American Shad Sustainable Fishing Plan for the St. Johns River System, Florida
(Updated to include St. Johns River Tributaries)

Prepared by

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On Behalf of

Florida Fish and Wildlife Conservation Commission

Fish and Wildlife Research Institute and Division of Marine Fisheries Management

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System Descriptions:

St. Johns River and Tributaries

The St. Johns River in Florida drains 22,900 km^2 along east central Florida from Vero Beach to Jacksonville. The primary spawning run of American Shad in Florida historically was and currently is in the St. Johns River. Spawning occurs from late December to early May in most years, with peak activity from mid-January to mid-March. (Walburg 1960, Williams and Bruger 1972, McBride and Holder 2008). The spawning grounds have been documented from rkm 230 to rkm 433 near the headwaters (Williams and Bruger 1972, Williams et al. 1975). Of that distance 160km can be classified as river and 43 km as lake. Primary spawning grounds were in river habitats between rkm 275 and rkm 360 (Williams and Bruger 1972). Contemporary egg collection (Miller et al. 2012b) and telemetry (Dutterer et al. 2011) confirm that spawning grounds still exist between rkm 230 and a weir at rkm 415. The mainstem run of the St. Johns River supported significant commercial fisheries in the 19^{th} and 20^{th} centuries and continues to support a small recreational fishery.

Some tributaries to the St. Johns River that are thought to include American Shad spawning habitat are the Econlockhatchee River which enters the St. Johns at rkm 317 in the heart of the spawning grounds, the Wekiva River which enters the St. Johns between Lake Monroe and Lake George at rkm 255, the Ocklawaha River which enters the St. Johns in tidal freshwater at rkm 168 near Welaka, and Black Creek at rkm 74. Potential spawning habitat in these systems is limited.

The Econlockhatchee River is the second largest tributary to the St. Johns River encompassing a watershed area of 700 km^2 with a stream length of 57 km. It discharges into the St. Johns River at rkm 317. American Shad spawning has been documented in the lower Econlockhatchee River (Williams and Bruger 1972). It is not known if the Econlockhatchee River supports its own run of American Shad or if it attracts strays from the adjacent St. Johns River spawning grounds. However, recent electrofishing and telemetry surveys have located adult shad from rkm 4 to rkm 14 during the spawning season (McBride and Holder 2008, Holder et al. 2012, Dutterer et al. 2011, Hyle 2019) in all years that sampling has occurred. There is evidence that the Econlockhatchee River provides some amount of alternative habitat for American Shad in the upper St. Johns River during periods of extreme low flow in the St. Johns River (Hyle 2019).

The Wekiva River is a spring fed tributary to the St. Johns River and shares extensive floodplain forest with the St. Johns River in its lower reaches. Preliminary investigations for the previous stock assessment found a few spawning capable American Shad in the lower reaches of the Wekiva River. Blueback Herring and Hickory Shad were more common (Mcbride et al. 2008, McBride 2007). A preliminary field study found suitable substrate and velocity for American Shad in only 7.6 km of river (Miller and Mace 2019).

The Ocklawaha River is the largest tributary of the St. Johns River at 118 kilometers in length. It is the largest Atlantic drainage river in Florida obstructed by a dam in its lower reaches. There is no record of a

spawning run of American Shad in the Ocklawaha River pre-dating construction of the dam in 1968. There are anecdotes from veteran commercial fishermen of American Shad present in the Ocklawaha River prior to dam construction (Jordan 1994) but no confirmation. There are modern anecdotes of shad present below the dam but recent efforts to locate spawning American Shad in the Ocklawaha River below the dam have yielded none (Holder et al. 2012).

Black Creek is a small tributary of about 200 km^2 that drains from the ridge that separates the Suwannee River watershed from the St. Johns River. An Ichthyoplankton survey in 1972 and 1973 collected a very small number of American Shad eggs and larvae from Black Creek and a fish camp along the river reported that some anglers caught shad there (Williams et al. 1975). Most recently, one ripe female American Shad was captured in the north fork of Black Creek in exploratory electrofishing that occurred during the 2004 and 2005 spawning seasons (McBride 2007).

Florida's Commercial American Shad Fishery

There have been no reported landings of American Shad from any commercial fishery in Florida state waters since 2000.

Florida's Recreational American Shad Fishery

Recreational hook and line sport fishing for American Shad was popular on the St. Johns River by the 1950s and 1960s (Nichols 1959, 1966a; Walburg and Nichols 1967). In 1958 there were an estimated 6,000 boat trips by anglers targeting American Shad in the St. Johns River that harvested 63,693 American Shad. The average effort was about 5,000 angler hours from 1993 to 2005 with total catch ranging from 1,860 fish to 12,106 shad and harvest from 328 to 1,509 fish (McBride and Holder 2008). Recreational fishing for American Shad is known to occur only on the St. Johns River and the Econlockhatchee River. Fishing occurs on the St. Johns River between rkm 279 and 370 with a majority occurring near access points at rkm 285, 290, and 316. A limited amount of recreational fishing occurs in the Econlockhatchee River which drains into the St. Johns River at rkm 317. The Econlockhatchee recreational fishery operates in tandem with the adjacent St. Johns River and uses a common access point.

No directed recreational fishing for American Shad or incidental catch of American Shad has been documented in Florida waters other than in the middle/upper St. Johns River and adjacent Econlockhatchee River. MRIP has not detected American Shad fishing or catch to occur in the coastal systems (Nassau, Pelicer, Tomoka). FWC has regular contact with recreational fishing clubs (e.g. First Coast Fly Fishing Club, Mosquito Lagoon Fly Fishing Club, Orlando Kayak Fishing Community) from Jacksonville to Orlando. None report fishing for American Shad outside the St. Johns River.

