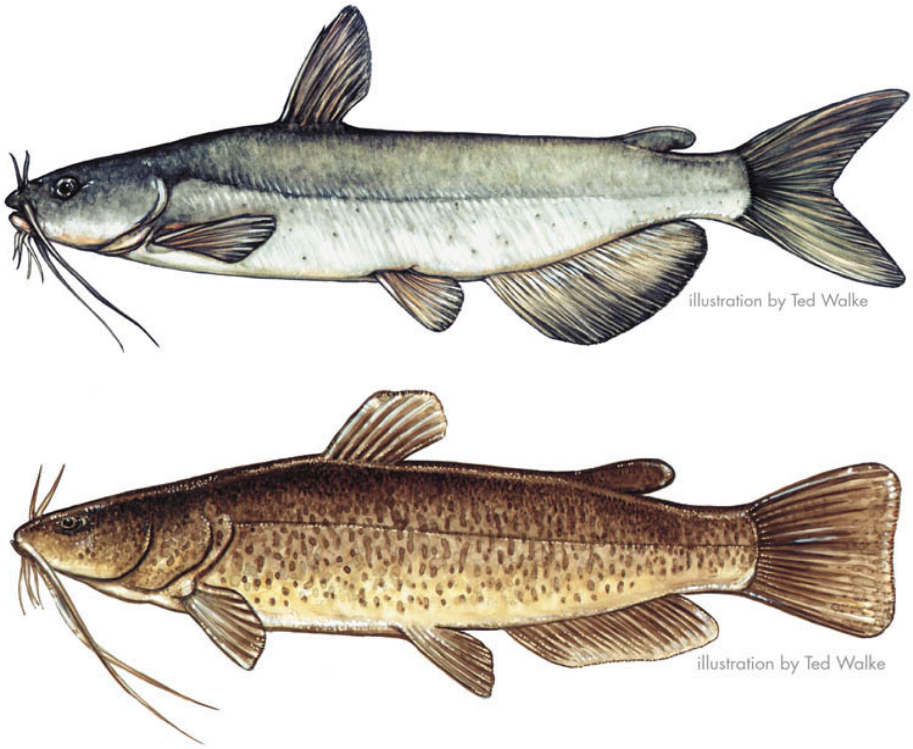
Strategic Plan for Management of

Channel Catfish and Flathead Catfish in Pennsylvania

2013-2017



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Fisheries Management Area 8

Pennsylvania Fish and Boat Commission

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Executive Summary

In a 1996 Pennsylvania telephone survey in which licensed anglers were asked what species they fish for, catfish ranked fifth behind trout, bass, Walleye, and panfish, demonstrating their level of importance to Pennsylvania anglers. This mirrored data from the U.S. Fish and Wildlife Service National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, which also documented that catfish and bullheads were the fifth most sought after species group in Pennsylvania. A 2005 Pennsylvania Fish and Boat Commission (PFBC) statewide creel survey data compilation estimated the number of angler trips directed specifically at channel catfish in Pennsylvania to be 229,700 per year. The economic value from these channel catfish trips was estimated at just over 14 million dollars. In recent years, overall interest in angling for catfish has been increasing in Pennsylvania. Data from the U.S. Fish and Wildlife Service National Survey of Fishing, Hunting, and Wildlife-Associated Recreation documented a 24% increase in angler days spent fishing for catfish and bullheads in Pennsylvania from 1996 to 2006.

The highest densities of Channel Catfish tend to be found in Pennsylvania's major rivers, where fisheries are sustained by natural reproduction. Impoundments that maintain a Channel Catfish fishery are typically sustained through supplemental stocking of fingerlings; however, there are a few Pennsylvania impoundments where natural reproduction alone provides an attractive fishery. In 2010, the PFBC stocked 53 lakes and two rivers with a total of 280,041 Channel Catfish fingerlings.

The ecology and population characteristics of Flathead Catfish in its native and non-native range vary, and as such, different strategies to manage this species are in order. Both native and invasive Flathead Catfish fisheries are addressed and recommendations are provided for future management within waters of the Commonwealth.

The goal of this plan is to maximize high quality fishing opportunities for Pennsylvania catfish anglers and to ensure the effective and efficient use of PFBC hatcheries. Strategies to achieve this goal include:

> The PFBC will use the historical average angler directed Channel Catfish catch rates as a guideline for success on wild and stocked Channel Catfish fisheries.

> Channel Catfish population descriptive statistics (*e.g.*, the median fish survey catch rate by gear type) will be used as benchmarks for wild and stocked Channel Catfish fisheries.
> A cross section of wild and stocked Channel Catfish populations in Pennsylvania's lakes and rivers will be assessed for age, growth, size structure, and total annual mortality.
> A plan will be developed and implemented to increase angler awareness and use of both wild and hatchery supported Channel Catfish populations statewide.
> An evaluation will be conducted of ways to improve Channel Catfish fisheries through stocking density changes, stocked fish size assessment, and spawning habitat development
> The PFBC Division of Fisheries Management will work with the PFBC Bureau of Outreach, Boating and Education to inform anglers of the season of highest Channel Catfish catch rates, proven techniques for catching Channel Catfish, and the best waters from which to catch Channel Catfish.
> A pilot program will be developed to provide new summer season catfish angling opportunities focused primarily on family groups and youth in waters with high densities of stocked Channel Catfish in small impoundments.
> The PFBC will promote Pennsylvania's premier Channel Catfish fisheries to provide anglers the opportunity to fish over abundant populations with an expectation of higher catch rates.
> Educate anglers and the public about the potential ecological impacts of invasive species including specific, documented impacts of Flathead Catfish to increase awareness and prevent further angler-facilitated range expansion.
> Investigate developing regulations that permit the use of jug lines or trotlines to target catfish in the Ohio River drainage, Atlantic Slope drainage, and Great Lakes.

Acknowledgements

The impetus for this plan resulted from the Pennsylvania Fish and Boat Commission's 2010-2015 Strategic Plan. Specifically, Issue 2, Strategy 2, Goal 2, Item H of the plan which states: "*By July 2014, evaluate and improve gamefish management programs for muskellunge, walleye, Channel Catfish and striped bass/hybrid bass*. "

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Table of Contents

Page

Chapter 1: Introduction and Historical Perspective

Channel Catfish (*Ictalurus punctatus*) are considered to be the most important catfish species in North America for both food and sport (Jenkins and Burkhead 1993; Cooper 1983). From 2007 through 2009, Channel Catfish was the sixth most popular fish or seafood consumed in the United States; only shrimp, canned tuna, salmon, Pollock and *Tilapia* were more popular (National Fisheries Institute 2009). The commercial Channel Catfish aquaculture industry in the United States had total sales of $373 million during 2009 (NASS 2010). In 2006, the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation reported that nearly seven million American anglers spent over 98 million days targeting catfish (USFWS 2006). Catfish ranked fifth in angling popularity among freshwater sport fish groups, trailing the black basses, striped basses, crappie, and panfish, but ahead of Walleye, Sauger, Northern Pike, Muskellunge, trout, and salmon. In a 1996 telephone survey conducted in Pennsylvania where licensed anglers were asked what species they fish for, catfish ranked fifth behind trout, bass, Walleye, and panfish (Duda et al. 1996) further demonstrating their importance to Pennsylvania anglers. These statistics are a testament to the popularity of catfish by both American consumers and the angling public. The native range of Channel Catfish extends from the southern portions of the Canadian Prairie Provinces, south to the Gulf States, west to the Rocky Mountains, and east to the Appalachian Mountains (Trautman 1981; Miller 1966; Scott and Crossman 1973). The Channel Catfish was also suspected to be native to drainages of the Atlantic and Gulf Slopes (Lee *et al.* 1980); however, the currently accepted native distribution excludes those drainages (Jenkins and Burkhead 1993) (Figure 1). They have been widely introduced outside this range and occur in essentially all Pacific and Atlantic Slopes drainages throughout the 48 contiguous states (Moore 1968; Scott and Crossman 1973). The greatest abundances of Channel Catfish tend to occur in the un-leveed floodplains of the Mississippi and Missouri River drainages (Walden 1964).

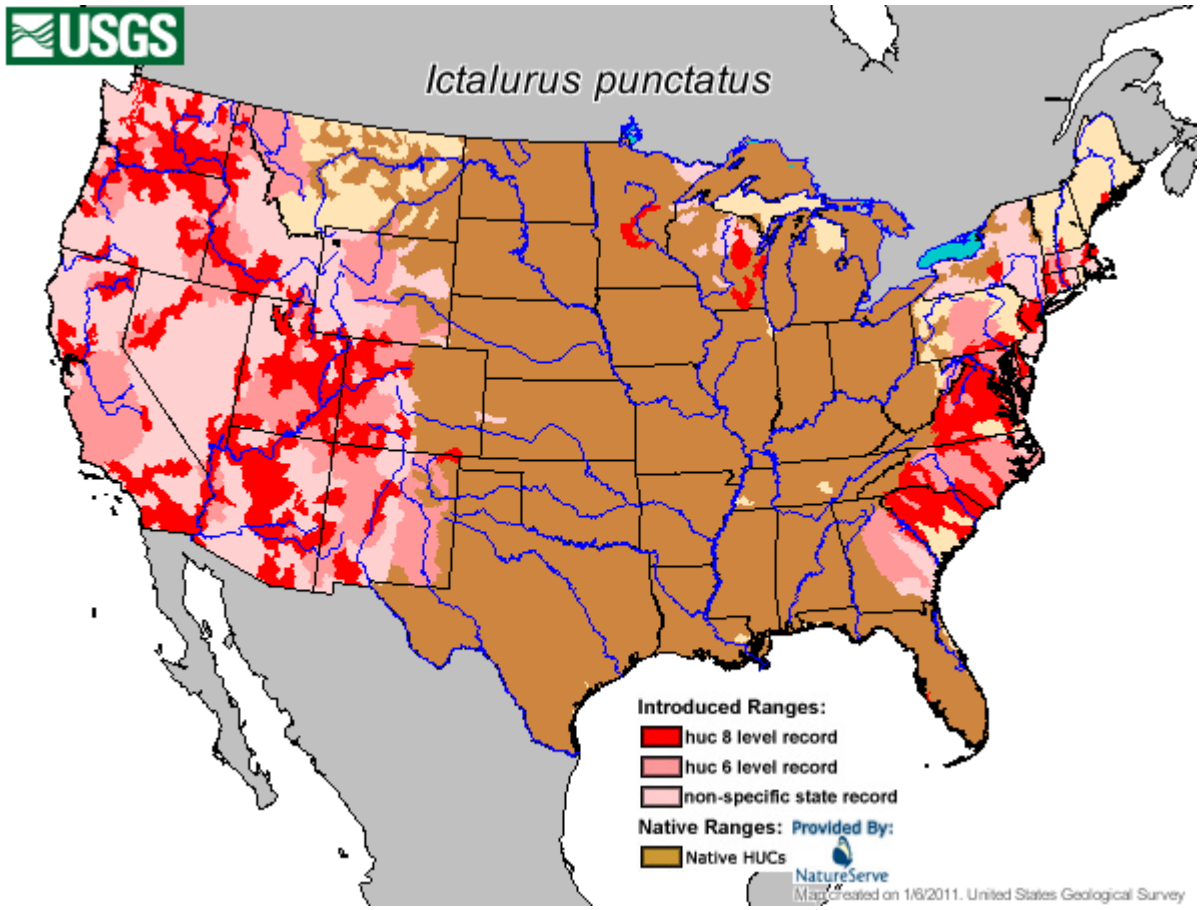

Figure 1. Native and introduced North American distribution of Channel Catfish. (Map from the USGS Nonindigenous Aquatic Species Database and Website).

The Ohio River served as the type locality (*i.e.*, geographical location where a type specimen was originally discovered) for Channel Catfish, where specimens collected near Pittsburgh were first described by Rafinesque in 1818 as *Silurus punctatus*. In Pennsylvania, Channel Catfish are native to the Ohio River and Lake Erie drainages (Cooper 1983; Trautman 1981). Through intentional or accidental introductions, the species now occurs in nearly all drainages within Pennsylvania. Highest densities of Channel Catfish tend to be found in the major rivers, where fisheries are sustained by natural reproduction. Impoundments that maintain a Channel Catfish fishery are typically sustained through supplemental stocking of fingerlings; however, there are a few Pennsylvania impoundments where natural reproduction alone provides an attractive fishery.

Channel Catfish are known to tolerate varying environmental conditions, but prefer warm, clear, and deep waters with sand, gravel, and/or cobble substrates. In its native environment, the

Channel Catfish inhabits moderate to swiftly flowing streams and rivers, but can be abundant in sluggish streams, rivers, lakes, and other impoundments. Juvenile and yearling Channel Catfish inhabit faster currents than adults. Adults in rivers typically can be found under cover provided by large woody debris, boulders, or undercut banks. They move from cover into flowing water to feed (Miller 1966; Scott and Crossman 1973).

Historical guidance for the management of Channel Catfish can be found in the Pennsylvania Fish and Boat Commission (PFBC) Warmwater Rationale planning documents of 1976 and 1985. The PFBC Warmwater Rationale planning document of 1976 stated the objective for Channel Catfish was to provide trophy fisheries maintained through natural reproduction (Selcher and Cooper 1976). The Rationale further stated that Channel Catfish fingerlings were to be stocked only in rehabilitated rivers and new impoundments (this included 21 waters from 1968 to 1974). The recommended fingerling stocking rates for new impoundments were 100/ac for lakes smaller than 500 acres; 75/ac for lakes larger than 500 acres; and 10/ac for adults. Rehabilitated river fingerling stocking rates included 500/mi for those less than 100 yards wide and 750/mi for those rivers wider than 100 yards. The average annual number of Channel Catfish fingerlings less than 8 inches stocked from 1974 to 1976 was 503,917. Stocking of fingerlings between 8 and 12 inches was not considered feasible at the time due to Pennsylvania's latitude and the subsequent additional time and cost required raising Channel Catfish to a larger size.

The overriding thought from the 1976 plan was that Channel Catfish in Pennsylvania were under- harvested and would be prone to stunting as a result. Selcher and Cooper (1976) stated the current regulations of no length limit and no closed season were "adequately liberal"; and that the 50 per day creel limit was unnecessary biologically. The 1976 plan concluded that Channel Catfish were not sufficiently abundant in most Pennsylvania lakes to be a "significant species" and were also not considered as a panfish control agent like some other predators at the time (*i.e.*, bowfin).

The 1985 PFBC planning document suggested that catfishes, including Channel Catfish, were probably the most underutilized sport fish species in Pennsylvania (Hoopes and Cooper 1985). The authors considered that unfortunate since they reach a large size, are vulnerable to angling, have considerable fighting ability, and are very palatable. Pymatuning Lake was the only

impoundment at that time considered to have a naturally reproducing population of Channel Catfish. The 1985 planning document listed 51 lakes and 18 rivers stocked with Channel Catfish from 1977 to 1984. The average annual stocking during that same time period was 255,296 fingerlings, or approximately 50% of the 1974 to 1976 average annual number. From 1977 to 1984, more than 70% of the Channel Catfish stocked in Pennsylvania were allocated to rivers and lakes in the warmer southeastern and southwestern corners of the state. The Channel Catfish management philosophy at that time was directed towards maintenance stocking of waters located within populated suburban areas to develop new trophy fisheries there. Unfortunately, evaluations of those maintenance stockings were never initiated. The policy guideline for Channel Catfish fingerling stocking was 50 per acre, as this was the most frequently requested stocking rate. The fingerlings for stocking during that era came from the federal stocking system and were generally also less than 8 inches long.

In recent years, overall interest in angling for catfish has been on an increasing trend in Pennsylvania. Data from the U.S. Fish and Wildlife Service (USFWS) National Survey of Fishing, Hunting, and Wildlife-Associated Recreation showed that catfish and bullheads are the fifth most sought after species group in Pennsylvania and a 24% increase in angler days spent fishing for catfish and bullheads in Pennsylvania occurred from 1996 to 2006 (USFWS 1996 and 2006). In contrast, the survey results for trout, which are the most sought after species group in Pennsylvania, showed a 31% decrease in anglers' days spent from 1996 to 2006. Black bass were the second most sought after species group and had a slim 4% increase in angler days from 1996 to 2006. PFBC statewide creel survey data were utilized in 2005 to estimate the number of annual angler trips directed specifically at Channel Catfish in Pennsylvania to be 229,700 (Robert Lorantas, PFBC, personal communication). The economic value from these Channel Catfish trips was estimated at $14,011,700.

Currently, Channel Catfish in Pennsylvania are considered to be a panfish species. They are managed with no length limit, no closed season, and a 50 per day creel limit. The current state record Channel Catfish, which was caught from the Lehigh Canal in Northampton County in 1991, weighed 35.2 pounds. From 2001 to 2009, the PFBC's Biggest Fish program listed Lake Erie as the water with the most reported catches of large (> 14 lbs.) Channel Catfish; followed

closely by the Susquehanna River, Lake Wallenpaupack, Beltzville Lake, Lake Nockamixon, and the Monongahela River.

The average annual number of fingerlings stocked in Pennsylvania from 1985 to 2009 was 197,776, which was a 23% decrease over the average annual number from 1977 to 1984. In 2010, the PFBC stocked 53 lakes and two rivers with a total of 280,041 Channel Catfish fingerlings. Four percent (12,700 fish) of the total Channel Catfish stocked were large fingerlings, which averaged 8 inches long. These large fingerlings were stocked into four waters (Appendix C). The heavily populated areas of southeastern and southwestern Pennsylvania continued to receive the majority of the Channel Catfish stocked in Pennsylvania waters.

