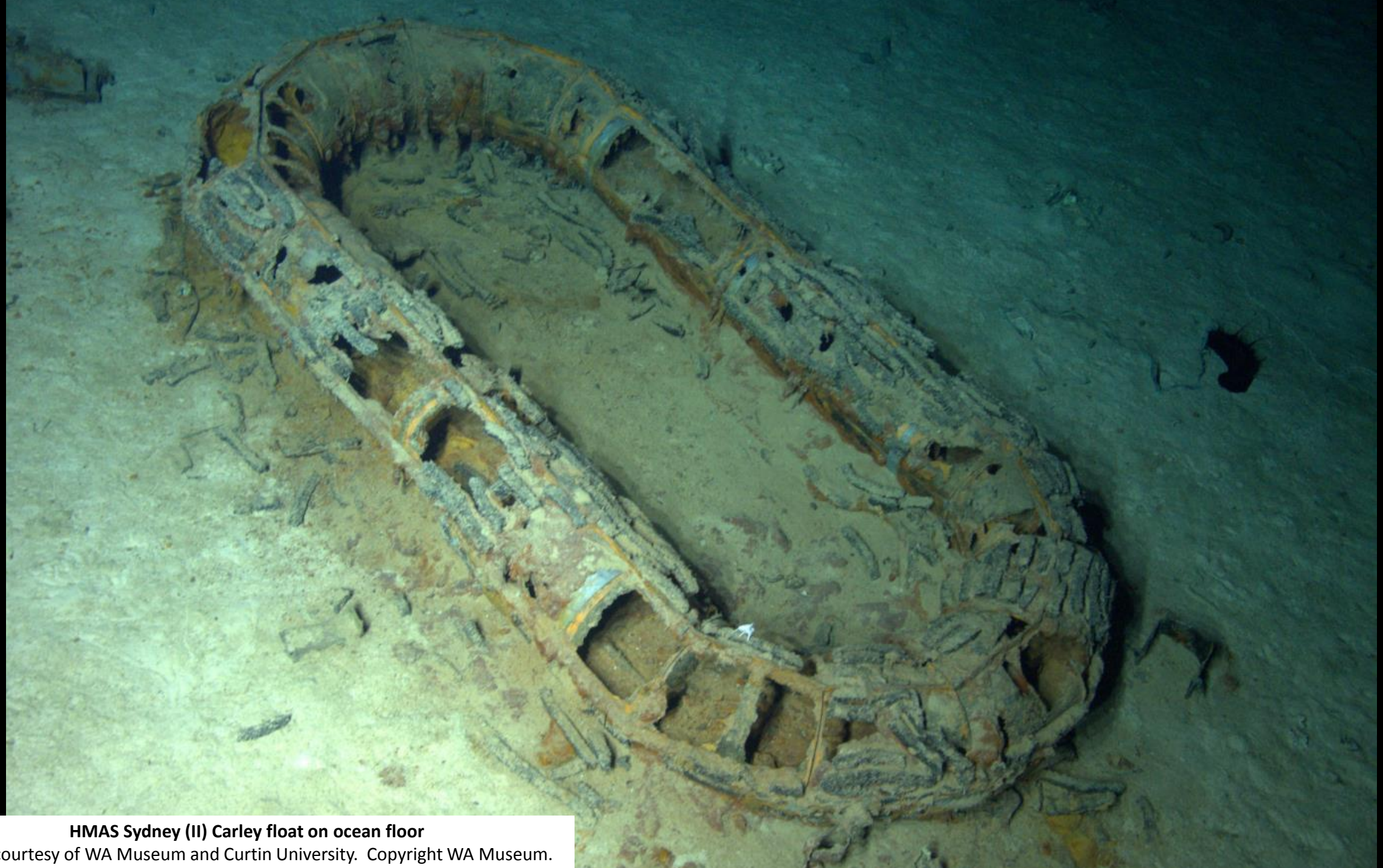
Sydney-Kormoran Expedition 2015 – HMAS Sydney (II) damaged 'B' turret
Image courtesy of WA Museum and Curtin University. Copyright WA Museum.

ROV at stern of HMAS Sydney (II)

Image courtesy of WA Museum and Curtin University. Copyright WA Museum.



