Report of the Science and Research Synthesis of Invasive Catfish Working Group (update by Dec 2021 with new activities in red)

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The Science and Research Synthesis subcommittee (SRS) of the Invasive Catfish Working Group (ICW) is composed of 15 members. The SRS subcommittee had two Zoom meetings in the spring of 2021 to accomplish the actions suggested from the ICW. This report followed the actions. In Dec 2021, the SRS updated it and the new actions are highlighted in red.

List of Actions:

1. Compile available data sources and identify gaps/needs
2. Investigate what other jurisdictions are doing to address the issue (Great Lakes) – reach out and make connections with these groups
3. Develop and prioritize a list of science needs (e.g. habitat use, stock assessment modeling, population connectivity, predation impacts)
4. Identify/compile potential funding sources (e.g. specific grants)
5. Consider developing more preliminary population models (for specific tribs) to help managers establish removal targets

Below please find the actions, the finding and suggestions for each action.

Action 1: Compile available data sources and identify gaps/needs

We used a table to list the data sources available, contact and related information (Table 1). Table 1 is composed of 3 sub-tables in which 1a includes all the datasets on invasive catfish surveys in Virginia tidal rivers, 1b includes all the datasets in the Potomac river areas, and 1c includes all the datasets from the Maryland areas. We expect that the tables can be extended and updated over time. The Tributaries subcommittee should also help to identify the missed datasets. We combined the action of identifying gaps and needs with the Action 3.

Table 1: Compiled available data sources.
1a: data sources for Virginia tidal rivers invasive catfish

Data short name	Agency /institute	Time period	Purpose or function	Availability/ sharable	Contact	Note	member who added the information	Publications
BCF Growth0	VIMS	2000-2002	Growth and Condition	Sharable	William Connelly	Length, weight and age (otoliths); James, York, Rappahannock	Vaskar Nepal	
BCF Growth 1	VIMS	2010-2012	Growth and condition		Rob Latour	Length, weight and age (otoliths); James, York, Rappahannock, Potomac	Vaskar Nepal	
BCF Growth 2	VIMS	2015-2017	Growth and condition	Sharable	Vaskar Nepal	Length, weight and age (otoliths); James, York	Vaskar Nepal	
BCF Reproduction	VIMS	2015-2017	Maturity, reproductive traits	Sharable	Vaskar Nepal	Length, age, GSI; James, York; in press	Vaskar Nepal	
BCF Acute Salinity	VIMS	2016	Acute salinity tolerance	Sharable	Vaskar Nepal	72 hour salinity tolerance experiment (i.e., ex-situ); time-to-death	Vaskar Nepal	
BCF Chronic Salinity	VIMS	2018-2019	Chronic salinity tolerance	Sharable	Vaskar Nepal	16 week lab experiment with fish exposed to 1, 4, 7 or 10 psu at 12 or 22C; response: Length, body condition, proximate body composition; consumption rate	Vaskar Nepal	
BCF Distribution and salinity	VIMS	1975-2017	Effects of fish size on salinity at catch	Sharable	Mary Fabrizio	Based on VIMS juvenile fish trawl survey; Length, salinity	Vaskar Nepal	

BCF ration needs	VIMS	2018	Effects of food limitation	Sharable	Vaskar Nepal	16 week lab experiment; response: growth, body condition and metabolic rates	Vaskar Nepal	
BCF YOY Growth	VIMS	1996-2017	Effects of temperature and conspecific density	Sharable	Mary Fabrizio	Monthly length frequency distributions from James, York, Rappahannock rivers	Vaskar Nepal	
BCF population estimate 1	VIMS	2013			Mary Fabrizio			
BCF diet 1	VIMS, MDNR, VDWR, VCU	2004-2007			Mary Fabrizio	James, York, Rappahannock		
BCF survival and movement 1	VIMS; MDNR	2012-2015	Survival and movement		Troy Tuckey	Tag-recapture; Potomac	Vaskar Nepal	
BCF contaminants 1	VIMS; W&M	2011-2012	Assessment of contaminants (PCBs, PBDEs, OCs, Hg)			James, Rappahannock, Potomac	Vaskar Nepal	
Growth 3	VDWR, VT	1998 - 2020	Age & growth	sharable	Margi Whitmore		Margi	
Relative abundance 1	VDWR	1995 - 2020	Size distribution, rel abundance	sharable	Margi Whitmore	Fixed-station LFEF	Margi	
BCF Diet	VT				Don Orth			
BCF telemetry	VDWR	2015 - 2016	Movement	sharable	Margi Whitmore	Rappahannock, York		
BCF and FHC	VMRC				Alexa	James, York,		