Purpose of the Strategic Plan for Management of Channel Catfish Fisheries in Pennsylvania for 2013 to 2017.

The purpose of this Strategic Plan (Plan) is to identify the primary goal, supporting objectives and opportunities, and potential strategies for Channel Catfish management. The Plan is designed to provide the PFBC direction for Channel Catfish management, whether a naturally reproducing or hatchery supported population, by identifying priority needs, establishing a means for measuring progress, and providing a structure for making improvements.

Goal of the Channel Catfish Plan for 2013 to 2017

The primary goal of this plan is to maximize high quality fishing opportunities for Pennsylvania catfish anglers and to ensure the effective and efficient use of PFBC hatcheries. To achieve this goal, the PFBC will work to maintain or improve existing high quality Channel Catfish sport fisheries and create new ones of equally high quality through directed fishery management, preservation and enhancement of essential habitats, administration of a practical stocking program, and implementation of science-based harvest regulations designed for both wild populations and populations sustained through stocking; while also enhancing Channel Catfish specific data statewide.

Chapter 2: Description of Pennsylvania's Channel Catfish Resource, Catfish Anglers, and Catfish Angling Effort

The Resource

In 2010, the status of Pennsylvania's Channel Catfish resource was defined by evaluating historical and contemporary data secured within the PFBC's Aquatic Resource Database and consulting with knowledgeable biologists of the PFBC's Fisheries Management Division. The results of this determination found that viable Channel Catfish fisheries currently reside within 188,728 acres of 143 Commonwealth waters. This includes 88 river and stream sections (Figure 2) and 55 lakes and impoundments (Figure 3).

Figure 2. Pennsylvania's 88 river and stream sections with existing Channel Catfish fisheries (in red) and where Channel Catfish occurrence has been documented (in blue).

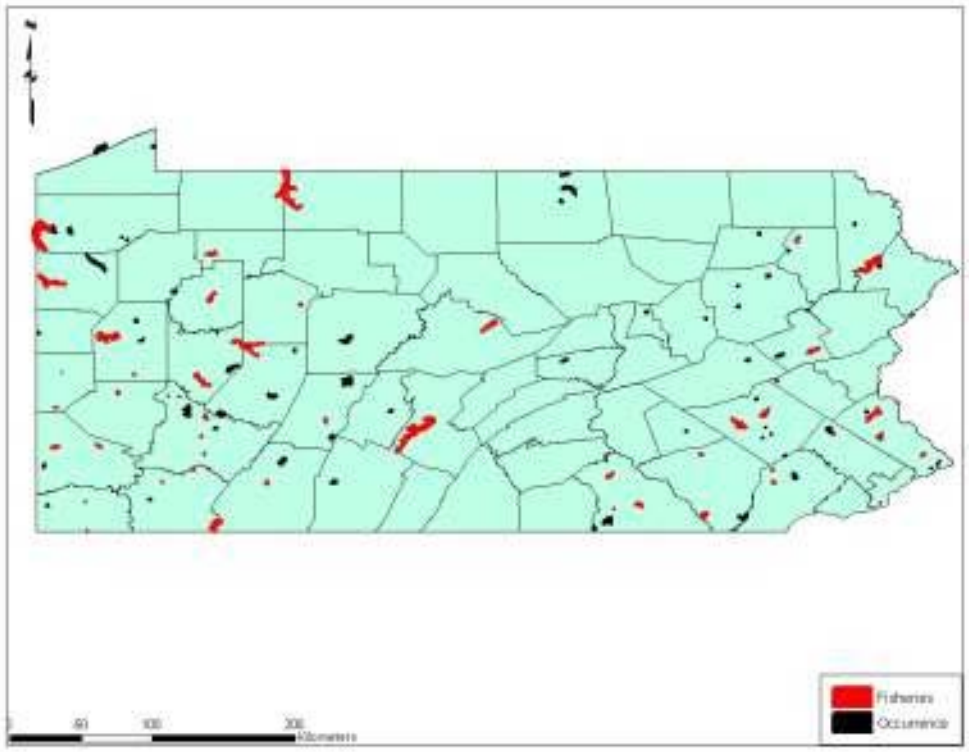

Figure 3. Pennsylvania's 55 lakes and impoundments with existing Channel Catfish fisheries (in red) and where Channel Catfish occurrence has been documented (in black).

Pennsylvania's Channel Catfish fisheries largely exist as wild populations (Figure 4) sustained by natural reproduction in 100,763 acres (53%) of 91 Commonwealth waters. The remaining fisheries are maintained by Channel Catfish stocking (Figure 5) in 87,965 acres (47%)) of 52 Commonwealth waters (Figure 6).

Figure 4. Wild Channel Catfish collected by PFBC biologists in 2010 from a baited tandem hoop net set at Allegheny River Section 21, Allegheny County (PFBC photograph).

Figure 5. Stocked Channel Catfish collected by PFBC biologists from a Pennsylvania-style trap net set in 2005 at Lake Somerset, Somerset County (PFBC photograph).

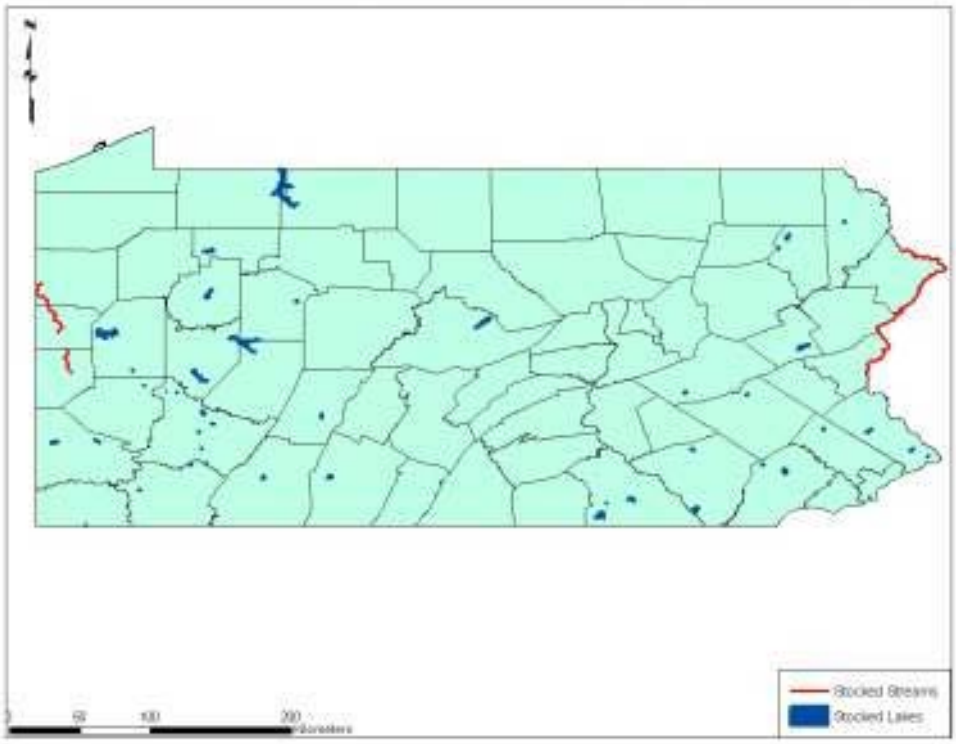

Figure 6. Pennsylvania's 52 waters currently stocked with Channel Catfish: three rivers (red) and 49 impoundments (blue).

Catfish Anglers

In 1996, opinions of Pennsylvania catfish anglers (not specific to Channel Catfish) were compiled during a rigorous telephone survey. The survey results were published as "Pennsylvania Anglers' and Boaters' Attitudes toward Aquatic Resources, Fishing, and Boating" (Duda *et al.* 1996). Thirteen percent of resident anglers and 17% of boaters fished for catfish over the two years prior to the survey. This placed catfish as the fifth highest sought species overall after trout, bass, walleye, and panfish (Table 1). These anglers were then asked how satisfied or dissatisfied they were with catfish angling in Pennsylvania. It is notable that 81% of both resident anglers and boaters were somewhat satisfied or very satisfied with catfish angling in Pennsylvania (Table 2).

Table 1. Percent of Pennsylvania resident anglers and boaters responding as fishing for various species in Pennsylvania in a 1996 opinion survey (Duda *et al.* 1996).

Species Targeted	Percent of Resident Anglers	Percent of Boaters
Trout	63	77
Bass	62	56
Walleye	20	35
Panfish	18	28
Catfish	**13**	**17**
Any Species	8	7
Perch	6	15
Musky	6	12
Carp	4	7
Pike	3	10
Striped Bass	3	9
Salmon	2	3
Pickerel	2	5
Steelhead	1	3
Shad	1	5

Table 2. Percent of Pennsylvania resident anglers and boaters responding to: "How satisfied or dissatisfied are you with catfish fishing in Pennsylvania?" from a 1996 opinion survey (Duda *et al.* 1996).

Response Category	Resident Anglers (n=62)	Boaters (n=32)
Very Satisfied	**31**	**34**
Somewhat Satisfied	**50**	**47**
Very Dissatisfied	3	5
Somewhat Dissatisfied	9	11
Neither	3	3
Don't Know	3	0

Catfish Angling Effort.

The USFWS National Survey of Fishing, Hunting, and Wildlife-Associated Recreation data provides another perspective on catfish anglers and angling (USFWS 1996 and 2006). In the 10-year period from 1996 to 2006, Pennsylvania data for number of anglers and days of fishing for trout, black bass, and catfish-bullheads were compared (Table 3). There were declines from 1996 to 2006 in the number of anglers from all three categories ranging from 8 to 28%, with the smallest decline of 8% being recorded for catfish-bullhead anglers. There was a 24% increase over the ten-year period in the number of angler days for catfish-bullheads. Bass angler days increased by 4%, while trout angler days decreased by 31%. Thus, trends in catfish-bullhead angling effort in Pennsylvania were better than those for trout and bass.

Table 3. The USFWS National Survey of Fishing, Hunting, and Wildlife-Associated Recreation for Pennsylvania of 1996 and 2006 for Number of Anglers and Days of Fishing (USFWS 1996 and 2006).

	Number of Anglers			Number of Angler Days		
Type of Fish	1996	2006	Percent Change	1996	2006	Percent Change
Catfish-Bullheads	**156,000**	**143,000**	**-8%**	**1,527,000**	**2,017,000**	**+24%**
Trout	745,000	610,000	-18%	8,861,000	6,090,000	-31%
Black Bass	576,000	416,000	-28%	5,444,000	5,671,000	+4%

PFBC statewide creel survey data indicate that, in reservoirs, the greatest catch rate for Channel Catfish occurs from July to October. In rivers, the greatest catch rate occurs from June through September (Lorantas and Hobbs 2005). Statewide Pennsylvania creel survey data was compiled by our PFBC Warmwater Unit in 2005 to report to Commissioners (Robert Lorantas, personal communication). These creel survey data from 1986 to 2002 (34 surveys total) revealed that the highest *directed* Channel Catfish fishing effort (7.847 hours/acre) took place in reservoirs between 50 to 500 acres (Table 4). This should be considered when assigning supplemental stockings or allocating unexpected surplus Channel Catfish from the production system. PFBC data on directed fishing effort for Channel Catfish from reservoirs smaller than 50 acres is needed as none are available. Reservoirs larger than 500 acres and rivers were comparable in Channel Catfish directed angler effort at 1.653 hrs/ac and 1.684 hrs/ac, respectively.

The statewide creel survey data summary indicated that the highest *non-directed* Channel Catfish mean total angler catch rate occurred in rivers at 0.061/hr (Table 5). This catch rate was generated from catfish fisheries almost exclusively sustained through natural reproduction. The catch rates were somewhat lower from reservoirs from 50 to 500 acres at 0.013/hr and for reservoirs larger than 500 acres it was 0.018/hr.

We place emphasis on *directed* catfish angler catch rates due to rather specific angling techniques for catfish. The PFBC has limited data from creel surveys with directed Channel Catfish angler catch rate. Catch rate estimates from a *directed* river Channel Catfish fishery were

considerably greater than those for non-directed fisheries as evidenced from the Susquehanna River and Juniata River creel survey of 2007 (PFBC data). The catch rate from anglers targeting Channel Catfish during that survey was 0.800/hr (interestingly, the directed smallmouth bass catch rate was also 0.800/hour), compared to the Channel Catfish mean (non-directed) total angler catch rate of 0.153/hour. Thus, a "Directed Effort Factor" of about five times higher (0.800/hour divided by 0.153/hour = 5.23 times for Directed Effort Factor) than the statewide mean rivers total angler catch rate could be estimated for those targeting Channel Catfish. This factor was used to obtain an "Estimated Directed Channel Catfish Angler Catch Rate" for Pennsylvania Channel Catfish (Table 5). According to these rates, the average effort to catch one Channel Catfish is 3 hours for a river, 11 hours for a lake larger than 500 acres, and 15 hours for a lake 50 to 500 acres in size. Another aspect that must be recognized in our review of catfish angler catch rates is that nearly all of the PFBC creel surveys have taken place during the day. Therefore, the night fishing for catfish component has not been captured.

Table 4. Channel Catfish directed angler effort data for Pennsylvania creel surveys from 1986 to 2003 (Lorantas et al. 2005). Waters were included if they were deemed by AFM's to have a Channel Catfish fishery. Highest effort category depicted in bold print.

Resource Category	Creel Survey Sample Size	Total Waters Sampled	Sample Years Range	Mean Directed Channel Catfish Angler Effort (Hours/Ac)	Range	Standard Deviation
Reservoirs 50 to 500 acres	**8**	**5**	**1986 to 1999**	**7.847**	**0 to 25.853**	**8.948**
Reservoirs > 500 acres	15	7	1986 to 2003	1.653	0 to 7.449	2.372
Rivers	11	3	1994 to 2002	1.684	0 to7.812	2.718

Table 5. Channel Catfish non-directed mean total angler catch data and estimated directed catch rate for Pennsylvania creel surveys from 1986 to 2003 (Lorantas *et al.* 2005). Waters were included in these data if deemed by AFM's to have a Channel Catfish fishery.

Resource Category	Creel Survey Sample Size	Total Waters Sampled	Sample Years Range	Non-Directed Channel Catfish Mean Angler Catch Rate (No/hr)	Range	Standard Deviation	Estimated Directed Channel Catfish Angler Catch Rate (No/hr)*
Reservoirs 50 to 500 acres	6	4	1986 to 1999	0.013	<0.001 to 0.031	0.012	0.068
Reservoirs > 500 acres	10	6	1986 to 2003	0.018	0.002 to 0.059	0.016	0.094
Rivers	**14**	**5**	**1994 to 2002**	**0.061**	**0.006 to 0.452**	**0.115**	**0.319**

*The Estimated Directed Channel Catfish Angler Catch Rate = Non-Directed Channel Catfish Mean Angler Catch Rate (No/hr) x "Directed Effort Factor" of 5.23.

Chapter 3: Management of Waters with Naturally Reproducing Channel Catfish

The majority of Commonwealth rivers and lakes featuring a Channel Catfish fishery are sustained through natural reproduction and thus classified as "Wild" by PFBC Fisheries Management personnel (*i.e.* those that have a fishery **and** have 0% maintained by stocking in Appendix B). There are 88 river sections that support a Channel Catfish fishery, as classified by PFBC Fisheries Management personnel, and 94% of these are entirely maintained through natural reproduction. River sections provide the highest Channel Catfish estimated directed angler catch rates by a factor of at least three compared to any size reservoir (Table 6).

Goals

The goals for PFBC management of Pennsylvania's naturally reproducing Channel Catfish waters are as follows:

1. Maintain the high-quality Channel Catfish fisheries in waters where they currently exist.
2. Seek to improve the quality of Channel Catfish fisheries sustained through natural reproduction in waters that are not meeting program guidelines.
3. Seek to create new naturally reproducing high quality Channel Catfish fisheries in waters where there is angler demand and a fishery does not currently exist.

Stressors and Threats

The stressors and threats to Pennsylvania's naturally reproducing Channel Catfish populations are varied; however, adequate water quality and habitat are the minimum requirements needed to support high quality Channel Catfish populations. It is recognized that the protection and enhancement of water quality and habitat extends to other species (*e.g.*, smallmouth bass, walleye, and sauger) and that efforts to maintain or improve water quality and habitat for any of these species as defined within other fisheries management plans, will be beneficial to all species. With this in mind, the PFBC will work to maintain water quality and habitats suitable for wild Channel Catfish populations.

Current Pennsylvania Channel Catfish harvest regulations (PFBC 2011) are liberal (no minimum length limit and 50/day creel limit), which could allow for overharvest to become an issue in individual waters with high Channel Catfish harvest. Arterburn *et al*. (2002) surveyed fisheries agency biologists throughout the United States, and found the majority (64%) were uncertain if harvest regulations were an effective tool for management of Channel Catfish. Alternately, 21% of biologists responded that harvest regulations were effective, while 15% considered them ineffective. The survey results could be indicative of a general lack of importance being placed on catfish management by state resource agencies. The implementation of this Channel Catfish plan will place Pennsylvania among the leaders with respect to active Channel Catfish management programs.

Currently, there are only a few waters in Pennsylvania where overharvest of Channel Catfish is considered a management concern. The PFBC Area Fisheries Managers were polled in December 2010 and only four waters were identified. The four waters included three reclaimed impoundments: Leaser Lake and Chambers Lake in Fisheries Management (FM) Area 6 and Lake Oneida in FM Area 1; and one established impoundment: Blue Marsh Lake in FM Area 6. Blue Marsh Lake was unique in that the overharvest concern was mainly for Channel Catfish of Memorable Size ($\geq$ 28 inches as defined by Anderson and Neumann (1996)).

