TIDAL BASS SURVEY
Standard Operating Procedure
2020

Prepared by Joseph W. Love, Ph.D.
Tidal Bass Manager
Maryland Department of Natural Resources
Freshwater Fisheries Program
This SOP will be updated at least annually or more frequently as needed
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Table of Contents

1. Scope of the Survey

1.1 Mission of Survey

- To ensure population integrity and sustainability of tidal populations of black bass in Maryland;
- To promote and protect angling opportunities of constituents;
- To respond to public concerns of the black bass fishery in tidal freshwater rivers of Maryland with well-researched answers and awareness programs or materials.

1.2 Objectives of Survey

The objectives of the tidal bass survey are: 1) to generate indices for assessing populations of black bass (particularly largemouth bass) and habitat conditions; and 2) to report trends in these indices. During surveys, data regarding selected environmental factors and additional species collected will be recorded. These data are important for standardizing catch estimates and providing more reliable catch indices.

1.3 Period of Survey

The Tidal Bass Survey conducts a survey that targets adults and juveniles from September through October. In all cases, specific dates and times will be specified by regional managers who are crew leaders for survey efforts. Dates may vary by weather conditions. All adult surveys should be completed prior to November, when water temperatures reach 10° C.

1.4 Rivers of Survey

There approximately 25 major tidal rivers of the Chesapeake Bay watershed in Maryland. While largemouth bass likely inhabit all of these tidal rivers, financial and time constraints prevent meaningful surveys of all of these rivers. A collaborative effort among stakeholders resulted in a ranking of 12 major tidal rivers of the Chesapeake Bay watershed. Tidal rivers were scored from 1 (do not agree) to 10 (strongly agree) for the following criteria: 1) lacks ample baseline data; 2) important as a major fishery; 3) there are perceived problems with the fishery; and 4) there is good evidence for problems with the fishery. Rivers ranked of high priority included: Choptank River, upper Bay rivers, Patuxent River, Pocomoke River, Sassafras River and Wicomico River. The Potomac River and upper Chesapeake Bay are the most popular tidal fisheries in Maryland and therefore require annual monitoring. In support of the "Fishery Management Plan for Largemouth Bass (*Micropterus salmoides*)," 10 years of baseline, reference data from the survey is required for prioritized rivers. Once a 10-year reference data set is generated, it will be used as a benchmark for assessing the status of the population. The 10-year reference dataset will embody 10 years of natural variation in population dynamics, due mainly to environmental influences. As targeted rivers for the Tidal Bass Survey change, this Standard Operating Procedure (SOP) will be updated with both the change and the justification of the change.

1.5 Supplies for Survey

Supplies for the survey are listed in Appendix 1.

During the 2018 caucus of the Tidal Bass Program, it was agreed to adopt the current 50 year plan for sampling:

Future	River	Total # Yrs	Since 1999	Baseline?
Every 3 yr or as needed	Choptank	19	15	YES
Every 3 yr or as needed	Marshyhope	12	10	YES
Every 3 yr or as needed	Patuxent	13	10	YES
Annually	Potomac	28	18	YES
Annually	Sus/NE/Flats	17	14	YES
2019 for baseline	Chester	13	9	IN 2019
2019 & 2020	Pocomoke	12	8	NO
Every 3 yr or as needed	Wicomico	12	9	IN 2018
2028 – 2038, or never	Bohemia	1	0	NO
2018 – 2027	Bush	3	0	NO
2028 – 2038, or never	Elk	3	0	NO
Until at least 2024	Gunpowder	5	4	NO
2018 – 2027	Middle	2	0	NO
2028 – 2038, or never	Patapsco	2	0	NO
2019 – 2028	Sassafras	4	0	NO

2. Tidal Bass Survey

2.1 General

The experimental design used to generate indices for the tidal bass survey is a stratified, random design. The strata are defined by two habitat types: prime or habitat with a high level of submerged complexity; and marginal or habitat with little or no submerged complexity. Habitats were stratified in order to improve efficiency of the survey. More effort will be directed to prime sites than marginal sites. Approximately 3-times as many prime sites should be sampled to marginal sites. The variance in catch among prime sites is greater than that for marginal sites, which necessitates a greater sample size within that stratum. The sites are randomly selected within each of the strata.

The catch estimate is the most common index used by fishery biologists to monitor populations. The index and its variance calculated from a stratified design depend on: 1) the proportion of prime and marginal habitat in the river; 2) the number of sites sampled within each stratum; 3) environmental conditions at the time of sampling; and 4) the time spent electrofishing.

2.2 Protocol for Defining Stratum Coverage

Sites were classified by habitat and stratified according to habitat type. Linear shoreline habitat for each prioritized river was divided into regions of prime or marginal habitats for tidal bass based on previous site-inspections (annually, 1999 – 2008). Marginal regions were defined as mostly downstream reaches and/or those lacking significant submerged structure and prone to significant water loss during falling or ebb tides. Prime habitats were defined as those with clear and fresh water and submerged structure. Prior analyses indicated that variance in catch estimates within the prime habitat stratum was much greater than that for the marginal stratum. As a result, the number of sites within the prime habitat stratum should be approximately three times that for the marginal stratum. This proportion should be re-evaluated each year after the survey is completed.

All potentially sampled sites have been classified using a combination of field inspections, aerial imagery, and GIS data. The coverage of each stratum in the river will be computed by summing up the linear shoreline distances (in meters) of sites representing each stratum.

2.3 Protocol for Choosing Number of Sites within each Stratum

Sites are randomly chosen within each habitat stratum. The number of sites that can potentially be sampled ranges from 70 (Wicomico River) to 474 (Potomac River)(Table 2.1), depending on river length, its level of branching, and extent of upriver tidal influence. Only sites within the tidal fresh reaches of the river are surveyed.

For most sites, the average number of sites surveyed for tidal rivers is sufficient for detecting a change in CPUE among years (Table 2.2). Assuming 5% type I error rate ($\alpha = 0.05$), the number of sites needed to detect a change in CPUE among assessments ($P = 0.95$) ranges from 2 to 6810 (Table 2.2). Large sample sizes were identified when there was little difference in CPUE among assessments. Routine power assessments may be needed as more catch data become available.

The minimum proposed number of surveyed sites is 25, which provides a minimum standard of coverage for tidal fresh reaches. The maximum proposed number of surveyed sites is 45, which is a maximum value determined based on sampling ability within a year. The proportion of sampled area ranges from 9% to 36% across rivers, depending on length of the river and the potential number of sites, but commonly is 14% (see Table 2.1). Each year, the number of sites per river will be at least 2 sites greater than needed in order to account for the need to abandon a site if occupied by an angler. Sites should be scrutinized prior to surveys to ensure they can be sampled; and if not, changed prior to surveys.

Table 2.1. For targeted rivers of the tidal bass survey, the average number of sites surveyed from 1999 - 2009 (Ave) and the potential number of surveyed sites (Pot). The proposed number (Prop) is subject to change.

River	Average	Potential	Proposed	Proportion of Potential
Chester	31	108	30	28%
Choptank	35	254	30	12%
Marshyhope	26	182	25	14%
Patuxent	27	162	25	15%
Pocomoke	24	184	25	14%
Potomac	44	474	45	9%
Sassafras	28	128	25	19%
Upper Bay	28	211	30	14%
Wicomico	25	70	25	36%

Table 2.2. Power analysis to detect a change in CPUE across three sampling periods for targeted tidal rivers of the conventional tidal bass survey.

River	CPUE (earliest assessment)	CPUE (prior to latest assessment)	CPUE (latest assessment)	Average SD (across assessments)	Sample Size Needed to Detect Change
Chester	23.09	13.10	12.16	2.87	4
Choptank	43.00	14.76	5.27	3.49	2
Marshyhope	29.32	28.787	32.46	11.47	259
Patuxent	36.82	47.44	23.94	11.55	9
Pocomoke	29.43		29.75	5.18	6810
Potomac	90.37	113.74	107.26	12.84	10
Sassafras	36.88		16.27	4.95	3
Upper Bay	59.98	46.33	52.01	7.54	11
Wicomico	21.65		16.67	6.67	48

2.4 Protocol for Sampling

2.4.1 General

Dates and location of sampling will be made known at least 1 month in advance of sampling so that this information can be posted on the Tidal Bass Survey website or disseminated using social networking programs. To ensure the accuracy of site coordinates, the coordinates will be screened electronically with aerial images or other spatial data by regional biologists prior to the survey.

