



# 2 Year Review Outline



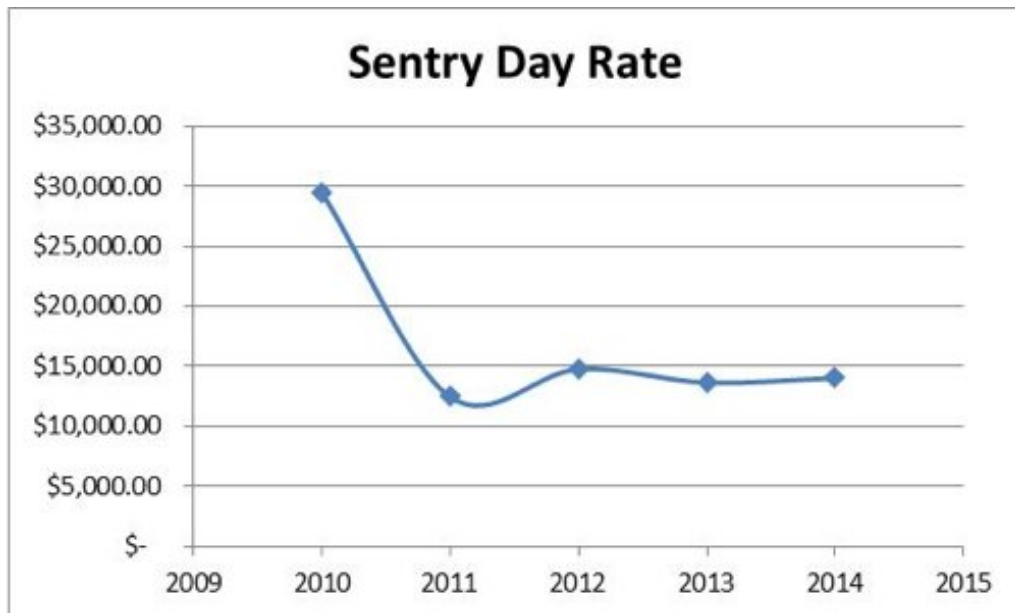
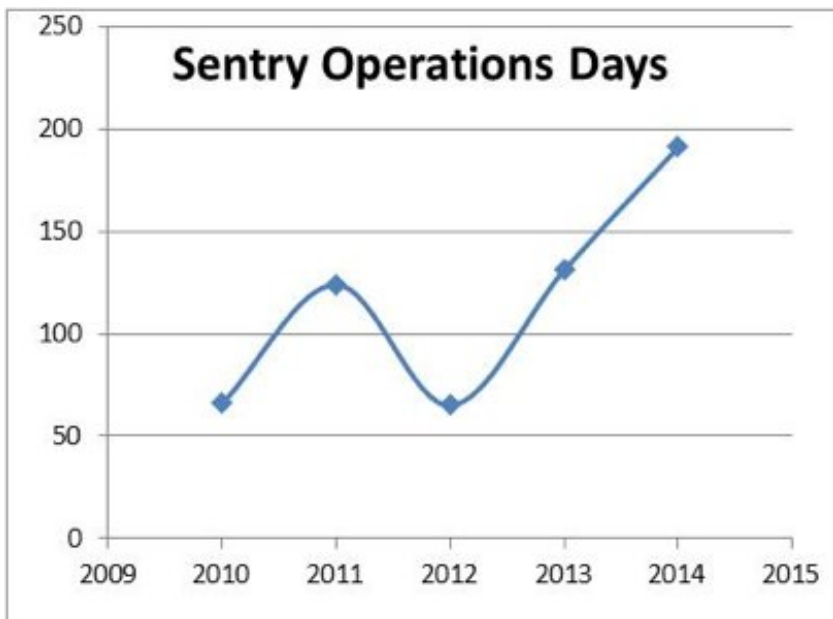
- Summary of *Sentry* NDSF Operations
- Concerns
  - Staffing
  - Depth Capability
  - Specification Matching and Testing
  - Documentation
  - Website
- Future Vision



# 2 Year Review Utilization



- 226 dives since 2010
- 17 different PIs since 2010
- Multiple NSF-sponsored and external cruises where *Sentry* was requested but could not be scheduled





## 2 Year Review Major Upgrades



- 4500m → 6000m
- Sustainable staffing
- Simplified operation → Easier to staff
- Many new instruments
- New support infrastructure
- Several new data pipelines
- Documentation and web site
- New propulsion
- Much larger payload