ROV inspecting HMAS Sydney (II)'s torn-off bow section

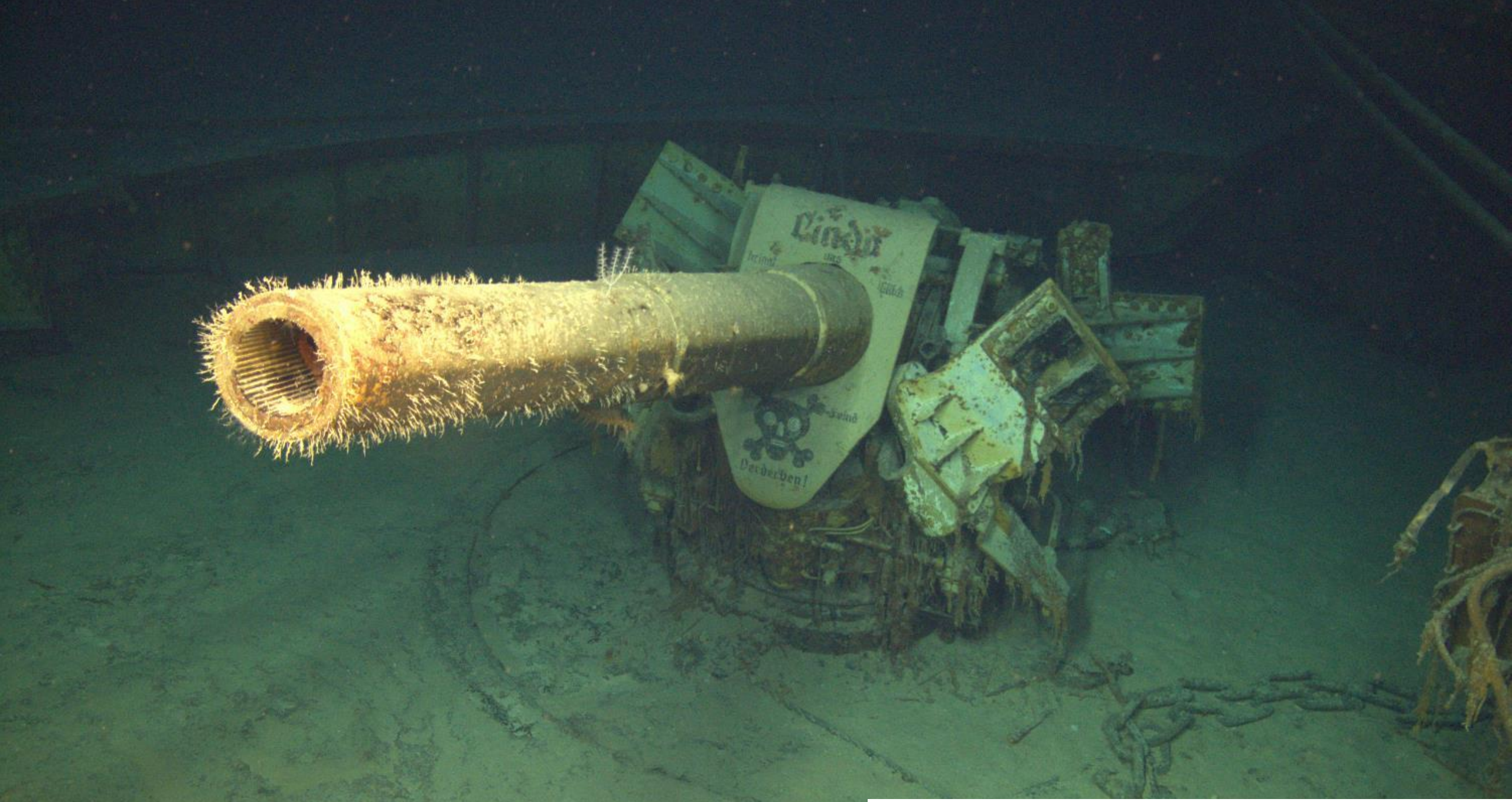


HMAS Sydney (II) Carley float on ocean floor

Image courtesy of WA Museum and Curtin University.