A minimum of three researchers is required for this boat electroshocking survey. The captain will be responsible for generating float plans, piloting the vessel to georeferenced locations, helping to spot stunned black bass, and recording data. The remaining two researchers will be responsible for spotting and netting fish as they are stunned.

2.4.2 Environmental Conditions

Equipment needed to measure environmental variables will be checked for measurement accuracy and calibrated 1 week prior to sampling. Throughout the sampling season, water quality equipment will be calibrated once a week. All faulty equipment should be repaired prior to the next sampling day. When costly repairs or replacement units are needed, the appropriate regional manager and the tidal bass manager should be notified so that a resolution can be quickly reached. **Water quality equipment include: 1) a Yellow-Springs, hand-held meter (temperature, salinity, conductivity, dissolved oxygen, pH); 2) a Secchi disk; and 3) a GPS unit.**

Prior to sampling for fish, water quality measurements with the hand-held meter should be made at 0.3 m from surface (i.e., surface measurements). A Secchi disk measurement should be made in centimeters. The Secchi disk (20 cm in diameter) should be used between 10:00 – 2:00 pm and on a shady side of the boat[1]. It will be affected by eyesight of the viewer, contrast of the disk and surrounding water, and reflectance of disk. The measurement should be taken while the reader is not wearing polarized sunglasses.

At each site, the relative ranking of submerged aquatic vegetation (SAV) species will be assessed for the 250 m of sampling habitat. A key of SAV can be found at: https://dnr.maryland.gov/waters/bay/Pages/sav/key.aspx.

2.4.3 Electroshocking Conditions

A common method to survey fishes is electroshocking. For riverine assessments, a boat or barge electroshocker is often used. For the Tidal Bass Survey, a boat electroshocker will be used. Boat electroshocking is not expected to survey all species or largemouth bass size classes equally well. Electroshocking should be conducted downstream when the nearshore current is greater than 0.5 m/s. This will prevent stunned fish from floating under the boat. When the current is less than 0.5 m/s, electroshocking may be conducted upstream. The power and current (in amps) can be optimized for the conductivity of the water (Table 2.3); however, crew leaders should prioritize use of the U.S. Fish and Wildlife Service mobile app and recommendations (below).

[1] Cole, G.A. 1994. Textbook of Limnology, 4th edition. Waveland Press, Inc., Prospect Heights, Illinois.

For warmwater fishes and when using pulsed DC, optimum duty cycle and fish capture is achieved at 120 pps and a percent of range of 40% - 60%. However other settings may be tried. Low conductivity equals greater resistance, which requires more metal in the water and greater voltage. When conductivity is extremely low (<= 50 microS/cm) or high (>=800 microS/cm), AC should be tried. In 2014, the electron gradient was measured at various conductivities (up to 4000 microS). It was determined that power to stun Largemouth Bass is generally sufficient when the captain sets standard controls (low conductivity, 680 V, 50 – 80% range, 60 pps; high conductivity, 340 V, 50 – 80% range, 60 pps).

Sites will be surveyed beginning with a freshwater area (usually upstream environment) to standardize electrofishing operation at subsequent sites with similar effectiveness. This will be done by using a mobile application developed by U.S. Fish and Wildlife Service. The mobile application was developed by the National Conservation Training Center as an Eelectrofishing Tool for U.S. Fish and Wildlife Service. The application's calculated current output needed to elicit electrotaxis at subsequent sites with different conductivities will be targeted by adjusting controls (e.g., AC, DC, voltage level) aboard the boat.

Prior to each fall, power density should be tested using an oscilloscope. Rust of probes or electrical problems may be undetected unless power density is estimated prior to the field season. Thus, it is recommended that an oscilloscope be used prior to each fall, for each boat and each anode probe array to ensure that the power output is sufficient for effecting electrotaxis and immobilization.

The time spent electroshocking will differ among sites, but a minimum amount of effort is spent across sites. From 1999 – 2009, the median number of shocking seconds was 253 (4.2 mins) and ranged from 63 – 1449 seconds in habitats lacking structure or significant habitat for largemouth bass (Fig. 2.2). Approximately 9% of the values were 150 seconds or less. **It is recommended to expend at least 150 seconds of shock time at a site.** As more effort is expended in shock time for the river, the precision of the catch estimate for the river increases (Fig. 2.3)(Bonar et al. 2009). The precision, as measured with a coefficient of variation in catch within a year and river, was near a minimal value of 10% when the river had been surveyed for at least 1.75 hours. (Fig. 2.3).

Boat electrofishing should be discontinued when another person is within 100 feet of the boat.

While it is expected that the level of effort spent at a site may differ among sites because of logistic issues, every effort should be made to maintain consistency in sampling.

- Do not attempt to retrieve an escaped fish because that action will bias the catch per unit effort data.
- Sample every observable microhabitat, which traditionally has encompassed a shoreline of approximately 250 m. Do not target one microhabitat at the expense of another as this will bias the sample.
- Starting and ending coordinates will be provided for each site by the tidal bass manager at least 1 month in advance.

Table 2.3. Target power and current for boat electroshocking in warmwater with 60 Hz pulse rate. Table adapted from Table 14.1 in Bonar et al. (2009).

	Target Power (W)		Target Current (A)	
Conductivity (µS/cm)	Min	Max	Min	Max
50	3255	3847	4.8	5.4
100	2763	3266	6.2	7.0
150	2799	3308	7.7	8.6
200	2966	3505	9.1	10.2
250	3186	3765	10.5	11.9
300	3432	4056	12.0	13.5
350	3693	4365	13.4	15.1
400	3964	4685	14.9	16.7
450	4240	5012	16.3	18.4
500	4522	5344	17.8	20.0
550	4807	5681	19.2	21.6
600	5094	6020	20.6	23.2
650	5383	6361	22.1	24.8
700	5673	6704	23.5	26.5
750	5964	7048	25.0	28.1
800	6256	7394	26.4	29.7
850	6550	7740	27.9	31.3
900	6843	8088	29.3	33.0
950	7138	8435	30.7	34.6
1000	7432	8784	32.3	36.2
1100	8023	9482	35.1	39.5
1200	8615	10181	38.0	42.7

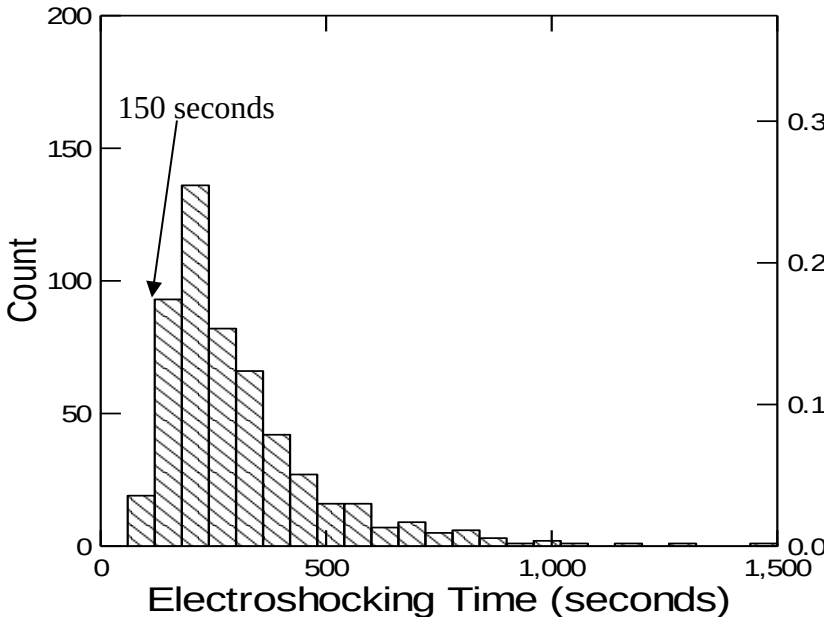

Figure 2.2. Histogram of electroshocking time (in seconds) spent in marginal habitats during the conventional survey (1999 – 2009).

