BioOne COMPLETE

Development of a Multipurpose Telemetry and Habitat Survey Instrument Platform for Small Boats

Authors: Griffith, David W., Peery, Christopher A., Daigle, William R., Keefer, Matthew L., and Wright, Nancy

Source: Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science, 2010(2010) : 299-303

Published By: American Fisheries Society

URL: https://doi.org/10.1577/C09-016.1

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://complete.bioone.org/journals/Marine-and-Coastal-Fisheries:-Dynamics,-Management,-and-Ecosystem-Science on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 2:299–303, 2010
© Copyright by the American Fisheries Society 2010
DOI: 10.1577/C09-016.1

[Note]

Development of a Multipurpose Telemetry and Habitat Survey Instrument Platform for Small Boats

David W. Griffith,*[1] Christopher A. Peery,[2] William R. Daigle,[3] Matthew L. Keefer, and Nancy Wright[4]

Fish Ecology Research Laboratory, Department of Fish and Wildlife Resources, College of Natural Resources, University of Idaho, Moscow, Idaho 83844-1136, USA

Abstract.—We developed a telemetry and remote-sensing instrument platform for a small vessel (6.1-m inboard jetboat) to collect fish telemetry and environmental data in real time as well as to collect data during habitat surveys in the Columbia River estuary. The instrumentation consisted of two acoustic telemetry hydrophones, an acoustic telemetry receiver, a conductivity–temperature–depth probe, an acoustic Doppler current profiler, a differential Global Positioning System, and a side-scan sonar integrated with an onboard portable computer. The system can be used on other vessels, has the flexibility to adapt to a range of telemetry and small oceanographic instrument systems, and allows for deployment and data collection from all instruments simultaneously.

Improvements in survey and telemetry instrument technologies and methods have increased our ability to address complex ecological questions related to aquatic habitat quality and quantity and the movement patterns of aquatic macrofauna (e.g., Brown et al. 2002; Kenny et al. 2003; Glasgow et al. 2004; Keefer et al. 2008a; Parsley et al. 2008). A critical aspect of many restoration and conservation programs is the combining of data from these technological tools to better understand the linkages between available aquatic habitat and its use by biota. The recent development of smaller-scale scientific instrumentation and more powerful portable computers has facilitated the deployment of multiple instruments on small research vessels. The advantages include improved maneuverability for following telemetry-tagged fish while collecting critical habitat information in real time, greater ability to access and survey shallow waters, and reduced deployment costs.

In 2003, we began projects in the lower Columbia River estuary to map subtidal estuarine habitat, test a habitat classification system (Keefer et al. 2008b), and evaluate adult Chinook salmon residence times, movement patterns and habitat use (Griffith 2007). All of these objectives required the deployment of multiple telemetry and/or survey instruments on a small (6.1-m) research vessel. This paper describes the methods used to collect georeferenced habitat data while individually tracking telemetered fish in a complex estuarine environment.

Instrument Mounting System

The primary element of the instrument platform was a pair of booms. The boom system was used to deploy two acoustic telemetry hydrophones and an acoustic Doppler current profiler (ADCP) (Workhorse Rio Grande 1200; Teledyne RD Instruments, Inc., San Diego, California) and was adapted as a hard point mount for a side-scan sonar (SportScan sonar system; Imagenex Technology Corp., Port Coquitlam, British Columbia). The system consisted of a set of pivoting booms that were raised and lowered by cables run through blocks on bow-mounted davits (Figure 1). The booms were constructed of 3-m-long 6061-T3 aluminum tubing with an outside diameter of 50.8 mm. Aluminum fins were attached to the rear face of the lower 150 cm of the booms to provide stabilization and improved hydrodynamics.

Hydrophones (LHP-1; Lotek Wireless, Inc., New Market, Ontario) were inserted into the hollow of the boom and secured by two set screws. The hydrophone cable ran inside the boom for protection and to reduce drag. The design of the boom mounts allowed for hydrophone deployment deep enough to clear the bottom of the hull in the horizontal plane (2 m) while providing sufficient rigidity and hydrodynamics to track acoustically tagged fish at speeds up to 16 km/h. The booms were attached to the vessel by 50.8-mm (inner diameter) sleeves mounted to 90° elbows (Figure 2). Matching holes were drilled in the booms and elbow sleeves so that the depth of the hydrophones

Subject editor: Donald Noakes, Thompson Rivers University, Kamloops, British Columbia, Canada

* Corresponding author: david.w.griffith@usace.army.mil

[1] Present address: U.S. Army Corps of Engineers, 333 Southwest First Avenue, Portland, Oregon 97204, USA.