Sydney-Kormoran Expedition 2015 – Sea Anemones on HSK Kormoran
Image courtesy of WA Museum and Curtin University.

Sydney-Kormoran Expedition 2015 – sea mine on HSK Kormoran wreck
Image courtesy of WA Museum and Curtin University.



Sydney-Kormoran Expedition 2015 – 6” gun on HSK Kormoran
Image courtesy of WA Museum and Curtin University.

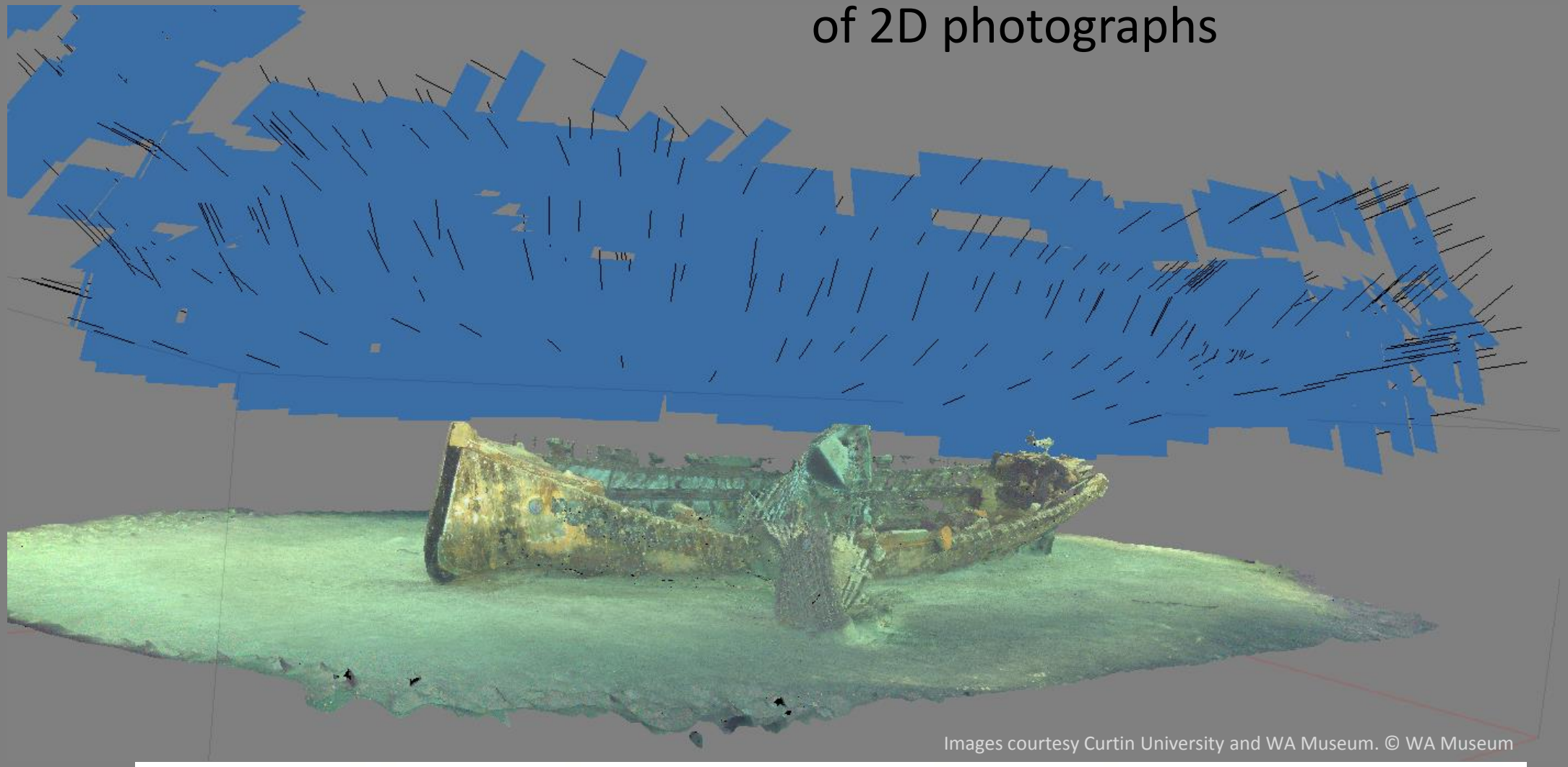
Video

Footage courtesy Curtin University and WA Museum. © WA Museum

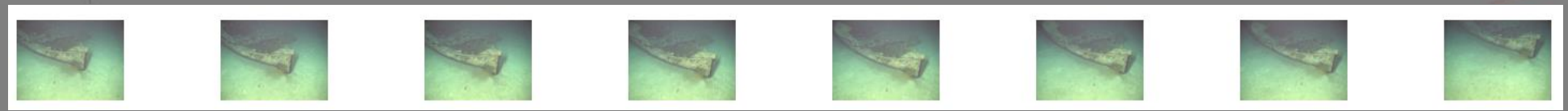
Why so many images?

3D Reconstruction:

Generating 3D models from a series of 2D photographs

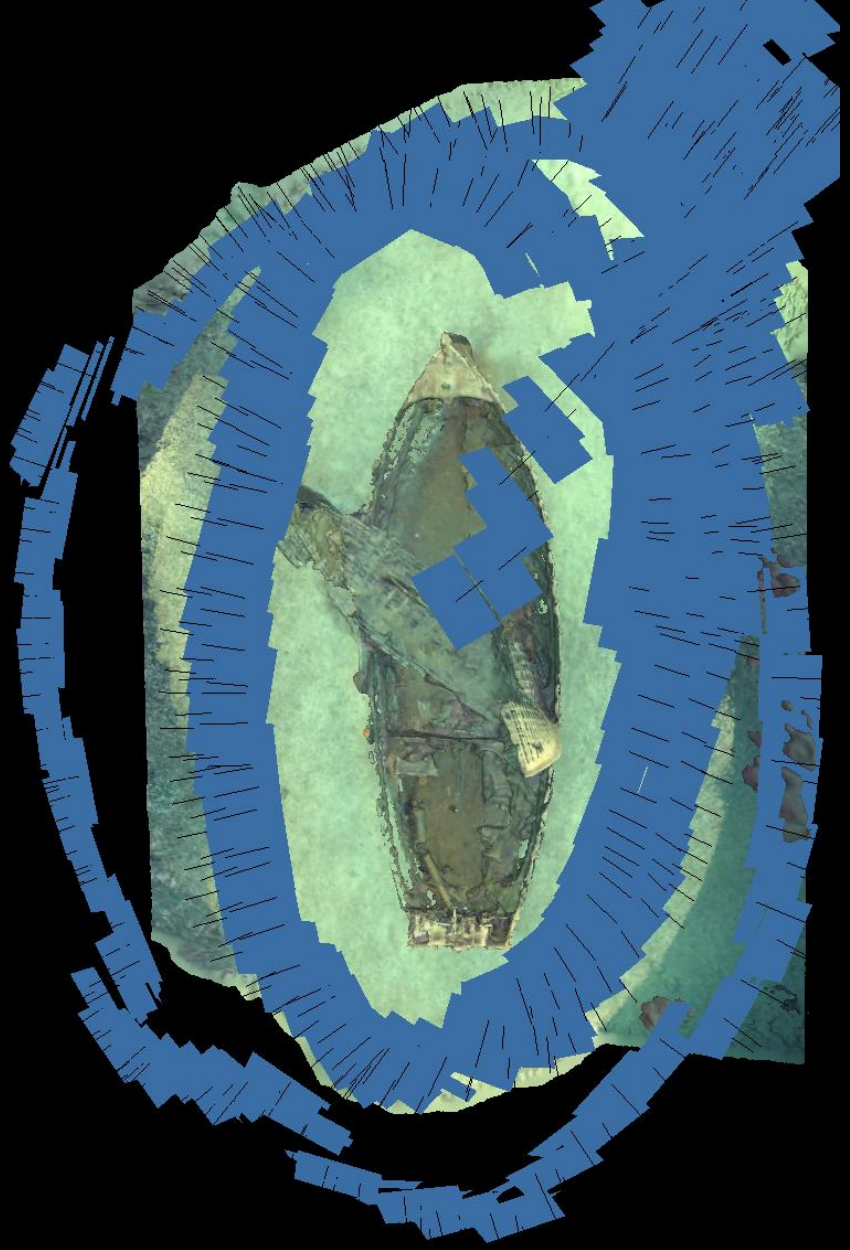


Images courtesy Curtin University and WA Museum. © WA Museum



3D Reconstruction

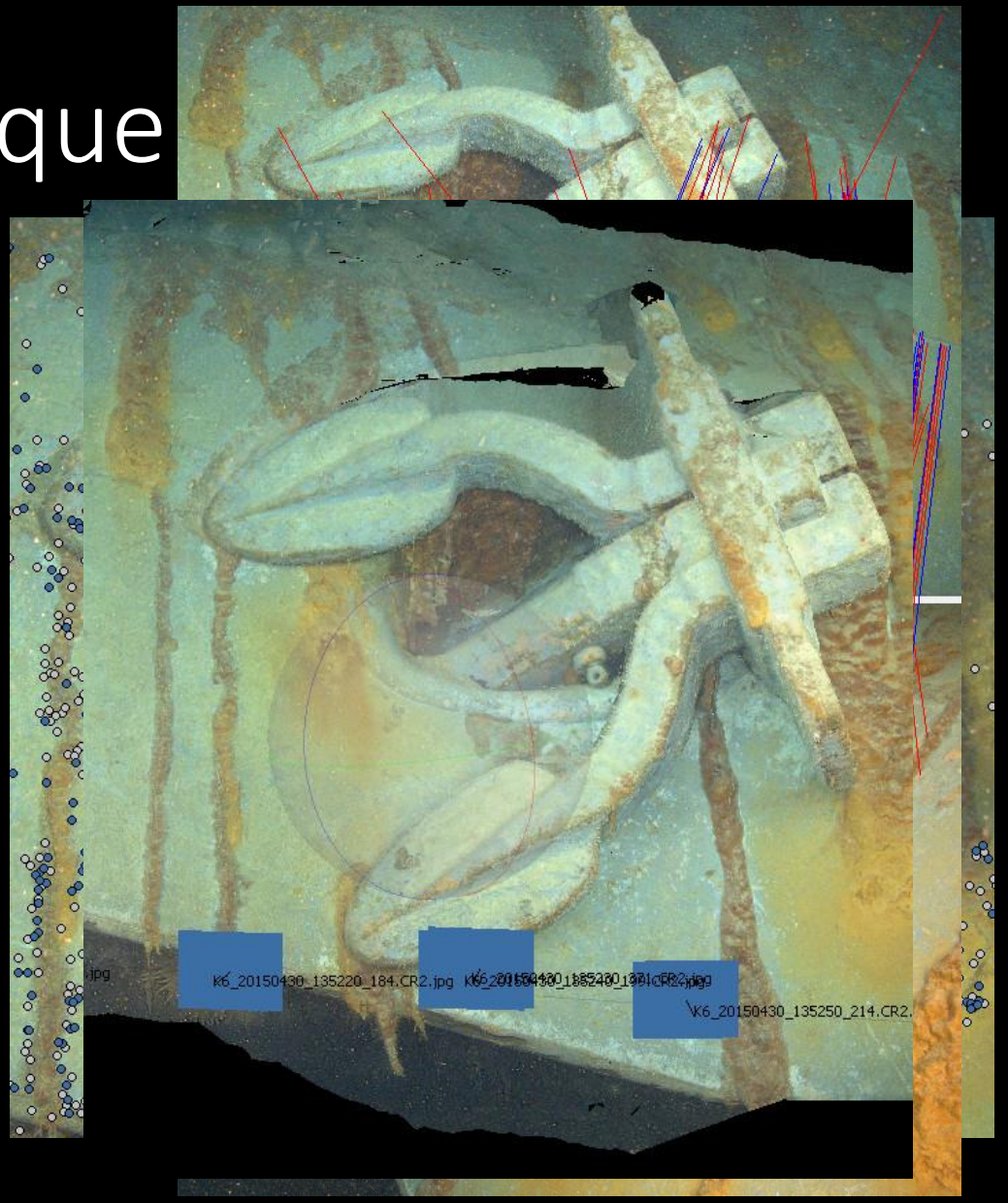
- aka: 3D Photogrammetry, Structure from Motion
- Primarily based on still images but may also use video data to provide more coverage
- Good coverage and lots of angles are important for high-quality models