Commercial harvest					Galvan	Rappahannock		
BCF nutrient quality					Yixiang Xu			
BCF diet	SERC				Matt Ogburn			
BCF nutrient and contaminant	VIMS				Robert Fisher			
BCF commercial products fact sheet (nutrition and safety)	UME				Cathy Liu Robert Fisher		Cathy Liu	
BCF telemetry	VDWR	2021-	Evaluate movement patterns, identify aggregation areas/spawning habitat, overwintering habitat		Margi Whitmore	DWR has tagged 40 blue catfish at four sites within and above the commercial LFEF fishing zone	Margi Whitmore	

1b: data sources for Potomac River invasive catfish

Data short name	Agency/ institute	Time period	Purpose or function	Availability/ sharable	Contact	Note	Member who added the information	Publications

Blue Catfish diet	MD DNR Fisheries	2009-2016	Looking at prey selectivity or use		M Groves		M Groves	
Age and Growth	MD DNR Fisheries	2010-2014		sharable	M Groves		M Groves	
Maryland Blue Catfish commercial catch	MD DNR Fisheries	2012 - present		sharable	M Groves		M Groves	

1c: data sources for Maryland and Delaware invasive catfish

Data short name	Agency/ institute	Time period	Purpose or function	Availability /sharable	Contact	Note	Member who added the information	Publications
Blue catfish diet/predation - Patuxent River	Maryland DNR	2019 - 2020	Assess trophic impact of blue catfish in the Patuxent River		Mary Groves,	Maryland DNR data - USGS assisting with molecular identification of stomach contents	Christine Densmore	
Blue catfish health- mid-Patuxent River	USGS with MD DNR	Summer 2020	Assess blue catfish health status histologically		Christine Densmore	Samples collected for processing but analysis not completed currently (fall 2021). Samples also collected from James River VA and Nanticoke River, DE	Christine Densmore	

						for comparative analyses.		
Blue catfish tracking data- Patuxent River	MDDNR Fisheries Service	2020-2021	Track movement of BCF in Spring (spawning) and Winter		M Groves	Not completed	M Groves	
Blue Catfish age and growth- Patuxent River	MDDNR Fisheries Service	2019-2020			M Groves	Not completed	M Groves	
Blue catfish population density- Patuxent River	MDDNR Fisheries Service	2020			M Groves	Due to insufficient cataloging of reliably used habitat estimates will be limited to identified 'hot spots'	M Groves	
Blue Catfish Assessment- Nanticoke River	DNREC	2021	Monitor Blue Catfish population within Delaware waters and gather information for management purposes		J Moore	Samples collected but no analysis conducted yet	Dave Secor	

Action 2* - *Investigate what other jurisdictions are doing to address the issue (Great Lakes) – reach out and make connections with these groups

The SRS subcommittee discussed the achievement of the Great Lakes Fisheries Commission (GLFC) in dealing with invasive species. The SRS wondered that jurisdictions in GLFC are well organized, very cooperative, and sharing goals and targets in dealing with invasive species across jurisdictions. The SRS also feels that long term funding in dealing with invasive species in GLFC is important. The SRS suggested future cooperation among the jurisdictions in the Chesapeake Bay and Delaware area to deal with conflicts of goals and interests among agencies. The SRS also suggested that we may invite people working in Tribal impact, such as Dr. Woody Walker, into SRS subcommittee discussions.

Action 3* - *Develop and prioritize a list of science needs (e.g. habitat use, stock assessment modeling, population connectivity, predation impacts)

The subcommittee identified a number of high-priority science needs that focus on two aspects of the management of blue catfish: (1) understanding the scale of the issue, and (2) identifying solutions. Science needs include estimating the population size, understanding the population dynamics, evaluating the impact of blue catfish predation on native fishes, predicting the spatial expansion of blue catfish populations into new habitats and movement of fish among habitats, and assessing the human consumption risks associated with contaminant loads in blue catfish. Collaborative research activities will provide the most effective approach to understand the impact of blue catfish on the Chesapeake Bay ecosystem, identify strategies to reduce negative impacts, and recommend the spatial scale necessary to implement management actions.

