

**The 2018-2019 TIOGA Working Group
Final Report
January, 2019**

Executive Summary

The Tioga Working Group was convened after the catastrophic engine failure and crew resignation that occurred in 2018 to assess the business and operational model of the R/V Tioga. While it is the smallest vessel WHOI operates, the Tioga is the only Coast Guard certified vessel the institution owns. This report serves as the final product of the working group and contains all pertinent information from a 5-month data gathering and assessment process.

From these assessments, it is clear that the Tioga is a highly-valued facility of the institution and is uniquely equipped to support the institution's core mission. However, the operational model for the vessel is not sustainable, and over the past 5+ years, served to exacerbate known maintenance issues with the ship's engines. In effect, the events of 2018 were symptoms of a larger problem that left the vessel starved of resources and isolated the former crew. Users currently have low confidence in the vessel's reliability, Ship Operation's administration of the vessel, and the experience of the crew.

The repowering that is presently taking place is just the first step towards ensuring proper operation of the vessel. The institution must also invest in crew training, change operational procedures such as scheduling and onboard science support, and alter the business model of the vessel. Ten specific suggestions for improvement are given to ensure both the original investment in the vessel and this most recent investment in new engines will be successfully utilized to support WHOI's mission for the decade to come.

Report Outline:

1. A Pertinent History of the R/V Tioga
2. Working Group Goals and Methods
3. Findings
4. Detailed Suggestions for Improvement
5. Working Group Membership
6. Appendices

1. A Pertinent History of the R/V Tioga

April 2004	WHOI takes possession of the purpose-built coastal research vessel, designed and constructed with funds donated to the Institution.
2014	After a decade of service to the institution, the engines – twin turbo-charged Detroit Diesels -- are seen to be problematic, with multiple failures and higher than anticipated maintenance requirements due to both high wear and substandard parts.
2016	Ken Houtler and Ian Hanley complete 12 years of service to the institution as Captain and Mate of the Tioga.
Fall 2016	The Tioga is laid up for 5 months due to an engine failure.
June 2017	Mechanical failures limit operations for 3-4 weeks.
Fall 2017	Ship Operations requests funds to re-power the vessel (i.e. a total replacement of both engines, transmissions, etc. ~\$1M) or purchase a 3 rd unit of the existing engine (~\$70k) to have a backup on hand if needed. Neither are approved as part of the 2018 budget.
May 8 th , 2018	50 NM offshore in route to the shelf break, the starboard engine suffers a catastrophic failure, creating a 4x8” hole in the engine block and filling the engine room with superheated fluids and engine fragments.
Late May 2018	Ship Operations receives funding to purchase a replacement. A brand-new Detroit Diesel engine of the existing engine type (referred to here as Engine A) is purchased for delivery in September 2018.
June 2018	Al Suchy retires as Marine Operations lead and is replaced by Tim Twomey. A used Detroit Diesel engine of the existing engine type (Engine B) is located and ordered for delivery in July.
July 2018	The rebuilt Engine B arrives and is installed in the Tioga. Houtler and Hanley express concern about the vessel’s reliability and safety due to the engines to Ship Operations. They later resign.
August 2018	Eric Benway and Hank Ayers are charged with overseeing the daily operations of the scheduling and maintenance respectively. The vessel, with Engine B, is put back in service with a contract crew. On its first operational day, Engine B suffers substantive mechanical failure and is pulled from the boat to be overhauled and rebuilt again, a 4-week process.
September 2018	The vessel is put back into service using Engine B, again with a contract crew, conducting two trips. Staff council approves re-powering the Tioga using new

Caterpillar engines, which will require a major overhaul of the vessel. Engine A is received and placed into storage.

- October 2018 Pete Collins is hired as the Tioga's Captain. Five trips are made with the new Captain and contract Mate. Late in the month, divers are called out from WHOI to cut lines fouled on the prop shaft due to operational errors, incapacitating the vessel at sea.
- November 2018 Tioga completes three trips before suffering mechanical issues in route to a dive operation, aborting the trip. Diagnosing, repairing, and sea-trials take one week. The WHOI Dive Safety Officer suspends all dive operations from vessel citing continued mechanical issues and crew training as concerns.
- December 2018 Tioga completes one trip before preparing for shipyard and refitting. The vessel was unavailable for use after December 16th and will be unavailable until April 2019.