Images courtesy Curtin University and WA Museum. © WA Museum

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

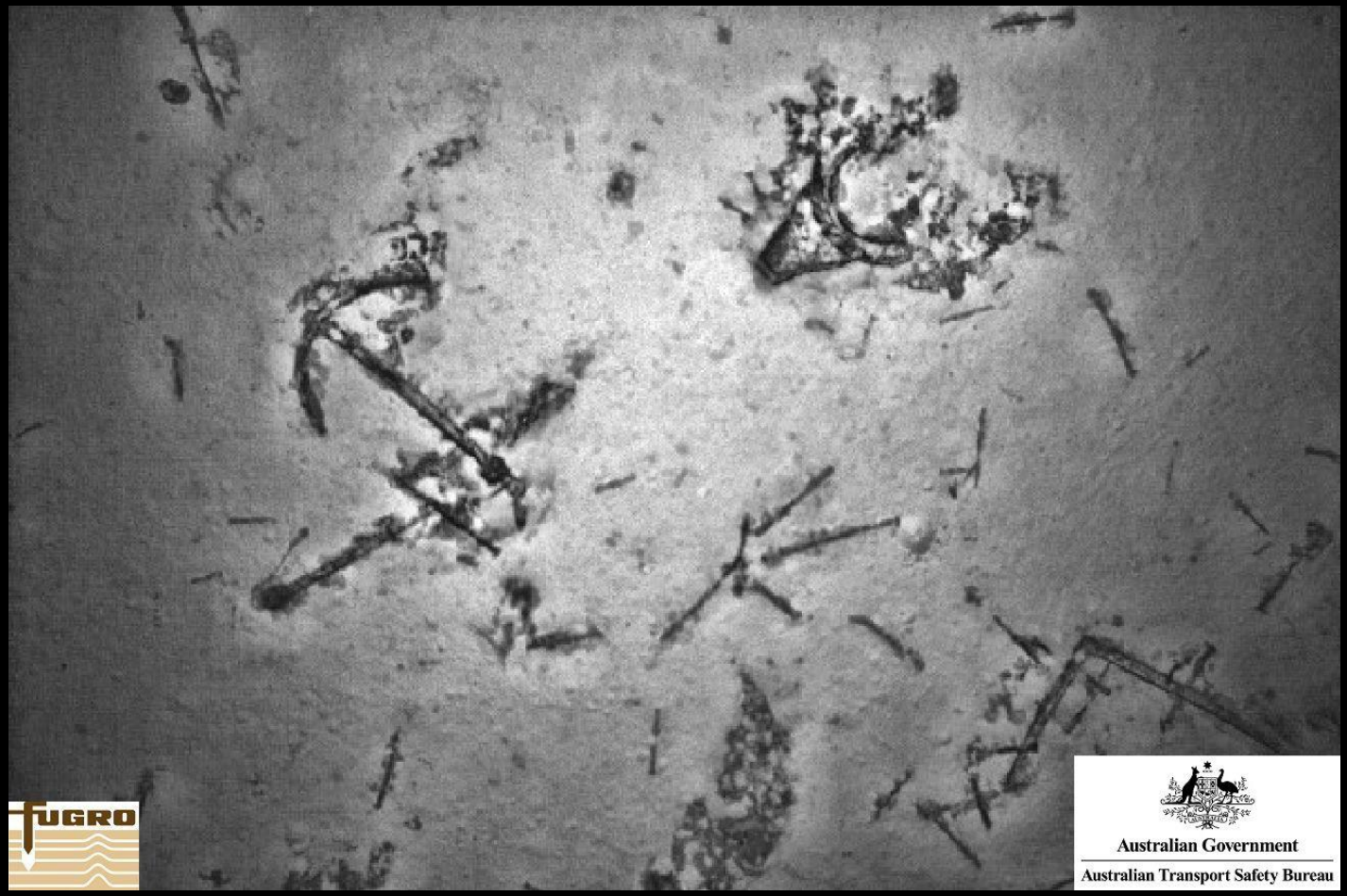


Images courtesy Curtin University and WA Museum. © WA Museum

Video

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.