OPPORTUNITIES and STRATEGIES

Opportunity 1. The opportunity exists to develop standardized fishery dependent and fishery independent criteria to define water specific successful Channel Catfish management.

Strategy 1. The Channel Catfish fishery guideline will be a directed Channel Catfish angler catch rate (*i.e.* anglers fishing specifically for catfish) of 0.068 per hour for reservoirs smaller than 50 acres; 0.068 per hour for reservoirs 50 to 500 acres; 0.094 per hour for reservoirs larger than 500 acres; and 0.319 per hour for rivers. These guidelines were derived from the current average of PFBC creel surveys for a particular resource category (as summarized in Table 6).

- The PFBC will use the historical average angler directed catch rates as a guideline for success on wild Channel Catfish fisheries (Table 6) when those data are available. If directed angler catch rates fall below the average value, several fish management actions will be triggered. They include, but are not limited to: harvest regulations, fishery promotion,

habitat consideration, supplemental stocking, or removal from active Channel Catfish management.

Strategy 2. Angler catch data from creel surveys is desperately needed to assess directed Channel Catfish angling catch rates and provide an economic valuation component. These data are most needed for reservoirs less than 50 acres in size. A minimum of two creel surveys would be required statewide on waters less than 50 acres between 2013 and 2016 to determine directed Channel Catfish angler catch rates. PFBC funding levels will determine the ability to complete this portion of the plan within the plan timeline.

Strategy 3. The PFBC has rarely acquired angler catch data from wild Channel Catfish fisheries. Therefore, statewide Channel Catfish biological sampling data from 1980 to 2009 and specific to a habitat (lotic and lentic) were compiled from the PFBC Aquatic Resource Database. In the absence of angler catch data, these Channel Catfish population descriptive statistics (*e.g.*, the median fish survey catch rate by gear type) will be used as guidelines to be met for wild Channel Catfish fisheries (Tables 7, 8, and 9).

- Length groupings were adopted from published stock, quality, and preferred categories (Anderson and Neumann 1996; Gabelhouse 1984). Stock length is defined as the length at which most Channel Catfish are sexually mature ($\geq$ 275 mm). Quality length is defined as the minimum Channel Catfish length that most anglers want to catch ($\geq$ 400 mm). Preferred length is described as approximately 60% of the International Game and Fish Association world record length ($\geq$ 600 mm). These indices allow comparison on a relative and peer reviewed basis. The catch of fish from less than 275 mm can be used as a recruitment index and for year class strength where deemed appropriate to determine if natural reproduction is sufficient to sustain the fishery. The PFBC fishery resource categories are those that have had historical angler catch data collected from them. Area Fisheries Management personnel determined the representative sampling data to include in this analysis. In the current Plan (2013 to 2017), sampling gear CPUE data are combined from wild and stocked fisheries due to the paucity of Channel Catfish sampling events per gear type and per resource category. Total CPUE was not included as this Plan focused on juvenile size (< 275 mm) and sizes anglers prefer to catch ($\geq$ 400 mm). If sampling gear specific catch rates (CPUE) fall below the median value, several fish management actions will be triggered. They include, but are not limited to: harvest regulations, fishery promotion, habitat consideration, supplemental stocking, or elimination of directed Channel Catfish management for the water.

Strategy 4. An assessment of age, growth, size structure, and total annual mortality from lakes and rivers will be undertaken from a cross section of wild Channel Catfish populations in Pennsylvania.

- This will require age and growth analysis using otoliths. This will also require a minimum sample size of 100 fish per water to attain reliable age and size structure based population parameters. However, if precision from catch curve estimated population parameters is inadequate an aged fish sample size of at least 200 individuals may be required. This would apply to a heavily exploited short lived population with few age classes (Miranda and Bettoli 2007). One wild Channel Catfish population from each Area will be sampled in this way between 2013 and 2016. Target waters should include those suspected of having Channel Catfish overharvest.

Strategy 5. Baited, tandem hoop nets are effective for obtaining a representative sample of Channel Catfish to develop the population parameters mentioned above (Guy *et al*. 2009; Michaletz and Sullivan 2002). Pennsylvania's wild Channel Catfish fisheries have not historically been sampled with tandem hoop nets. Hoop net catch statistics for the populations studied in Strategy 4 will be collected from 2013 to 2016.

Figure 4. A large baited, tandem hoop net set for Channel Catfish and retrieved by PFBC biologists in 2010 at Allegheny River Section 21, Allegheny County (PFBC photograph).

Table 6. Guidelines for directed angler catch rates for Pennsylvania Channel Catfish fisheries (No angler catch data was available for reservoirs less than 50 acres, so the 50 to 500 acre statistic was used). These rates were derived from the estimated average of PFBC statewide creel surveys (Robert Lorantas, PFBC Warmwater Unit Leader, personal communication and Table 5).

	Reservoirs < 50 acres	Reservoirs 50 to 500 acres	Reservoirs > 500 acres	Rivers
Program Objective for Directed Channel Catfish Angler Catch Rate (No/hr)	0.068	0.068	0.094	0.319

Opportunity 4. There is potential for increased recruitment of wild Channel Catfish in some waters with improvement to or provision of catfish spawning habitat.

Strategy 1. In 2012, the PFBC Division of Habitat Management evaluated the utility of Pennsylvania catfish spawning boxes to improve natural reproduction of Channel Catfish (Appendix F). Spawning was observed in these structures. The next phase of the catfish spawning box study will be developed by November 1, 2013 for implementation in the 2014 field season.

Table 7. Survey catch rate (CPUE as number of fish per hour; blank entries have insufficient data) guidelines for the management of Channel Catfish fisheries in Pennsylvania's Reservoirs (as summarized from Appendix E).

Resource Category	Gear Type	Sample Size	Statistic	Length Grouping			
				CPUE <275 mm	CPUE ≥275 mm	CPUE ≥400 mm	CPUE ≥600 mm
Reservoirs < 50 acres	PA Trap Net	53	Median	--	0.008	0.008	--
	Gill Net	12	Median	--	0.017	0.017	--
Reservoirs 50 to 500 acres	PA Trap Net	1150	Median	--	0.018	0.011	--
	Gill Net	206	Median	--	0.029	0.007	--
Reservoirs > 500 acres	PA Trap Net	2390	Median	0.002	0.064	0.038	0.004
	Gill Net	485	Median	--	0.032	0.018	--

Table 8. Survey catch rate (CPUE as number of fish per hour; blank entries have insufficient data) guidelines for the management of Channel Catfish fisheries in Pennsylvania's rivers (as summarized from Appendix E).

Resource Category	Gear Type	Sample Size	Statistic	Length Grouping			
				CPUE <275 mm	CPUE ≥275 mm	CPUE ≥400 mm	CPUE ≥600 mm
All Rivers	Gill Nets	297	Median	--	0.124	0.034	--
	Night Electrofishing	34	Median	--	1.130	0.474	--

Table 9. Survey catch rate (CPUE as number of fish per hour and blank entries have insufficient data) guidelines for the management of Channel Catfish fisheries in Pennsylvania's warmwater streams (as summarized from Appendix E).

Resource Category	Gear Type	Sample Size	Statistic	Length Grouping			
				CPUE <275 mm	CPUE ≥275 mm	CPUE ≥400 mm	CPUE ≥600 mm
Warmwater Streams	Electrotowboat; Electrobackpack; Two Towboats; Towboat and Backpack; Two Backpacks	31	Median	--	2.662	1.754	--

Chapter 4: Management of Channel Catfish Fisheries Maintained by Stocking

PFBC warmwater and coolwater management philosophies have shifted in the new millennium.

Current Channel Catfish Size and Numbers Produced

Fisheries Management has requested for a number of years a larger size Channel Catfish fingerling to overcome predation of stocked fingerlings. Historically, Channel Catfish in Pennsylvania have been stocked at an average size of 2 inches. These Channel Catfish fingerlings were acquired through trades (of percids and/or esocids) with other states. Stocked Channel Catfish survival by size has been studied extensively over the years and the evidence supports that survival increases substantially when a Channel Catfish fingerling of over 8 inches is stocked (Storck and Newman 1988; Santucci *et al.* 1994).

In order to provide an 8-inch fingerling Channel Catfish in Pennsylvania, fish culturists from the PFBC Bureau of Hatcheries have determined that a rearing cycle of approximately 14 months is required (Lorantas 2011). State of the art work continues in PFBC fish culture stations combining extensive and intensive fish culture techniques toward producing larger Channel Catfish fingerlings for stocking.

Standard Channel Catfish stocking rates (Table 13) have been established for various habitats and are based on stocking of 2 inch fingerlings in Pennsylvania. These rates have been refined over the years based on PFBC fishery assessments of Channel Catfish. These rates will likely include some adjustments after assessment work is completed between 2013 and 2016 comparing survival to harvestable size of 2 inch versus 8 inch fingerlings as outlined in Objective 4 below.

Table 13. Current Channel Catfish stocking rate guidelines by resource category, life stage, rate type (base or supplemental). Coarse historic criteria or management objectives are listed.

Species and Stocking Mode	Resource Category	Life Stage	Base Rate (Number/acre)	Supplemental Rate (Number/acre)	Maximum Number of Supplementals	Management Objective
Channel Catfish Annual Stocking Guidelines	Lakes > 50, < 500 ac; Small Rivers > 250, < 1500 mi^2 drainage area	Fingerling	10	10	4	Provide for a sport fish fishery
	Reservoirs > 500 ac; Warmwater Streams < 250 mi^2 drainage area	Fingerling	5	5	4	Provide for a sport fish fishery
Channel Catfish Alternate Year Stocking Guidelines	Ponds < 50 ac; Major Rivers >1500 mi^2 drainage area	Fingerling	30	10	4	Provide for a sport fish fishery and establish species on a self-sustaining basis
	Lakes > 50, < 500 ac; Small Rivers > 250, < 1500 mi^2 drainage area	Fingerling	15	10	4	Provide for a sport fish fishery and establish species on a self-sustaining basis

Species and Stocking Mode	Resource Category	Life Stage	Base Rate (Number/acre)	Supplemental Rate (Number/acre)	Maximum Number of Supplementals	Management Objective
Channel Catfish Alternate Year Stocking Guidelines	Reservoirs > 500 ac; Warmwater Streams < 250 mi^2 drainage area	Fingerling	7.5	5	4	Provide for a sport fish fishery and establish species on a self-sustaining basis
Channel Catfish Annual Stocking Guidelines	Ponds < 50 ac; Major Rivers > 1500 mi^2 drainage area	Fingerling	20	10	4	Provide for a sport fish fishery

Cost to Produce Channel Catfish for Stocking

Up until 2008, the PFBC invested about 20 cents per Channel Catfish fingerling. The historical average size stocked was about 2 inches and the fish were acquired from other states in trade agreements. With the preference of the Division of Fisheries Management to stock 8 inch yearlings the production cost has increased to 40 cents per yearling produced due to the increased time and care associated to providing the larger individuals. The total number of 8 inch Channel Catfish requested for 2010 was 240,850, which equated to $96,340. This request was not met due to a disease outbreak in the rearing ponds prior to stocking. The actual total PFBC hatchery production and stocking of Channel Catfish in 2010 was 12,700 yearlings; 280,041 fingerlings; and 300 adults for an estimated total cost of $77,219. The PFBC has had to move from an original expectation of all Channel Catfish stocked as 8 inch yearlings to a mix of yearlings and fingerlings as a result of hatchery space limitations and disease problems (Larry Hines, Northern Hatcheries Fish Production Manager, 2010 personal communication). The 2011 Channel Catfish production request includes 86,580 yearlings and 154,150 fingerlings (Appendix D). The Division of Fisheries Management wishes to evaluate survival of yearlings in several waters (see Opportunity 3 below).

OBJECTIVES

Directed Channel Catfish Sampling

As an important component of fisheries management strategies for rivers and lakes, fish population assessments and related surveys will continue to serve as necessary operations; however, refinements are needed that are designed to improve data precision as well as elevate the importance of meeting new objectives. Fishery dependent and independent surveys targeting Channel Catfish are generally lacking for Pennsylvania. Due to differences in the seasonal catchability of Channel Catfish, shifts in approaches (*e.g.*, surveys targeting Channel Catfish instead of routine fish population monitoring) may need to be made and new techniques (*e.g.*, Channel Catfish directed sampling with hoop nets in September or trap nets in June in a lake; gill nets and low-frequency pulsed DC electrofishing in a river in summer; or seasonally timed angler use and harvest surveys) may need to be adopted in order to establish management benchmarks and meet Channel Catfish specific management objectives. Such a program will

increase our understanding and allow us to determine the quality of Channel Catfish populations throughout Pennsylvania.

Utilizing the available but limited PFBC directed Channel Catfish angler creel survey data, a coarse set of angler catch rate guidelines for identifying a successful Channel Catfish stocking program was developed (Table 6). Additional angler catch data from creel surveys are needed to assess directed Channel Catfish angling catch rates. These data are most needed for reservoirs that are less than 50 acres in size.

Statewide Channel Catfish sampling data from 1980 to 2009 and specific to a habitat (lotic and lentic) were compiled from the PFBC Aquatic Resource Database (Tables 7 – 9). In the absence of angler catch data, these Channel Catfish population descriptive statistics (*e.g.,* the median fish survey catch rate by gear type) will be used as guidelines to be met for stocked Channel Catfish fisheries (Tables 7, 8, and 9). In the current Plan (2013 to 2017), sampling gear CPUE data are combined from wild and stocked Channel Catfish fisheries due to the paucity of sampling events per gear type and per resource category. Total CPUE was not included as this Plan focused on juvenile size (< 275 mm) and sizes anglers prefer to catch (≥ 400 mm). If sampling gear specific catch rates (CPUE) fall below the average value, several fish management actions will be triggered. They include, but are not limited to: harvest regulations, fishery promotion, habitat consideration, or supplemental stocking rate change; stocking cessation; or removal of active Channel Catfish management from a water.

Objective 1: Assure that Channel Catfish fisheries managed by stocking attain satisfactory fisheries dependent and/or fisheries independent catch rates. Satisfactory is defined as above the mean for directed angler catch rates and above the median for gear specific sampling catch rates.

Objective 2: Provide greater numbers of Channel Catfish ≥ 8 inches long for stocking to improve post-stocking survival through reduced vulnerability to piscivores.

Objective 3: Improve natural recruitment potential for Channel Catfish in stocked waters through improvement of spawning habitat.

Stressors and Threats

Piscivory on two inch fingerling Channel Catfish may limit the establishment of Channel Catfish fisheries in some waters. Research has documented that a Channel Catfish stocked at about 8

inches has a much greater chance for survival than fish stocked at a shorter length (Storck and Newman 1988; Santucci *et al.* 1994). The PFBC has historically stocked Channel Catfish averaging about 2 inches long. A shift to stocking an 8 inch yearling Channel Catfish was made by the PFBC in 2010. The original intent was to utilize these yearlings for all stocking requests. Hatchery space and disease problems precluded this approach by 2012. Therefore, many waters may not sustain a Channel Catfish fishery without the opportunity to stock fingerlings over 8 inches long.

OPPORTUNITIES and STRATEGIES

Opportunity 1. Additional angler catch and harvest data from creel surveys would allow the PFBC to develop more realistic Channel Catfish angler catch benchmarks for making informed fisheries management decisions. Opportunities must be made available for lakes creel surveys where Channel Catfish stocking occurs. These data are most needed for reservoirs less than 50 acres in size.

Strategy 1. The PFBC will use the historical average angler directed catch rates as a guideline for success (Table 6) when those data are available. If directed angler catch rates fall below the average value, several fish management actions will be triggered. They include, but are not limited to: harvest regulations, fishery promotion, habitat consideration, supplemental stocking change, stocking cessation, or elimination of directed Channel Catfish management for a water resource.

Strategy 2. By December 31, 2014 develop a low cost, standardized creel survey that can be quickly deployed to collect species specific catch data. These protocols will include a minimum of two creel surveys on waters less than 50 acres with a Channel Catfish fishery between 2013 and 2016.

Strategy 3: The PFBC has rarely acquired angler catch data from stocked Channel Catfish fisheries. Therefore, statewide Channel Catfish biological sampling data from 1980 to 2009 and specific to a habitat (lotic and lentic) were compiled from the PFBC Aquatic Resource Database. In the absence of angler catch data, these Channel Catfish population descriptive statistics (*e.g.*, the median fish survey catch rate by gear type) will be used as guidelines to be met for stocked Channel Catfish fisheries (Tables 7, 8, and 9).

- Length groupings were adopted from published stock, quality, and preferred categories (Anderson and Neumann 1996; Gabelhouse

1984). Stock length is defined as the length at which most Channel Catfish are sexually mature (≥ 275 mm). Quality length is defined as the minimum Channel Catfish length that most anglers want to catch (≥ 400 mm). Preferred length is described as approximately 60% of the International Game and Fish Association world record length (≥ 600 mm). These indices allow comparison on a relative and peer reviewed basis. The catch of fish from less than 275 mm can be used as a recruitment index and for year class strength where deemed appropriate to determine if natural reproduction becomes sufficient to sustain the fishery. The PFBC fishery resource categories are those that have had historical angler catch data collected from them. Area Fisheries Management personnel determined the representative sampling data to include in this analysis. In the current Plan (2013 to 2017), sampling gear CPUE data are combined from wild and stocked fisheries due to the paucity of Channel Catfish sampling events per gear type and per resource category. Total CPUE was not included as this Plan focused on juvenile size (< 275 mm) and sizes anglers prefer to catch (≥ 400 mm). If sampling gear specific catch rates (CPUE) fall below the average value, several fish management actions will be triggered. They include, but are not limited to: harvest regulations, fishery promotion, habitat consideration, supplemental stocking rate changes, stocking cessation, or elimination of directed Channel Catfish management for the water.