1. Habitat use of blue catfish, particularly spawning and nesting habitats, was discussed based on the ongoing activities and future needs. Spawning likely occurs over a long season. The team members listed ongoing activities which include: 1) the surveys conducted by VT led by Drs. Orth and Joe Schmidt; 2) DWR has this as a priority and plan to active tracking and passive monitoring the spawning locations; 3) Maryland DNR is trying to identify spawning locations using telemetry; 4) DWR also interested in using telemetry in studying the movement and spawning habitat; and 5) Steve McCormick lab from USGS has 2021 plans to develop vitellogenin/reproductive hormone assays to assess spawning comparatively across tributaries through plasma samples of blue catfish.

   The SRS also discussed telemetry transmitter code collision issues especially relevant to sturgeon tagging. There is ongoing telemetry array development in the mainstem of the Bay. For the long-term cooperation and information sharing to the best use of the ongoing effort, standardization of gears is crucial.

Blue catfish as a potential habitat modifier was discussed. There are no known or limited studies as to whether blue catfish may modify the habitat through resuspension of the sediment and consumption of vegetation.

2. The SRS subcommittee discussed the need to study the population structure, especially the population connectivity, dispersal, or movement across tributaries, streams and rivers. The existing studies suggested that the lower Bay has distinct populations but probably not for upper Bay and fish may move and migrate to tributaries (e.g., James and Chickahominy). Such movement influences the population size estimation and management since management is often based on specific tributaries.

   Virginia DWR has tributary-specific management goals owing in part to stakeholder differences, and population characteristics which include different introduction/invasion histories, population densities, demographics, and other aspects of their invasion ecology.

   The SRS also discussed whether similar strategies may be used for Virginia as well as Maryland. Members feel probably not since blue catfish in different salinity tolerance/seasonal salinity profiles.

3. Stock assessment was discussed based on the existing models developed and the problems or needs to further improve the models. Corbin Hilling from VT developed a statistical catch-at-length model which is for Virginia tributaries and based on the data available in Virginia tidal rivers. The current model has high uncertainty especially for F and B estimates in recent years, which is largely because of lacking data on the size or age structure of the harvest.

   VMRC is planning to sample the age structure of commercial catch data. The sample size on the growth has been evaluated through a simulation study based on the existing age-length observations and a future discussion may be done in the next SRS subcommittee meeting. Population size and age structure need to be representative of the aggregate harvest. A sampling protocol needs to be further discussed. There is no gear-specific size selectivity estimation both from field surveys and from the statistical catch-at-length models, which is likely influenced by the fish market size preferences.

   Recreational harvest is not included owing to insufficient data and low catch-release mortality. According to SRS members, there are some coastal survey data available through the Marine Recreational Information Program (MRIP), which may be further contacted with Alexa Galvan. The regulations on recreational fishery are different among jurisdictions. Such differences should be reflected in regional gear selectivity of the stock assessment and management strategy evaluation when recreational harvest is included in stock assessment.

The SRS wondered about the potential models for the population estimates of blue catfish for Maryland regions and questioned whether it can be done through extrapolation based on VA data and relative densities. The SRS also wondered about the commercial data availability, both the total catch and the size or age structure of the catch in Maryland and the Potomac River. We hope that such information can be updated through Tables 1b and 1c over time.

The SRS subcommittee strongly suggested continuity in Virginia DWR electrofishing survey which is needed for long-term population trend monitoring and life history variation. The SRS also suggested surveys on the commercial and recreational fishery. The stock assessment will be improved with better harvest data included in the existing population dynamics models,

4. Predation studies remain a key priority. There have been recent advances in our knowledge on the diet of blue catfish based on Dr. Don Orth and Dr. Mary Groves' work in both Virginia or Maryland. The subcommittee highlighted the need to understand the native fish community vulnerable to catfish predation, particularly threatened species such as Atlantic sturgeon. There is an ongoing study to include predation impact into ecosystem changes through Ecospace and Ecosim in the Potomac river by Dr. Kim DeMutsert. The SRS highlighted the need of developing more integrated food web models of predation impacts that can be integrated into stock assessment models.