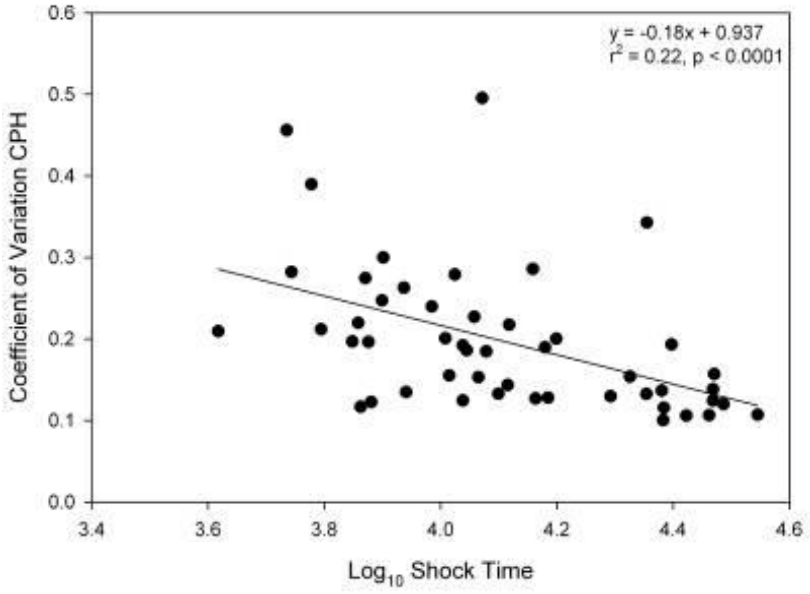

Figure 2.3. The coefficient of variation (CV) in the catch per unit effort or hour (CPH) of tidal bass versus seconds spent electroshocking among all targeted rivers and years of the conventional survey (1999 – 2009).

2.4.4 Operation of Boat on Site

Sampling shall commence as: 1) a slowing of boat speed just prior to sampling; 2) the researcher at the bow should instruct the captain when sampling should begin; 3) a researcher at the bow will apply electricity to the water constantly as the boat vessel travels parallel to the shoreline, or as the boat vessel travels 1 – 3 boat lengths toward the shoreline, if surveyed using a scalloped matter (Fig. 2.4); and 4) all microhabitats within the site should be sampled with equal effort. In the cases where scalloping is used, the captain will be responsible for ensuring that the moves toward shore occur at equidistant increments along the stretch of surveyed stream. Parallel electrofishing techniques may be conducted when electroshocking is conducted in rare situations as the vessel moves parallel the shoreline. When used, electrofishing should be conducted as an intermittent pulse. Use of parallel electrofishing yields similar diversity and size structure information, but lower relative abundance.[2]

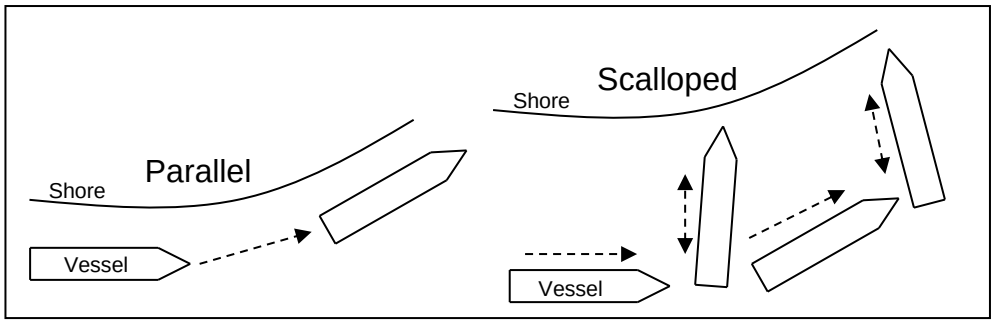

Figure 2.4. Figure depicting two sampling methods utilized by the tidal bass survey. Parallel surveys are defined by times when electroshocking is conducted while the boat vessel is moving parallel with the shoreline. Scalloped surveys are defined by times when electroshocking is conducted while the boat vessel moves 1 – 3 boat lengths toward the shoreline.

2.5 Protocol for Handling Procedures

When a black bass is stunned by the electroshocking boat, they should be quickly transferred to an oxygenated (near or above 100% oxygen saturation), re-circulating holding tank. Temperature and dissolved oxygen of the water in the holding tanks should be monitored regularly to ensure ambient, oxygenated water is provided the tidal bass.

Most specimens will be measured for total length (in millimeters) and weighed (in grams) before being returned to the site from where they were taken. Each fish will be inspected for lesions or injuries that will be recorded. When a tagged fish is encountered, then the tag number will also be recorded. For largemouth bass collected from some rivers where coded wire tagged largemouth bass have been released (currently, Choptank River and Patuxent River), then the fish will be scanned to determine presence of the tag. In some cases, it may not be possible to obtain a weight. In those cases, the fish will be released following its length measurement; "NA" will be recorded for the weight measurement.

[2] Trumbo, B.A. M.D. Kaller, A.R. Harlan, T. Pasco, W.E. Kelso, and D.A. Rutherford. 2016. Effectiveness of continuous versus point electrofishing for fish assemblage assessment in shallow, turbid aquatic habitats. North American Journal of Fisheries Management 36:398-406.

At the discretion of the tidal bass manager and regional managers, a small random sample of individuals may be sacrificed for life history information (Table 2.4). This random sample will not exceed 25 individuals per river in a year. A maximum of 5 individuals from discrete size classes (Table 2.5) sampled within each river may be taken. The first 5 individuals meeting the length requirements will be sacrificed. Sacrificed individuals will be measured, weighed, placed in a bag with a waterproof label detailing river and date, and euthanized by chilling or freezing.

Other species collected will be identified and noted on datasheets. A whiteboard at the bow and/or a digital voice recorder will be necessary for netters to record species as they are encountered. At the discretion of the regional managers, counts of particular species may be additionally required.

Following field sampling operations, crew leaders will ensure that the boat vessels do not transport aquatic nuisance species for unwitting introduction by following the associated and adopted Hazzard Analysis Critical Control Point Plan (Appendix 2).

2.6 Protocol for Handling Atlantic (or Shortnose) Sturgeon

According to Biological Opinion (Section 11.3) issued by NMFS to U.S. FWS regarding the handling of the endangered species Atlantic Sturgeon[3], the following shall be performed:

1. For electrofishing, no sturgeon over 2 feet in length shall be netted. All observations of netted sturgeon must be reported to NMFS as required… All observations of non-netted sturgeon should also be reported to NMFS via e-mail (incidental.take@noaa.gov), as soon as practicable. This report must contain the date, location, tentative species identification, and approximated size of the fish.
2. If the sturgeon comes in contact with sampling gear, all electrofishing must cease for 5 minutes or until the fish is observed to recover and leave the area.

3. Data Collection and Disposition

3.1 Protocol for Data Collection

Prior to collecting data, all researchers participating in the survey should be made fully aware of the information they are recording and how that information is obtained. **Researchers will collect data in a consistent and uniform manner, using similar gear.** A meeting prior to sampling events may be necessary for ensuring quality of the data collection.

All data should be recorded using an iPad with digital datasheets created using Apple Numbers or Microsoft Excel. For consistency, all tidal bass surveys will use a datasheet similar to that in Appendix 3 of this document. If a paper copy is necessary (not encouraged), then electronic versions are available on the common network drive, J:/Inland fisheries/tidal bass.

[3] https://repository.library.noaa.gov/

3.2 Protocol for Data Disposition

Following data collection, all digital datasheets will be collated to a common network drive for long-term data storage. Paper copy sheets (not encouraged) will be collated and scanned to *.pdf files. **Collated datasheets will be stored using an electronic file name of river and year and will be stored at the common network drive,** J:/inland fisheries/tidal bass drives.