Opportunity 2. There is opportunity to vastly improve our sampling catch of Channel Catfish in some habitats with additional gear types. There is a need for additional sampling gear (fishery independent) CPUE data in some habitats to assist in the development of catfish specific benchmarks for making informed management decisions. Statewide hoop net catch statistics will be developed from catch data collected during the time frame of this plan.

Strategy 1. Beginning with the 2012 sampling season, the DFM increased the number of Channel Catfish directed sampling events by utilizing baited tandem hoop net sets, trap nets, and boat electrofishing techniques. These efforts will continue.

Strategy 2. A minimum of one water body per Fisheries Management Area will be sampled with tandem hoop nets between 2013 and 2016.

Opportunity 3. It is likely that opportunities to make significant improvements in Pennsylvania's Channel Catfish program hinges largely on the ability to stock larger (8 inch) fingerling Channel Catfish and on only stocking fingerling catfish into the number of waters that can be supported by available production at stocking rates high enough to produce high angler catch rate fisheries

Strategy 1. The PFBC Bureau of Hatcheries will continue to investigate opportunities to secure from other sources or to produce Channel Catfish yearlings (8 inch) to meet the Division of Fisheries Management requests. This will be only as a research mode due to fish production limitations.

Strategy 2. Yearling Channel Catfish were stocked into several waters for the first time in 2010, and again in 2011. More than two year classes of yearling Channel Catfish stocked in a water are needed for proper evaluation. Due to budgetary constraints on the PFBC Fish Production system, a commercial hatchery source of over 8 inch fingerling will be found to adequately complete this study. These waters will be utilized as part of a PFBC evaluation of stocked yearling versus fingerling survival and contributions to the fishery. This work will be completed between 2013 and 2019. Details of this assessment will be formulated by Area 8 and the PFBC Warmwater Unit in 2013 for implementation in 2014.

Strategy 3. Make best use of small fingerling Channel Catfish (2 inches) where survival has been shown to be sufficient to produce a directed and high angler catch rate fishery. Between 2013 and 2016, all Channel Catfish stocked waters should be evaluated by DFM for the need to stock 2 inch or 8 inch fingerlings. Cost of large fingerling or yearling Channel Catfish ($\geq$ 8 inches total length) may prohibit routine use such that means to enhance or encourage survival of small fingerlings may require added exploration in the next phase of this plan (i.e. habitat addition such as spawning boxes).

Strategy 4. Beginning in 2012, undertake an assessment of age, growth, and annual mortality from lake and river supplemental stocked Channel Catfish populations.

- An assessment of age, growth, size structure, and total annual mortality from lakes and rivers will be undertaken from a cross section of stocked catfish populations in Pennsylvania. This will require age and growth analysis using otoliths. This will also require a minimum sample size of 100 fish per water to attain reliable age and size structure based population parameters. However, if precision from catch curve estimated population parameters is inadequate an aged fish sample size of 200 individuals may be required. This would apply to a heavily exploited short lived population with few age classes (Miranda and Bettoli 2007). One stocked Channel Catfish population from each Area will be sampled in this way between 2013 and 2016. Target waters should include those suspected of having Channel Catfish overharvest.

Opportunity 4. There is potential for a reduced need to stock Channel Catfish in some waters with improvement to or provision of catfish spawning habitat.

Strategy 1. In 2012 the PFBC Division of Habitat Management evaluated the utility of Pennsylvania catfish spawning boxes to improve natural reproduction of Channel Catfish (Appendix F). Spawning was observed in these structures. The next phase of the catfish spawning box study at the population level will be developed by November 1, 2013 for implementation in the 2014 field season.

Chapter 5. Promoting Angling for Channel Catfish and New Channel Catfish Angling Initiatives

It is widely believed that catfish fisheries have generally been underutilized in Pennsylvania. In recent years, however, overall interest in angling for catfish has been increasing in Pennsylvania based on data gathered from the U.S. Fish and Wildlife Service (USFWS) National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (USFWS 1996 and 2006). This increase in angler participation has occurred without noted changes in the promotion of the fisheries by the PFBC and also follows a nationwide trend. There are however, steps the PFBC can take or have taken recently that could result in increased angler interest in fishing for Channel Catfish. Recent changes to PFBC regulations, such as allowing bow fishing and an increase to the total number of fishing rods (from 2 to 3) that may legally be used while fishing could, if marketed properly, improve angler participation in Channel Catfish angling. Similarly, participation in catfish angling could increase by allowing additional gear types for catfish such as trot lines or jug lines for anglers wishing to harvest catfish. Additional angling gear types will be considered in the next update of this Plan. Finally, PFBC angler catch data indicates that June through October produce the highest angler catches of Channel Catfish. Efforts to provide anglers with easy access to this information may help to improve catch rates and peak angler participation in this fishery.

OBJECTIVES

Objective 1: Increase the amount of directed angler effort toward Channel Catfish.

Stressors and threats.

Stemming from their omnivory and benthic feeding mode, fish flesh contamination can be an issue with Channel Catfish, exclusively in wild Channel Catfish waters in rivers. Fish consumption advisories of varying degrees of severity, have been placed on Channel Catfish on 17 waters or water sections as listed in the 2011 PFBC Summary Book (PFBC 2011). The vast majority of these are due to PCB contamination; one water section is listed for mercury. The angling public must be kept aware of consumption advisories for Channel Catfish.

OPPORTUNITIES and STRATEGIES

Opportunity 1. Wild Channel Catfish fisheries are underutilized in the vast majority of Pennsylvania waters as determined from available population parameter data. Opportunities exist to increase directed angler effort and success in these naturally reproducing fisheries, above levels published in this plan (Tables 4, 5, and 6).

Strategy 1. By June 2013, work with the Bureau of Boating and Outreach to develop an approach to inform anglers of the season of highest Channel Catfish catch rates, proven techniques for catching Channel Catfish, and the best waters in which to catch Channel Catfish.

- Family fishing should be emphasized, as well as the fact that Channel Catfish angling success is higher between June and October which is a time when fishing success for many other species is lower (*e.g.* trout, bass, panfish, walleye, perch, *etc.*) Channel Catfish also add a night fishing component to many reservoirs and rivers.

- By January 1, 2014, update the PFBC Channel Catfish web page including new material and a copy of this Plan (http://fishandboat.com/catfish.htm).

Strategy 2. By December 1, 2014 develop a pilot program to provide new catfish angling opportunities in summer focused primarily on family groups and youth where there are good opportunities to target Channel Catfish. The best opportunity for this effort would be in Southeast or Southwest Pennsylvania. This pilot program consistent with the following strategy of the Agency Strategic Plan: "Advocate for passage by December 2015 of funding *to increase youth education programs and participation in fishing and boating based upon successful results of pilot programs in test areas."*

Strategy 3. By December 31, 2014 develop and promote a list of Pennsylvania's premium Channel Catfish fisheries (Table 14) to provide anglers the opportunity to fish over abundant populations with expectation of higher catch rates. The abundance statistic of CPUE above the 66th percentile using statewide data will be used as a benchmark for those fisheries to be promoted as premium fisheries. This list is more inclusive than the Pennsylvania Best Fishing Waters list due to it being specific to Channel Catfish angling interests.

Strategy 4. By December 31, 2013 develop a low cost, standardized creel survey to be used on a cross section of these premium waters by 2017. This would allow a determination whether a high quality catfish fishery brings with it higher targeted fishing effort and catch rates for catfish.

- A cursory survey will be conducted if the more formal and expensive surveys cannot be conducted. This survey may be as simple as contact with a local WCO or State Park Manager. Prioritization for this strategy will be developed after this plan is adopted. This action can be joined with those in Chapters 3 and 4, Opportunity 1, Strategy 3 dealing with angler catch and opinion data.

Strategy 5. By December 31, 2014 the Division of Fisheries Management should investigate the use of trotlines and jug lines as legal gear. This should include review of the use of these gears in other states. If determined reasonable, educate internally and externally on the utility of trotline and jug line fishing for Channel Catfish during 2014 to determine acceptance of this type of change in management approach. Finally, if deemed acceptable, develop a new regulation to allow these gear types and select a group of waters that support a high density of Channel Catfish and are capable of supporting increased levels of harvest to implement the new regulations. Information on trotline fishing can be found at: (http://ezcliptrotline.com/videos.html).

Opportunity 2. The opportunity exists to promote wild caught Channel Catfish as a healthy food and thereby encourage fishing for catfish

Strategy 1. By December 31, 2014 work with the PFBC Bureau of Boating and Outreach to promote a clear message to Pennsylvania anglers about the various positive health aspects of eating fish described below and as it appears in the PFBC Summary Book (PFBC 2011):

“*HEALTH BENEFITS OF EATING FISH*

Fish are nutritious and good to eat. Fish are low in fat, high in protein and provide substantial human health benefits. Fish provide valuable vitamins and minerals and beneficial oils that are low in saturated fat. Omega-3 fatty acids found in fish are also beneficial, particularly in terms of cardiovascular health. The Federal Food and Drug Administration (FDA) recommends that consumers eat a balanced diet, choosing a variety of foods including fruits and vegetables, foods that are low in trans-fat and saturated fat, as well as foods rich in high fiber grains and nutrients. A diet that includes a variety of fish and shellfish can be an important part of a balanced healthy diet. The U.S. FDA, EPA, the American Heart Association and other nutrition experts recommend eating two meals (12 oz.) of fish per week. Following these advisories means that you should feel comfortable making one of those meals (up to 8 oz.) a recreationally caught Pennsylvania sport fish.”

- As part of this, continue to disseminate by way of the PFBC Summary Book; the PFBC website; and other means all contaminants information to those anglers catching catfish to allow them to make an informed decision of whether or not to eat their catch and/or how much to eat.

Strategy 2. Continue assisting the Pennsylvania Department of Environmental Protection and Department of Health with contaminant sampling of Channel Catfish. This becomes important as Channel Catfish are long lived benthic fish and tend to accumulate contaminants. This information then allows us to promote either from a harvest oriented fishery or a catch and release directed fishery.

Table 14. Premium Channel Catfish fisheries as established by Pennsylvania Fish and Boat Commission guidelines of 2011 by sampling collection method. Waters with an asterisk (*) are also on the Pennsylvania's Best Fishing Waters List.

Water	Resource Category	Gear Type	Mean CPUE ≥ 275 mm
Large Reservoir Trap Net 66th Percentile = 0.156 fish/hr (> 500 acres)			
Lake Arthur*	Large Reservoir	Trap Net	0.333
Shenango River Lake	Large Reservoir	Trap Net	1.853
Foster Joseph Sayers Lake*	Large Reservoir	Trap Net	0.156
Nockamixon Lake*	Large Reservoir	Trap Net	0.493
Ontelaunee Lake*	Large Reservoir	Trap Net	0.399
Blue Marsh Lake*	Large Reservoir	Trap Net	0.253
Chester Octoraro Reservoir	Large Reservoir	Trap Net	0.207
Green Lane Reservoir	Large Reservoir	Trap Net	0.775
Medium Reservoir Trap Net 66th Percentile = 0.045 fish/hr (50 to 500 acres)			
Crooked Creek Lake	Medium Reservoir	Trap Net	0.337
Lake Galena*	Medium Reservoir	Trap Net	0.563
Lake Luxembourg	Medium Reservoir	Trap Net	0.472
Lake Redman	Medium Reservoir	Trap Net	0.064
Struble Lake*	Medium Reservoir	Trap Net	1.364
Canonsburg Lake	Medium Reservoir	Trap Net	0.183
Loyalhanna Lake	Medium Reservoir	Trap Net	0.169

Green Lick Reservoir	Medium Reservoir	Trap Net	0.126
North Park Lake	Medium Reservoir	Trap Net	0.090
Small Reservoir Trap Net 66th Percentile = 0.017 (< 50 acres)			
Deep Creek Dam	Small Reservoir	Trap Net	0.236
FDR Park Lake*	Small Reservoir	Trap Net	0.116
Lake Wilma	Small Reservoir	Trap Net	0.095
Large Reservoir Gill Net 66th Percentile = 0.061 fish/hr (> 500 acres)			
Shenango River Lake	Large Reservoir	Gill Net	0.383
Lake Arthur*	Large Reservoir	Gill Net	0.257
Tionesta Lake	Large Reservoir	Gill Net	0.098
Lake Wallenpaupack	Large Reservoir	Gill Net	0.216
Nockamixon Lake*	Large Reservoir	Gill Net	0.121
Chester Octoraro Reservoir	Large Reservoir	Gill Net	0.061
Medium Reservoir Gill Net 66th Percentile = 0.073fish/hr (50 to 500 acres)			
Crooked Creek Lake	Medium Reservoir	Gill Net	0.077
Mahoning Creek Lake*	Medium Reservoir	Gill Net	0.143
Lake Williams	Medium Reservoir	Gill Net	0.086
Pinchot Lake	Medium Reservoir	Gill Net	0.087
Rivers Gill Net 66th Percentile = 0.201			
Schuylkill River, sec 16	River	Gill Net	4.516

Allegheny River, sec 22	River	Gill Net	0.259
Monongahela River, sec 5	River	Gill Net	0.450
Monongahela River, sec 6	River	Gill Net	0.251
Ohio River, sec 1	River	Gill Net	0.563
Ohio River, sec 2	River	Gill Net	0.436
Ohio River, sec 3	River	Gill Net	0.319
Ohio River, sec 4	River	Gill Net	0.743
Rivers Night Electrofishing 66th Percentile = 1.781			
Schuykill River, sec 15	River	NEF	1.810
Delaware River, sec 8	River	NEF	8.000
Wadeable Streams, Electrofishing gear 66th Percentile = 7.148			
Pequea Creek	Wadeable Stream	EF	11.913
French Creek	Wadeable Stream	EF	24.000
Chester Creek	Wadeable Stream	EF	12.000
Codorus Creek	Wadeable Stream	EF	18.400

Chapter 6. Evaluation of the Pennsylvania Channel Catfish Plan

Objective: Review and revise this plan in 2017. Utilize the knowledge gained to guide PFBC Channel Catfish management for the next version of the Plan (2018 to 2022).

Opportunity 1: There are numerous ways described in this Plan to improve Channel Catfish angling and management by 2017.

Strategy 1: Channel Catfish creel and length limits will be evaluated as part of the 2017 revision of this plan. Catfish angler opinions and fishery dependent and independent data collected from 2013 to 2017 will be used in this evaluation.

Strategy 2: All strategies outlined in the current Plan will be reevaluated during 2017 and improvements and adjustments made at that time.

Strategy 3. A Fisheries Management Biologist will incorporate improvements and adjustments to this Plan to be utilized during the next cycle from 2018 to 2022.

Chapter 7: Management of Waters with Naturally Reproducing Flathead Catfish

The Flathead Catfish *Pylodictis olivaris* has recently become widespread in Pennsylvania; initially inhabiting the Great Lakes and Ohio drainages and more recently the Susquehanna and Delaware drainages. Its distribution consists of a native population (Ohio and southern Great Lakes drainages) and an introduced population that is expanding in range in the Atlantic slope where it is considered invasive (Figure 5). The ecology and population characteristics of Flathead Catfish in its native and non-native range vary, and as such, different strategies to manage this species are in order. This chapter will address both native and invasive Flathead Catfish fisheries and provide recommendations for future management within waters of the Commonwealth.