5. Social-economic impacts of the invasive catfish species were discussed. Such aspects are often important for invasive species especially those that change the native community or ecosystem largely. According to Troy and Margaret, anglers said that blue catfish dominate the catch in recent trips. Alexa Galvan indicated that MRIP periodically conducts socio-economic add-on surveys, which may include trips with blue catfish targeted. Information such as travel, logging, and fishing activities is collected. Margaret Whitmore said that the creel survey proposed in the tributary surveys will also include such information. There may be existing data or surveys done by USGS and USFWS that need to be further checked. Surveys from for hire, charter boat communities including MRIP surveys may be explored in the future.

   Margaret Whitmore introduced that the Tributary Subcommittee is developing a standardized creel survey. Such kind of surveys is strongly supported by the SRS subcommittee, which provides data for fisheries stock assessment and management.

6. Studies on fish health and contamination are important for further blue catfish management. Such information plays an important role in human health, fish marketing, fisheries management strategy evaluation etc. There are existing studies such as Luellen et al. (2018). There are also ongoing studies provided by the SRS members: 1) Comparative histopathological assessments (and follow-up microbial analyses possible) of blue catfish health/pathogen status across

Nanticoke, James, and Patuxent Rivers (summer 2020-2021 samples); 2) Delaware DNREC (John Cargill, hydrologist) leading efforts to assess Nanticoke River DE blue catfish fillets (muscle tissue) for organic contaminants - Summer 2020 specimen collections.

Dr. Cathy Liu indicated that there are differences in design for microbial, contamination, and food safety, and the types of pathogen analysis between studies with objectives on human and fish health. Communications among team members may help broaden the impact of the studies.

EPA and FDA have established different safety standards of chemical contaminants to judge the safety of recreational (0.4ppm, EPA Advisory Threshold) and commercial (2.0ppm, EPA under agreement with FDA) fish. Based on Luellen et al. (2018), none of the tested Chesapeake Bay blue catfish fillets had levels of mercury and PCB that exceeded the safe to eat level from "FDA and EPA Safety Levels in Regulations and Guidance". This means that commercially harvested blue catfish are safe to eat but the same fish are not safe to eat if the fish are recreationally harvested.

***Action 4* - Identify/compile potential funding sources (e.g. specific grants)**

The SRS members identified or suggested funding sources based on existing funded projects and ongoing funding programs known. Below please find them.

1. S-K: there are currently two projects funded by S-K. One is funded to VIMS: *Evaluating production constraints and consumer demand in an emerging blue catfish (Ictalurus furcatus) fishery*. The other one is led by LSU/UMD/VT: *Improving U.S. wild catfish market opportunities through improved cold chain management and packaging.*

2. Aquatic invasive species fund: Currently there is a project funded to study blue catfish movement. Contact Margaret Whitmore for further information.

3. Sea Grant: the SRS members discussed the potential to develop multistate Sea Grant proposals such as the states of MD, VA, and DE.

4. USGS and FWS RFP: Communication and collaborations with team members working at USGS and FWS for further opportunities.

5. Mitigation account/dollar: Troy and Margaret suggested this potential funding source for consideration in the future. Strategies to secure this fund may be through other topics such as protected resources and other species of concern/ interests.

6. Other funding sources such as funds from ASFMC and NOAA CBO. The SRS members commented on these funding sources. For example, to secure ASMFC

fund the project needs to link to ASMFC managed species and NOAA CBO usually prefers projects on council managed species.

Overall, the subcommittee feels that the invasive catfish problem is regional and there are limited funding sources. The invasive catfish research needs support from regional agencies.

***Action 5* - Consider developing additional preliminary population models (for specific tribs) to help managers establish removal targets**

This task is suggested to be done in 2 ways. One way is to extend the existing population models developed for James River blue catfish to other rivers/tributaries with similar datasets or types of data available. The other way is to consider alternative models and analyses based on existing data available in each tributary. No matter which way is recommended or considered for developing population models, identifying data gaps (see table 1a, 1b, and 1c) and developing data collection programs are important for improving the quality of the current stock assessment and for developing new models.

Citations in this report:

U.S. Department of Health and Human Services. 2021. FDA's Fish and Fishery Products Hazards and Controls Guidance (Fourth Edition – June 2021). https://www.fda.gov/media/80637/download

Luellen, D.R., LaGuardia, M.J., Tuckey, T.D., Fabrizio, M.C., Rice, G.W., and Hale, R.C. 2018. Assessment of legacy and emerging contaminants in an introduced catfish and implications for the fishery. Environmental Science and Pollution Research 25:28355-28366. https://doi.org/10.1007/s11356-018-2801-9