Regulation

Effective January 1997, hook and line fishing is the only allowable gear to fish for any Alosa species (Chapter 46-52.001 [2], Florida Administrative Code [FAC]) and the possession of more than an aggregate of 10 American, hickory, or Alabama shad is unlawful (Chapter 46-52.001 [3], FAC). A saltwater fishing license is also required of most anglers to fish for Alosa species in Florida

Stock Monitoring Programs

a) Fishery Independent

i. Juvenile abundance indices (JAI)

The relative abundance of young of the year American Shad in the St. Johns River has been assessed annually as catch per tow by a bow mounted push net since 2007. A standard sample night comprises 12 5-minute tows at stations selected at random within a 40 kilometer long sampling reach. Two representative index reaches were selected in 2010 based on a pilot project that ran from 2007 to 2009; one in the river run between river kilometer 210 and 260 and one in tidal freshwater between river kilometer 125 and 165 (Figure 1). Index sampling occurs bi-weekly from the end of March until the CPUE drops below 10% of the peak nighly average. The initial sustainable fishing plan did not identify which sampling index should be used as a benchmark citing a lack of information about which location would best perform in describing recruitment success or failure. The JAI from the tidal freshwater reach was correlated to year class strength in the spawning stock in subsequent years (Figure 2). The JAI has been highly variable but generally increasing (Figure 4). River discharge during the spawning season accounts for a large proportion of the interannual variability in JAI in the lower St. Johns River (Figure 5). The lower St. Johns River American Shad JAI appears to predict both recruitment to the spawning stock and recruitment response to a significant environmental variable.

The index sampling area on the St. Johns River between rkm 125 and 165 is downstream of all tributaries except Black Creek. It encompasses juvenile production from the entire system except from Black Creek.

ii. **Spawning stock survey**

The spawning stock survey tracks the relative abundance of adult American shad by electrofishing the spawning stock. The spawning stock index is reported as the geometric mean catch per standard sample. The current benchmark is that three consecutive years with the CPUE below the 25^{th} percentile of the time series will trigger a management action. Sampling occurs biweekly from January through March between river kilometers 314 and 357 (Figure 3). A standard sample day includes 10 standard samples at randomly selected sites within the reach. Sampling will continue on an annual basis. Biological samples are collected for length, sex composition, and aging (beginning in 2011) from these

electrofishing collections. This is the longest continuous index currently running on the St. Johns River. The CPUE was at the 25th percerntile in the upper river reach between river kilometer 314 and 357 in both 2015 and 2016 (Figure 6). River discharge was above the 90th percentile during the spawning season in both years and this seems to have altered the distribution of fish within the sampling areas. Two peak season sampling trips also occur between river kilometers 279 and 297 (Figure 3). The CPUE was the highest and second highest in the time series between river kilometers 279 and 297 in 2015 and 2016 respectively.

Electrofishing samples also occur annually on the Econlockhatchee River as water levels permit. However, these are not included as part of standard long term index monitoring because the system does not appear to behave independently of the St. Johns River (Hyle et al. 2019) and because drought conditions preclude often sampling in the Econ.

Several tributaries were sampled in between 2006 and 2011 to look for the presence of American Shad. Shad were located only in the Econlockhatchee River and in channel braids along the main river. None were located in other tributaries (Holder et al. 2011, Figure 7).

b) Fishery Dependent

A roving creel survey of recreational anglers was conducted between the mouth of Lake Jesup (river kilometer 285) and just south of Iron Bend (river kilometer 298) in 11 out of 13 years from 1992 to 2005 (McBride and Holder 2008). This creel documented declining effort and relatively stable catch rates (Figure 8 and Figure 9). An access point creel was introduced in 2011 and will continue annually as funds allow. The access point creel covers the old creel area (Mullet Lake Creel Area) via two boat ramps and an upstream area (Puzzle Lake Creel Area) via one boat ramp (Figure 3). Canvassing anglers on the water indicated that greater than 95% of shad fishing effort originates at these ramps. These ramps are the primary access points to the ~14 km of river in which most shad fishing occurs. The angler success rate in the Mullet Lake Creel Area from 2011 to 2016 was 0.92 fish/hour compared to the 0.71 fish/hour average for shad between 1992 and 2005 (McBride and Holder 2008). There has been no trend in angler CPUE (Figure 9) but effort continues to decline in the Mullet Lake Creel Area (Figure 8). Effort increased in the Puzzle Lake Creel Area though 2014 but was low in 2015 and 2016 due to high water related access difficulty. Angler harvest has been >20% catch for all years 1992 to present.

A benchmark angler catch rate of 1 fish per angler hour was selected as a restoration target based on the previous roving creel (ASMFC 2007). However, the nature of the fishery has changed. The fish camp at river kilometer 287, from which much of the shad fishing effort occurred in the past, has closed and some fishing effort has shifted to another section of river (Figure 8). Additionally, fishing techniques have changed from primarily trolling to primarily fly fishing. Therefore we do not believe that angler catch rate should be used as a stand alone benchmark. Annual monitoring of this fishery through an access point creel will continue as long as funding is available.

This angler survey captures fishing effort and CPUE from the Econlockhatchee River because most anglers that target American Shad in the Econlockhatchee River originate their trips at the boat ramp that serves the "Puzzle Lake Creel Area" in the St. Johns River.

Sustainable Fishery

FWC requests to maintain the recreational fishery in Florida without changing gear restriction or bag limits. Recreational fishing is known only for the St. Johns River and adjacent Econlockhatchee River and it is appropriate to maintain sustainability benchmarks from this primary run.

The fishery independent American Shad spawning stock monitoring and fishery dependent creel survey both overlap all known American Shad recreational fishing areas. The primary JAI survey occurs downstream of all significant tributaries except Black Creek. Management actions necessary for any part of the St. Johns River American Shad population will apply to the entire watershed.

a) Fishery Independent Spawning Stock Index Benchmark (Table 1)

The 25th percentile of the fishery independent spawning stock index 2003 through 2016 was 4.04 (Table 1, Figure 6). Three consecutive years below the 25th percentile will trigger a management review. Data informing this index cover the population that is subject to fishing.

b) JAI Benchmark (Table 1)

The 25th percentile of the JAI from the lower St. Johns River river during the period 2007 to 2016 was 2.33. Three consecutive years below this level will trigger a management review. This index captures juvenile production from all waters upstream of rkm 125 which covers the St. Johns River and all tributaries other than Black Creek.

c) Future Benchmark to Incorporate Fishery Dependent Data

In the St. Johns River, FWC will continue to monitor the ratio of fishery metrics (e.g. effort, catch, harvest) to fishery independent abundance indexes with the intention of developing a benchmark based on a 'relative exploitation index'.

Literature Cited

ASMFC (Atlantic States Marin Fisheries Commission). 2007. American shad stock assessment peer review report. Washington, D.C.

Dutterer, A.C., Allen, M.S., and W.E. Pine. 2011. Spawning Habitats for American Shad as the St. Johns River, Florida: Potential for Use in Establishing MFLs. Special Publication SJ2012-SP1. St. Johns River Water Management District. Palatka, FL.