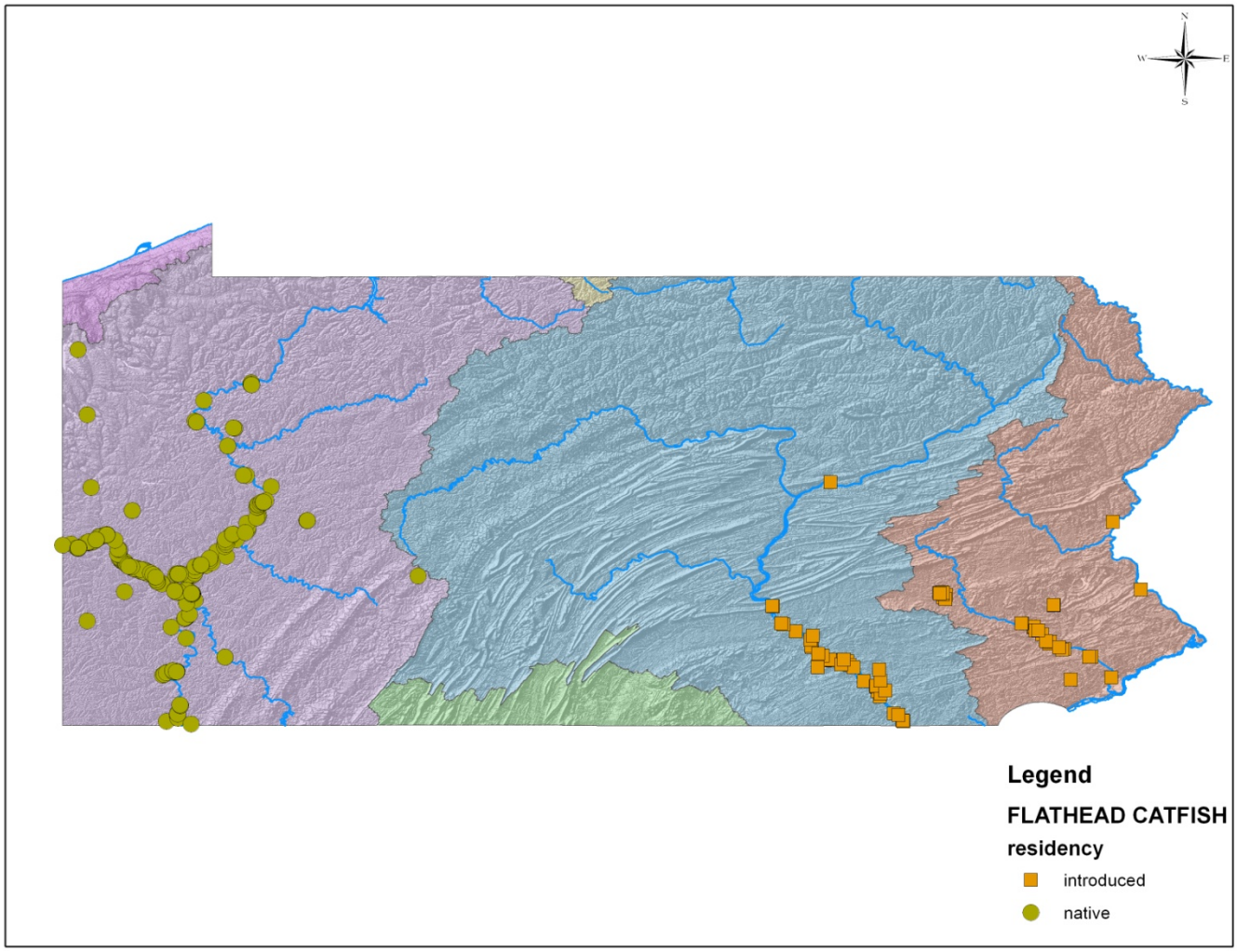

Figure 5: Records of Flathead Catfish *Pylodictis olivaris* from both their native (circle) and introduced (square) ranges within Pennsylvania (data source: ARDB and Scientific Collectors database).

Native Range

The Flathead Catfish is typically found in medium to large rivers, lakes, and reservoirs in the central United States west of the Appalachian divide (including the southern Great Lakes drainage) and in the Gulf drainages from the Mobile Basin to Mexico (Etnier and Starnes 1993; Jenkins and Burkhead 1993; Boschung and Mayden 2004). In Pennsylvania, this distribution includes the Allegheny, Monongahela, and Ohio river systems as well as the Lake Erie drainage.

Within their native range in western Pennsylvania, PFBC's Flathead Catfish management strategies rely on natural reproduction coupled with harvest regulations. Pennsylvania's Flathead Catfish harvest regulations of no minimum length restrictions, a 50-per-day creel limit (combined with other catfish and panfish species), and no closed season offer anglers ample opportunities to catch and harvest this highly-prized game fish. A portion of avid, Flathead Catfish anglers in western Pennsylvania are trophy catch-oriented and release most or all of their catch. Like Channel Catfish, it is believed that the Flathead Catfish fishery is not fully utilized by anglers; however, interest in Flathead Catfish has gained momentum in the last decade. In western Pennsylvania, Flathead Catfish recruitment rates apparently compensate for fishing mortality or angler exploitation. As a result, their populations are considered self-sustaining and remain undeterred by the liberal harvest regulations.

In areas of their native range outside of Pennsylvania, rates of Flathead Catfish exploitation have been reported to be relatively low; including commercial harvest in the upper Mississippi River (15%; Pitlo 1997), and recreational harvest in the Tennessee River/Lake Wilson (5%; Marshall *et al.* 2011). Based on a review of the available scientific literature and findings of the PFBC and the West Virginia Division of Natural Resources, Flathead Catfish populations within their native range are typically slow growing, long-lived (some of the longest-lived fish of the Ohio River system), and have maintained low rates of total annual mortality (Table 15).

Table 15. Selected growth parameters of surveyed Flathead Catfish populations within their native range.

Source	Water	Oldest Aged Fish	Estimated Total Annual Mortality	Von Bertalanffy Growth Coefficient
Marshall *et al.* 2011	Lake Wilson/ Tennessee River	Age 34	17%	0.07
Steuck and Schnitzler 2011	Upper Mississippi River	Age 30	16%	0.12
Wellman (personal communication 2013)	Ohio River	Age 33	11%	0.08
Ventorini (personal communication 2013)	Three Rivers	Age 32	15%	0.06

Management Recommendations for Native Stocks

OBJECTIVES

Objective 1: Collect adequate water-specific fisheries-dependent and fisheries-independent data to allow for management of Flathead Catfish populations within their native range.

Objective 2: Utilize fisheries-independent data to develop new regulations, if required, and public relations in an effort to expand recreational use of the existing Flathead Catfish fishery and participation in the sport.

OPPORTUNITIES and STRATEGIES

Opportunity 1: The opportunity exists to gather Flathead Catfish data to document characteristics of extant populations to set minimum target parameters for continued management of this species.

Strategy 1: Utilize on-going catfish sampling techniques using baited, tandem hoop nets in impoundments and river lock and dam (L/D) tailwaters to define population characteristics of Flathead Catfish. Baited, tandem hoop net surveys have recently proven to be effective in lakes and large rivers in the scientific literature as well as in Pennsylvania and can be established as a standard technique, state-wide.

Strategy 2: Evaluate the effectiveness of low frequency electrofishing as a suitable technique for gathering Flathead Catfish data in their native range, especially the lock and dam tailwaters of the Three Rivers. Recent studies have found that low frequency electrofishing has been effective for collecting adult Flathead Catfish for determining population characteristics (D. Wellman, WVDNR, Personal Communication; Bonovechio et al. 2011; Gelwicks and Steuck 2012). Some trials have been conducted but more effort should be put forward before a determination is made.

Strategy 3: Maintain periodic surveys (< 10 year intervals) to track population characteristics (i.e., age structure, size structure, annual mortality, and relative abundance).

- Changes in angler behavior (i.e., modest increase in exploitation) could lead to substantial changes in biomass (Quinn 1993;

Sakaris et al. 2006; Pine et al. 2007; Bonvechio et al. 2011; and Kaeser et al. 2011) under current, liberal harvest regulations. The initial surveys mentioned previously will serve as the comparative base line values for evaluation of regulatory efficacy.

Strategy 4: Develop a low cost and repeatable angler use and harvest survey to gather information about angler behavior in the native range. There is currently little information about catfish angler behavior and a better understanding of this information would benefit future Flathead Catfish management by the agency.

Opportunity 2: The opportunity exists to encourage anglers to utilize available Flathead Catfish fisheries in order to foster increased participation in the sport.

Strategy 1: In the Ohio River and Great Lakes drainages, maintain current minimum length limit (none), daily creel limit (50 fish per day combined species), and season (year-round) so participation in the recreational Flathead Catfish fishery is encouraged. Data collected from Three Rivers Flathead Catfish sampling suggests low exploitation with a total annual mortality estimate of 15%.

Strategy 2: Investigate developing regulations that permit the use of jug lines or trotlines to target catfish in the Ohio River and Great Lakes. Arterburn and Berry (2002) found that the specific bait and hook type used by anglers influence catch of Channel Catfish and Flathead Catfish on trotlines, so differential techniques can be used to target one species or the other if there are concerns over excessive exploitation. Three Rivers survey data and population parameters suggest that extant populations are sufficient to support increased harvest using this technique; however, continued monitoring to determine effects on the population are necessary as stated in Opportunity 1, Strategy 2.

Strategy 3: Based upon the outcome of Strategy 2, work with the Bureau of Boating and Outreach to inform the public about new allowable gears and techniques for targeting Flathead Catfish to increase fishing opportunities and bring new participation to the sport. In Pennsylvania the use of trotlines has not been permitted in recent history, so anglers may be reluctant to use them since they have no experience with their use and may not have a full understanding of compliance issues pertaining to the use of trotlines. Similarly, the

recent increase in the number of allowable rods from two to three would also be beneficial to many catfish anglers and may have gone overlooked.

Strategy 4: Educate the anglers and general public about potential health benefits of eating fish.

Strategy 5: Collect fish tissue contaminant data to develop fish consumption guidance for Flathead Catfish. Efforts to encourage exploitation should clarify the health benefits of consuming wild caught fish and accurately convey any negative health impacts with consuming these fish, should they exist.

- There have been few Flathead Catfish samples analyzed for consumption guidance so there may be health concerns associated with consumption of Flathead Catfish that may be overlooked. Flathead Catfish shift their diet primarily to piscivory around 500 mm TL (Bonovechio et al. 2011) and there is evidence that anglers prefer to harvest large (600 – 800mm TL) individuals (Marshall et al. 2009). As such, differences in bioaccumulation between both dietary stages of Flathead Catfish may occur. This would require the need for separate testing of both dietary stages to accurately assess and issue consumption advisories for this species. Samples of fish prior to (< 500 mm TL) and following this shift (>600 mm TL) should be submitted for analysis based on the recommendations of the Fish Consumption Advisory Workgroup. Increasing the minimum length for the larger group should allow adequate time for this shift to result in accumulation of contaminants in edible tissue to be more representative of larger fish preferred by anglers. This will provide the agency with clear, concise recommendations about consumption to pass on to anglers. Periodic testing for each of the dietary stages should continue indefinitely or until it is clear that changes in concentration are insufficient to necessitate a change in the advisories.

Strategy 6: Add a "Flathead Catfish" option to the *PRIMARY FISH* field of the Charter Boat/ Fishing Guide Permit Application (PFBC-G-1) to track the size of the commercial guide fishery within the native range. This database has served as a low-cost means to track the commercial guide component of some fisheries. This will help to

inform resource managers of the contribution of different aspects of the fishery when evaluating regulatory action.

Introduced Range

Flathead Catfish records in the Atlantic slope drainage of Pennsylvania date back to the early 1990s; however, large-scale range expansion and population increases were not realized until the late 1990s in the Delaware River drainage and the early 2000s in the Susquehanna River drainage (Brown *et al*. 2005). The mode of introduction is unknown, but three theories are held: accidental stocking along with Channel Catfish, intentional introduction by anglers to create a fishery, and migration from established populations in other portions of the Atlantic slope (Brown *et al.* 2005).

Following the discovery of Flathead Catfish, the PFBC made recommendations (via the PFBC webpage) to anglers to kill any Flathead Catfish upon capture in the Atlantic slope drainages in an attempt to prevent populations from establishing as well as to limit their spread. However, like most waters where they have been introduced, Flathead Catfish quickly became established and as such, recommendations to kill upon capture have been removed from the PFBC webpage. Currently, Flathead Catfish are included under a liberal harvest regulation (no minimum length limit, no closed season, and 50 fish per day creel limit combined with other panfish species).

Within the introduced range, the Flathead Catfish fishery quickly grew in popularity with local anglers. The large size, strong fight, and palatability of this species provided a unique opportunity for anglers, including the conventional recreational fishery, competitive recreational fishery (i.e., organized tournaments), and a commercially guided fishery. Recently, a small lobby has come forward requesting conservative harvest regulations to develop a trophy catfish fishery within its introduced range.

Resource management organizations such as the Atlantic States Marine Fisheries Commission (ASMFC), of which Pennsylvania is a member, and the Chesapeake Bay Program, have recently expressed their concerns over the status of invasive catfishes in the Chesapeake Bay drainage. This includes a resolution passed by the ASMFC in 2011 stating that all practical efforts should be made to reduce the population level and range of non-native invasive species in the Chesapeake Bay drainage. Further, the National Oceanographic and Atmospheric Administration (NOAA) Sustainable Goal Implementation Team developed an Invasive Catfish Taskforce to research the ecological impacts of these species and provide guidance on management efforts moving forward. The Taskforce includes resource agencies (including PFBC), university researchers, and local watermen that will report to NOAA and the ASMFC.

Management Recommendations for Introduced Stocks

OBJECTIVES

Objective 1: Collect adequate water-specific fisheries dependent and fisheries-independent data to improve our understanding of Flathead Catfish populations throughout their introduced range. This work should focus on documenting the characteristics of existing populations, tracking range expansion, and determining the impacts and potential threats to resident and native species.

Objective 2: Investigate new regulations in an effort to expand recreational use of the existing Flathead Catfish fishery in an effort to increase exploitation throughout the introduced range.

Objective 3: Encourage anglers to utilize Flathead Catfish fisheries to increase participation in the sport, as well as increase exploitation to alleviate negative impacts potentially affecting native and resident species.

Objective 4: Study the potential impacts of invasive catfish, including Flathead Catfish, in the Chesapeake Bay and Delaware drainages to determine means and endpoints for population control if needed.

Opportunity 1: The opportunity exists to collect Flathead Catfish data to document characteristics of extant populations to set target parameters for future management of the species.

Strategy 1: Develop and employ standardized, catfish-specific survey procedures to establish distribution, abundance, and population characteristics data to guide future management activities. Flathead Catfish populations have not been adequately quantified since their presence was initially documented in their introduced range. Standardization of procedures and protocols for data collection will allow for establishment of population data, as well as provide the opportunity to track effects of potential future management actions.

Strategy 2: Establish a network of monitoring locations to conduct full assessments of the fish community periodically to track changes in species presence, absence, and abundance in relation to Flathead Catfish range expansion.

- The impacts of introduced Flathead Catfish on migratory and resident fishes are well documented (Guier et al. 1981, Ashley and Buff 1988, Thomas 1995, Brown et al. 2005, Pine et al.

2005, Sakaris et al. 2006, Pine et al. 2007, Bonovechio et al. 2009). Models suggest that Flathead Catfish suppress native fish biomass 5 – 50% through predation and competitive interactions (Pine et al. 2007). In other areas of the Atlantic Slope where Flathead Catfish occur, they often became established prior to these data being developed, so the full extent of the implications of their introduction cannot fully be assessed (Pine et al. 2005, Pine et al. 2007). Without data to describe the full fish community present in these systems it will be impossible to determine potential impacts to current fish assemblages from established Flathead Catfish populations. Also, these data will provide the opportunity to develop existing fish community values to assess the potential risks and impacts that future introductions may cause in areas where they are not yet established. This recommendation is also an objective of the Large River Program and the River Management Plans.

Strategy 3: Establish a small network of sentinel monitoring sites (e.g., one per Area, one per reach of large river) to track distribution of Flathead Catfish. These can be undertaken as part of existing directed sampling efforts for gamefish species (i.e., adult black bass, YOY black bass, YOY walleye) in rivers and lakes.

Strategy 4: Develop a low cost and repeatable angler use and harvest survey to gather information about angler behavior in the introduced range. It is possible that angler behavior differs in the introduced range where the fishery is new compared to those in the native range.

Opportunity 2: The opportunity exists to allow use of additional tackle and equipment types to provide more angling opportunities within the introduced range in an attempt to increase exploitation and decrease biomass where the invasive Flathead Catfish are already established, as well as limit range expansion in other waters.

Strategy 1: Investigate developing regulations that permit the use of jug lines or trotlines to target catfish in the Atlantic Slope drainage in an attempt to increase exploitation.

- Modeling suggests that moderate, sustained levels of exploitation may release native fish species from predation by and competition with Flathead Catfish (Pine et al. 2007). Schramm

et al. (1999) reported that Mississippi anglers found it important to keep large numbers of catfish, inferring that increased fishing effort and high harvest could potentially deplete catfish resources. By utilizing this angler behavior, it provides an opportunity to the benefit of native species. In estuarine fisheries, trotlines where determined to be effective at reducing black drum *Pogomais cromis*, a molluscivore, to support oyster restoration efforts (George et al. 2008). Arterburn and Berry (2002) reported that bait and hook type influenced catch of Channel Catfish and Flathead Catfish on trotlines; with bait type having the greatest influence on numbers and species. When live bullheads were used as bait, they were 28 times more likely to catch Flathead Catfish than Channel Catfish. Similarly, Stauffer and Koenen (1999) reported catching larger Flathead Catfish with larger bait (150-400mm) and larger hooks (7/0 – 8/0). Arterburn and Berry (2002) reported that hook type (O'Shaughnessy and modified circle hook over sea-circle hooks) was more influential than size. Bycatch of other sport fish on bait lines (e.g., trotlines and jug lines) in commercial fisheries did not pose a threat to sport fish populations (Timmons *et al.* 1989). To further limit bycatch it may be beneficial to require large, live baitfish as well a large ($\geq$ 3/0) modified circle hooks.

Strategy 2: Based upon the outcome of Strategy 1, work with the Bureau of Boating and Outreach to inform the public about new allowable gears and techniques for targeting Flathead Catfish to increase fishing opportunities and bring new participation to the sport.

- The recent regulation allowing three rods, use of an additional gear type, as well as development of a new fishery may open up a number of new fishing opportunities and consequently increase license sales. As a relatively newly introduced species and unlike any other species present in the Atlantic slope, many anglers may be unaware of the techniques and tackle needed to target Flathead Catfish. In Pennsylvania, however, the use of trotlines has not been permitted, so anglers may be reluctant to use them since they have no experience with their use and may not have a full understanding of compliance issues pertaining to the use of trotlines. A campaign to educate anglers on the angling opportunities provided by this species would help to

increase angler participation in this activity and potentially increase exploitation.

Opportunity 3: The opportunity exists to encourage anglers to take advantage of available Flathead Catfish fisheries to potentially increase exploitation. Reductions in Flathead Catfish biomass attributable to increased exploitation could potentially benefit native ictalurids, panfishes, and alosines which have been documented to be negatively impacted by invasive Flathead Catfish populations.