# 2 Year Review Total Staffing



Category	Regular and Fully Trained	Regular and in Training	Emergency Backup (at sea w/ Sentry at least once)	Total
<b>June 2010</b>				
Mechanical	2	0	0	2
Electrical	1	0	0	1
Software/Data	2	0	0	2
EL	1	0	0	1
<b>June 2014</b>				
Mechanical	2	1	2	5
Electrical	2	1 crossover w/ SW	3	6
Software/Data	5	1 crossover w/ EE + 2	0	8
EL	4	1	0	5



# 2 Year Review Depth Upgrade



- Extensive root cause analysis
- Extensive modifications and testing
- 28 dives > 5000m since correcting the issues
  - *No depth-related failures*



## 2 Year Review

# Testing and Qualification



- Requested and received 2 engineering dives per year
- Much more extensive and formal pressure and functional testing requirements before integration
- In order to keep pace with innovation, we still have to take many capabilities into the field not yet tested in deep water
  - AUVs are fast evolving
  - *Sentry* aims to both keep pace and innovate in order to be relevant to science
  - Not likely to change, but:
    - Changing how engineering dives are scheduled
    - Warn PIs well in advance
    - Distinguish between standard and experimental
    - Fallback plans in place



# 2 Year Review Web Site



- Still under construction, but most content now up
- Please tell us what else you want

Main *Sentry* Page:

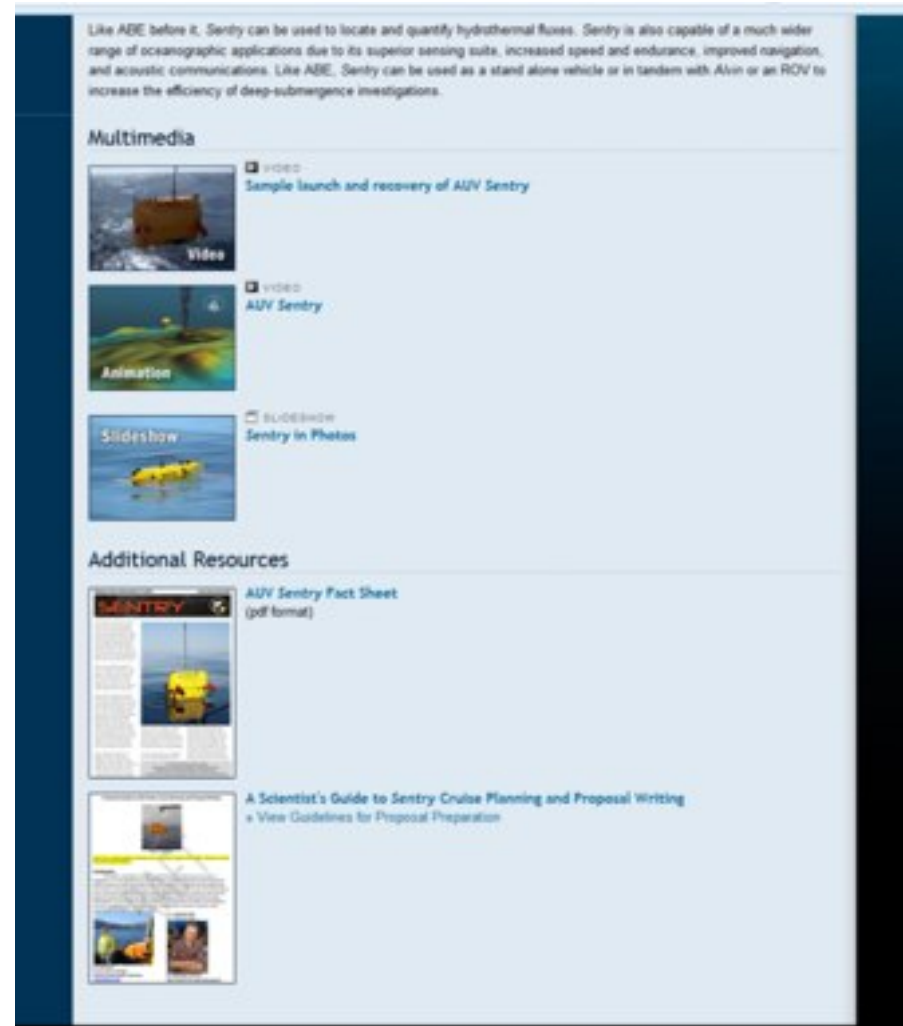
<http://www.whoi.edu/main/sentry>

Planning Guide:

<http://www.whoi.edu/>

[fileserver.do?](http://www.whoi.edu/fileserver.do?)