Holder, J., R. Hyle, and E. Lundy. 2012. ST. JOHNS RIVER AMERICAN SHAD INVESTIGATIONS COMPLETION REPORT, Fiscal Year 2006-2011. Freshwater Fisheries Research, Resource Assessment: Fish and Wildlife Research Institute. Fish & Wildlife Conservation Commission, Tallahassee, FL, USA

Hyle, R., A. Marbury, E. Lundy, and J. Holder 2019. Saint Johns River American Shad Long Term Monitoring. Annual Project Report. Florida Fish and Wildlife Research Institute – Freshwater Fisheries Research.

McBride, R.S and J. C. Holder. 2008. A review and updated assessment of Florida's anadromous shads: American shad and hickory shad. North American Journal of Fisheries Management 28: 1668-1686.

Miller, S.J., Brockmeyer, R.E., Tweedale, W., Shenker, J., Keenan, L.W., Connors, S., Lowe, E.F., Miller, J., Jacoby, C., and L. McCloud. 2012b. Appendix 12.C. Potential Withdrawal Effects on Anadromous Herrings. St. Johns River Water Supply Impact Study. St. Johns River Water Management District. Technical Publication SJ2012-1.

Walburg, C. H., and P. R. Nichols. 1967. Biology and management of the American shad and status of the fisheries, Atlantic coast of the United States, 1960. U.S.Fish and Wildlife Special Scientific Report Fisheries. 550:1–105

Williams, R. O., W. F. Grey, and J. A. Huff. 1975. Study of anadromous fishes of Florida. Completion Report for the period 1 May 1971 to 30 June 1974 for research funded by the Anadromous Fish Act (PL 89-304). National Marine Fisheries Service, St. Petersburg, Florida

Table 1. Florida St. Johns River American Shad Management Benchmarks and Triggers

River System	Index	Index Years	Benchmark Value	Benchmark Level	Management Trigger
St. Johns River	Spawning Stock Electrofishing CPUE	2003-2016	4.04 shad/standard sample	25th percentile	3 consecutive years below the benchmark
St. Johns River	Pushnet Juvenile Abundance Index	2007-2016	2.33 shad/standard sample	25th percentile	3 consecutive year below the benchmark

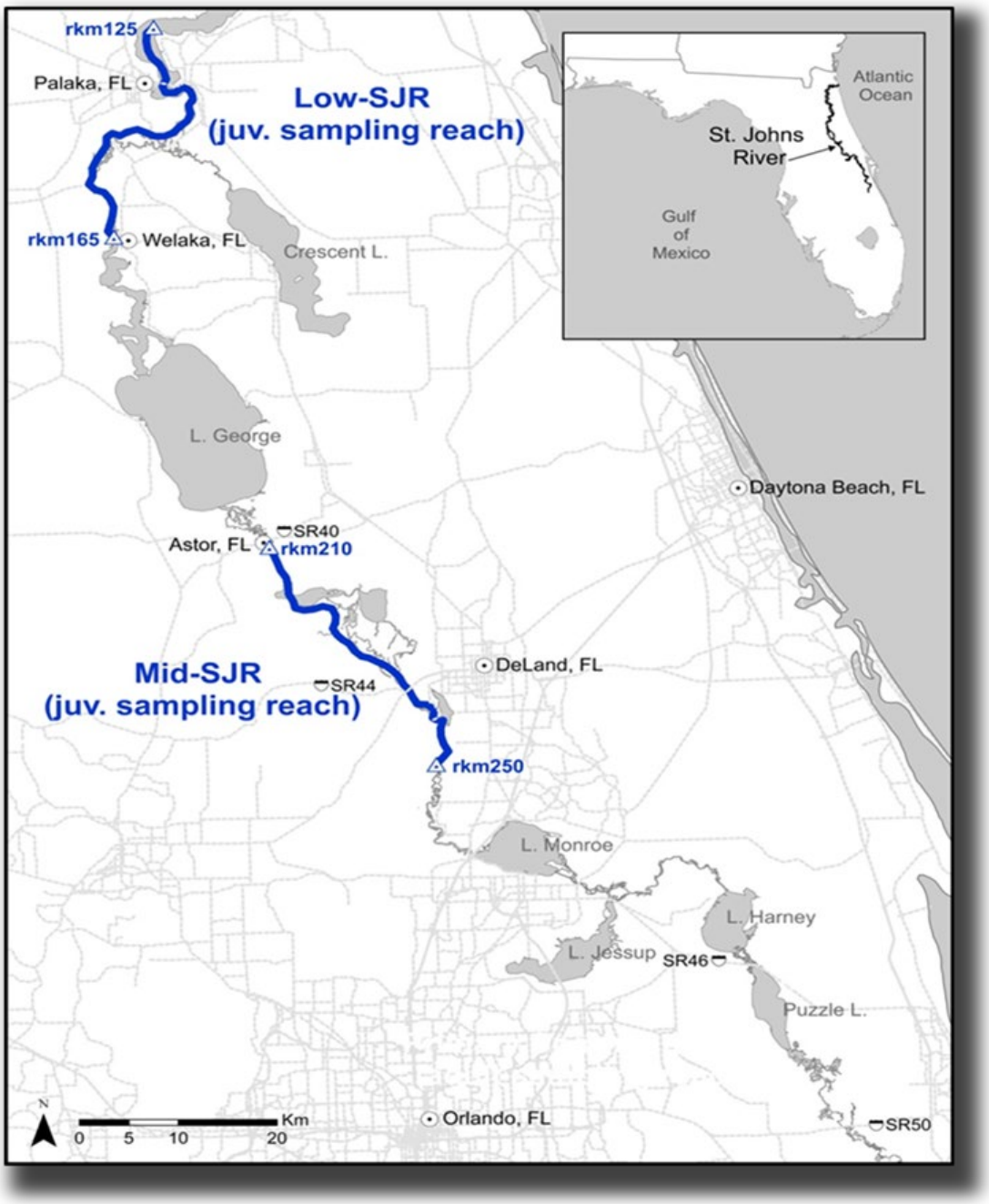

Figure 1. Middle and lower St. Johns River. Diurnal tides extend up to Lake George. Spawning grounds begin between Lakes George and Monroe but are primarily south of Lake Monroe. Juvenile sampling by pushnet in 2007-2009 extended from rkm 125 to 305 from spring to fall. From 2010 forward, the Mid-SJR Sampling Reach (rkm 210-260) and the Low SJR Sampling Reach (rkm 125-165) are sampled biweekly from the end of the spawning season until the nightly CPUE drops below 10% of the seasonal peak.

