

A New University-Based Vessel and ROV Platform for Multidisciplinary Ecosystem Research on Canada's West Coast.

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BACKGROUND: In 2009, the University of Victoria and four partner universities (UBC, SFU, U of A and VIU) were awarded \$23.3M from the Canada Foundation for Innovation (CFI) and the British Columbia Knowledge Development Fund (BC-KDF) to acquire and refit a coastal ocean research vessel. The need for such a vessel was predicated on (i) reduced availability of DFO/CCG vessels to university researchers, (ii) the need for a platform from which to deploy remotely operated vehicles (ROVs) in support of the VENUS and NEPTUNE cabled observatories, and (iii) recent growth in the number of ocean researchers at Canada's western universities. In December of 2010, UVic acquired the *Tsekoa II*, a 27m coastal vessel that was about to be surplus by the Canadian Coast Guard. Since then, design plans for refitting the *Tsekoa II* have been completed, with the refit set to begin in early 2012. Briefly, the refit calls for lengthening the vessel from 27m to 36m in length and the addition of new laboratory and cabin space to accommodate a team of eight researchers (the attached two-pager highlights the key innovations and capabilities of the refitted vessel).

RESEARCH OBJECTIVES: The area of operation of the vessel will be the Straits of Georgia and Juan de Fuca, plus BC's numerous fjords and inlets, as well as shelf regions on the west coast of Vancouver Island and Haida Gwaii. The team of investigators who led the project identified five key areas of research to be supported by this vessel: (i) changing coastal ecosystems, (ii) marine resources of coastal BC, (iii) continental shelf and slope dynamics, (iv) social science research in coastal communities, (v) green shipping technologies. Within the context of the Commission's mandate, however, we would like to focus specifically on the first of these themes.

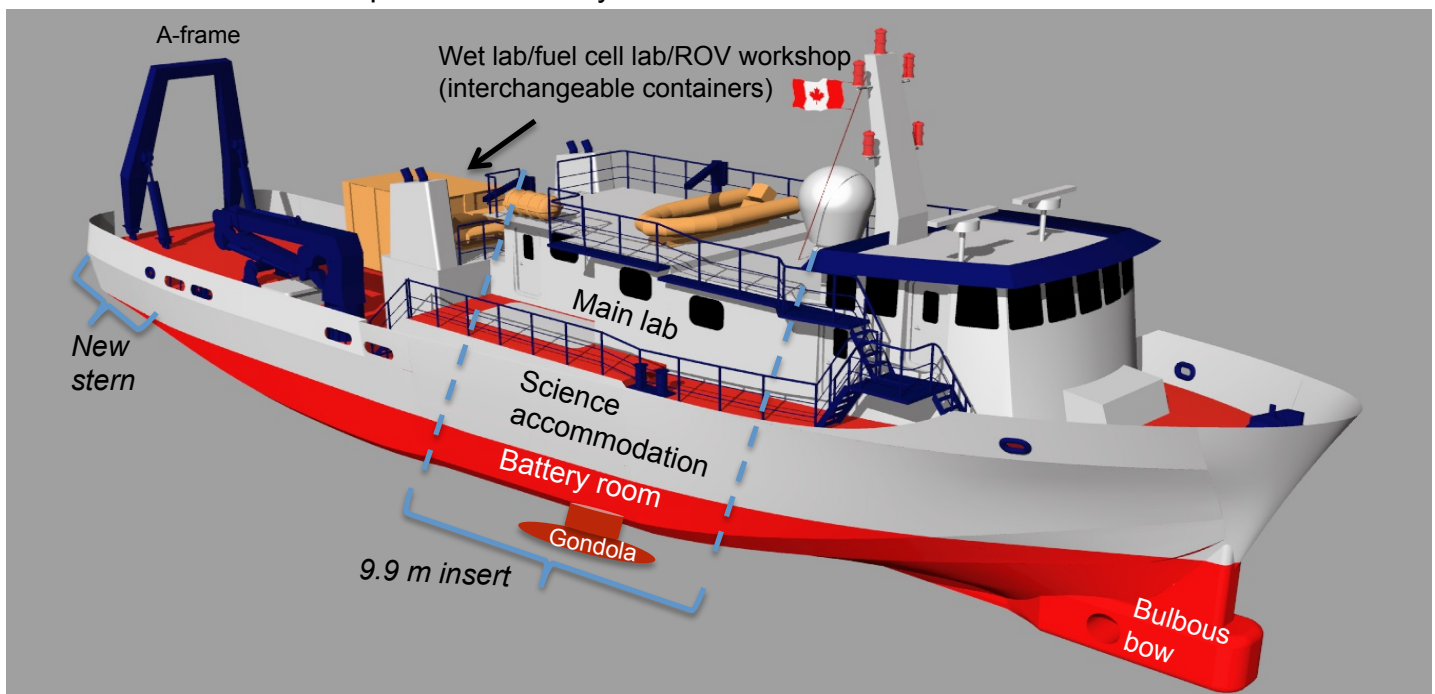
Changing coastal ecosystems: Most, if not all, marine environments in coastal British Columbia are changing at unprecedented rates. In fact, a recent article in *Science* listed the Georgia Basin as one of the most severely stressed marine ecosystems on the planet, largely as a result of expanding maritime traffic and other anthropogenic influences. Within this context, this new vessel will enable university-based researchers to undertake research aimed at understanding and predicting the future trajectories of coastal marine ecosystems in coastal British Columbia, in response to natural fluctuations, anthropogenic climate forcing, and other human influences.