[2] Present address: U.S. Fish and Wildlife Service, 4147 Ahsahka Road, Ahsahka, Idaho 83520, USA.

[3] Present address: Montana Fish, Wildlife and Parks, 1420 East 6th Avenue, Helena, Montana 59620-0701, USA.

[4] Present address: Olympic Coast National Marine Sanctuary, 115 East Railroad Avenue, Port Angeles, Washington 98362, USA.

Received April 21, 2009; accepted June 7, 2010
Published online September 13, 2010

Downloaded From: https://complete.bioone.org/journals/Marine-and-Coastal-Fisheries:-Dynamics,-Management,-and-Ecosystem-Science on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

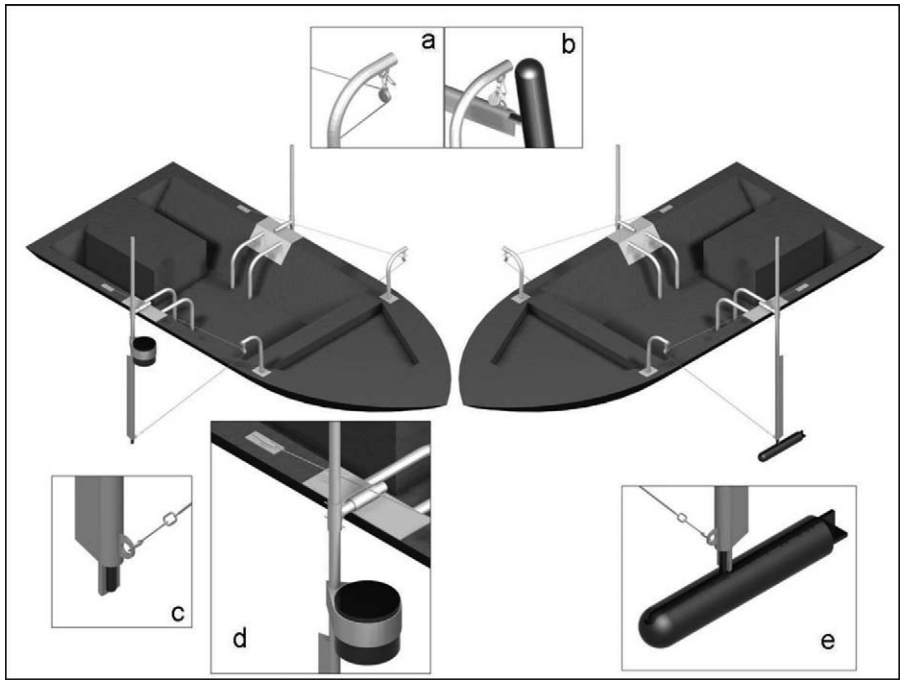


FIGURE 1.—Diagram of the boom system and instruments: a, davit arm and swivel block with boom deployed; b, close-up of davit arm with boom in stowed position and safety cable attached; c, close-up of boom end with hydrophone; d, gunnel cap, elbow, and ADCP in deployed position; and e, side-scan sonar hard point deployment configuration.

could be adjusted. The elbows provided a pivot point connecting to the gunnel through another sleeve on the gunnel plate. The gunnel plate was reinforced by gussets and wrapped around the vessel's gunnel. The vessel gunnels were further reinforced by pipe trusses that were secured by bolts to the deck of the boat.

To prevent damage at high vessel speed or if the booms ran aground, a short length of 113-kg-test multibraid nylon fishing line (250 lb [113 kg] tuna cord; Ashaway Line and Twine Manufacturing Co., Ashaway, Rhode Island) was tied between the cable and a quick link on the boom. When sufficient force was applied to the boom, the cord broke, allowing the boom to swing free, avoiding potential damage to the hydrophones and other equipment deployed on the booms. This breakaway system has proven effective in the field with the instrumentation described here. However, the loads borne by this type of breakaway system will vary with the weight and cross-sectional area of the instruments deployed. Safety testing is recommended prior to field use because most off-the-shelf fishing and recreational boating equipment is not specifically designed for research applications.