2. Working Group Goals and Methods

The Tioga Working Group sought to provide the Institution information and recommendations on the following two questions (*See Appendix A for details*):

- What capabilities should the vessel have over the next 10 years of its life?
- What is the appropriate operational/business model for this vessel at the Institution?

Data were collected from the internal financial reporting tools available to the group's members, SSSG-collected data on the Vessel's usage, and publicly available information on comparable research vessels in the same class. Interviews were also conducted with WHOI Ship Operations personnel, WHOI Finance personnel, and personnel from other institutions that host comparable research vessels. A survey of users was conducted using an online survey tool.

The working group met approximately once per month in addition to email communications to review its charge, define the data sets that would be needed, and analyze and evaluate the results. The final report was read by all group members and the group unanimously agrees with the findings described below.

3. Findings

The group's findings can be summarized by three main statements, each of which are supported below with additional details:

1. The R/V Tioga is a highly-valued facility of the institution which is uniquely equipped to support the institution's mission.
2. Users currently have low confidence in the vessel's reliability, Ship Operation's administration of the vessel, and the experience level of the crew.
3. The business model for the vessel is not sustainable in its current form.

3.a. Why the Tioga is valuable to WHOI

The R/V *Tioga* is a purpose-built, 60', aluminum-hulled coastal research vessel designed and outfitted to conduct a wide range of oceanographic sampling, support, and lifting operations. ***Small, light, and fast, the Tioga was designed to do the same activities as boats twice its length and ten times its displacement but operate in the narrow weather windows that can exist in the Northeastern US.***



Image Credit: Ken Kostel

In the past 14 years since arriving at WHOI, the *Tioga* has sampled harmful algal blooms throughout the Gulf of Maine, conducted detailed turbulence surveys of the Hudson, overnighted at the shelf break off New Jersey and New England, recovered gliders, floats, and AUVs, conducted tracer releases, tagged right whales, serviced MVCO operations, served as a test platform for new and old instruments destined for bigger ships and open ocean work, and provided an introduction to the ocean and ocean sampling techniques for 100s of undergraduates and graduate students (*See Appendix B for example vessel ranges*).

The boat has made more than 1000 cruises over its lifetime. On an average year, the R/V *Tioga* will spend around 90 days at sea.

Specific comparisons to other vessels in the same class, defined here as regional vessels of similar size, utility, or purpose that have been utilized by WHOI staff, have shown that the *Tioga* is highly capable. Summarized in ***Table 1***, a detailed assessment of the *Tioga*'s value over a replacement vessel suggests that:

- The *Tioga* is generally 50% faster than comparable vessels
- Capable of the widest variety of at-sea tasks
- Carries the widest suite of vessel-provided sensors and equipment

Table 1: Vessels-in-Class Comparisons*

Name	R/V Tioga	R/V Discovery	R/V Connecticut	R/V Gulf Challenger	R/V Scarlett Isabella	F/V Gloria Michelle
Owner	WHOI	Ryan Marine	U. CONN	UNH	Boston Harbor Cruises	NOAA
Size /Speed	60'/18knots	60'/12knots	103'/10knots	50'/18knots	135'/10knots	72'/ 11knots
Capabilities	CTD/other survey, mooring ops, vehicle ops On-board winches and sensors	Vehicle ops, Survey with own supplies, supply operations	CTD/other survey, mooring ops, vehicle ops On-board winches and sensors	CTD/other survey, mooring ops, vehicle ops On-board winches	Mooring ops with own supplies, Surveys with own supplies	Survey/other, with own supplies
Rates (full day equivalent)	\$3700, 12-hr	\$2700, 10-hr	\$9000, 24-hr, doesn't include transit from Groton (1 full day extra)	\$2700, 8-hr. Doesn't include transit from Portsmouth (1 full day extra)	\$12-14K, 24-hr. Doesn't include transit from Boston (2 full days extra)	\$4400/day
Additional Charges	None	Fuel, loading time, weather days	CTD, ADCP, small boat, CTD Tech	CTD, CTD Tech, extended day/away from port +50%	Winch, accessories.	Not known
Operational Subsidies	Vessel capital costs		Vessel capital costs, Indirect is covered by University	Vessel capital costs, staff paid by University		Vessel costs, US Gov. vessel.
Appraised Value vs Tioga		Slower, Less capable for some tasks	Larger deck and A-frame, longer cruise times for comparable efforts, extra costs	Smaller deck, same speed/capabilities, extra costs for sensors	Much larger deck, longer cruise times for similar efforts, BYO everything, no lab space	Nominally set up for trawl work only

* 'In class' vessel was defined as regional vessels of similar size/utility or purpose that have been utilized by WHOI staff.