Original data sheets will be stored at the regional office with whom the survey was conducted. No data sheets will be discarded until all sheets have been scanned and the scanned copy, checked by at least two researchers. No data sheets will be discarded without notifying the regional managers.

3.3 Protocol for Data Entry

Data will be entered into a relational, archival data base. This database is currently called GIFS. Data will be imported into GIFS from digitally saved datasheets that were exported from the iPad Number's program. The regional office responsible for the survey will administer the entry of data into the relational, archival data base. The catch data tab for GIFS will include all species observed during survey. For species that are counted and measured during survey, those data will ALSO be entered to the Individual Fish data tab for GIFS.

3.4 Protocol for Quality Assurance/Quality Control Procedures

All (or most) data will be imported into GIFS directly from datasheets populated during field surveys. Therefore, data entry errors to GIFS should be rare or uncommon. On occasion, data may need to be entered manually into GIFS (e.g., biologist uses a paper datasheet). Therefore, data entered into GIFS will be cross-checked by a second researcher. Pass data will be checked against those presented on the data sheet. Corrections will be made to the pass data in the archival data base.

Data exported from the archival database to a worksheet will be checked for errors. The minimum and maximum values will be determined for variables within the worksheet. Additional procedures, such as scatterplots, may also be employed for determining errors. When discovered, errors will be cross-referenced with recorded data to datasheets. Corrections will then be made to the spreadsheet and the archival database.

The number of fish caught during a survey will be plotted by effort. The expected, positive relationship will be evaluated for each dataset. A catch datum that is low relative to effort for the relationship will be considered an outlier. These outliers will be removed from the average catch estimate, but noted in subsequent reports, such as the Federal Aid Report.

The length-weight relationship will be evaluated using a scatterplot. Outliers will include those data points that deviate significantly from the global, length-weight relationship. When an outlier is discovered, the values will be cross-checked with datasheets to determine if mass or length were recorded in units different from those generally used (i.e., grams, millimeters). When necessary, data will be corrected on the spreadsheet and archival database.

4. Required Staff Training

All staff who were born on or after July 1, 1972 and who collect data during the Tidal Bass Survey as described in Section 2 are required to have a Maryland Safe Boating Certificate. A certificate may be obtained after successfully completing a boating safety course. Staff can register here: https://dnr.maryland.gov/nrp/Pages/BoatingSafety/Safety_Certificate.aspx.

All staff who collect data during the Tidal Bass Survey as described in Section 2 are required to review Appendix 4 and https://www.fws.gov/policy/241fw6.html. Staff will satisfactorily complete the USFWS online safety training course offered via National Conservation Training Center (CSP2202 - Principles and Techniques on Electrofishing). This online training is free. Instructional videos for Electrofishing Essentials that review safety and operation of electrofishing equipment.

5. Common Sense Provision

Safety of researchers and living organisms supersedes the desire for quality or robust data. Field ecology is challenged by changing environmental conditions, perception and background of the researchers, and "demonic intrusion" or unpredictably, maligning events. The best defense against challenging conditions is common sense. When an event arises that challenges the traditional collection of data, then researchers should collectively choose the best course of action by weighing ramifications of such a choice against the act of doing nothing. Researchers are held accountable for their actions and the data they collect. The highest standard of scientific ethics is expected.

APPENDIX 1

Supply List for Survey

Supply List

For each boat:

- Anode droppers (at least 2 array sets)
- Automated External Defibrillator (recommended, not required).
- Batteries (for GPS, YSI camera)
- Digital camera
- Dip nets (at least 2, long handled, 0.25-inch mesh nets; 30 cm deep with a 2 m, fiberglass handle)
- Dry erase board and marker (i.e., tally sheet for presence-absence data)
- Fire extinguisher (inspected) mounted away from gas can, generator or other fire sources.
- First Aid Kit
- GPS unit (with programmed site coordinates)
- Hearing protection for those who want it; if generator creates noise at or above 85 decibels, then crew must wear hearing protection.
- iPad (or datasheets if needed)
- Length measuring board
- Maps of site locations (printed, optional)
- Nonslip or skid resistant pad to decrease slipping on boat bow deck.
- Plastic bags (sealable)
- Secchi disk
- Standard Operating Procedure
- Water quality meter
- Weight scale
- Wireless phone

For each crew member:

- Polarized sunglasses, required when there is glare
- Rubber gloves long enough to isolate hands from touching external surfaces must be worn while electrofishing. Gloves may be made from neoprene, polyurethane, butyl, silicone, natural rubber, and PVC material
- Rubber gloves with punctures must be recycled or disposed
- Rubber-soled boots or other boots rated for electrical hazard protection must be worn
- U.S. Coast Guard approved PFDs must be worn by crew members when boat is underway.

APPENDIX 2

HAACP Plan for Tidal Bass Program

Tidal Bass Program HACCP plan

HACCP Step 1 - Activity Description

Facility:

Maryland Department of Natural Resources, Inland Fisheries, Tidal Bass Program - Tawes Building

Site:

Aquatic habitats in tidal rivers of Chesapeake Bay

Project Coordinator:

Joseph Love

Project Description:

Fishery Resource Management

Site Manager:

Project biologists include: Mary Groves, Tim Groves, Branson Williams, Ross Williams, Mark Staley, Adam Eschleman, Todd Heard, Brett Coakley, and Jerry Stivers

Address:

580 Taylor Avenue, B-2

Annapolis, MD 21401

Phone:

410-260-8257

Project Description

(Who, What, Where, When, How & Why)

Maryland Department of Natural Resources staff conducts fishery surveys, tagging, spawning and monitoring of Largemouth Bass and Smallmouth Bass. Invasive species management includes control of northern snakehead, blue catfish, and flathead catfish, where possible.

Sampling methods include boat and backpack electrofishing

These activities are conducted in the major tributaries to the Chesapeake Bay including (but not limited to)
the Potomac, Choptank, Susquehanna, Northeast, Pocomoke, Wicomico, Gunpowder, Middle,
and Patuxent Rivers.

Tidal Bass Program HACCP plan

HACCP Step 2 - Potential Hazard Identification
Vertebrates: Channa argus (northern snakehead) Pylodictis olivaris (flathead catfish) Ictalurus furcatus (blue catfish)
Invertebrates: Dreissena polymorpha (zebra mussel)
Plants: Hydrilla verticillata (hydrilla) Trapa natans (water chestnut) Myriophyllum spicatum (eurasian milfoil) Eichornia crassipes (water hyacinth)
Other Biologics:
Others:

Tidal Bass Program HACCP plan

HACCP Step 3 - Flow Diagram

Task # 1	Arrive at location, dress in personal gear and prepare gear needed for the sampling effort

Task # 2	Deploy boat or walk to sampling location and bring supplies to water

Task # 3	Conduct sampling (electrofish)

Task # 4	Identify species, measure length, and collect samples of aquatic species

Task # 5	Measure water quality, qualify habitat, and collect GPS coordinates at sampling locations

Task # 6	After survey is complete, return to truck and load sampling gear and personal gear

Tidal Bass Program HACCP plan

Task # 7 Return to office

Task # 8 If specimens have been collected, process samples, place in aquaria or freeze for later analysis

Task # 9 Unload and attend to sampling gear and personal gear

Tidal Bass Program HACCP plan

Task	Hazard	Probable?	Justification	Control Measures	CCP?	
Arrive at location, dress in personal gear and prepare gear needed for the sampling effort	Vertebrate: Channa argus (northern snakehead); Ictalurus furcatus (blue catfish); Pylodictus olivaris (flathead catfish)	No	if gear has been properly attended to following prior sampling events, there should be no transport		No	
	Plant: Hydrilla verticillata (hydrilla); Trapa natans (water chestnut); Myriophyllum spicatum (eurasian milfoil); Eichornia crassipes (water hyacinth)	No	if gear has been properly attended to following prior sampling events, there should be no transport		No	
	Invertebrate: Dreissena polymorpha (zebra mussel)	No	if gear has been properly attended to following prior sampling events,		No	