To further our understanding of these important societal issues, this new vessel will be equipped with state of the art scientific sampling gear, including; a fisheries bio-acoustics system, a bottom-habitat classification system, and a full suite of underway oceanographic instrumentation. The vessel will thus support coordinated, multi-disciplinary, time-series studies that also take advantage of the unique infrastructure provided by the VENUS and NEPTUNE Canada cabled observatories. Initial studies will focus on 1) the Georgia Basin, adjacent to metropolitan Vancouver and the intensively farmed lower Fraser Valley, 2) the more remote Barkley Sound, on the west coast of Vancouver Island and 3) the Central and North Coasts of BC. These three areas are key nursery grounds for numerous species of commercially valuable fish species, including salmon. Fixed instruments at VENUS and NC observatory nodes will provide continuous time-series observations in the first two of these areas. Elsewhere, the ship will operate as a "mobile observatory node", gathering data via shipboard instruments linked to the vessel's data management system. The resulting, freely available database will provide a regional context for the fixed ocean observatories and provide new insight into BC's coastal ecosystems.

Conclusions: University-based researchers on Canada's west coast already have a strong track record of conducting high-quality ecosystem-level research. The addition of this new research vessel, together with other recent federal/provincial investments in leading-edge ocean infrastructure (e.g. VENUS and NEPTUNE) have positioned Canada's university-based researchers to play a leadership role in the furthering our understanding of coastal ecosystems and the factors that regulate fisheries production in BC waters. We therefore look forward to seeing the scientific recommendations from the Commission, and playing a role in their implementation in the coming years.

Coastal Research Vessel Refit

- ① Cut original vessel in half and add 9.9 m insert containing:
 - Main laboratory (upper deck)
 - 8 science berths + new mess area (middle deck)
 - Battery room for hybrid power (lower deck)
- ② Remove stern, lengthen by 1.5 m to accommodate:
 - A-frame
 - launch and recovery of ROV and VENUS instrument platforms
 - towing and bottom sampling operations
 - New thrusters and steering gear
- ③ New propulsion system
 - All diesel-electric - most adaptable to hybrid power supply
 - Paired azimuthing thrusters (200 kW ea.)
 - Enhanced maneuverability and quiet operation
 - Bow thruster for maneuvering and station keeping
 - Top speed approx. 10.5 knots
- ④ Add bulbous bow to:
 - House bow thruster
 - Dampen vessel pitch
- ⑤ Add below-hull gondola to house acoustic sensors
 - Sensors separated from surface noise, bubbles and vessel vibrations – improved sensitivity



Coastal research vessel capabilities

① Coastal oceanography

- Full water column sampling and sensing with CTD-rosette
- Seafloor sampling with box corer, grab and trawl
- Two shipboard labs for sample handling, experiments and incubations

② Acoustic sensing

- 4-frequency fisheries sonar for imaging plankton to fish
- Acoustic Doppler Current Profiler (ADCP) for full water column current profiling
- Multi-beam sonar for seafloor mapping
- 3.5 kHz sub-bottom profiler for sensing sediment properties
- Passive hydrophone for marine mammal observations

③ Observatory support

- Launch and recovery of ROV and observatory platform through A-frame, using specialized winches
- ROV acoustic navigation system deployed via through-hull ram
- Dynamic vessel positioning during dive operations
 - Software control of bow and stern thrusters synched to GPS navigation

④ Green shipping research

- All-electric propulsion system accepts power from multiple sources
 - Diesel generators
 - Li-batteries
 - Fuel cell stack
- First ever combined fuel-cell and plug-in battery hybrid ship
 - Experiments with software control of power management
 - 8 hours hotel power or 1 hour propulsion with full battery charge
 - Up to 8 hours propulsion with fuel cell system on board
- Batteries charged from multiple
 - Shore power at wharf
 - Diesel generators
 - Fuel cell stack

⑤ Deck machinery

- Stern and portside A-frames
- Deck crane
- 3 oceanographic winches (hydro, CTD, towing)

⑥ Data archiving

- Onboard server logs and archives all instrument and acoustic data
- Cellular and satellite data links to shore