- Has a competitive day rate as published.
- When factoring the overall trip costs to a WHOI investigator conducting substantive work, including mobilize/demobilize in other ports and/or extra personnel time for longer transits, the day rate becomes highly advantageous.
- Relies on the smallest number of operational subsidies of the institution-run research vessels in class.

Local competitors such as the R/V Discovery are able to undercut the Tioga in terms of price for simpler, closer to port, tasks such as routine autonomous vehicle testing. However, ***it is clear that the Tioga has the functional ability to successfully support harder, more challenging operations in challenging ocean conditions, and is regularly used for tasks both big and small.*** Results of a survey of Tioga Users (see Appendix E for individual responses) as well as the August 7th, 2018 Tioga Users Meeting (see Appendix F for Meeting Minutes) make it clear that:

- The Tioga is highly regarded for its abilities.
- Having the Tioga’s crew be institutional employees benefits both the scientific and educational uses of the vessel.
- Having/maintaining a fleet of coastal research vessels is highly advantageous to WHOI and directly supports a wide sector of WHOI scientists and staff in carrying out the institution’s core mission.

3. b. Issues of Concern for Users

A voluntary, anonymous survey was conducted of Tioga users by the working group (Appendix E). In all, 24 individuals wrote responses to all or part of the questions. While the speed and capabilities of the vessel were highly valued, as were the abilities of crew members Houtler and Hanley, feedback within the user survey was not all positive. Some of the vessel’s built-in support instrumentation was deemed unnecessary to segments of the user base, and a small subset had negative experiences with the crew or ship ops personnel regarding use of the vessel. While an individual user suggested drastic changes for the needed capabilities of the vessel, most users were satisfied with the vessel design, layout, and onboard systems. ***The only significant areas where the vessel was found to be lacking was for support of side-based instrument recoveries such as autonomous vehicles.***

In general, ***most users expressed appreciation for the capabilities of the vessel and frustration over the state of the vessel.*** Vessel reliability was the paramount concern followed by crew burnout, crew training, and scheduling issues. The events of 2018, both the period between May and late July when Houtler and Hanley resigned, as well as the period of operations in the fall that contained multiple additional failures, further eroded user confidence in Ship Ops’ abilities to keep the vessel working at its full potential. If Ship Ops was an independent service provider, this level of frustration from its sole customer group would constitute a crisis.

“I lost more money on my grant due to the boat’s 2016 outage than the spare engine would have cost.” -Tioga User

Concern about the vessel's reliability and lack of appropriate communications from Ship Ops on the status of the vessel and reasonable predictions of service periods **led multiple users to seek out other options** to complete their needed science tasks on more reliable platforms, generally at significant additional expense. It should be noted that this generally represents lost overhead to the institution. **Scheduling was an issue**, explicitly for more infrequent users of the vessel, but the scheduling procedure was viewed unfavorably by many. While any scheduling system will be viewed poorly by a subset of the user base, this issue was likely exacerbated by the frequent engine-related outages that have occurred over the past few years.

Additionally, a number of users interviewed or responding to the poll have stated that their science questions and topics have migrated away from coastal or regional in-situ observational work in part due to the difficulties in using the Tioga due to its long-term reliability, organizational structure, or difficulties in finding a suitable replacement vessel.

Polling the users on the approximate value of a day of shiptime on the Tioga resulted in a wide span of valuations, from \$1500-\$4000. Valuations were highly correlated with the complexity of the user's task and familiarization with the 'market'. Analyzing user responses across questions suggests that valuations at the lower end represented tasks that could be undertaken by simpler vessels, i.e. a single-handed, sub-30' open console vessel as opposed to the 103' R/V Connecticut. Higher end valuations were correlated with more difficult stated tasks/capabilities.

3. c. The Business Model

The business model for the vessel, as a cost center within the institution, can be summarized as a balance between operational costs and income from user fees. Major operational expenses include salary (both direct and indirect costs), fuel, insurance, maintenance, port fees, and supplies; and have increased from \$465K to \$524K from 2013 to 2017 (*Table 2: See Appendix D for details*). Note that Tioga budgets include SSSG 'technical operations' support time for the onboard sensors such as the CTD rosette and the ADCP but also echosounders, flow-thru systems, and UNOLS-style automatic met packages.