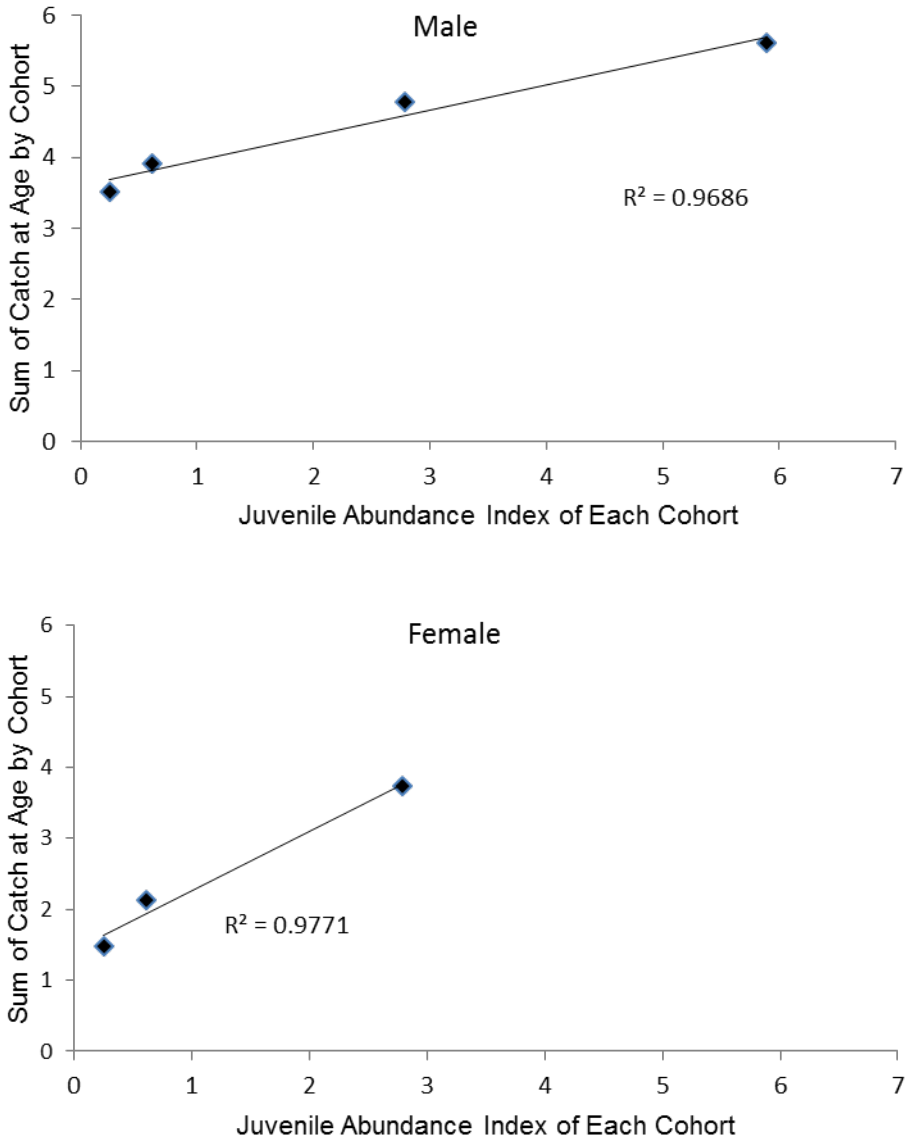

Figure 2. The CPUE at Age of the adult spawning stock versus the JAI in prior years. The electrofishing CPUE was summed across years for each age of each sex, ages 3 through 6 for males and ages 3 through 7 for females. This produced a sum of CPUE at Age for the 2007 through 2010 year classes of male American Shad and the 2007 through 2009 year classes of female American Shad. That value was tested for correlation with JAI. Males are in the top figure and females in the lower. Both simple linear regressions are significant at 0.05. As both regressions are short, the relationship will be tested with more robust methods as additional data are gathered.

