

# DESSC Subcommittee on Telepresence-Enabled Science Missions: Mandate

Draft a paper providing guidance to potential telepresence science users. The resulting paper should describe:

- Telepresence-enabled science missions
- Modes of operations
- End user expectations
- Operational perspectives – looking at reduced berths
- Limitations
- Products
- Time management considerations
- Logistical considerations
- Recommendations on the utility of telepresence

# Subcommittee on Telepresence-Enabled Science Missions: Participants

- Chris German – WHOI (Chair)
- Dwight Coleman – URI/ISC
- Amanda Demopoulos - DeSSC
- Dave Emerson – DeSSC
- Nick Hayman - DeSSC
- Matt Heintz - NDSF
- Jon Howland - NDSF
- Carl Kaiser - NDSF
- Amanda Netburn – NOAA
- Anna Louise Reysenbach – DeSSC
- Pete Girguis – Harvard/ex-DeSSC
- Annette de Silva – UNOLS (ex officio)

# Proposed Outline:

## Deep Sea Research *Methods* Paper

- Introduction
- Methods: Modes of Operation; Case studies for each.
- Results: Outcomes; Positive & Negative.
- Discussion: Recommendations for future science users
- Summary

# Methods: Modes of Operation

## 1. ROV Operations

- Science Lead at sea; Shore Scientists co-located
- Science Lead at sea; Shore Scientists distributed
- Science Lead on shore; Facilitator at sea; Shore Scientists co-located
- Science Lead on shore; Facilitator at sea; Shore Scientists distributed

## 2. AUV Operations

- Science Lead at sea; Shore Scientists co-located
- Science Lead on shore; Facilitator at sea; Shore Scientists co-located

## 3. Night Programs (swath mapping, CTD casts & tow-yos)

- Science Lead at sea; Shore Scientists co-located
- Science Lead on shore; Facilitator at sea; Shore Scientists co-located

# Results: Benefits

- A huge pool of scientists is available on shore to contribute to the intellectual expertise of a cruise.
- Telepresence allows each shoreside scientist to participate in only those portions of a cruise that are of interest/relevance.
- Telepresence offers more opportunity for accessibility to cruises: huge potential to improve diversity/career opportunities.
- Telepresence allows more opportunity for rescoping the science program in response to discoveries made at sea – especially when pertinent expertise is not represented among the shipboard team.
- Allows shore scientists, less taxed by seagoing activities, to provide fresh perspective and data advice/guidance to the shipboard team. Especially valuable on long/demanding cruises.
- The organized data streams that are important for an effective telepresence-enabled cruise can also make for well-archived data.

# Results: Challenges

- Decentralized planning requires care, can be inefficient.
- Multiple opinions, some based on less context than others, adds complication to decision-making.
- Substantial communication effort required to keep shore party informed as well as to plan forward.
- Part-time participants ashore can be disruptive to achieving overall cruise objectives if they lose track of “big picture”.
- Situational awareness ashore is less than at sea
- Ship-based team typically even less aware of shore team than vice versa (shore participants easily overlooked by busy ship team = frustrating !).
- Participants ashore can be unreliable due to competing professional/ personal commitments, not experienced at sea.
- At sea, being constantly “overwatched” can be draining.

# Discussion: *Draft* Recommendations

- Done well, telepresence is sufficiently beneficial to be worth pursuing
- Effective telepresence requires detailed advanced dive planning
  - NDSF dives would benefit from the same level of discipline:
  - Sentry requirement / Alvin best practice / Jason more effective.
- Effective telepresence also requires **two-way** communications:  
Shore to ship as well as Ship to Shore.
- To broaden \*awareness\* of Telepresence among ocean scientists, NOAA-OER and OET should routinely inform DeSSC/UNOLS of forthcoming Okeanos Explorer & Nautilus cruises & participation options.
- Effective use of telepresence from a remote location (e.g. home laboratory) will benefit from a progression that includes experience both at sea *and* in a structured on shore environment (e.g. URI's Inner Space Center).
- To implement telepresence for research, we recommend that a PI's easiest path to success would be to restrict shore-based participation to "by invitation only" – i.e. an on-shore extension of the similarly selected sea-going cruise participants.

# An Idealized NDSF Telepresence Capability

- Shore-based participants in a cruise should expect, and be expected, to serve as an active team member who has recognized and designated “science watches” but who, like shipboard scientists, is also on-call, 24/7.
- On shore participants should expect to be able to advise, but never out-rank, at sea participants over final decisions (situational awareness). As with shipboard scientists, the Chief Scientist’s decision is what the ship works with.
- Shore based participants should expect to be able to play an active role in:
  - science meetings (dive planning/post-dive evaluation)
  - vehicle & instrument preparation (incl. trouble shooting)
  - real-time engagement in dive progress (video, nav. GUI)
  - monitoring post-dive sample handling/lab. processing
  - active participation in data manipulations/documentation



# Implementation: Advantages

- Effective use of telepresence could help make more effective use of limited bunk-space as we continue to pursue complex multi-disciplinary science
  - useful for single vehicle ops on Armstrong, Ride and Kilo Moana
  - useful for dual-vehicle ops on Atlantis, Revelle, Thompson, other global
- There will ALWAYS be a need for scientists working with samples to be at sea. But for current ROV Jason ops, control van requires 48 scientist-hours of effort per day, beyond watch-keeping, just to manipulate **digital** information.
- Scope exists to port scientific efforts to shore that could include:
  - ROV dive operations (watch leads, event and data loggers)
  - AUV data manipulation / mission planning.
- Scope exists to port engineering efforts to shore :
  - Data QA/QC

# Implementation: Challenges

- Facilitating effective communications for telepresence may require additional NDSF/ISC support (with new skill sets) out at sea.
- Facilitating effective communications for telepresence may also require additional NDSF/ISC support (with new skill sets) on shore.
- Porting NDSF engineering effort to shore would not mean that individual shore staff are as available as at sea (16h/day, 7d/week).
- Less engineering support staff at sea would reduce the number of engineers available when things need fixing.