Table 2: Tioga Budget Summary for 2013-2018

TIOGA Budget Summary	2018	2017	2016	2015	2014	2013
Vessel Operations	\$496,356.0	\$475,403.00	\$471,137.0	\$527,856.00	\$474,735.00	\$439,008.00
Technical Operations	\$25,839.00	\$27,914.00	\$23,059.00	\$23,450.00	\$28,005.00	\$24,917.00
Totals per year	\$524,213.0	\$505,334.00	\$496,212.0	\$553,321.00	\$504,754.00	\$465,938.00

In the past 5 years, the daily rate of the vessel has increased steadily to \$3750 for a 12-hour day in 2018 for an internal WHOI-based user, with the cost increasing ~\$200 each year. Half day rates (0-5 hours) are 50% of the full day rate and 'extended day' rates are 150% of the 12-hour rate. This base rate, and the rate of increase, was set internally by Ship Ops personnel via an assessment process not available to the working group. In general, the vessel has averaged approximately 90 days of operations each calendar year (*Table 3: See Appendix C for details*).

Partly by design, user fees do not fully balance the operational costs of the vessel.

The difference, or gap, is filled by pulling additional funds from an endowed account or via a direct supplement from other Ship Ops accounts. The endowed source of income was originally set up solely to provide funds to pay the depreciation charges levied against the vessel’s operational account, but has also been used to supplant user fees. As a result, the endowed account was significantly overdrawn at the end of 2016, reaching a crisis ‘position’ as noted by WHOI Finance in internal reports. However, due to the switch to MTDC in 2017 which reduced the depreciation costs levied against the vessel directly, the account has rebounded somewhat to be approximately \$45K overdrawn as of November, 2018.

Table 3: Tioga Usage Summary for 2013-2017

Year	Total Hours	1/2 Days	Full Days	Extended Days	Income
2013	766.90	28.00	63.00	5.00	\$251,678.00
2014	647.40	20.00	58.00	9.00	\$259,007.00
2015	629.05	20.00	59.00	9.00	\$282,144.00
2016	416.85	17.00	26.00	5.00	\$158,835.00
2017	648.00	28.00	53.00	12.00	\$339,437.00

Despite this change, ***user fees have consistently accounted for only 50-60% of the operational costs of the vessel*** in each of the five years 2013-2017. This is a significant issue. As a result, tremendous pressure existed on the former crew to cut costs as much as possible. The crew ceased to provide meals on board for cruises less than 12 hours, stayed aboard during all trips away, and were known to purchase supplies themselves as well as over-extend their working periods in order to get extra paid ship days. Regular maintenance was deferred.

Finally, with the long-term outage during the peak summer period of 2018, the 2018 operating expenses were \$300K more than the 2018 collected user fees. This has dramatically worsened the financial issues faced by the vessel. Initial reports by WHOI Finance has suggested that this additional short fall should be recouped, and repaid to the institution, within a 3-year period.

4. Detailed Suggestions for Improvement

The mission of WHOI’s Ship Operations is to provide access to the sea for WHOI and UNOLS science users. This is central to our success as a scientific organization and a core part of our organizational DNA. Our logo is a boat.

Within the institution, Ship Ops is a service provider with customers. For the regional vessel operations, few of those customers are happy with the services being provided. Regaining user confidence will be difficult. Only in correcting the underlying structural problems with the

vessel’s operational and financial model will ensure the new investment of the institution will be successfully utilized in ways that benefit WHOI science for the next decade to come.

4.a. The business model of the vessel must be changed to protect the vessel’s long term service to the institution.

It is critical to note that *the Tioga’s value over a replacement vessel is task-dependent, and presents a paradox to the institution.* This was directly seen in the user valuations, as simple uses led to smaller valuations while more complex tasks were valued higher. For specific examples: A glider that could be picked up via the OSL Hurricane or a SeaTow-type vessel in a 7-hour trip might value a Tioga day equivalently at \$2K. A slightly longer mooring operation that would otherwise require the R/V Connecticut to be brought over at a total cost to the investigator of \$20K would see even a \$7K day rate as a tremendous value. An off-site 6-day survey campaign of the Gulf of Maine might otherwise require a 10-day UNOLS vessel to undertake, making a \$10K day rate highly competitive.