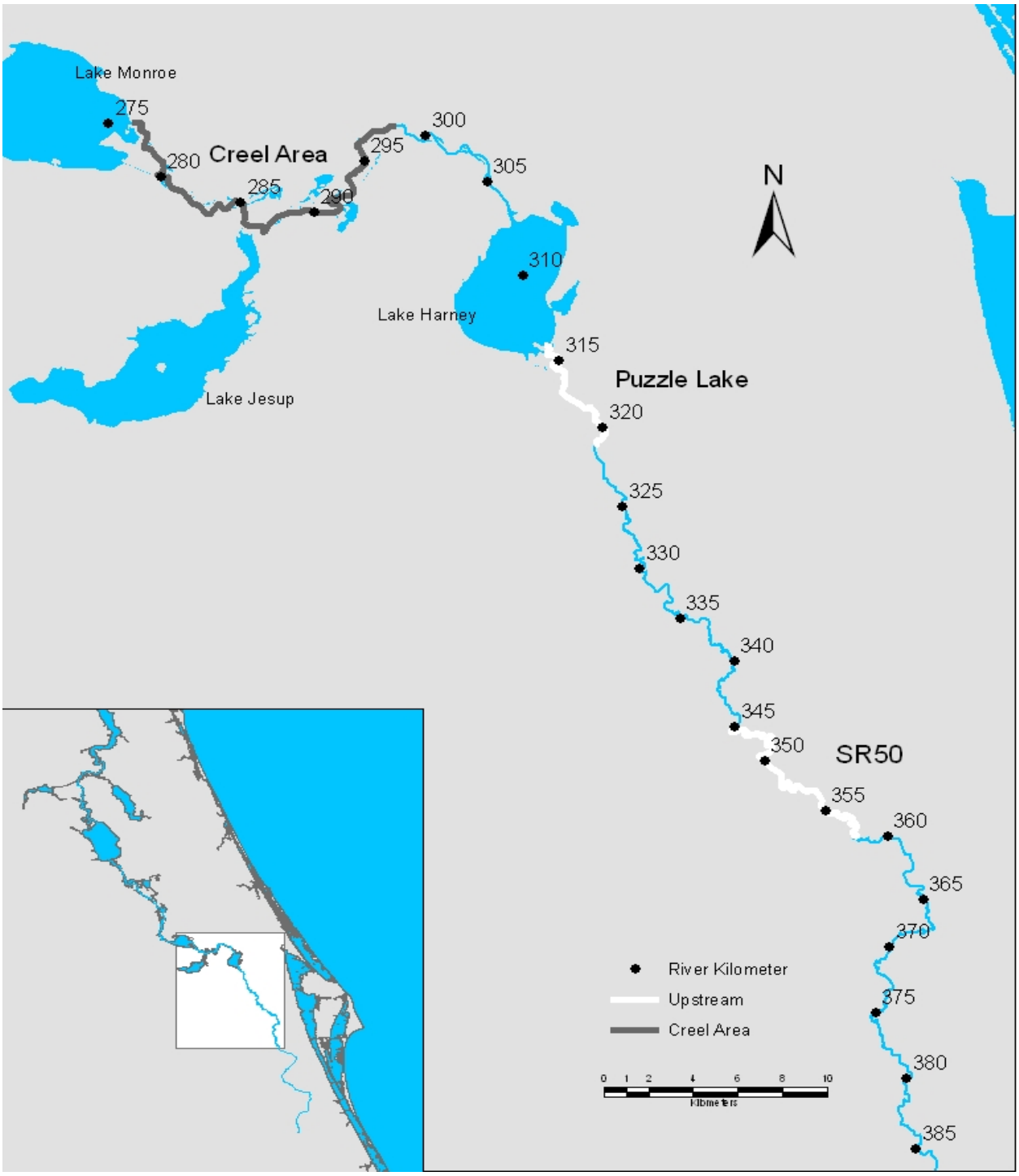

Figure 3. Upper St. Johns River. Primary spawning grounds occur from river kilometer (rkm) 276 to 378. Fishery independent monitoring for adult American shad occurs at Puzzle Lake (rkm 314-320), at State Road 50 (SR50, rkm 345-357), and at the Mullet Lake Creel Area (rkm 279-297) annoted on this figure as “Creel Area”. The recreational fishery occurs mainly at the Creel Area and Puzzle Lake.

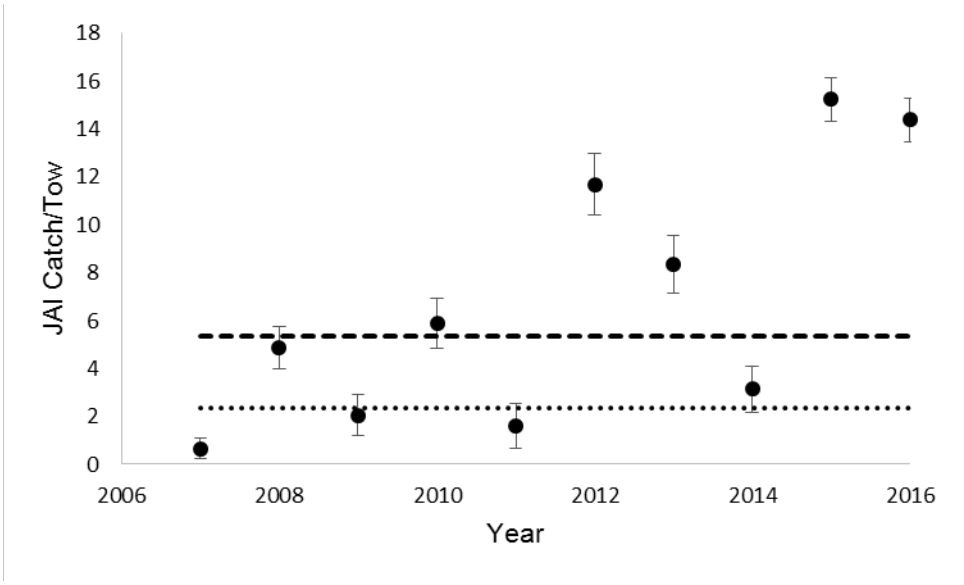

Figure 4. The summer juvenile abundance index, calculated as Geometric Mean, of American Shad from the lower St. Johns River, Florida from 2007 to 2016. Median is the dash line. 25th percentile is the dotted line.

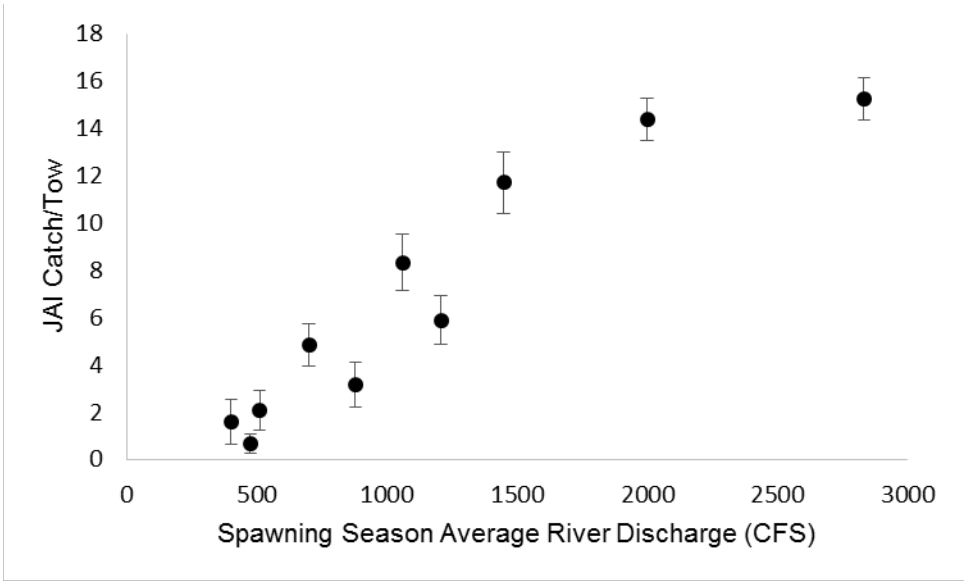

Figure 5. The summer juvenile abundance index of Amerian Shad from the lower St. Johns River, Florida from 2007 to 2016 versus the mean spawning season (January through March) discharge at USGS Gage 02232500 on the spawning grounds of the St. Johns River near State Road 50 in Christmas, Florida.