Tidal Bass Program HACCP plan

			there should be no transport			
Deploy boat or walk to sampling location and bring equipment to water	Vertebrate: Channa argus (northern snakehead); Ictalurus furcatus (blue catfish); Pylodictus olivaris (flathead catfish)	No	if gear has been properly attended to following prior sampling events, there should be no transport		No	
	Plant: Hydrilla verticillata (hydrilla); Trapa natans (water chestnut); Myriophyllum spicatum (eurasian milfoil); Eichornia crassipes (water hyacinth)		if gear has been properly attended to following prior sampling events, there should be no transport		No	
	Invertebrate: Dreissena polymorpha (zebra mussel)	No	if gear has been properly attended to following prior sampling events, there should be no transport		No	

Tidal Bass Program HACCP plan

Conduct sampling (electrofish)	Vertebrate: Channa argus (northern snakehead); Ictalurus furcatus (blue catfish); Pylodictus olivaris (flathead catfish)	Yes	northern snakeheads could be transported from one sample location to another	secure northern snakeheads in enclosed tanks when travelling between sites	No	
	Plant: Hydrilla verticillata (hydrilla); Trapa natans (water chestnut); Myriophyllum spicatum (eurasian milfoil); Eichornia crassipes (water hyacinth)	Yes	sampling could be conducted in more than one watershed or more than one localized area	Ensure that plants and nets is free from electrofishing probes, array, and prop before driving to a new waterway.	Yes	
	Invertebrate: Dreissena polymorpha (zebra mussel)	Yes	sampling could be conducted in more than one watershed or in more than one localized area	Pumps should be off and tank or bilge water should be empty when going from one waterway to another	Yes	
Identify species, measure length, and collect samples of captured aquatic species	Vertebrate: Channa argus (northern snakehead); Ictalurus furcatus (blue catfish); Pylodictus olivaris (flathead catfish)	Yes	Samples could be transported as part of a sample collection.	Secure fish in enclosed tanks when transporting between waterways.	No	

Tidal Bass Program HACCP plan

Identify species, measure length, and collect samples of captured aquatic species	Plant: Hydrilla verticillata (hydrilla)	No	this process occurs at one location		No
	Invertebrate: Dreissena polymorpha (zebra mussel)	No	this process occurs at one location		No
Measure water quality, qualify habitat, and collect GPS coordinates at locations	Vertebrate: Channa argus (northern snakehead); Ictalurus furcatus (blue catfish); Pylodictus olivaris (flathead catfish)	No	this process occurs at one location		No
	Plant: Hydrilla verticillata (hydrilla); Trapa natans (water chestnut); Myriophyllum spicatum (eurasian milfoil); Eichornia crassipes (water hyacinth)	No	this process occurs at one location		No
	Invertebrate: Dreissena polymorpha (zebra mussel)	No	this process occurs at one location		No
After survey is complete, return to truck and load sampling gear and personal gear	Vertebrate: Channa argus (northern snakehead); Ictalurus furcatus (blue catfish); Pylodictus olivaris (flathead catfish)	Yes	fish are often transported back to the office for experiments or for	secure fish in enclosed tanks when travelling	Yes

After survey is complete, return to truck and load sampling gear and personal gear					
	Plant: Hydrilla verticillata (hydrilla); Trapa natans (water chestnut); Myriophyllum spicatum (eurasian milfoil); Eichornia crassipes (water hyacinth)	Yes	Plants could be attached to sampling and/or personal gear	remove vegetation and mud from botas and gear/	Yes
	Invertebrate: Dreissena polymorpha (zebra mussel)	No	boats and gear will be visually cleared before the return trip to the office	remove vegetation and mud from boats and gear	Yes
Return to office					
	Vertebrate: Channa argus (northern snakehead); Ictalurus furcatus (blue catfish); Pylodictus olivaris (flathead catfish)	No	boats and gear will be visually cleared before the return trip to the office		Yes

Tidal Bass Program HACCP plan

			boats and gear will be visually cleared before the return trip to the office		
If specimens have been collected, process samples, place in aquaria or freeze for later analysis	Vertebrate: Channa argus (northern snakehead); Ictalurus furcatus (blue catfish); Pylodictus olivaris (flathead catfish)	No	Specimens will be held in aquaria or killed and disposed of properly		No
	Plant: Hydrilla verticillata (hydrilla); Trapa natans (water chestnut); Myriophyllum spicatum (eurasian milfoil); Eichornia crassipes (water hyacinth)	No	No specimens are retained		No
	Invertebrate: Dreissena polymorpha (zebra mussel)	No	No specimens are retained		No
Unload and attend to sampling gear	Vertebrate: Channa argus (northern snakehead); Ictalurus furcatus (blue catfish); Pylodictus olivaris (flathead catfish)	No	Specimens will be held in aquaria or disposed of properly	Debris will be visibly inspected and removed from trailer, bilge, prop, probes and hull	No
	Plant: Hydrilla verticillata (hydrilla)	Yes	Hydrilla could be attached to sampling or personal gear	Pressure wash trailer and outside of boat, bleach the live well, and dry completely before moving a new watershed.	Yes
	Invertebrate: Dreissena polymorpha (zebra mussel)	Yes	Zebra mussel larvae could be attached to sampling or personal gear		Yes

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Tidal Bass Program HACCP plan

Critical Control Point #1:

Task # 3: Conduct sampling (electrofish)

Significant Hazards:

Invertebrate: Dreissena polymorpha (zebra mussel)
Plant: Hydrilla verticillata (hydrilla); Trapa natans (water chestnut); Myriophyllum spicatum (eurasian milfoil); Eichornia crassipes (water hyacinth)

Control Measures:

check array, probes, prop and dip nets for debris and remove before moving to another sampling location, if in a separate watershed.

Limits for Control Measures:

visually inspect nets array, probes, props, dip nets before moving to another site, if in a separate watershed.

Monitoring: What?

that debris (SAV, mud) is removed from areas that come in direct contact with vegetation and mud in shallow areas and likely cling

Monitoring: How?

visually

Monitoring: Frequency?

every time a site a different watershed is sampled

Monitoring: Who?

Biologists

Evaluation & Corrective Actions:

boat and nets can be checked at the office and reinspected

Supporting Documentation: Britton, David. Zebra Mussel (Dreissena polymorpha). ANS Taskforce Web site. 2006.<http://www.anstaskforce.gov/spoc/zebra_mussels.php> (Accessed December 1, 2008).

Tidal Bass Program HACCP plan

Critical Control Point #2:

Task # 6: After survey is complete, return to truck and load sampling gear and personal gear

Significant Hazards: Vertebrate: Channa argus (northern snakehead)
Vertebrate: Ictalurus furcatus (blue catfish)
Vertebrate: Pylodictus olivaris (flathead catfish)

Control Measures:

secure fish in enclosed tanks when travelling between sites

Limits for Control Measures:

fishwill be placed in a secure tank for transport

Monitoring: What?

that the tank is closed and secured

Monitoring: How?

visually

Monitoring: Frequency?

each time a fish is caught and transported

Monitoring: Who?

biologists

Evaluation & Corrective Actions:

if no lid is available for a tank, either transport fish inside the truck or kill it before transporting

Supporting Documentation: Courtenay, Walter Jr., and Williams, James D. Snakeheads (Pisces, Channidae) — A Biological Synopsis and Risk Assessment. US Geological Survey Circular 1251. <http://fisc.er.usgs.gov/Snakehead_circ_1251/circ_1251_courtenay.pdf > (Accessed December 1, 2008).

Tidal Bass Program HAACP plan

Critical Control Point #3:

Task # 6: After survey is complete, return to truck and load sampling gear and personal gear

Significant Hazards:

Plant: Hydrilla verticillata (hydrilla); Trapa natans (water chestnut); Myriophyllum spicatum (eurasian milfoil); Eichornia crassipes (water hyacinth)

Control Measures:

remove vegetation and visible sediment from boats and gear, if travelling outside the watershed, power wash boat and trailer and bleach the live well

Limits for Control Measures:

Remove vegetation and mud from boats and gear

Monitoring: What?