[id=159424&pt=10&p=39047](http://www.whoi.edu/fileserver.do?id=159424&pt=10&p=39047)





# 2 Year Review Operations Summary & Basic Metadata



Eventually link to map

Eventually link to gridded data

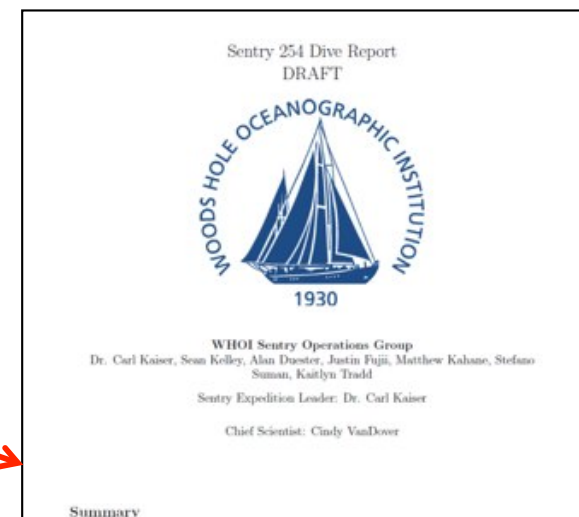
Dive #	Cruise Name	Chief Scientist Name	Embargoed?	Area	Data Summary	Map	Multibeam	Images
sentry001			No					
sentry002			No					
sentry003			No					

Link to Chief Scientist e-mail

Link to Cruise Report if data embargo is over

Link to Dive Report if data embargo over and standalone dive report was generated

Dive #	Cruise Name	Chief Scientist	Date	Area	Embargoed?	Notes
sentry162	KuK13-08_Okazaiki12	DORD	Oct. 2014	Ogishiro Clarion Fracture Zone		
sentry163	KuK13-08_Okazaiki12	DORD	Oct. 2014	Ogishiro Clarion Fracture Zone		
sentry164	T1293_Moyer13	Craig Moyer	Mar. 2016	Lohs Seamount		
sentry165	T1293_Moyer13	Craig Moyer	Mar. 2016	Lohs Seamount		
sentry166	T1293_Moyer13	Craig Moyer	Mar. 2016	Lohs Seamount		
sentry167	T1293_Moyer13	Craig Moyer	Mar. 2016	Lohs Seamount		
sentry168	T1293_Moyer13	Craig Moyer	Mar. 2016	Lohs Seamount		
sentry169	T1293_Moyer13	Craig Moyer	Mar. 2016	Lohs Seamount		
sentry170	T1293_Moyer13	Craig Moyer	Mar. 2016	Lohs Seamount		
sentry171	T1293_Moyer13	Craig Moyer	Mar. 2016	Lohs Seamount		
sentry172	T1293_Moyer13	Craig Moyer	Mar. 2016	Lohs Seamount		
sentry173	K1210-05_Smith13	Deborah Smith	No	Mid Atlantic Ridge		
sentry174	K1210-05_Smith13	Deborah Smith	No	Mid Atlantic Ridge		
sentry175	K1210-05_Smith13	Deborah Smith	No	Mid Atlantic Ridge		
sentry176	K1210-05_Smith13	Deborah Smith	No	Mid Atlantic Ridge		
sentry177	K1210-05_Smith13	Deborah Smith	No	Mid Atlantic Ridge		
sentry178	K1210-05_Smith13	Deborah Smith	No	Mid Atlantic Ridge		
sentry179	K1210-05_Smith13	Deborah Smith	No	Mid Atlantic Ridge		
sentry180	K1210-05_Smith13	Deborah Smith	No	Mid Atlantic Ridge		
sentry181	K1210-05_Smith13	Deborah Smith	No	Mid Atlantic Ridge		
sentry182	K1210-05_Smith13	Deborah Smith	No	Mid Atlantic Ridge		
sentry183	K1210-05_Smith13	Deborah Smith	No	Mid Atlantic Ridge		
sentry184	K1210-05_Smith13	Deborah Smith	No	Mid Atlantic Ridge		
sentry185	K1210-05_Smith13	Deborah Smith	No	Mid Atlantic Ridge		
sentry186	K1210-05_Smith13	Deborah Smith	No	Mid Atlantic Ridge		







# 2 Year Review Sample Data



The screenshot shows a webpage titled "Sample Data Products" with a navigation menu on the left. The main content area lists several data categories:

- Sample Sidescan & Sub-bottom
  - Sub-bottom
  - Sidescan
  - Raw
  - Navigated
- Sample SSC File
  - sentry100\_20120721\_1726 ssc
- Sample PPL File
  - sentry100\_20120721\_1721 ppl
- Sample Photos
  - Old Camera (pre 2014)
    - Thumbnails
    - Raw
    - Movies
    - Kml
    - Color Corrected
  - New Camera (2014)
- Sample Multibeam
  - Water Column
  - Bathymetry Snippets
- Sample Magnetic Data
  - 20120721\_0400 MAG
- Sample Engineering, communications, and basic sensor logs
  - BASIC\_LOGS\_README.txt
  - raw
    - topside nav
    - subsea nav
  - rsv (engineering and basic sensor)
    - 20120721\_0404 MSRAW
    - 20120721\_0400 THRUST
    - 20120721\_0400 SDY
    - 20120721\_0400 SDE
    - 20120721\_0400 SCS
    - 20120721\_0400 SCL
    - 20120721\_0400 SDE49
    - 20120721\_0400 RSVFASCR
    - 20120721\_0400 RBSTE
    - 20120721\_0400 PHD
    - 20120721\_0400 OPT

- Most types of data now on line for at least one dive
- If more detail needed, still best to contact us directly



# 2 Year Review Documentation



## “A Scientist’s Guide to *Sentry* Cruise Planning and Proposal Writing”

A Scientist's Guide to AUV Sentry Cruise Planning and Proposal Writing





Figure 1- AUV Sentry


**Introduction**

→ This guide is intended to provide you with the basics of planning a Sentry dive or expedition. It is not intended to be and cannot be a complete reference (in part because we pride ourselves on trying new things to solve your problems). As always we encourage early and frequent interaction. We are more than happy to, indeed prefer to, be involved and aware even as you write your proposal. Many people and resources exist to assist you, but two key points of contact for you are the Sentry Project Manager and the Chief Scientist for Deep Submergence. Due to frequent travel schedules, contacting both Carl Kaiser and Adam Soule is recommended. As soon as they are contacted they will pull in whatever other resources are necessary to meet your needs.

Section Break (Continued)

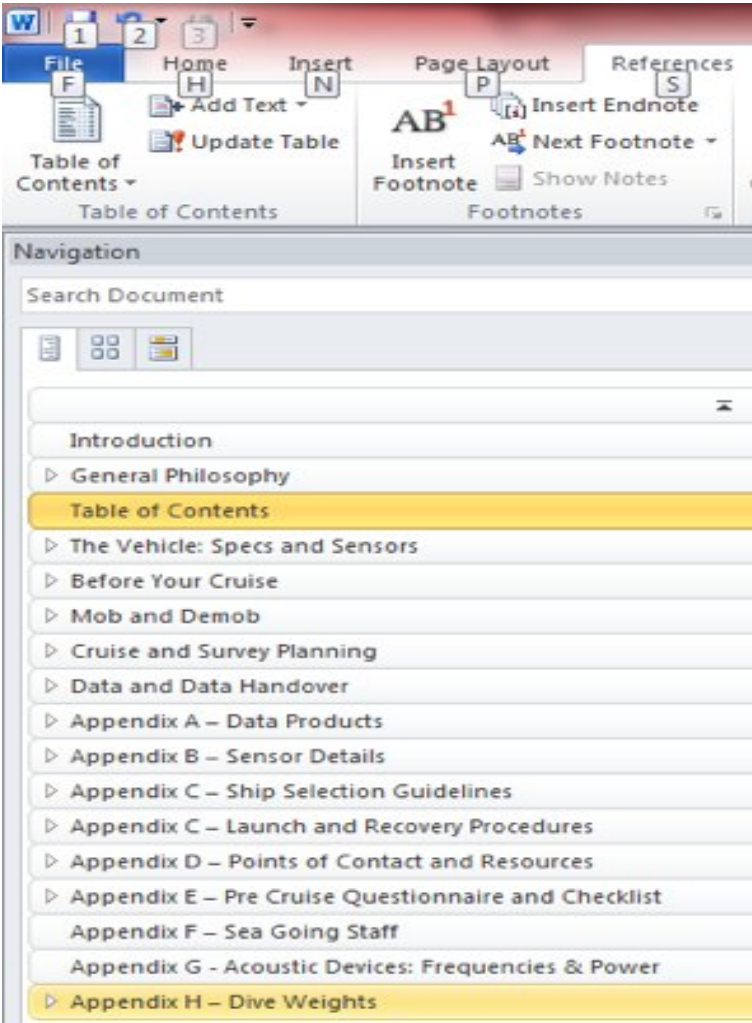


**Dr. Carl Kaiser**  
Sentry Project Manager  
Woods Hole Oceanographic Institution  
[ckaiser@whoi.edu](mailto:ckaiser@whoi.edu)  
p. +1-508-289-3269  
m. +1-970-217-1328