Strategy 1: Educate anglers and public about the established Flathead Catfish fisheries that exist in the lower portions of the Schuylkill, Delaware, and Susquehanna rivers, as well as some nearby lakes to potentially increase angler effort and exploitation.

Strategy 2: Collect fish tissue contaminant data to develop fish consumption guidance for Flathead Catfish in an effort to promote harvest. The angling public seems to be overly cautious when considering harvesting fish for consumption as it is often felt that all fish are unsafe to eat. Frequently harvesting fish for testing and publicizing the results may help alleviate concerns and encourage exploitation.

- Efforts to encourage exploitation should clarify the health benefits of consuming wild caught fish and accurately convey any negative health impacts with consuming these fish, should they exist, in order for this goal to be realized. Flathead Catfish shift their diet primarily to piscivory around 500 mm TL (Bonovechio et al. 2011) and there is evidence that anglers prefer to harvest large (600 – 800mm TL) individuals (Marshall et al. 2009). As such, differences in bioaccumulation between both dietary stages of Flathead Catfish may occur. This would require the need for separate testing of both dietary stages to accurately assess and issue consumption advisories for this species. Samples of fish prior to (< 500 mm TL) and following this shift (>600 mm TL) should be submitted for analysis based on the recommendations of the Fish Consumption Advisory Workgroup. Increasing the minimum length for the larger group should allow adequate time for this shift to result in accumulation of contaminants in edible tissue to be more representative of larger fish preferred by anglers. Two rounds of testing for each of the dietary groups prior to moving forward with efforts to encourage Flathead Catfish harvest (i.e., changing

allowable gear, changing daily creel). This will provide the agency with clear, concise recommendations about consumption to pass on to anglers. Frequent testing (every other year) for each of the dietary stages should continue indefinitely or until it is clear that changes in concentration are insufficient to necessitate a change in the advisories.

Strategy 3: Educate the anglers and public about the positive ecological benefits of utilizing an invasive, wild fishery over a farm-raised or already heavily exploited wild fishery (i.e., traditional ocean fisheries).

Strategy 4: Educate the anglers and public about the potential ecological impacts of invasive species including specific, documented impacts of Flathead Catfish to increase awareness and prevent further angler-facilitated range expansion.

Strategy 5: Add a "Flathead Catfish" option to the *PRIMARY FISH* field of the Charter Boat/ Fishing Guide Permit Application (PFBC-G-1) to track the size of the commercial guide fishery within the introduced range. This will be informative as to role in the existing recreational fishery for future management. Meet with fishing guides who are catching these fish and determine catch rates, length frequencies and sport fishing potential.

Opportunity 4: The opportunity exists to work with research partners in the NOAA Sustainable Fisheries Goal Implementation Team, Invasive Catfish Taskforce to collect data and conduct research regarding Flathead Catfish population characteristics, diet, ramifications of range expansion, and control measures in Chesapeake Bay Tributaries.

Strategy 1: Utilize on-going research of partners in the Chesapeake Bay and tributaries to guide management and identify areas where additional efforts are needed as they relate to invasive catfish species. This will help to stream-line effort and reduce resource expenditures.

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Appendix A: Summary of Channel Catfish management in Pennsylvania's surrounding states

Delaware:

Angler interest in Channel Catfish is low in the state of Delaware and the species is not a management priority. The state has no formal management plan for the species and few recreational fishing opportunities are provided by the species. There is no season, no size, and no creel limit on Channel Catfish. Stocking of Channel Catfish occurs occasionally in Little Park Pond, to provide for youth angling. These fish typically range between 10 and 14 inches in length. Natural reproduction of Channel Catfish has been documented in the Delaware, Cristina, and Nanticoke Rivers.

Maryland:

Recreational and commercial fisheries for Channel Catfish, and increasingly Blue and Flathead Catfish, are present in Maryland. There is no closed season for Channel Catfish in tidal or non-tidal waters. In tidal waters there is a 10" minimum size and no creel limit, whereas in non-tidal waters there is no minimum size and a 5 fish daily limit. The recreational fishery in non-tidal waters, including both lakes and rivers, is currently not actively managed (at least in the Southern region). Catfish are not known as one of the top fish that anglers target. Catch of catfish during fisheries management sampling in these non-tidal waters is purely incidental. Some stocking of catchable sized catfish does occur primarily for youth fishing derbies.

Maryland's tidal Channel Catfish fishery is both a significant recreational and commercial fishery that is maintained solely through natural reproduction. Channel Catfish have been shown to be the second most harvested species and second most sought after species in the lower Potomac River according to a 1990 angler survey. Attempts to sample the population in tidal portions of the river have included low frequency electrofishing, hoop nets, and trawling. No formal management plan has been developed for Maryland, but limited information on the tidal catfish fishery can be found at this Web address: http://www.dnr.maryland.gov/fisheries/management/FMP/FMPCatfish04.pdf

In recent years increasing populations of Blue catfish and Flathead Catfish have begun to compete with Channel Catfish in tidal portions of Maryland. Fisheries managers are concerned

with the impact that these two species will have on the Channel Catfish population in Maryland. Surveys in the Potomac River indicate that Blue catfish may be replacing Channel Catfish as the primary catfish species.

New Jersey:

Channel Catfish are an important component of the recreational freshwater fishery in New Jersey. Approximately 15% of freshwater anglers target Channel Catfish and 73% of those anglers are satisfied with the fisheries present. New Jersey contains only a few naturally reproducing Channel Catfish waters, including the Delaware and Raritan Rivers, and Union Lake. The remaining 90 waters are supported by hatchery stockings. There is a year-round season, a 12" minimum size limit, and a 5 fish per day creel limit statewide.

The 90 stocked lakes are stocked according to location with lakes in the eastern part of the state stocked in even years, and western lakes in odd years. Stocking rates are based on the number of littoral acres (total acreage with depths $\leq$ 15 feet) in the lake (Table 1). Smaller lakes (<11 ac) are stocked annually at 25 fish/acre.

Table 1: Stocking rates for impoundments in New Jersey.

Total Acres	No./acre $\leq$15 feet (littoral acre)	No. Stocked Lakes	Percent of Stocked Lakes
1-10	25	19	23
11-74	25	47	56
75-99	20	4	5
100-1000	10	11	13
>1000	4	3	3

The Hackettstown State Fish Hatchery raises approximately 40,000 Channel Catfish fingerlings for stocking in the fall at a size of 7 to 10 in. Until recently, an additional 4,000 advanced fingerlings (11 to 14") were raised over winter to be stocked in the spring time. However, due to cost and equipment wear, these fish are no longer being raised over winter. Instead, fingerlings are purchased from southern hatcheries at a size of 1.5" in June and are raised to the target size of 11" by fall when they are subsequently stocked.

New Jersey recently completed an assessment of Channel Catfish to determine which ponds and lakes were best for stocking. They determined that there was no consistent method of capture in their waters. Gear types used included trap nets, gill nets, and electrofishing. The study was performed once by fisheries biologists and once by hatchery personnel, neither of which could consistently catch Channel Catfish. Sampling was performed during all times of year and all times of day. Based on these results, angler reports now drive the stocking, with the best fisheries often getting the larger sized fingerlings.

New York:

Channel Catfish are not considered to be an important species in New York, as angler effort for them is low and no management for the species takes place. Channel Catfish are not stocked or raised in hatcheries in New York, there is no season, size, or creel limits, and there are no fisheries management sampling efforts for Channel Catfish. The species does reproduce naturally in large rivers and lakes throughout the state including the Finger Lakes, Lake Champlain, and the Hudson and Mohawk Rivers.

Ohio:

Channel Catfish are an important part of the recreational fishery in Ohio, with both naturally reproducing and stocked fisheries present statewide. Regulations for Channel Catfish include a 1 fish, 26" minimum size limit, for all waters statewide and a 6 fish, 26" maximum size limit, for all lakes under 700 acres (no harvest of Channel Catfish under 26" on lakes >700 acres). Other special regulation waters such as Lake Erie, Pymatuning Lake, and the Ohio River have different harvest regulations for Channel Catfish.

Stocking of Channel Catfish occurs mainly in lakes less than 700 acres, as rivers and lakes >700 acres are deemed to have sufficient natural reproduction to sustain a rewarding fishery. Fish are

stocked in sizes between 8 and 12". In 2008, approximately 200000 Channel Catfish were stocked and in 2009 approximately 122000 Channel Catfish were stocked. Lakes are stocked biennially. In addition, a catchable Channel Catfish program is present in which 10000 Channel Catfish (>12") are stocked in heavy use ponds in state parks and at the Ohio State Fair.

No formal fisheries management plan or sampling techniques appear to be used to evaluate the Channel Catfish fisheries in Ohio. Gill net catch rates are used to evaluate the Channel Catfish populations, but Channel Catfish are considered incidental catches, and are most often caught while evaluating walleye fisheries.

West Virginia:

As of this writing, West Virginia is in the process of writing a formal Channel Catfish management plan for the state (Zack Brown, Fisheries Biologist, personal communication January 2011). Channel Catfish provide an important recreational fishery in West Virginia, with both naturally reproducing and stocked fisheries occurring statewide. Statewide creel limit for Channel Catfish is 4 fish/day with no minimum size or closed season in impoundments in West Virginia.

Stocking of Channel Catfish occurs in lakes less than 500 acres that primarily are not cold, oligotrophic lakes high on the Allegheny Plateau. Stocking is done biennially. Two different sizes of fingerlings are stocked, including advanced fingerlings (fish that overwinter, 8 to 10") and age 0 (4 to 6") fingerlings. In addition, in some small lakes (< 20 acres) catchable sized fish (1 to 2 lbs.) are stocked to provide for "family fishing opportunities."

Fisheries personnel are in the process of evaluating the success of stocking using three different gear types in West Virginia. Baited Missouri style tandem hoop nets, experimental gill nets, and electrofishing have been used in three impoundments over a 3 or 4 year study period to evaluate the fisheries. Sampling has been conducted in July and August and the best catch rates have been observed using the baited Missouri style tandem hoop nets.

Appendix B. Listing of Fisheries Management Division personnel determined Channel Catfish lake, river, and stream fisheries for 2010

Fish Management Area	Water Name	Section	Surface Area (ac)	Fishery?	% Maintained By Stocking
1	BEAVER R	2	502.9	Y	100
1	BRADY RUN LK	0	25.94	Y	100
1	GLADE RN LK	0	51.87	Y	100
1	SHENANGO R	5	3426.4	Y	100
1	LK ARTHUR	0	3224.09	Y	90
1	MAHONING RIVER	1	196.52	Y	50
1	GLADES WLDF MGT LK	0	200.07	Y	0
1	PYMATUNING LK	0	13919.93	Y	0
1	SHENANGO LK	0	3559.27	Y	0
2	ALLEGHENY R	11	661	Y	0
2	ALLEGHENY R	12	2530	Y	0
2	ALLEGHENY R	13	1634.9	Y	0
2	ALLEGHENY R	14	728.3	Y	0
2	ALLEGHENY RS	0	12080.77	Y	100
2	CROOKED CK LK	0	350	Y	100
2	KYLE LK	0	165	Y	100
2	MAHONING CK LK	0	279.11	Y	100
2	PINEY DM	0	689.62	Y	100
2	TIONESTA LK	0	569.83	Y	100
2	CLARION R	5	304.7	Y	30
2	MAHONING CK	3	46.4	Y	30
2	ALLEGHENY R	7	283	Y	0
2	ALLEGHENY R	9	1881.7	Y	0

2	ALLEGHENY R	15	914.2	Y	0
2	ALLEGHENY R	16	964.5	Y	0
2	ALLEGHENY R	17	1192.4	Y	0
2	ALLEGHENY R	8	335.5	Y	0
2	ALLEGHENY R	10	1512	Y	0
3	F J SAYERS LK	0	1729.25	Y	100
3	PENNS CK	8	440.8	Y	0
3	SUSQUEHANNA R W BR	4	3885.8	Y	0
3	SUSQUEHANNA R W BR	5	3234.5	Y	0
3	SUSQUEHANNA R W BR	6	4302.8	Y	0
4	LACKAWANNA LK	0	198.09	Y	100
4	SUSQUEHANNA R N BR	1	196.7	Y	0
4	SUSQUEHANNA R N BR	2	573.5	Y	0
4	SUSQUEHANNA R N BR	3	675.8	Y	0
4	SUSQUEHANNA R N BR	4	280.6	Y	0
4	SUSQUEHANNA R N BR	5	854.6	Y	0
4	SUSQUEHANNA R N BR	6	1819.4	Y	0
4	SUSQUEHANNA R N BR	7	293.9	Y	0
4	SUSQUEHANNA R N BR	8	2503.1	Y	0
4	SUSQUEHANNA R N BR	9	2074.1	Y	0

4	SUSQUEHANNA R N BR	10	2980.8	Y	0
5	DELAWARE R	1	819.3	Y	0
5	DELAWARE R	2	1185.6	Y	0
5	DELAWARE R	3	571.6	Y	0
5	DELAWARE R	4	1120.29	Y	0
5	BELTZVILLE LK	0	946.5	Y	100
5	DELAWARE R	5	2325.58	Y	0
5	DELAWARE R	6	2194.4	Y	0
5	LEHIGH R	8	527.9	Y	0
5	LEHIGH R	9	953.82	Y	0
5	LK WALLENPAUPACK	0	5697.8	Y	0
6	CHAMBERS LK	0	88.92	Y	100
6	FALLS TOWNSHIP PARK LK	0	67.18	Y	100
6	HANOVER DM	0	8.4	Y	100
6	LEASER LK	0	117.08	Y	100
6	LK GALENA	0	364.82	Y	100
6	LK LUXEMBOURG	0	165.98	Y	100
6	MUDDY RN REC LK	0	97.81	Y	100
6	STRUBLE LK	0	145.98	Y	100
6	SPEEDWELL FORGE LK	0	105.96	Y	90
6	THE GIVING POND	0	62.24	Y	75
6	DEEP CK DM	0	24.95	Y	50
6	LK WILLIAMS	0	219.83	Y	50
6	FRENCH CK	7	13	Y	30
6	FDR PARK LK	0	17.78	Y	25
6	LK ONTELAUNEE	0	1081.86	Y	25
6	LK REDMAN	0	289.98	Y	25
6	BLUE MARSH RS	0	1149.54	Y	0
6	CHESTER CK	6	20.16	Y	0

6	DARBY CK	5	180.31	Y	0
6	DELAWARE ESTUARY	1	2753.4	Y	0
6	DELAWARE ESTUARY	2	1421.3	Y	0
6	DELAWARE ESTUARY	3	5085.3	Y	0
6	DELAWARE ESTUARY	4	8669.2	Y	0
6	DELAWARE R	7	2030.3	Y	0
6	DELAWARE R	8	1749.5	Y	0
6	MAIDEN CK	4	38.53	Y	0
6	NOCKAMIXON LK	0	1449.89	Y	0
6	PERKIOMEN CK	5	668.68	Y	0
6	PEQUEA CK	3	113.8	Y	0
6	PEQUEA CK	4	141.5	Y	0
6	SCHUYLKILL R	4	68.4	Y	0
6	SCHUYLKILL R	6	132.4	Y	0
6	SCHUYLKILL R	7	341.4	Y	0
6	SCHUYLKILL R	10	329.4	Y	0
6	SCHUYLKILL R	11	191.5	Y	0
6	SCHUYLKILL R	13	166.9	Y	0
6	SCHUYLKILL R	14	245.9	Y	0
6	SCHUYLKILL R	15	323.5	Y	0
6	SCHUYLKILL R	16	350.8	Y	0
6	SUSQUEHANNA R	5	4118.7	Y	0
6	SUSQUEHANNA R	6	7133.9	Y	0
6	SUSQUEHANNA R	7	3026.3	Y	0
6	SUSQUEHANNA R	8	3302.1	Y	0
6	TULPEHOCKEN CK	4	25.7	Y	0
7	PINCHOT LAKE	0	339.87	Y	100
7	CONEWAGO LK	0	339.87	Y	100
7	JUNIATA R	5	676	Y	0

7	JUNIATA R	6	1050.5	Y	0
7	RAYSTOWN LK	0	8296.73	Y	0
7	SHERMAN CK	4	198.5	Y	0
7	SUSQUEHANNA R	2	13937.3	Y	0
7	SUSQUEHANNA R	3	9522.5	Y	0
7	SWATARA CK	5	295.5	Y	0
8	ACME DM	0	24.21	Y	100
8	CANONSBURG LK	0	76.08	Y	100
8	CROSS CK LK	0	244.04	Y	100
8	GREEN LICK LK	0	100.04	Y	100
8	LK SOMERSET	0	252.93	Y	100
8	LK WILMA	0	19.27	Y	100
8	LOYALHANNA LK	0	479.18	Y	100
8	MAMMOTH DM	0	26.92	Y	100
8	NORTH PARK LK	0	75.09	Y	100
8	NORTHMORELAND LK	0	17.04	Y	100
8	PETERS LK RS NO 2	0	35.57	Y	100
8	RACCOON LK	0	101.02	Y	100
8	TWIN LK LW	0	30.01	Y	100
8	TWIN LK UP	0	20.01	Y	100
8	VIRGIN RN DM	0	33.1	Y	100
8	WILMORE DM	0	195.13	Y	100
8	WISECARVER RS	0	18.03	Y	100
8	ALLEGHENY R	18	595.3	Y	0
8	ALLEGHENY R	19	702.5	Y	0
8	ALLEGHENY R	20	1100.9	Y	0
8	ALLEGHENY R	21	936.7	Y	0
8	ALLEGHENY R	22	731.8	Y	0
8	BRIDGEPORT DM	0	69.9	Y	0
8	KISKIMINETAS R	1	1157.69	Y	0
8	MONONGAHELA R	1	697.8	Y	0
8	MONONGAHELA R	2	1662.3	Y	0

8	MONONGAHELA R	3	1541.7	Y	0
8	MONONGAHELA R	4	1559.2	Y	0
8	MONONGAHELA R	5	1133	Y	0
8	MONONGAHELA R	6	1134.2	Y	0
8	OHIO R	1	1032	Y	0
8	OHIO R	2	1253	Y	0
8	OHIO R	3	2621.1	Y	0
8	OHIO R	4	1059.1	Y	0
8	YOUGHIOGHENY R	6	1906.6	Y	0
8	YOUGHIOGHENY R LK	0	2840.01	Y	0

Total Acres with a Channel Catfish Fishery = 88727.47
Total Acres supported at Least partially by stocking = 87964.83

Percent of Total Acres CC fishery supported at Least Partially by stocking= 47%

Totals Waters (Lakes and River Sections) supporting a Channel Catfish fishery = 143

Total Waters (Lakes and River Sections) supporting a Channel Catfish fishery at Least Partially by stocking = 52

Percent of Total Waters (Lakes and River Sections) supporting a Channel Catfish fishery at Least Partially by stocking = 36%

Appendix C. Listing of waters stocked with Channel Catfish in Pennsylvania in 2010.