That boats and gear are clean

Monitoring: How?

visually

Monitoring: Frequency?

each time the truck is packed for return to the office, additional steps (pressure washing boat and bleaching live well) will be taken if travelling outside of the watershed

Monitoring: Who?

biologists

Evaluation & Corrective Actions:

If boat and trucks are extremely muddy, trucks and boats will be washed at a car wash before leaving the watershed

Supporting Documentation: Elwell, Leah.,Spaulding, Sara. 2007. Increase in nuisance blooms and geographic expansion of the freshwater diatom Didymosphenia geminate. White paper. <http://www.macfff.org/pdf/ScientificKnowledgeofDidymo.pdf> (Accessed December 1, 2008).

Tidal Bass Program HACCP plan

Critical Control Point #4:

Task # 6: After survey is complete, return to truck and load sampling gear and personal gear

Significant Hazards:

Invertebrate: Dreissena polymorpha (zebra mussel)

Control Measures:

remove vegetation and visible sediment from boats and gear remove vegetation and visible sediment from boats and gear, if travelling outside the watershed, power wash boat and trailer and bleach the live well

Limits for Control Measures:

Remove vegetation and mud from boats and gear

Monitoring: What?

That boats and gear are clean

Monitoring: How?

visually

Monitoring: Frequency?

each time the truck is packed for return to the office or to a different watershed, additional steps (pressure washing boat with hot water and bleaching live well) will be taken if travelling outside of the watershed

Monitoring: Who?

biologists

Evaluation & Corrective Actions:

If boat and trucks are extremely muddy, trucks and boats will be washed at a car before leaving the watershed

Supporting Documentation: Britton, David. Zebra Mussel (Dreissena polymorpha). ANS Taskforce Web site. 2006.<http://www.anstaskforce.gov/spoc/zebra_mussels.php> (Accessed December 1, 2008).

Tidal Bass Program HACCP plan

Critical Control Point #5:

Task # 9: Unload and attend to sampling gear and personal gear

Significant Hazards:

Plant: Hydrilla verticillata (hydrilla); Trapa natans (water chestnut); Myriophyllum spicatum (eurasian milfoil); Eichornia crassipes (water hyacinth)

Control Measures:

Pressure wash trailer and outside of boat, bleach the live well, and dry completely before moving to a new watershed.

Limits for Control Measures:

If travelling outside the watershed,
power wash boat and trailer, bleach the live well, and allow 48 hours of drying time

Monitoring: What?

That dip nets and boats are washed and dried

Monitoring: How? visually

Monitoring: Frequency?

at the completion of sampling, before gear is used in another body of water

Monitoring: Who?

biologists

Evaluation & Corrective Actions:

If mud persists, scrub and dip in salt solution again.

Supporting Documentation: Elwell, Leah.,Spaulding, Sara. 2007. Increase in nuisance blooms and geographic expansion of the freshwater diatom Didymosphenia geminate. White paper. <http://www.macfff.org/pdf/ScientificKnowledgeofDidymo.pdf> (Accessed December 1, 2008).

Tidal Bass Program HACCP plan

Critical Control Point #6:

Task # 9: Unload and attend to sampling gear and personal gear

Significant Hazards:

Invertebrate: Dreissena polymorpha (zebra mussel)

Control Measures:

Pressure wash trailer and outside of boat, bleach the live well, and dry completely before moving to a new watershed.

Limits for Control Measures:

If travelling outside the watershed, power wash boat and trailer, bleach the live well, and allow 48 hours of drying time

Monitoring: What?

That nets and boats boats are completely dry before changing watersheds and that boats and trailers are washed and dried

Monitoring: How? visually

Monitoring: Frequency?

at the completion of sampling, before gear is used in another body of water

Monitoring: Who?

biologists

Evaluation & Corrective Actions:

If mud persists, scrub and dip in salt solution again.

Supporting Documentation: Britton, David. Zebra Mussel (Dreissena polymorpha). ANS Taskforce Web site. 2006.<http://www.anstaskforce.gov/spoc/zebra_mussels.php> (Accessed December 1, 2008).

Tidal Bass Program HACCP plan

Facility:

Maryland Department of Natural Resources

Address:

580 Taylor Avenue

Annapolis, MD 21401
(Headquarters)

Signature:

Activity:

Fishery Resource Management

Date:

Tidal Bass Program HACCP plan

HACCP Checklist:

Fishery Resource Management

Facility Maryland Department of Natural Resources

Site Chesapeake Bay and Tributaries

Coordinator Joe Love

Manager Staff (Joe Love, Mary Groves, Time Groves, Ross Williams, Branson Williams, Mark Staley, Adam Eshelman, Todd Heard, Brett Coakley, Jerry Stivers, Rebecca Bobola

Address 580 Taylor Avenue, Annapolis, MD 21401 (Headquarters)

Task # 1: Arrive at location, dress in personal gear and prepare gear needed for the sampling effort

Task # 2: Deploy boat or walk to sampling location and bring sampling gear to water

Task # 3: Conduct sampling (electrofish)

CRITICAL CONTROL POINT

Hazards were contained

Hazards: Invertebrate: Dreissena polymorpha (zebra mussel); Plant: Hydrilla verticillata (hydrilla); Trapa natans (water chestnut); Myriophyllum spicatum (eurasian milfoil); Eichornia crassipes (water hyacinth)

Control measures were implemented

Control Measures: Check array, probes, nets, and prop before moving to a new watershed.

Control limits were maintained

Control Limits: Visually inspect nets and boat.

Corrective actions were (performed if necessary)

Corrective Actions: Boats can be reinspected at the office.

Task # 4: Identify species, measure length, and collect samples of captured aquatic species

Task # 5: Measure water quality, qualify habitat, and collect GPS coordinates at sampling locations

Task # 6: After survey is complete, return to truck and load sampling gear and personal gear

CRITICAL CONTROL POINT

Hazards were contained

Hazards: Vertebrate: Channa argus (northern snakehead); Vertebrate: Pylodictus olivaris (flathead catfish); Vertebrate: Ictalurus furcatus (blue catfish)

Control measures were implemented

Control Measures: secure fish in enclosed tanks when travelling between sites

Control limits were maintained

Control Limits: fish will be placed in a secure tank for transport

Corrective actions were (performed if necessary)

Corrective Actions: If no lid is available for a tank, either transport fish inside the truck or kill it before transporting

Tidal Bass Program HACCP plan

Hazards were contained

Hazards: Plant: Hydrilla verticillata (hydrilla); Trapa natans (water chestnut); Myriophyllum spicatum (eurasian milfoil); Eichornia crassipes (water hyacinth)

Control measures were implemented

Control Measures: remove vegetation and visible sediment from boats and gear, if travelling outside the watershed, power wash boat and trailer and bleach the live well

Control limits were maintained

Control Limits: remove vegetation and mud from boats and gear

Corrective actions were (performed if necessary)

Corrective Actions: If boat and trucks are extremely muddy, trucks and boats will be washed at a car wash before leaving the watershed

Hazards were contained

Hazards: Invertebrate: Dreissena polymorpha (zebra mussel)

Control measures were implemented

Control Measures: remove vegetation and visible sediment from boats and gear remove vegetation and visible sediment from boats and gear, if travelling outside the watershed, pressure wash boat and trailer and bleach the live well

Control limits were maintained

Control Limits: Remove vegetation and mud from boats and gear, boats should be pressure washed with hot water (>140° if possible) and live wells should be treated with a bleach solution (at least 2%), if traveling outside of the watershed.

Tidal Bass Program HACCP plan

Corrective actions were (performed if necessary)

Corrective Actions: If boat and trucks are extremely muddy, trucks and boats will be washed at a car wash before leaving the watershed

Task # 7: Return to office

Task # 8: If specimens have been collected, either process samples or place them in either aquaria or the freezer for later analysis

Task # 9: Unload and attend to sampling gear and personal gear

CRITICAL CONTROL POINT

Hazards were contained

Hazards: Plant: Hydrilla verticillata (hydrilla); Trapa natans (water chestnut); Myriophyllum spicatum (eurasian milfoil); Eichornia crassipes (water hyacinth)

Control measures were implemented

Control Measures: Pressure wash trailer and outside of boat, bleach the live well, and dry completely before moving to a new watershed.