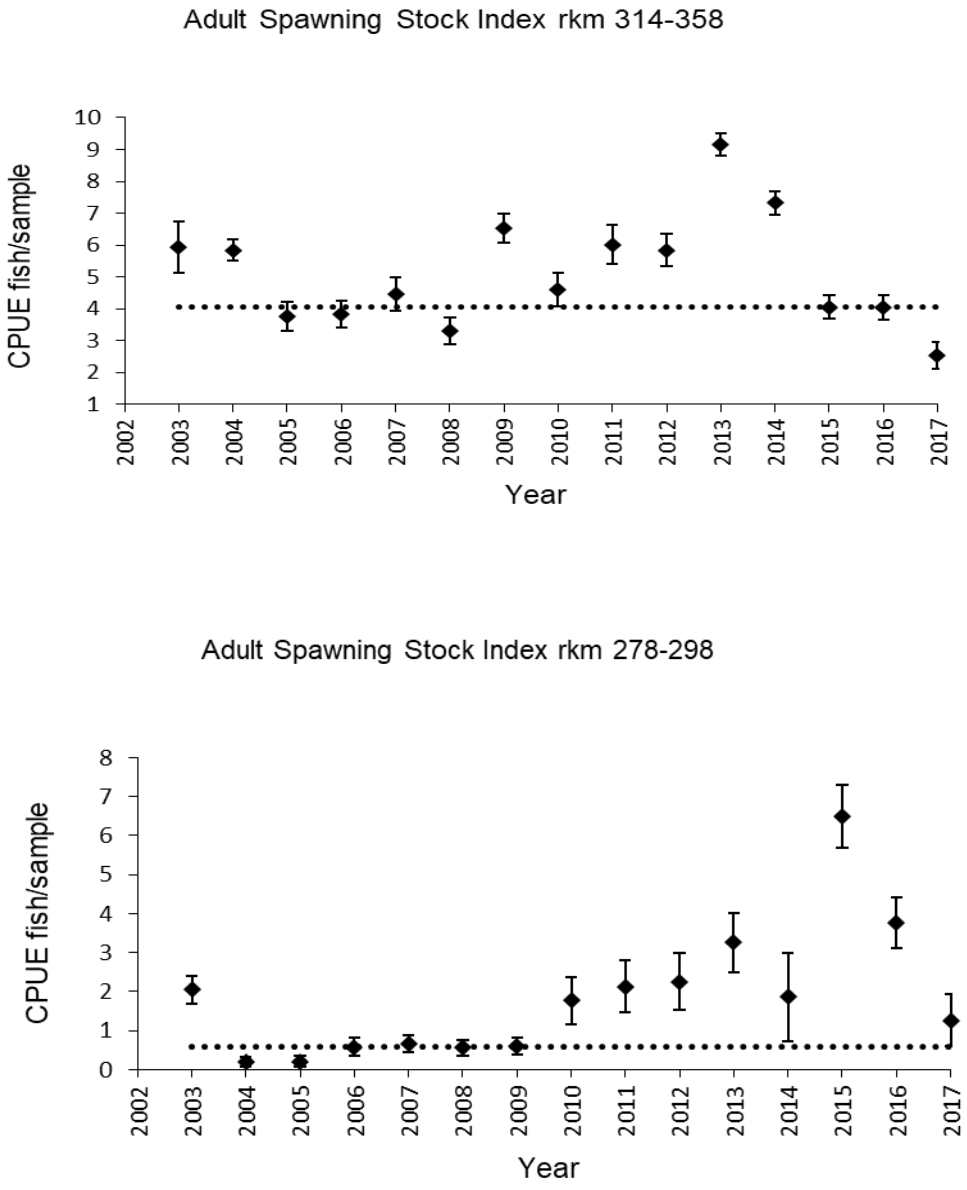

Figure 6. Electrofishing catch per unit effort (geometric mean catch per 10 minute transect) of American Shad from the St. Johns River in each of two areas. Dashed line is the media. Dotted line is the 25th percentile. The spawning stock index from rkm 314-358 was designated as the index for a fishery independent benchmark in the initial SFMP.The water level in 2015 and 2016 was above the 90th percentile of historic levels during the spawning season and may have impacted the electrofishing survey's ability to correctly index relative abundance by causing the distribution of fish on the spawning ground to shift downstream.