To protect against the failure of the breakaway cord when the vessel was under way or being transported via trailer with the booms in the stowed position, a short safety cable (4.8-mm coated to 6.35-mm nylon-coated galvanized aircraft cable) with a snap-hook was attached to the davits. When a boom was retracted the snap-hook was attached to the quick link on the boom securing it for travel (Figure 3).

The bow davit arms were constructed of the same pipe material used for the booms. The bow davits were attached to the front deck with a socket plate that was through-bolted to the deck and a backing plate. This socket plate allowed for quick disassembly of the davits. A large quick link was used to secure both the swivel block and safety cable to the end of the davit (Figure 3). The cable (4.8-mm coated to 6.35-mm nylon-coated galvanized aircraft cable) used to raise and lower the booms passed through the swivel block and was bent to a nylon line (13 mm multibraid). The nylon line was easier to handle than the cable and enabled the cable to be cleated off at different lengths to alter the angle of the booms.

If one boom was not needed for a deployment, the davit arm could be adapted to hold a block amidships over the water. This was done by outfitting the davit with a crab block and inserting it into the elbow sleeve

Downloaded From: https://complete.bioone.org/journals/Marine-and-Coastal-Fisheries:-Dynamics,-Management,-and-Ecosystem-Science on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

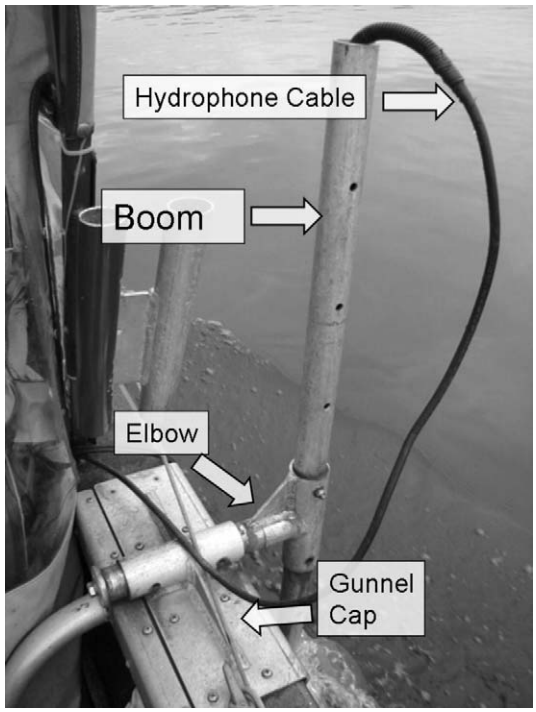


FIGURE 2.—Photograph of the starboard boom in the deployed position.

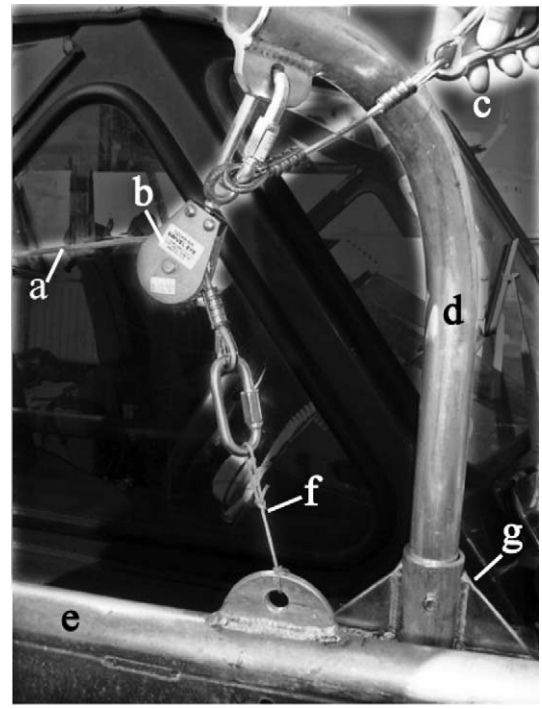


FIGURE 3.—Close-up of bow davit: a, cable to stern cleat; b, swivel block; c, safety cable and snap; d, davit arm; e, hydrophone boom; f, breakaway cord; and g, socket plate. The background has been digitally darkened to clearly show the bow davit.

with the arm of the davit overboard for hauling up heavy objects such as PONAR dredges and instrument mooring anchors.