It is difficult to have a 1-1 cost to value agreement over such a wide range. Additionally, none of the user-estimated valuations in the survey matched the median per cruise cost of the vessel (~\$5500/user-day), though many approached the published internal full day rate. *Users clearly know the recent range of the daily rate, but are unaware of the true vessel costs. It is this disparity that has, in large part, led to the present situation.* To achieve long term sustainability, the business model of the vessel should be altered to reduce this disparity and place the maintenance, safety, and performance of the vessel on solid footing. Some combination of the following changes could be made to achieve this goal:

4.a.1. Conform daily rates to true costs: Half days represent potential lost income to the vessel relative to full days as the fixed costs are nearly the same, and have the potential to preclude full day income. The vessel rarely is able to pair 2 half day trips on the same day. Days away from port represent an additional source of revenue for the vessel, but at an extraordinary burden on the ship’s crew as they regularly exceed 12 working hours per day. The rate structure should be altered to:

Category	Usage time	Charge
A half day	0-5 hours	75% Base rate
A day	5-12 hours	Base rate
An extended day*	12-24 hours	175% of the base rate
Non-WHOI port fee	per day away	25% of the base rate

*Any day away from home port or requiring a relief crew

4.a.2. Decrease the services offered for the Base Rate: Most of our competitors charge additional fees for both equipment, such as CTDs, ADCPs, etc. as well as the technical staff to operate them. Support for SSSG services onboard and maintenance of the existing services offered represents ~6% of the Tioga’s budget. While a number of users valued the CTD, others saw no value in any additional sensor. Users of the CTD in particular often had specific needs for the sensor package that required support. It would obviously be nice to collect as much data

as possible, always, but the end users of the data need to help justify the expense of maintaining data collection.

Each of the SSSG sensors should be evaluated for its need for support within the base rate. Those not deemed critical should be offered for extra charges above the base rate as they give additional value to the cruise day for those users. Moving to an ‘ala Carte’ pricing scheme for these scientific or use-specific services, might only cause moderate changes to the base rate, but would help ‘level the value’ of the boat to the wide variety of users the institution should be able to support with the Tioga.

Some competitors also charge extra for fuel. This represents ~15% of the Tioga’s budget in total, and a surcharge for high fuel usage could potentially serve as a way to account for additional wear on the engines due to high speed operations.

4.a.3. Fundraise for a Permanent Subsidy: Codify and fundraise for a permanent subsidy to maintain internal fees at an artificially lower level to ensure the vessel’s price competitiveness for basic tasks. *Among the institution-run vessels in class, WHOI contributes the smallest yearly subsidy.* It is clear that labor-related indirect costs and fringe benefits are a leading driver on the Tioga’s budget, as compared to vessels in class. As an institution, we contribute substantively to the operational costs of our larger ships via fundraising among the Trustees. Recognizing that the Tioga serves a critical role in equipment testing for open ocean-bound projects as well as provides our access to the coastal seas, should be seen as a sufficient, tractable, need to engage the Trustee community over. Tioga users should be tapped to help this process during Trustee and corporation meetings.

4.a.4. Increase the Base Rate: Both to recover from the financial situation the vessel is currently in as well as ensure for the long-term stability of the vessel, increasing the Base Rate must be considered such that the collected fees and planned subsidies fully fund the vessel and provide a cushion for expenses needed to ensure high reliability. This is obviously a challenging issue to address given the potential impact on users, but noting that the vessel has not balanced its costs in each of the past 6 years, along with an open discussion of the vessel’s budget structure, should provide evidence for a reasonable user to consider rate restructuring and fee increases.

4.a.5. Market the Vessel to increase the User Base: More trips per year equal a potentially smaller per trip cost. Both Ship Ops and the Institution should work to market the vessel broadly to science and educational users both inside and outside WHOI. Efforts to attract new science users, via direct marketing and user recommendations, will also help regain former users who have stopped using the vessel due to reliability issues. Educational trips can help support WHOI’s mission as well as add users to the vessel’s pool, especially those efforts focused on university programs and partnerships.

4.b. The Operational Model of the Vessel must be changed to increase vessel reliability, usefulness, and user confidence.

4.b.1. Train the Crew: Recognize that the Tioga does critical and difficult work, often with fewer staff onboard than most vessels. Thus, a focus on crew training and support such that the

crew's abilities match the vessel's abilities is critical. No one expects a brand-new hire to be as experienced as the former crew, having 15+ years of direct experience. But they would expect a training plan to attain that level. The institution would not send a brand-new engineer to pilot Alvin without an extensive training and oversight process. The Tioga should be no different. Additional support or technical staff should be required to be aboard when complex sensors are used, or operations are undertaken in which the crew is unfamiliar. Crew responsibilities should be clearly stated.