AFM	Water Name	Date	Life Stage	Number Stocked	Number Per Ac
8	Acme Dam	2010	FING	750	31
2	Allegheny Reservoir	2010	FING	12000	1
1	Beaver River	2010	FING	12000	48
5	Beltzville Lake	2010	FING	7000	5
8	Canonsburg Lake	2010	FING	3000	39
7	Cowans Gap Lake	2010	FING	2900	39
2	Crooked Creek Lake	2010	FING	3500	10
8	Cross Creek Lake	2010	FING	4880	20
6	Deep Creek Dam	2010	FING	1000	30
5	Delaware River	2010	FING	2500	5
5	Delaware River	2010	FING	11041	15
5	Delaware River	2010	FING	8240	11
6	Falls Township Park Lake	2010	FING	1700	25
6	FDR Park Lk	2010	FING	1150	42
8	Filbert Pond	2010	FING	450	29
4	Fords Lake	2010	FING	2800	29
3	Foster Joseph Sayers Lake	2010	FING	17300	15
1	Glade Run Lake	2010	FING	1100	21
8	Green Lick Reservoir	2010	FING	1500	15
6	Hanover Dam	2010	FING	550	42
8	Holtzhauer Lake (Lower Burrell Park Pond)	2010	FING	200	51

AFM	Water Name	Date	Life Stage	Number Stocked	Number Per Ac
8	Keystone Lake	2010	FING	1500	19
2	Kyle Lake	2010	FING	3400	21
4	Lackawanna Lake	2010	FING	1200	6
1	Lake Arthur	2010	FING	16000	5
6	Lake Galena	2010	FING	14550	30
6	Lake Luxembourg	2010	FING	6600	40
6	Lake Marburg	2010	FING	19200	15
6	Lake Redman	2010	FING	8700	20
6	Lake Williams	2010	FING	2200	10
8	Lake Wilma	2010	FING	800	42
5	Long Pond	2010	FING	800	10
8	Lower Deer Lake	2010	FING	100	37
8	Loyalhanna Lake	2010	FING	14400	30
2	Mahoning Creek Lake	2010	FING	2700	10
8	Mammoth Lake	2010	FING	750	28
6	Marsh Creek Lake	2010	FING	35030	40
8	Middle Deer Lake	2010	FING	150	47
6	Muddy Run Recreation Lake	2010	FING	1500	15
8	Northmoreland Lake	2010	FING	650	38
2	Piney Reservoir	2010	FING	1350	2
8	Reservoir Number Two (Peters Lake Reservoir No. 2)	2010	FING	800	22
7	Shawnee Lake	2010	FING	13500	10

AFM	Water Name	Date	Life Stage	Number Stocked	Number Per Ac
1	Shenango River	2010	FING	8000	15
6	Speedwell Forge Lake	2010	FING	3150	10
6	Struble Lake	2010	FING	5800	20
6	The Giving Pond	2010	FING	2400	19
2	Tionesta Lake	2010	FING	5700	10
8	Twin Lakes Number One Reservoir (Lower Twin Lake)	2010	FING	300	10
8	Twin Lakes Number Two Reservoir (Upper Twin Lake)	2010	FING	400	20
8	West Deer Lake (Upper Deer Lake)	2010	FING	150	40
8	Wilmore Dam	2010	FING	3900	20
6	Kaercher Creek Dam	2010	YRLN	600	19
7	Sweet Arrow Lake	2010	YRLN	5650	30
8	Lake Somerset	2010	YRLN	2550	10
5	Beltzville Lake	2010	YRLN	700	1

Appendix D. Listing of PFBC hatchery Channel Catfish stocking requests for 2011. (YRLN = Yearlings; FING = Fingerlings)

Area	Water	Life Stage	Number Requested	Per Acre	Request Level	Water Area
8	Canonsburg Lake	YRLN	750	10	B	76
8	Canonsburg Lake	YRLN	750	10	S1	76
8	Canonsburg Lake	YRLN	750	10	S2	76
8	Canonsburg Lake	YRLN	750	10	S3	76
6	Chambers Lake	YRLN	900	10	B	89
8	Cross Creek Lake	YRLN	2440	10	B	244
8	Cross Creek Lake	YRLN	2440	10	S1	244
8	Filbert Pond	YRLN	150	10	S1	16
8	Filbert Pond	YRLN	300	19	B	16
4	Fords Lake	YRLN	350	5	B	73
4	Fords Lake	YRLN	350	5	S1	73
4	Fords Lake	YRLN	350	5	S2	73
3	Foster Joseph Sayers Lake	YRLN	8650	5	B	1729
3	Foster Joseph Sayers Lake	YRLN	8650	5	S1	1729
8	Green Lick Reservoir	YRLN	1500	15	B	100

Area	Water	Life Stage	Number Requested	Per Acre	Request Level	Water Area
8	Holtzhauer Lake (Lower Burrell park pond)	YRLN	50	13	S1	4
8	Holtzhauer Lake (Lower Burrell park pond)	YRLN	50	13	S2	4
8	Holtzhauer Lake (Lower Burrell park pond)	YRLN	100	25	B	4
6	Kaercher Creek Dam	YRLN	600	19	B	32
4	Lackawanna Lake	YRLN	1000	5	B	198
8	Lake Somerset	YRLN	2550	10	B	253
8	Lake Somerset	YRLN	2550	10	S1	253
8	Lake Somerset	YRLN	2550	10	S2	253
8	Lake Somerset	YRLN	2550	10	S3	253
8	Lake Wilma	YRLN	200	10	S1	19
8	Lake Wilma	YRLN	200	10	S2	19
8	Lake Wilma	YRLN	400	21	B	19
8	Lower Deer Lake	YRLN	100	37	B	3
8	Loyalhanna Lake	YRLN	4800	10	B	479
8	Loyalhanna Lake	YRLN	4800	10	S1	479

Area	Water	Life Stage	Number Requested	Per Acre	Request Level	Water Area
8	Loyalhanna Lake	YRLN	4800	10	S2	479
8	Mammoth Lake	YRLN	250	9	S1	27
8	Mammoth Lake	YRLN	500	19	B	27
8	Middle Deer Lake	YRLN	150	47	B	3
8	North Park Lake	YRLN	750	10	S1	75
8	North Park Lake	YRLN	750	10	S2	75
8	North Park Lake	YRLN	750	10	S3	75
8	North Park Lake	YRLN	1500	20	B	75
8	Northmoreland Lake	YRLN	150	9	S1	17
8	Northmoreland Lake	YRLN	150	9	S2	17
8	Northmoreland Lake	YRLN	350	21	B	17
7	Pinchot Lake	YRLN	3400	10	B	340
7	Pinchot Lake	YRLN	3400	10	S1	340
7	Pinchot Lake	YRLN	3400	10	S2	340
8	Reservoir Number Two (peters lake reservoir no. 2)	YRLN	800	22	B	36
7	Sweet Arrow Lake	YRLN	3000	30	B	100

Area	Water	Life Stage	Number Requested	Per Acre	Request Level	Water Area
7	Sweet Arrow Lake	YRLN	3000	30	S1	100
7	Sweet Arrow Lake	YRLN	3000	30	S2	100
8	Twin Lakes Number Two Reservoir (upper twin lake)	YRLN	400	20	B	20
8	West Deer Lake (upper deer lake)	YRLN	150	40	B	4
8	Wilmore Dam	YRLN	1950	10	B	195
8	Wilmore Dam	YRLN	1950	10	S1	195
8	Wisecarver Reservoir	YRLN	450	25	B	18
		Total Yearling 2011	**86580**			

Area	Water	Life Stage	Number Requested	Per Acre	Request Level	Water Area
2	Allegheny Reservoir	FING	12000	1	B	12081
1	Beaver River, Section 2	FING	12000	24	B	503
5	Beltzville Lake	FING	4700	5	B	947
1	Bradys Run Lake	FING	600	23	B	26
1	Bradys Run Lake	FING	600	23	S1	26
7	Cowans Gap Lake	FING	1250	30	B	42
7	Cowans Gap Lake	FING	1250	30	S1	42
7	Cowans Gap Lake	FING	1250	30	S2	42
2	Crooked Creek Lake	FING	3500	10	B	350
6	Deep Creek Dam	FING	250	10	S1	25
6	Deep Creek Dam	FING	250	10	S2	25
6	Deep Creek Dam	FING	500	20	B	25
6	Falls Township Park Lake	FING	700	10	S1	67
6	Falls Township Park Lake	FING	1000	15	B	67
6	FDR Park Lk	FING	200	11	S1	18
6	FDR Park Lk	FING	200	11	S2	18
6	FDR Park Lk	FING	200	11	S3	18
6	FDR Park Lk	FING	550	31	B	18
1	Glade Run Lake	FING	500	10	B	52

Area	Water	Life Stage	Number Requested	Per Acre	Request Level	Water Area
1	Glade Run Lake	FING	600	12	S1	52
6	Hanover Dam	FING	100	12	S1	8
6	Hanover Dam	FING	100	12	S2	8
6	Hanover Dam	FING	100	12	S3	8
6	Hanover Dam	FING	250	30	B	8
2	Kyle Lake	FING	1700	10	B	165
2	Kyle Lake	FING	1700	10	S1	165
1	Lake Arthur	FING	16000	5	B	3224
6	Lake Galena	FING	3650	10	B	365
6	Lake Galena	FING	3650	10	S1	365
6	Lake Galena	FING	3650	10	S2	365
6	Lake Luxembourg	FING	1650	10	S1	166
6	Lake Luxembourg	FING	1650	10	S2	166
6	Lake Luxembourg	FING	2500	15	B	166
6	Lake Marburg	FING	6400	5	B	1275
6	Lake Marburg	FING	6400	5	S1	1275
6	Lake Redman	FING	2900	10	B	290
6	Lake Redman	FING	2900	10	S1	290
6	Lake Redman	FING	2900	10	S2	290
6	Lake Williams	FING	2200	10	B	220
6	Leaser Lake	FING	600	5	B	117
5	Long Pond	FING	800	10	B	81
2	Mahoning Creek Lake	FING	2700	10	B	279
6	Marsh Creek Lake	FING	2700	5	B	535

Area	Water	Life Stage	Number Requested	Per Acre	Request Level	Water Area
6	Marsh Creek Lake	FING	2700	5	S1	535
6	Muddy Run Recreation Lake	FING	1500	15	B	98
2	Piney Reservoir	FING	1350	2	B	690
5	Prompton Lake	FING	2800	10	B	280
7	Shawnee Lake	FING	4500	10	B	451
7	Shawnee Lake	FING	4500	10	S1	451
7	Shawnee Lake	FING	4500	10	S2	451
1	Shenango River, Section 5	FING	8000	8	B	1048
6	Speedwell Forge Lake	FING	1050	10	B	106
6	Speedwell Forge Lake	FING	1050	10	S1	106
6	Speedwell Forge Lake	FING	1050	10	S2	106
6	Struble Lake	FING	1450	10	B	146
6	Struble Lake	FING	1450	10	S1	146
6	Struble Lake	FING	1450	10	S2	146
6	The Giving Pond	FING	600	10	B	62
6	The Giving Pond	FING	600	10	S1	62
6	The Giving Pond	FING	600	10	S2	62
2	Tionesta Lake	FING	2850	5	B	570
2	Tionesta Lake	FING	2850	5	S1	570
		Fingerling Total 2011	154150			

Appendix E. Pennsylvania Channel Catfish catch statistics (CPUE as number of fish per hour) from various gear types from 1984 to 2009.

Table 1. Pennsylvania Channel Catfish catch statistics from trap nets in various size Reservoirs from 1984 to 2009.

Lake Size (Acres)	Sample Size (Trap Net Sets)	Statistic	Length Grouping			
			CPUE < 275 mm	CPUE ≥ 275 mm	CPUE ≥ 400 mm	CPUE ≥ 600 mm
Reservoirs < 50 acres	53	Mean	0.040	0.055	0.033	0.003
		Median	**0**	**0.008**	**0.008**	**0**
		66th Percentile	0	0.017	0.018	0
Reservoirs 50 to 500 acres	1150	Mean	0.061	0.076	0.040	0.008
		Median	**0**	**0.018**	**0.011**	**0**
		66th Percentile	0.008	0.045	0.017	0.004
Reservoirs > 500 acres	2390	Mean	0.030	0.166	0.093	0.015
		Median	**0.002**	**0.064**	**0.038**	**0.004**
		66th Percentile	0.009	0.156	0.067	0.008

Table 2. Pennsylvania Channel Catfish catch statistics (CPUE as number of fish per hour) from gill nets in Reservoirs from 1984 to 2009.

Lake Size (Acres)	Sample Size (Gill Net Sets)	Statistic	Length Grouping			
			CPUE < 275 mm	CPUE ≥ 275 mm	CPUE ≥ 400 mm	CPUE ≥ 600 mm
Reservoirs < 50 acres	12	Mean	0	0.017	0.017	0
		Median	**0**	**0.017**	**0.017**	**0**
		66th Percentile	0	0.017	0.017	0
Reservoirs 50 to 500 acres	206	Mean	0.006	0.059	0.047	0.019
		Median	**0**	**0.029**	**0.007**	**0**
		66th Percentile	0	0.073	0.048	0.008
Reservoirs > 500 acres	485	Mean	0.001	0.065	0.046	0.012
		Median	**0**	**0.032**	**0.018**	**0**
		66th Percentile	0	0.061	0.040	0.002

Table 3. Pennsylvania Channel Catfish catch statistics (CPUE as number of fish per hour) from gill nets and night electrofishing in Rivers from 1984 to 2009.

Gear Type	Sample Size (Gill Net Sets and Electrofishing Sites)	Statistic	Length Grouping			
			CPUE < 275 mm	CPUE ≥ 275 mm	CPUE ≥ 400 mm	CPUE ≥ 600 mm
Gill Nets	297	Mean	0	0.082	0.011	0
		Median	**0**	**0.124**	**0.034**	**0**
		66th Percentile	0.006	0.201	0.068	0
Night Electrofishing	34	Mean	1.934	3.047	0.756	0.025
		Median	**0**	**1.130**	**0.474**	**0**
		66th Percentile	0.142	1.781	0.748	0

Table 4. Pennsylvania Channel Catfish catch statistics (CPUE as number of fish per hour) from active electrofishing in Warmwater Streams from 1984 to 2009.

Gear Type	Sample Size (All Gears)	Statistic	Length Grouping			
			CPUE < 275 mm	CPUE ≥ 275 mm	CPUE ≥ 400 mm	CPUE ≥ 600 mm
Electrotowboat; Electrobackpack; Two Towboats; Towboat and Backpack; Two Backpacks	31	Mean	0.246	6.754	3.516	0.167
		Median	**0**	**2.662**	**1.754**	**0**
		66th Percentile	0.368	7.148	1.984	0

Appendix F. Evaluation of Channel Catfish Spawning Success using Pennsylvania Channel Catfish Spawning Boxes

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Introduction

Channel Catfish (*Ictalurus punctatus*) are popular sport fish in many Midwest and southern United States impoundments, and their popularity is steadily increasing in Pennsylvania. In recent years, overall interest in angling for catfish has been increasing in Pennsylvania (USFWS 1996, 2006). Catfish and bullheads are the fifth most sought after species group in Pennsylvania following trout, black bass, walleye, and panfish. Over a ten year period from 1996-2006, there was a 24% increase in angler days spent fishing for catfish and bullheads in Pennsylvania (USFWS 1996, 2006).

Given the importance of Channel Catfish as a sport fish, the Pennsylvania Fish and Boat Commission (PFBC) maintains many reservoir populations by stocking catfish fingerlings. Stocking is necessary because natural Channel Catfish recruitment is absent in most reservoirs (Storck and Newman 1988; Santucci et al. 1994), likely due to a lack of spawning habitat. Channel Catfish are obligatory cavity spawners. Spawning habitat can be described as secluded and semi-darkened areas providing visual cover and protection from current (Hubert 1999). In natural lakes, Channel Catfish spawn in depressions in undercut banks, submerged hollow logs, abandoned muskrat or beaver holes, or rock crevices (Steiner 2000). These habitats provide spawning cover and nursery areas for young-of-the-year catfish. However, these natural spawning habitats are absent in most reservoirs in Pennsylvania due to clearing during impoundment construction. To offset the lack of habitat in many reservoirs, the PFBC Lake Habitat Section places catfish spawning boxes into reservoirs to provide cavity habitat to induce Channel Catfish spawning and to provide nursery areas for catfish fry.