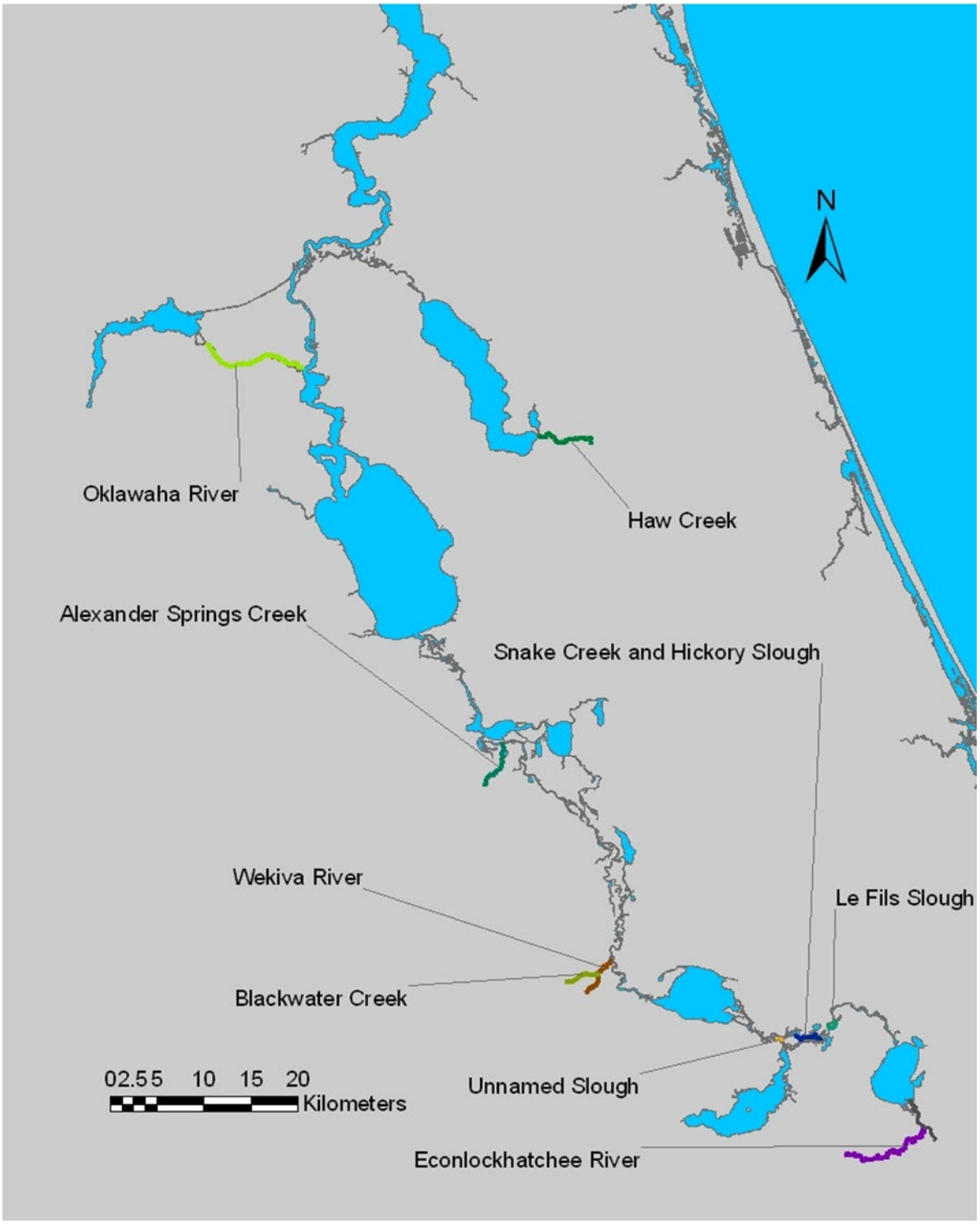

Figure 2. Tributaries of the St. Johns River that were sampled between 2006 and 2011 to detect American Shad and other *Alosa* species.

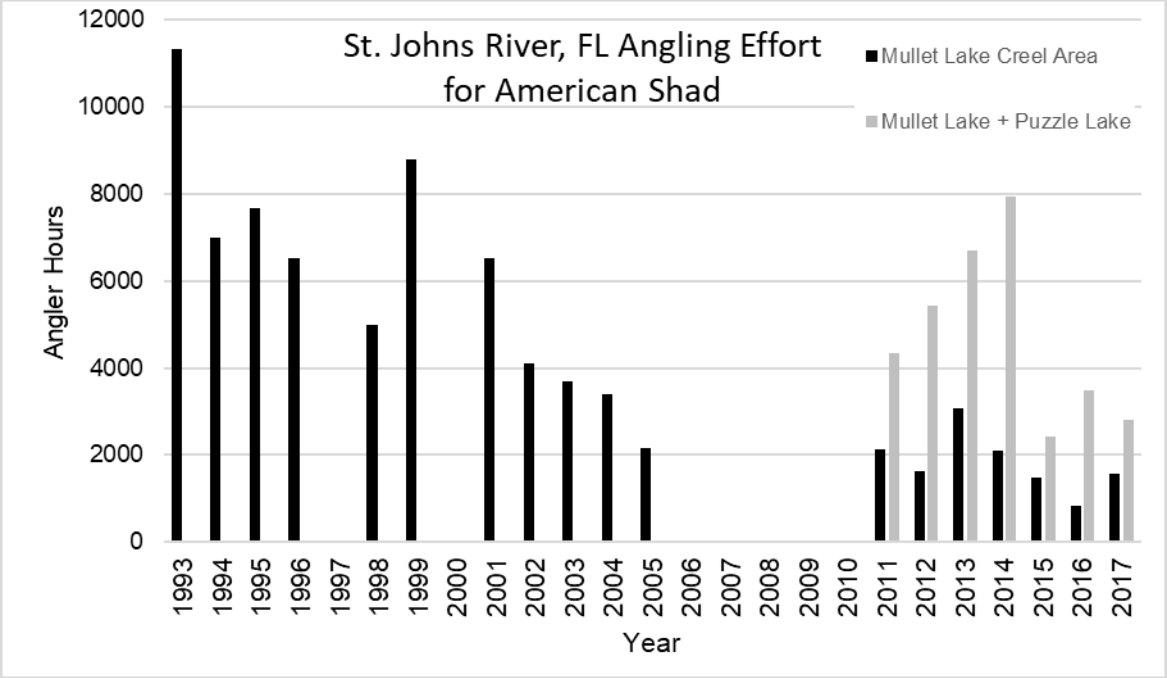

Figure 7. Recreation effort for American Shad in the St. Johns River, Florida expressed as angler-hours. An additional stratum was added in 2011 as effort shifted away from the orginial area. “Mullet Lake Creel Area” is still treated as a unique stratum for comparison to the 1993 to 2005 data.