Control limits were maintained

Control Limits: If travelling outside the watershed, power wash boat and trailer, bleach the live well, and allow 48 hours of drying time

Tidal Bass Program HACCP plan

Corrective actions were (performed if necessary)

Corrective Actions: If mud persists, scrub and dip in salt solution again.

Hazards were contained

Hazards: Invertebrate: Dreissena polymorpha (zebra mussel)

Control measures were implemented

Control Measures: Pressure wash trailer and outside of boat, bleach the live well, and dry completely before moving to a new watershed.

Control limits were maintained

Control Limits: If travelling outside the watershed, power wash boat and trailer, bleach the live well, and allow for several days of drying time

Corrective actions were (performed if necessary)

Corrective Actions: If mud persists, scrub again.

Appendix 3
Tidal Bass Survey Datasheet

Tidal Bass Survey

Collector* Initials_____
* Collector is the person recording the data

Date: _____/_____/_____
River: _____
Site Number: _____
Site Description _____

Tidal Stage:
☐ High Ebb ☐ High Flood
☐ Med Ebb ☐ Med Flood
☐ Low Ebb ☐ Low Flood
☐ High Slack ☐ Low Slack

Weather:
☐ Cloudy
☐ Overcast
☐ Rain
☐ Sunny
☐ Windy

Start Time: _____ Stop Time: _____
Start Lat ____ _____._____ Stop Lat ____ _____._____
Start Long ____ _____._____ Stop Long____ _____._____
Site Length _____ (m) Scalloped ___ Parallel ___
Site Width _____ (boat lengths)
Electrofisher: Duration: _____ (seconds) %Range:_____
Voltage: ___ High ____ Low ____ Pulse Rate ____
Current: _____Amps (mean value) _____Amps (expected value)

Bank Vegetation (Check if present):

Agriculture ____ Grass ____ Trees ____ Swamp/Wetland____ Dev/Paved ____ Beach ____ Riprap _____

Submerged Woody Structure (partially and observable submerged, consistently available structure to fishes)

Size: 0%___ Other Percent (5% increments) _____% *Density*: Absent ____ Not Dense ____ Dense ____

In-Stream Habitat: (Check if present):

Ledge/Drop-off ___ Gravel/Boulders____ Brush/Logs ___ Pier/Bulkhead ___ Wreck/Barge ___ Mudflat ___ SAV ___

Aquatic Vegetation (AV) Coverage in Sampling Area: (0 – 100%, 5% increments; Rank Species as 0, absent to 3, dominant)

% Algae _____ % SAV _____ % Emergent _____ Veg density (check one): ____dense ____med. ____sparse

Wild Celery ☐ Milfoil ☐ Hydrilla ☐ Coontail ☐ Algae ☐ Other_____ ☐

Water Quality (WRITE IN UNITS):

MinDepth _____ MaxDepth _____ Wat Temp: _____Air Temp:_____ DO _____

Spec. Cond. _____ Cond. _____ pH _____ Secchi Depth: _____ Sal. _____

Largemouth Bass Data (WRITE IN UNITS):

Fish #	TL (__)	Wt (__)	Tag?	Tag #	Lesion	Severity	Other
1			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
2			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
3			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
4			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
5			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
6			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN

Other Species	Cnt (R / A)	Other Species	Cnt (R / A)

Survey Notes
Number of Individuals Kept:_____
Number of Returned, Moribund Individuals: _____
Additional Comments:

(backside)

Fish #	TL (__)	Wt (__)	Tag?	Tag #	Lesion	Severity	Other
7			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
8			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
9			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
10			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
11			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
12			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
13			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
14			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
15			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
16			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
17			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
18			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
19			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
20			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
21			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
22			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
23			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
24			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
25			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
26			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
27			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
28			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
29			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
30			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
31			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
32			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
33			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
34			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
35			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
36			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
37			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
38			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
39			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN
40			☐SCAN ☐PIT ☐FLOY ☐CWT		☐ABR ☐NEC ☐TUM ☐HEM ☐ULC	☐MIL ☐FOC ☐MSEV ☐MFL	☐OPSD ☐OEMA ☐OPOP ☐OPHD ☐OCAT ☐OFUN

Tidal Bass Survey Fish Health Definitions and Abbreviations

ABR Abrasion. A fresh mechanical wearing away or roughening of the scales and skin. Caused through handling, nets or other mechanical sources.

HEM Hemorrhagic. Abnormal discharge of blood into tissues, into or from the body; the escape of blood from the vessels, bleeding under scales of skin or fins.

NEC Necrotic. Death of areas of cells and tissues [tissues] appear firm and pale, as if cooked.

ULC Ulcer. An excavation or penetration, generally round in shape, through the skin into the muscle or abdominal organs.

TUM Tumor. A swelling or enlargement. A spontaneous new growth of tissue forming an abnormal mass.

OSPD Spinal Deformity. Obvious twisting of the body, can be either side to side or top to bottom.

OPHD Physical Damage. Other anomalies on fish caused by external agent (hook wound, bird pecks, fish bites, gear damage). Includes scars, missing eyes, and damaged fins.

OEMA Emaciated. State of being extremely lean.

OCAT Cataract. Opacity of the lens of the eye.

OPOP Pop Eye. Abnormal protrusion of the eyeball.

OFUN Fungus. State of having fungal infection.

MIL Mild. The infection or anomaly is superficial, not penetrating.

MSEV Moderate or Severe. The anomaly or infection penetrates the scales, is bloody, or deeply penetrates skin and exposes organ.

FOC Focal. A very localized, discrete area of alteration.

MFL Multifocal. More than one (many) localized, discrete areas of alteration.

APPENDIX 4

Electrofishing Safety Policy
Selected from U.S. Fish and Wildlife Service

6.10 What design specifications are applicable to electrofishing boats and rafts?

A. Design.

(1) Boat design and equipment must be in compliance with U.S. Coast Guard and State regulations and U.S. Department of the Interior policy (also see 241 FW 1). The boat or raft crew must follow the additional guidelines in this electrofishing safety policy.

(2) The netting area must have substantial safety rails to help prevent netters from falling overboard. Safety rails must withstand netters leaning on them without collapsing.

> **(a)** On solid-hulled boats, safety rails should be at least 42 inches from the top of the rail to the deck. The top of the rail should be at or above the waistline of netters.
>
> **(b)** Safety rails on rafts may be lower, but netters must kneel to keep the top of the rail at or above their waistline.

(3) The team leader must ensure the boat bow deck is equipped with a nonslip or skid-resistant material or roughened in some manner to decrease the chance of slipping.

(4) Electrode booms (anodes with DC) must be mounted in a stationary position on a metal-hulled boat. Moveable anodes (prod poles) may be used on metal-hulled boats with non-conductive deck surfaces and railings.

(5) All metal surfaces on a boat or raft must be electrically connected (in electrical continuity) to eliminate differences in electrical potential that may cause electric shock. Ground the generator case to the hull or rowing frame (raft) by a direct attachment, with a ground strap, or 8 AWG sized wire. We recommend that you connect a ground wire from the pulsator to the hull or rowing frame. You may use a metal boat hull as a cathode.

(6) An acid proof, nonmetallic enclosure and holder must be provided for wet cell batteries.

(7) For typical power sources, the recommended conductor voltage capacity is 600 volts RMS minimum for the main circuit and 300 volts RMS maximum for the safety circuit.

(8) For typical power sources, the recommended conductor size is 10 AWG for the generator power cord and main circuit. The suggested safety circuit size is 14 – 16 AWG.

(9) For typical power sources, the recommended connector plug and socket rating is 600 volts/32 amps minimum for the main circuit and 250 volts/30 amps for the plug to the generator.