**Dr. Adam Soule**  
Chief Scientist for Deep Submergence  
Woods Hole Oceanographic Institution  
[asoule@whoi.edu](mailto:asoule@whoi.edu)  
p. +1-508-289-3213

Section Break (Continued)



Navigation

Search Document

- Introduction
- ▷ General Philosophy
- Table of Contents**
- ▷ The Vehicle: Specs and Sensors
- ▷ Before Your Cruise
- ▷ Mob and Demob
- ▷ Cruise and Survey Planning
- ▷ Data and Data Handover
- ▷ Appendix A – Data Products
- ▷ Appendix B – Sensor Details
- ▷ Appendix C – Ship Selection Guidelines
- ▷ Appendix C – Launch and Recovery Procedures
- ▷ Appendix D – Points of Contact and Resources
- ▷ Appendix E – Pre Cruise Questionnaire and Checklist
- Appendix F – Sea Going Staff
- Appendix G – Acoustic Devices: Frequencies & Power
- ▷ Appendix H – Dive Weights



# 2 Year Review

# Capabilities and Planning



Coverage Rate --- 10,000 m<sup>2</sup>/h

Space photo coverage

In this case the adjacent track lines become more spread out and overlap along track is reduced by increasing vehicle speed to 1.6kts (0.8m/s)

Coverage Rate (50% across track, no overlap) --- 50,000 m<sup>2</sup>/h

Coverage Rate (10% across track, no overlap) --- 100,000 m<sup>2</sup>/h

Dive Times, Turn-Around, Schedules, and Crew Rest

Dive Durations

Dive time is most frequently limited by battery capacity. Dives can generally be as short as desired (with some limitations on numerous very short dives) and can be terminated early on command.

When the battery is the determining factor in dive duration, several factors play dramatic role including speed, sensors, and depth. For a full charge (see turn-around section for exceptions), you should assume that you have 90% of the battery for use and then estimate times based on utilization of that battery. Typical values for both hourly usage and dive duration are given in Figure 7. Note that Ascent does not need to be included as part of the 10% not available to science. Other components of the 10% are contingency power and final pre-dive power. Typical on-bottom survey times in 2-3km of water are given as:

Activity	Range of 1/2 battery on bottom	Typical on bottom range of water
Descent	2-3:30	2-3:30
Surveys	3:00-4:00	3:00-4:00
Ascent	4:00-4:30	4:00-4:30
Turn-around	4:30-5:00	4:30-5:00
Pre-dive	5:00-5:30	5:00-5:30
Post-dive	5:30-6:00	5:30-6:00

Figure 7 - Typical Battery Usage (hours)

When determining Ascent and Descent times, 40m/min is a conservative number and is the one we encourage scientists to use. Under certain payload conditions, we can achieve as much as 50% more than this, but you will need to contact us ahead of time to discuss if you want to plan for anything other than 40m/min.

Turn-Arounds

Coverage rate formulas for standard survey types

Battery Use Rates

- Goal was to provide sufficient information to scientists to plan standard cruises without help if they wanted
- Still need to contact us for unusual situations
- Still happy to help and/or provide plans to anyone who doesn't want to wade through this

An accelerated turn-around with a partial battery charge is also possible. This faster turn-around results in only 75-80% of the battery capacity useable to science but saves 5-6 hours in the turn-around at a typical cost of 2-4 hours of dive time. The space between these two options is a continuous spectrum. In practical point, the decision between these two turn-around options will often be decided based on crew rest considerations as described below.

Figure 9 - Accelerated Turn Around for Partial Battery Charge

Important Notes:

- Depending on depth, the ship must be in USBL coverage (typically 1/2 - 1 water depth) two to three hours ahead of planned surface time. The exact timing will be up to the Expedition Leader, but the goal is always to have confirmed tracking at least 30 minutes before Sentry leaves the bottom. Depending on the uncertainty of the time of end-of-mission, weather, currents, vessel, and many other factors, this may be as much as 3 hours.

Typical Turn Around Times and Dive Schedules

Excerpts from Scientist's Guide



## 2 Year Review Future Vision



- Continued focus on simplification & reliability
  - Easy things easy – hard things possible
- Continued focus on innovation
  - Continue to expand relevance to Biology
  - Move up into the midwater – e.g. follow thermoclines/haloclines
- Second vehicle (probably non-NDSF)
  - We're turning away cruises with good science and good engineering left and right because of schedule