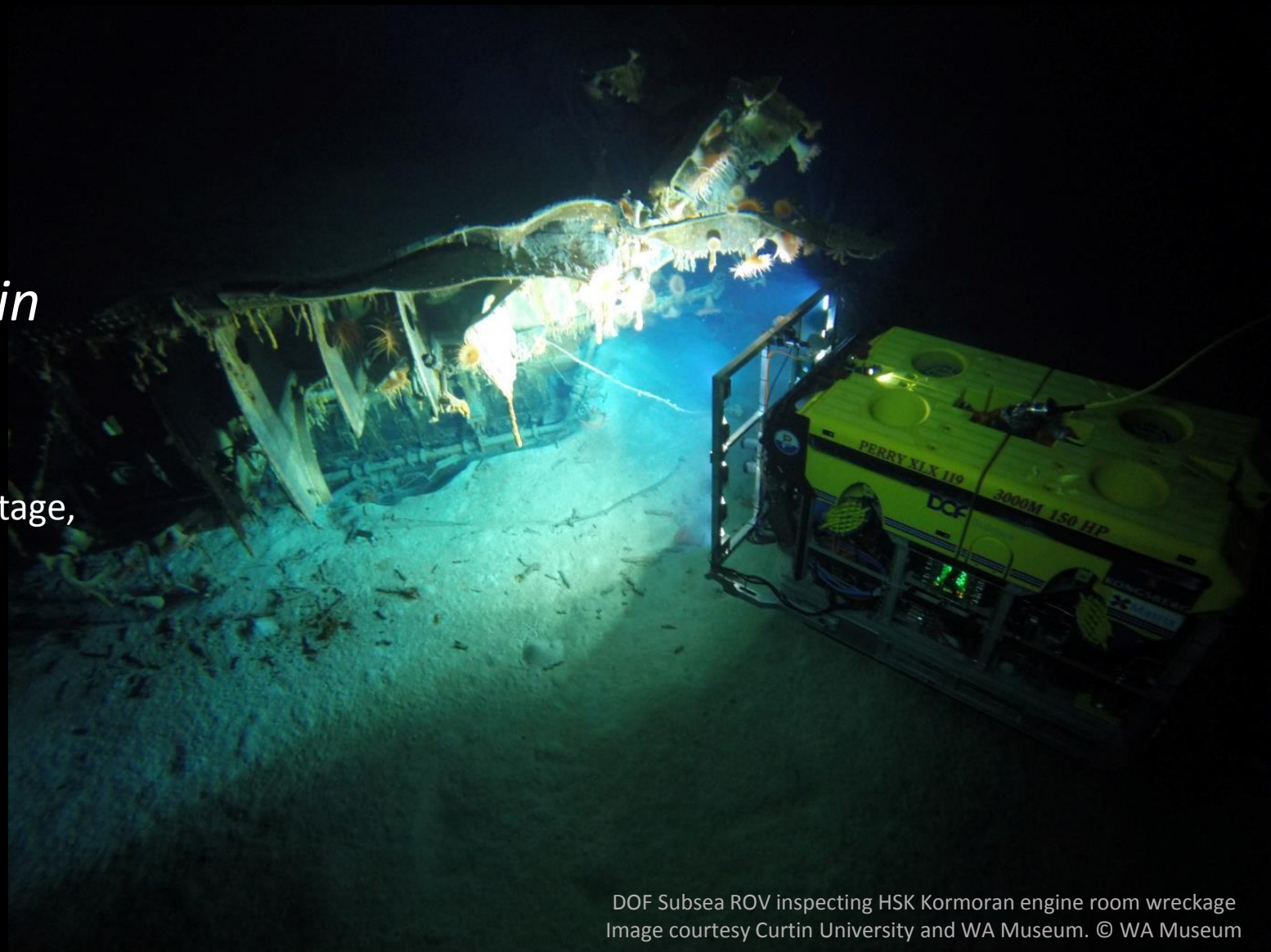
Where from here?

- 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