Deployment of Equipment

Side-Scan Sonar

The socket arrangement used to secure the hydrophones also allowed other instruments to be deployed off the boom end. A side-scan sonar instrument was deployed off the port boom end using a fabricated mounting adapter. The adapter was made of aluminum billet and machined to match the outer dimensions of the hydrophone. The sonar unit was then bolted directly to the adapter. When the sonar fish was not hard-mounted to the port boom it was deployed over the side with manufacturer-supplied tow/data cable. This cable was secured to a stern cleat by means of a 6-mm rope grommet (1 m in diameter) using a Prusik knot. This knot allowed the length of cable to be adjusted quickly without having to remove the grommet from the stern cleat.

Acoustic Doppler Current Profiler

The ADCP was mounted to the starboard boom using a custom-made mount (Figure 4). This mount slid onto the pole and was clamped tight with set screws. The use of the clamp system allowed for fine-scale adjustments of the instrument's depth. The forward beam of the ADCP was offset 45° so that the bottom portion of the boom would not interfere with any ADCP transducer beams.

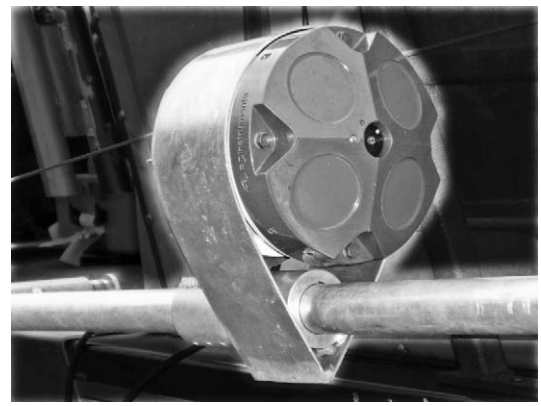


FIGURE 4.—Photo of the ADCP mounted to the starboard boom of the research vessel. The background has been digitally darkened to clearly show the instrument and mount.

Downloaded From: https://complete.bioone.org/journals/Marine-and-Coastal-Fisheries:-Dynamics,-Management,-and-Ecosystem-Science on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

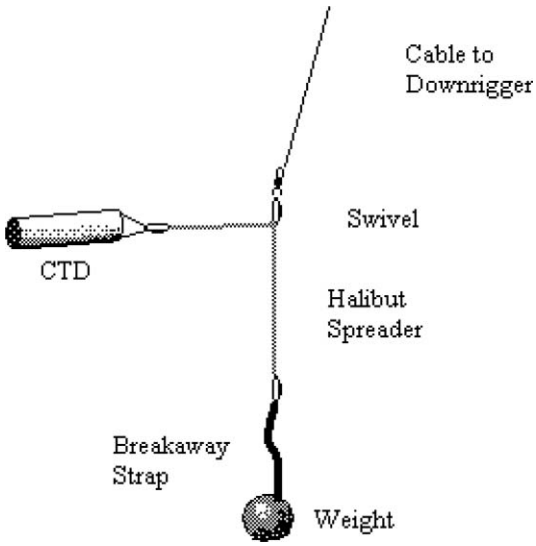


FIGURE 5.—Illustration of the wireless CTD deployment rigging.

Conductivity–Temperature–Depth Probe

To record water quality data at different depths (up to 50 m), a wireless conductivity–temperature–depth (CTD) probe (Minisonde 4a; Hach Environmental, Boulder, Colorado) was deployed using a separate downrigger mounted to the transom gunnel. The system consisted of a 4.5-kg cannon ball weight attached to a leather breakaway strap. The strap was connected to the long arm of a halibut spreader (a hardened stainless steel wire available through commercial and sportfishing tackle distributors). The CTD and its protective housing were attached to the short arm of the spreader, which was then connected to the downrigger cable by a heavy-duty stainless steel swivel (Figure 5). The purpose of the spreader was to ensure that the instrument would not foul in the downrigger cable or be struck by the weight. Because of the chance for metal fatigue with use, the spreader bar should be replaced every 500 casts.