A skill assessment and training plan should be written and submitted to the Marine Operations Oversight Committee (MOAC) before the vessel returns from its overhaul in April 2019.

4.b.2. Find and train a backup crew among existing WHOI employees: A relief skipper must be employed or available, to ensure weather windows can be properly utilized and prevent crew burn out. ***The working group notes that this recommendation was also given in a 2008 review of the Tioga and never acted on.***

We are an ocean-going workforce and the majority of our technical staff work on multiple projects within a given year. Multiple WHOI staff member have both experience running vessels and Coast Guard licenses to operate vessels approaching the Tioga in scope. For simpler tasks, or to serve as replacements during a longer cruise away from WHOI, these staff could offer relief to the permanent crew and could be retained for a low fixed cost per year.

4.b.3. Develop a maintenance plan to avoid prolonged outages: Much of the maintenance issues with the vessel were ascribed to be the result of prior operational procedures or poor record keeping (Appendix F). However, the subsequent failures, persistent engine problems, and poor reliability that occurred from August to December 2018 are evidence that these issues persist within Ship Ops to this day, despite the assigning of a port engineer and port captain to the Tioga. Training and oversight is key part of this effort, but ***a detailed maintenance plan must be devised, reviewed by an outside group such as the MOAC, and revisited yearly.*** A plan to fund the purchase of a new-style replacement engine by 2024, to allow short turnarounds on unplanned outages should be completed in 2019.

4.b.4. Communication between Ship Ops and end users must improve: Rumors and misinformation can only be reduced by over-communication. While emergency uses and users exist, most research activities that use the Tioga are planned months in advance (planned in terms of the task, operational area, and time window, but not the specific date or day) and thus need time to adjust their operations for a change in the vessel's schedule or availability. Adequate communications about changes in the vessel's status should be given as soon as possible, even if all the information is not yet available. Use of the tioga_users@whoi.edu list-serve for all Tioga related communications should be codified and updates or communications sent regularly.

Public sharing of the documents suggested above are critical to increasing user awareness and understanding of vessel's abilities, requirements, and financial needs as well as to allow for users to plan their research activities around known issues. The budgeting process should be open and available to users to allow feedback on user implications, needs, or benefits. Thus, more

oversight of the vessel is required moving forward, and could be accomplished via a small committee of users meeting with Ship Ops quarterly, or a dedicated member of the MOAC for Tioga-related issues.

4.b.5. Streamline scheduling and revamp the reservation process: It is critical to recognize that in terms of mobilization/planning needs and weather-related delays, the Tioga is essentially the opposite of the larger ships. Thus, *a planning process designed for our major UNOLS vessels is functionally unworkable for the Tioga*. Additionally, a web-based pdf that is updated weekly is no longer sufficient nor effective in helping users plan their ship-time around other users and ongoing vessel activities. The reservation system must be updated to:

- Collect only the minimum amount of information from users seeking reservations.
- Assign advanced reservations ship-time within blocks/periods (i.e. 2 op days in the 3rd week of July) rather than specific dates with weather days.
- Limit the number of day per week that can be assigned months in advance, to allow for weather days, maintenance operations, and short fuse needs via a waitlist for each period.
- Give the captain the ability to update the near-term reservation list and wait list in real time and from the vessel using a simple connected device such as a smartphone.
- Extended trips away from the institution should be coupled with time at WHOI to allow for local work to be completed.

5. Committee Makeup

Anthony Kirincich, coordinator

Eric Benway

Robbie Laird

Mark Baumgartner

Mike Purcell

Emily Peacock

Taylor Crockford

Pete Collins (Tioga Master as of October 2018, as an observer)

The working group was organized by Kirincich in September, 2018. Participants responded to a WHOI-wide announcement for volunteers. All responders were included in the group to represent the perceived stakeholder groups including: Scientific Staff, Technical Staff, Ship Operations Staff, and Ship Operations Technical Support staff.

6. Appendices

- A. Tioga Working Group Charge
- B. Tioga Geographical Range: 2010-2018
- C. Tioga Usage: 2013-2018
- D. Tioga Budgets: 2013-2018
- E. User Survey Results, all responses
- F. August 2018 Tioga User's meeting notes