(10) All conductors must be enclosed in liquid-tight conduits. Where external connections are necessary (e.g., to the booms, pulsator, or foot safety switch), use appropriately rated SOOW and SJOOW cables, watertight condulet/junction boxes, and connector plugs and sockets (meeting the NEMA 4 and IP65 standards or greater). All conductors installed in a common raceway (conduit) must be continuous (without

connectors, breaks, or splicing) and independently and correctly insulated. High and low voltage (safety circuit) conductors do not need to be placed in separate conduits.

(11) Mount fire extinguishers away from gas cans, generators, or other fire sources.

(12) Mark watercraft with “Danger Electricity” signage.

B. Controls for Electrical Equipment.

(1) The boat/raft operator must have ready access to a generator or pulsator on/off, emergency stop, or safety switch to cut the power in case of an accident.

(2) At least one netter on the bow work deck must have a safety switch connected to the power control circuit.

C. Lighting.

(1) When operating at night, you must have adequate lighting for working areas. Lighting may include fixed lights (12-24 volts) or head-lamps.

(2) You must use adequate lighting outside the watercraft to avoid safety hazards, such as striking logs, rocks, and overhead tree branches.

(3) Lighting and other auxiliary circuits should not exceed 24 volts. Light emitting diode (LED) lamps can provide effective lighting with low amperage draw, usually requiring 12 volts. If shielded with a protective housing, you may use 120 volt lamps.

PERSONAL PROTECTIVE EQUIPMENT AND SAFETY PRACTICES

6.11 What personal protective equipment and safety practices are applicable to all electrofishing operations?

A. Gloves.

(1) All team members must wear rubber gloves that are long enough to isolate hands from touching external surfaces. Common glove materials include neoprene, polyurethane, butyl, silicone, natural rubber, and PVC. Rubber insulating (“lineman’s”) gloves are not required. Class 0 rubber insulating gloves (maximum use voltage = 1,000 V RMS) with leather glove protectors are a practical glove system and allow for dexterity.

(2) Team members must visually inspect gloves for punctures before each use and replace them immediately if they are torn or punctured.

B. Net Handles. Net handles must be constructed of a nonconductive material and be long enough to avoid hand contact with the water.

C. Polarized Sunglasses. Team members should wear polarized sunglasses when there is glare.

D. Noise.

(1) If using a generator, a noise survey to document Sound Pressure Level (SPL) exposures to electrofishing crew members must be performed. When subjected to sound levels at or above 85 decibels (dBA), regardless of time exposed, crew members must wear hearing protection to reduce sound levels (see 242 FW 3). Also, whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level of 85 dBA, a continuing effective hearing loss prevention program, in accordance with 242 FW 3, must be administered. The team leader should ensure that any time a generator is used, hearing protection is available for anyone who wants to wear it, whether or not it is required. Inverter generators are substantially quieter than traditional generators, but require a special stabilizer sold by electrofishing equipment manufacturers.

(2) More information about personal protective measures for preventing hearing loss, such as using earplugs, is available in 242 FW 3.

(3) Project Leaders may buy 2-way communication headphones using duty station funds. If you use 2-way communication headphones, you should do so in accordance with 242 FW 3. To be effective, headphones should provide clear communication among personnel.

E. Gloves and Wader Repair or Replacement. Electrofishing operations should be discontinued if a crew member feels electroshock through gloves or waders. Replace or repair gloves or waders to eliminate electroshock.

F. First Aid Kit. Maintain and have available a well-equipped first aid kit (see 243 FW 1, Exhibit 1).

G. Automated External Defibrillators (AED). We recommend, but do not require, that all electrofishing crews be equipped with an AED. If AEDs are provided, then a minimum of two team members must be AED-certified and a formal written program established at the local level. A medical director must oversee the program.

H. Exhaust From Power Source. The exhaust from gasoline powered engines must be directed away from the equipment operator. Enclose any added exposed hot pipes in a protective covering (e.g., screening) that you may paint with high temperature yellow paint, or position them so that crew members will not be burned. Do not use plastic or galvanized pipe for exhaust because it may release toxic gases when extremely hot.

I. Fuel Storage.

(1) Store and transport gasoline and other fuels in approved safety cans. Unless specifically designed as a fuel tank for a generator, pump, or outboard motor, safety cans that meet OSHA standards are required (29 CFR 1926.152(a), 155(a), 155(l)). OSHA recognizes safety cans approved by testing laboratories as Factory Mutual (FM) or United Underwriters Laboratory (UL). We recommend that you use approved plastic containers with stainless steel fittings to reduce corrosion issues. Screw-cap type containers that do not meet safety standards are not permissible for such flammable liquids as gasoline.

(2) If rough transport could result in spillage from an approved safety can, then the team must use U.S. Department of Transportation (DOT)-compliant transport and dispensing safety cans. These are commonly referred to as DOT/OSHA cans and have filler caps you can lock down to avoid leaks during transport. You can also release the locking mechanism so that the container will function as a safety cap during fueling operations.

J. Refueling.

(1) Turn off all equipment before refueling the generator and allow hot surfaces to cool. We recommend that you fill all tanks before each operation to avoid the potential for explosion or fire while refueling.

(2) Only fuel away from any open flame or a flame-generating device. You should use a properly sized flexible filling spout or funnel during refueling to avoid spills.

(3) Place portable fuel tanks on a dock or pavement for refueling. Do not refuel portable fuel containers on a plastic surface (e.g., a plastic lined pickup truck bed). We recommend that you use a bonding wire between metal tanks/containers.

K. Handling Electrodes.

(1) After operation of an electrofishing unit, before handling electrodes, disconnect the electrodes from the rest of the system (e.g., with backpack shockers, unplug handheld electrode from the pulsator; with boats, unplug the power output cable from the pulsator). Capacitors in the pulsator hold a charge for a period of time after the power is turned off. Capacitors self-discharge, often in less than 5 minutes. Check with the equipment manufacturer to determine capacitor discharge times for your pulsator model.

(2) Never touch both electrodes simultaneously while the power source is running, when both electrodes are connected to the equipment circuit, or prior to capacitor discharge time after power shutdown.

L. Servicing Pulsator. Before opening a pulsator to service it (e.g., changing fuses), capacitors must be in a discharged state. Do not service the pulsator unit until the capacitor self-discharge time has elapsed, typically within 5 minutes (contact manufacturer for the discharge time). We recommend that you label pulsators with their capacitor discharge time.

M. Making Connections or Repairs. Prior to adjusting connections or making repairs, disconnect the power source.

N. Startup of Electrofishing Unit. Before turning on the electrofishing unit, warn all team members and check to be sure they are aware electrofishing is about to begin.

O. Equipment Inspection. Maintain all electrofishing equipment in a safe condition. Visually inspect external wiring, cables, and connectors for physical damage before each use and periodically during use. Test safety switch operation with a multimeter. Any equipment deficiency that may present a safety hazard must be corrected before beginning or resuming electrofishing activities.

P. Protecting Others. Discontinue electrofishing if anyone outside of the electrofishing team approaches within 30 feet (for backpack operations) or 100 feet (for all other electrofishing operations).

Q. Weather. Discontinue electrofishing during dangerous weather conditions.

6.13 What additional personal protective equipment and safety practices are applicable to electrofishing boats and rafts?

A. Standard Safety Equipment.

(1) All watercraft occupants must wear U.S. Coast Guard-approved personal flotation devices at all times in accordance with the U.S. Department of the Interior and Service watercraft safety policy (see 485 DM 22 and 241 FW 1).

(2) Boat crew members must wear, at a minimum, rubber-soled boots or other boots rated for electrical hazard protection (e.g., those meeting standards in ASTM F2412-11, ASTM F2413-11, and ASTM F2892-11).

(3) Netters in rafts that have a non-conductive work-deck surface must wear hip waders to prevent contact with wet surfaces.

(4) Motorized electrofishing boats must be outfitted with required safety equipment (also see 241 FW 1, Watercraft Safety).

B. Clear Working Space. There must be adequate working space to conduct safe operations. The team leader and all crew members must be careful to prevent clutter that may cause safety hazards.