Data Collection

With the exception of the data from the CTD, all instrumental data were captured and stored by an onboard laptop computer (DS 50E; Gateway, Inc., Irvine, California). The National Marine Electronics Association (NMEA) strand from the differential Global Positioning System (GPS) (DSM 132; Trimble Navigation, Ltd., Sunnyvale, California) entered through the serial port (RS232) and was shared through the creation of virtual serial ports using Serial Splitter version 3.5 (Eltima Software, Berlin, Germany). This enabled each instrument access to the GPS data without the use of additional hardware. The GPS data were also stored as an ASCII navlog file at 1-s intervals (Visual Navigation Suite version 7.0; NOBELTEC, Inc. Portland, Oregon). All other instruments interfaced with the laptop using a serial USB converter (GUC232A; IOGear, Inc; Irvine, California), and data were collected using the instrument manufacturer's supplied software.

Conclusion

In our studies, this integrated system has proven to be highly adaptable, economical, and effective for use on research vessels. The important advantage of the system is its ability to deploy multiple instruments simultaneously. This has allowed researchers to complete multiple tasks on one small vessel without the need to return to port to reconfigure vessel instrumentation. Furthermore, data sets were temporally and spatially synchronous, which proved vital in collecting and analyzing data in a stochastic estuarine environment (e.g., Griffith 2007; Keefer et al. 2008b).

Acknowledgments

We thank Pace Wilber and Katherine Nielsen of the NOAA Costal Services Center for funding. We also thank Antonio Baptista and Michael Wilkin of the Oregon Graduate Institute, Gene Bock and the crew of the RV *Forerunner* in Astoria, Oregon, Jeff Monyak (for help with boat operations), and members of the University of Idaho Fish Ecology Research Laboratory (for their expertise and help). Kirk Steinhorst, James Nagler, and James Congleton of the University of Idaho provided guidance and support.

References

Brown, C. J., K. M. Cooper, W. J. Meadows, D. S. Limpenny, and H. L. Rees. 2002. Small-scale mapping of seabed assemblages in the eastern English Channel using sidescan sonar and remote sampling techniques. Estuarine, Coastal and Shelf Science 54:263–278.

Glasgow, H. B., J. M. Burkholder, R. E. Reed, A. J. Lewitus, and J. E. Kleinman. 2004. Real-time remote monitoring of water quality: a review of current applications and advancements in sensor, telemetry, and computing technologies. Journal of Experimental Marine Biology and Ecology 300:409–448.

Griffith, D. W. 2007. Behavior of adult fall Chinook salmon in the lower Columbia River estuary. Master's thesis. University of Idaho, Moscow.

Keefer, M. L., C. C. Caudill, C. A. Peery, and S. R. Lee. 2008a. Transporting juvenile salmonids around dams impairs adult migration. Ecological Applications 18:1888–1900.

Keefer, M. L., C. A. Peery, N. Wright, W. R. Daigle, T. S. Clabough, D. W. Griffith, and M. A. Zacharias. 2008b. Evaluating the NOAA coastal and marine ecological

Downloaded From: https://complete.bioone.org/journals/Marine-and-Coastal-Fisheries:-Dynamics,-Management,-and-Ecosystem-Science on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

classification standard in estuarine systems: a Columbia River estuary case study. Estuarine, Coastal and Shelf Science 78:89–106.

Kenny, A. J., I. Cato, M. Desprez, G. Fader, R. T. E. Schuttenhelm, and J. Side. 2003. An overview of seabed mapping technologies in the context of marine habitat classification. ICES Journal of Marine Science 60:411–418.

Parsley, M. J., N. D. Popoff, B. K. van der Leeuw, and C. D. Wright. 2008. Seasonal and diel movements of white sturgeon in the lower Columbia River. Transactions of the American Fisheries Society 137:1007–1017.

Downloaded From: https://complete.bioone.org/journals/Marine-and-Coastal-Fisheries:-Dynamics,-Management,-and-Ecosystem-Science on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use