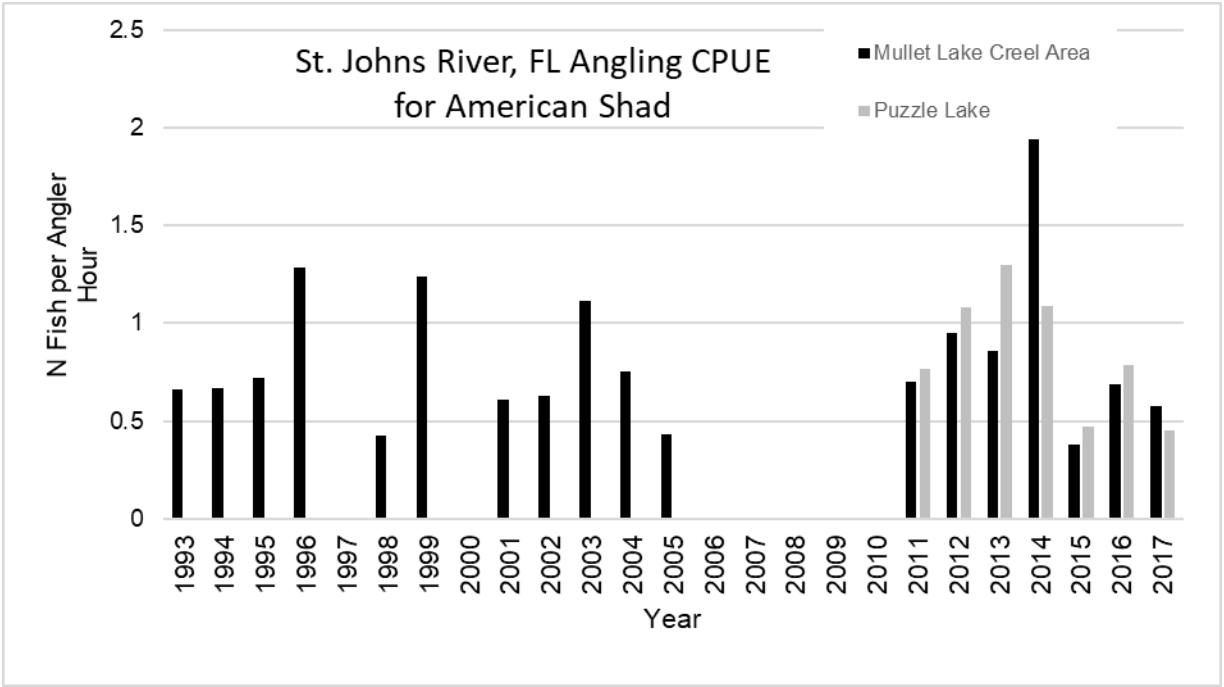

Figure 8. The catch per unit effort of American Shad from the recreational fishery in the St. Johns River, Florida from the Mullet Lake Creel Area stratum and averaged across both creel strata from 2011 to 2016.

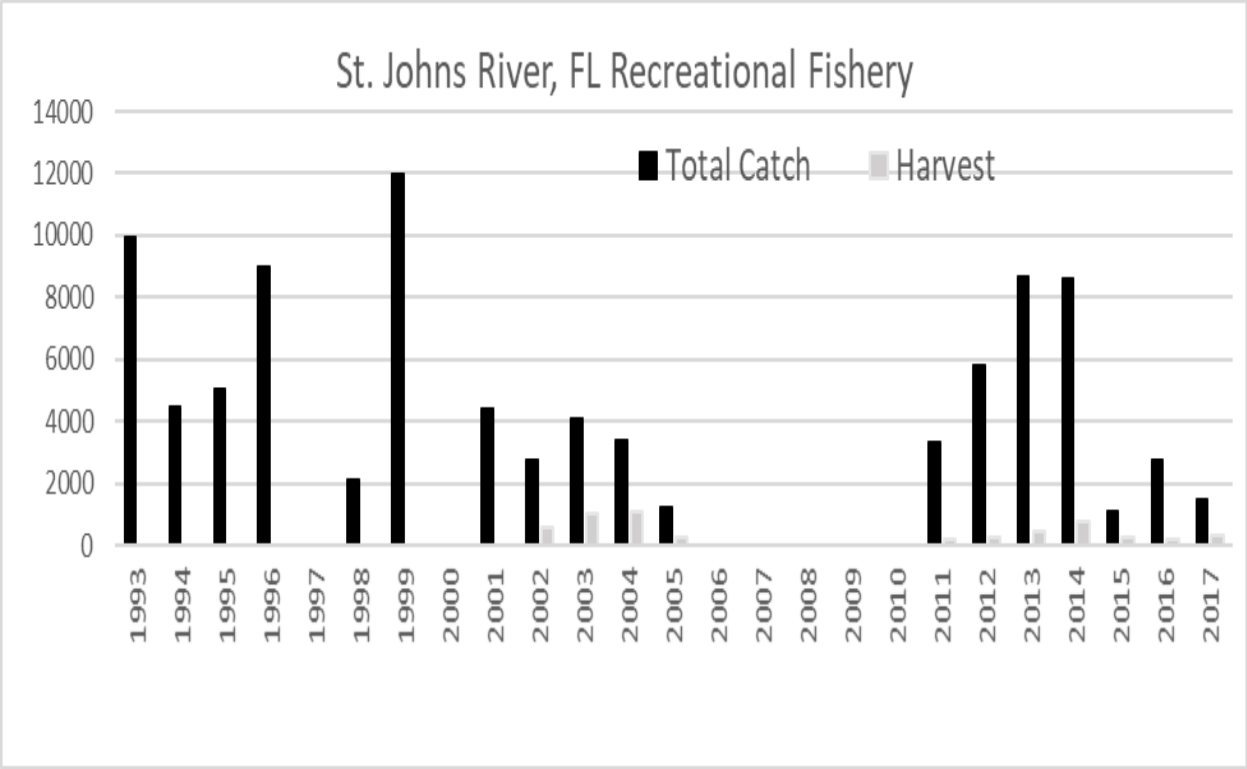

Figure 9. The total catch and harvest of American Shad in the recreational fishery in the St. Johns River, Florida.

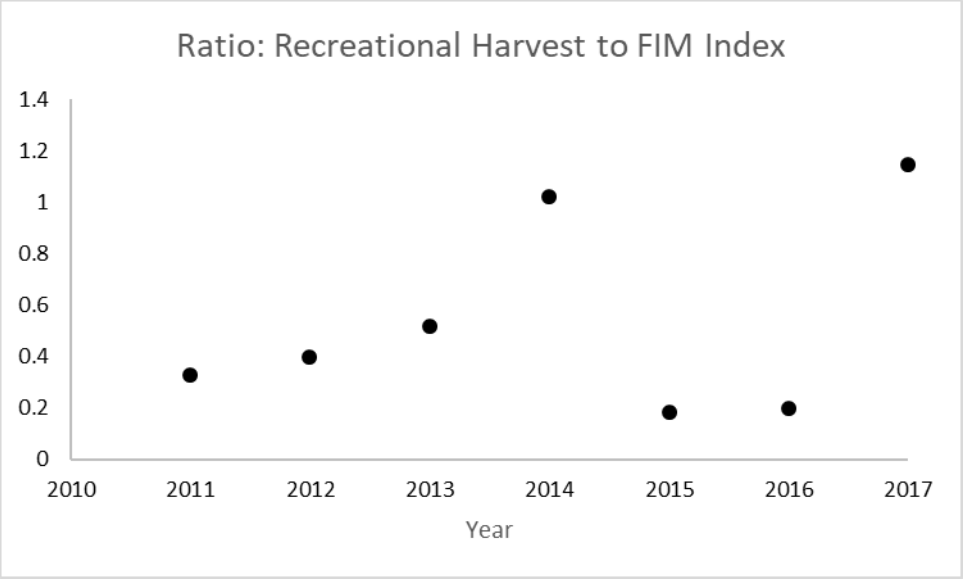

Figure 10. Relative harvest index. This is calculated as the ratio of the total number of American Shad harvested by the recreational fishery to the annual geometric mean electrofishing CPUE multiplied by 100. These data may be suitable to create a benchmark that combines fishery catch/harvest data and independent monitoring data in the future.