Historically, a variety of containers, including nail kegs, beer kegs, tiles, wooden boxes, and milk cans have been used for the production of Channel Catfish in earthen hatchery ponds (Clapp 1929; Vanderford 1984). More recently, commercially available metal spawning

containers and modified plastic buckets have become popular in commercial fish production facilities to successfully spawn Channel Catfish (Busch 1983; Steeby 1987). In a study conducted in a 3.7 acre Illinois surface mine lake, Moy and Stickney (1987) suspended milk cans where sufficient spawning habitat was absent, and found that Channel Catfish were successfully able to spawn. While information is available regarding the successful use of Channel Catfish spawning containers in small ponds, a paucity of information exists on implementation of spawning containers in a larger, more natural setting.

The effectiveness of the Pennsylvania Channel Catfish spawning box to stimulate spawning of Channel Catfish has yet to be evaluated. Therefore, the objective of this study was to evaluate the spawning success of Channel Catfish using PA Channel Catfish spawning boxes in a hatchery setting and in a large reservoir environment.

Methods

The PA Channel Catfish spawning box was designed to mimic cavity habitat typically used by Channel Catfish for spawning. These boxes are constructed using rough cut hemlock boards and weighted using concrete patio blocks (Figure 1). The dimensions of the PA Channel Catfish spawning box (81.3 cm L x 45.7 cm W x 33.0 cm D with a 15.2 cm diameter hole) are similar to spawning containers commonly used in commercial fish farms in the southeast U.S. (Busch 1983; Steeby 1987). The study boxes were modified with hinges and ropes to allow for ease of lifting and inspection during the evaluation.

This study was conducted at three study sites during the 2012 spawning season. The three sites chosen were Linesville State Fish Hatchery, Pymatuning Sanctuary, and F.J. Sayers Lake. Lineville State Fish Hatchery was chosen because this hatchery is responsible for the

propagation of all of the Channel Catfish stocked into Pennsylvania waters. Pymatuning Sanctuary was chosen because of its proximity to Linesville State Fish Hatchery and its robust naturally reproducing Channel Catfish population. F.J. Sayers Lake was chosen because of its proximity to the PFBC Pleasant Gap facility and its robust stocked Channel Catfish population. A total of 29 spawning boxes were used during the study.

Linesville State Fish Hatchery

A total of 10 PA Channel Catfish spawning boxes and 46 plastic catfish spawning containers used for hatchery production were placed into four hatchery ponds at Linesville State Fish Hatchery. The boxes were checked every 1-2 days by hatchery staff. Catfish eggs were removed from the artificial spawning habitats, weighed, and hatched inside the hatchery.

Pymatuning Sanctuary

Seven PA Channel Catfish spawning boxes and 15 plastic catfish spawning containers used for hatchery production were placed into Pymatuning Sanctuary. The boxes were checked every 1-2 days by hatchery staff.

F.J. Sayers Lake

On May 2, 2012, 12 PA Channel Catfish spawning boxes were placed into F.J. Sayers Lake at a mean depth of 1.32 m. The spawning boxes were examined every 2 – 4 days from June 1 to July 20, 2012 by Lake Habitat Section staff. The spawning boxes were carefully approached by two people with one person placing a hand over the 15.2 cm diameter hole, lifted to the water surface, and examined for evidence of spawning activity. Upon inspection of each box, it was documented whether eggs or fry were present and if an adult catfish was present.

Two HOBO® Water Temp Pro v2 loggers were secured to concrete blocks and placed near the spawning boxes on June 7, 2012. The loggers recorded water temperature every hour

and were removed from the lake on July 20, 2012. Mean daily water temperature was calculated from hourly data recorded by each temperature logger.

Results

Linesville State Fish Hatchery

At the Linesville State Fish Hatchery, successful spawning occurred in 3 of 10 (30%) boxes and 31 of 46 (67%) plastic containers that were placed into earthen hatchery ponds. Based on standard hatchery protocols, hatchery staff at the Linesville State Fish Hatchery estimated the number of eggs collected from each of the catfish spawning boxes, as well as the number of fry that hatched from each egg mass collected from the spawning boxes (Table 1). On average, 19,645 eggs were collected from each spawning box. From those eggs, an average of 12,088 fry were produced, a hatch rate of 62%.

Pymatuning Sanctuary

Successful spawning did not occur in the catfish boxes or the plastic containers that were placed into Pymatuning Sanctuary. This result is not surprising as quality natural spawning habitat exists in the sanctuary. Pymatuning Sanctuary maintains a self-sustaining Channel Catfish population and is the source of brood Channel Catfish for annual production of Channel Catfish at the Linesville State Fish Hatchery.

F.J. Sayers Lake

Channel Catfish began spawning in F.J. Sayers Lake when water temperatures reached 21^{o}C (Figure 2). Channel Catfish successfully spawned in 100% (12 of 12) of boxes that were placed into Sayers Lake throughout the course of the study (Table 2). Parental guarding by the male Channel Catfish was high, ranging from 30% - 100% during the study (Figure 3). The incidence of repeat spawning was high and occurred in 11 of 12 (92%) boxes and three spawning

events occurred in 25% (3 of 12) of the boxes. Of the 26 total egg masses, 18 (69%) produced fry during the study period (Table 2; Figure 4).

Discussion

While the plastic spawning containers are very effective in hatchery settings as seen by the results of the Linesville Hatchery portion of the study, there are several reasons that these containers are not used in reservoirs. The spawning container must be durable and heavy to remain stationary in the shallow areas of lakes during high winds and wave action. The PA Channel Catfish box weighs approximately 50 pounds when completed. This allows the box to remain stationary to the lake bottom even in severe weather conditions. During the Pymatuning Sanctuary portion of the study, three plastic hatchery containers were lost during a severe weather event, whereas the PA catfish spawning boxes remained in place. There is also concern about using plastic materials as habitat in lakes. These types of materials may be viewed as "trash" and there is concern that chemicals leach from the plastic through time and pollute the water. Therefore, natural material (rough cut hemlock) is used for the construction of these boxes. Hemlock has excellent longevity when placed underwater and is easy to work with. The PA Channel Catfish spawning boxes are typically constructed by volunteers through the Cooperative Habitat Improvement Program (CHIP) and placed in state owned lakes by the Lake Habitat Section of the Division of Habitat Management. Therefore, PA Channel Catfish boxes are far superior to the plastic bucket style container in lakes, because they are durable, are made from natural materials, and can be constructed easily during volunteer scale projects.

The implementation of the PA Channel Catfish spawning boxes into F.J. Sayers Lake was very effective in stimulating spawning of Channel Catfish. Spawning containers are commonly used to induce spawning in Channel Catfish production ponds in the southeast U.S.

(Busch 1983; Steeby 1987). During two different pond studies conducted in Mississippi, a metal can design of similar dimensions to the PA style Channel Catfish box was the most frequently used spawning container by Channel Catfish in a comparison of several types of spawning canisters (Busch 1983; Steeby 1987). Furthermore, Moy and Stickney (1987) suspended milk cans in a Illinois surface mine lake where sufficient spawning habitat was absent, and found that Channel Catfish were successfully able to spawn in these supplemented habitats. In a more recent evaluation, Channel Catfish spawning boxes similar to those used in PA were placed into 6 community fishing ponds in Utah (C. Penne, Utah DNR, personal communication). Out of the 6 ponds, spawning was confirmed in boxes from 4 of them, either through observation of adult fish or egg masses in the boxes at the time of the survey (Pearce 2011). These conclusions suggest that supplementing artificial cavity habitat should function well in water bodies that lack spawning habitat.

It appears that Channel Catfish spawning habitat is mostly lacking in the littoral areas of F.J. Sayers Lake based upon visual observations of the littoral zone during annual drawdowns and the high incidence of repeat or even triple spawning events that occurred in a single spawning box during the course of our evaluation. As boxes were vacated by fry and the guarding male or upon failure of the nest, another pair of catfish found the box and spawned successfully. This indicates that Channel Catfish were actively searching for suitable nesting sites throughout the spawning season.

These results have several implications for catfish production and management in Pennsylvania. Firstly, this may allow Fisheries Managers to eliminate stocking of Channel Catfish into some waters, which would allow the Channel Catfish that are produced annually to be reallocated into other water bodies across the state. Secondly, this could reduce the number of

Channel Catfish that need to be produced on an annual basis. In turn, this would reduce annual hatchery production costs. Lastly, Fish Production staff could concentrate on raising fewer catfish to larger sizes. The average size of catfish stocked in Pennsylvania is about two inches. However, stocking catfish at this size does not always lead to the creation of a fishery in some systems. Therefore, Area Fisheries Managers request larger sized catfish to stock into water bodies where stocking smaller fish is insufficient. Stocking catfish at larger sizes, especially when greater than 200 mm, typically leads to higher survival and better contribution to the adult population (Storck and Newman 1988; Santucci et al. 1994).

This study provides valuable information towards management of Channel Catfish in Pennsylvania reservoirs. However, the implementation of spawning boxes into reservoirs is by no means a cure-all for solving catfish reproduction problems in reservoirs. Further research is necessary to answer several questions. First, what lakes in Pennsylvania need habitat enhancement through the addition of catfish spawning boxes? The use of Channel Catfish spawning boxes in F.J. Sayers Lake was highly successful; however, no catfish spawning occurred in boxes that were placed into Pymatuning Sanctuary where quality spawning habitat does exist. Channel Catfish spawning habitat surveys should be conducted prior to implementation of spawning boxes in reservoirs where managing Channel Catfish is an objective.

Secondly, will the fry produced in the catfish spawning boxes contribute to the adult population? During the study 18 nests produced fry, and survival of these fry while in the box was likely high due to the high rate of parental guarding that was observed. However, the fate of these fry is unknown beyond them vacating the spawning boxes. Changes in abundance of

young-of-the-year or adult Channel Catfish populations should be monitored to determine if the fry from the spawning boxes are recruiting to these life stages.

Third, how many boxes are needed to produce enough fry to create a sustainable fishery? During this study, there was a high incidence of repeat or even triple spawning events that occurred in a single spawning box. From this, it seems reasonable that the number of Channel Catfish boxes placed into F.J. Sayers Lake could have been doubled, but would this have been necessary? Using the data collected during the portion of the study conducted at Linesville State Fish Hatchery, an estimated 216,000 fry were produced in the boxes in F.J. Sayers Lake. For comparison purposes, 8,650-17,300 Channel Catfish fingerlings (5-10 fish/acre) are stocked annually into F.J. Sayers Lake. The number stocked is far less than the estimated number of fry produced in the spawning boxes, but a rate which has led to the creation of one of the best reservoir Channel Catfish fisheries in PA (Lorson et al. 2012). Placing too many boxes into a water body may result in overpopulation and stunting of the Channel Catfish population (http://www.dgif.virginia.gov/fishing/pondmanagement/stocking.asp - accessed October 2012). Further research is needed to determine number of spawning boxes needed to produce a self-sustaining Channel Catfish population in reservoirs of different sizes.

Lastly, what environmental or ecological variables are most favorable for the survival of juvenile catfish? Reservoirs where 50 mm fingerling Channel Catfish stockings successfully create an adult population may be good candidates for implementation of catfish spawning boxes. The high success of these stocking efforts is likely related to low predator abundances (Storck and Newman 1988; Santucci et al. 1994) or availability of alternate prey items (Spinelli et al. 1985) and may lead to successful recruitment of fry produced in the Channel Catfish

spawning boxes to adulthood. Future PFBC investigations should attempt to answer these questions to best manage Channel Catfish habitat in Pennsylvania reservoirs.

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Table 1. Eggs mass weight, number of eggs per egg mass, number of fry hatched per egg mass, and hatch rate data collected from the PA Channel Catfish spawning boxes at the PFBC Linesville State Fish Hatchery, Linesville, PA during the 2012 Channel Catfish spawning season.

Egg Mass #	Mass Weight (g)	# Eggs/Mass	# Fry/mass	% Hatched
1	800	20,655	14,625	71
2	700	19,680	13,720	70
3	800	18,600	7,920	43
Average	767	19,645	12,088	62

Table 2. Number egg masses per box and nests producing fry for the twelve spawning boxes placed into F.J. Sayers Lake, Centre County, PA from 1 June – 20 July 2012.

Box Number	# Egg Masses	# Nests Producing Fry
1	2	1
2	3	3
3	2	1
4	3	2
5	3	2
6	1	0
7	2	1
8	2	1
9	2	2
10	2	2
11	2	2
12	2	1
Total	26	18

Figure 1. Photograph depicting the PA Channel Catfish spawning box. Note: These boxes were modified with hinges and ropes to allow for ease of lifting and inspection during the evaluation.

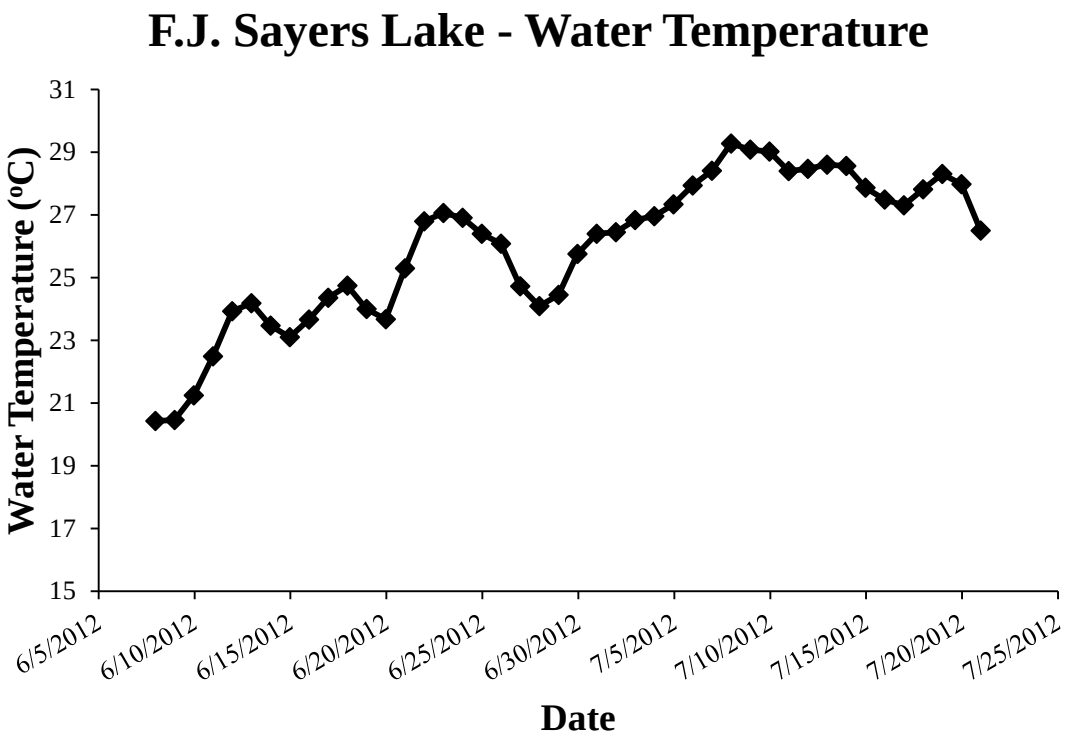

Figure 2. Mean daily water temperatures in F.J. Sayers Lake during the catfish spawning box evaluation from 7 June – 20 July 2012.

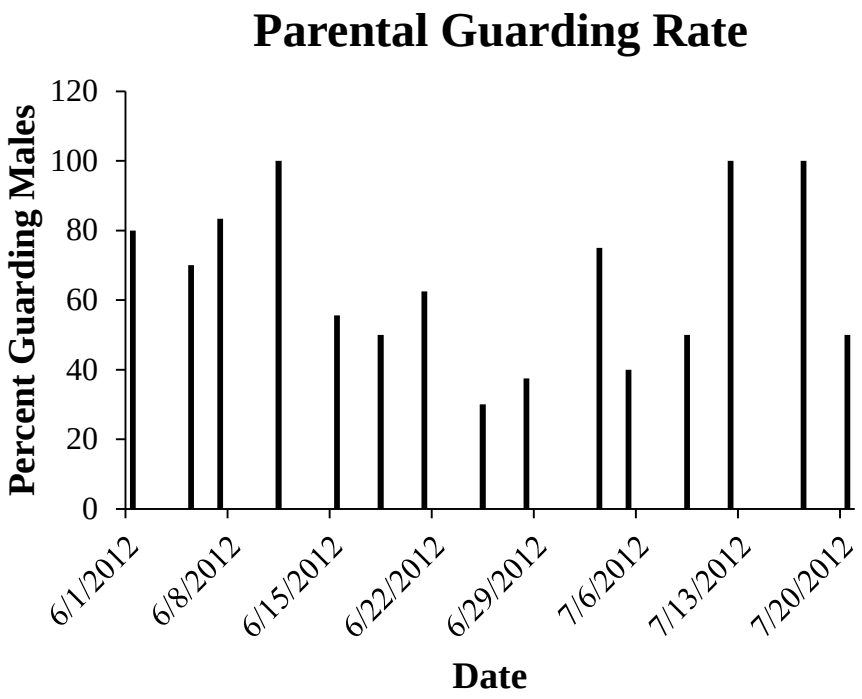

Figure 3. Guarding rate of spawning boxes by an adult male Channel Catfish during the catfish spawning box evaluation at F.J. Sayers Lake from 1 June – 20 July 2012.

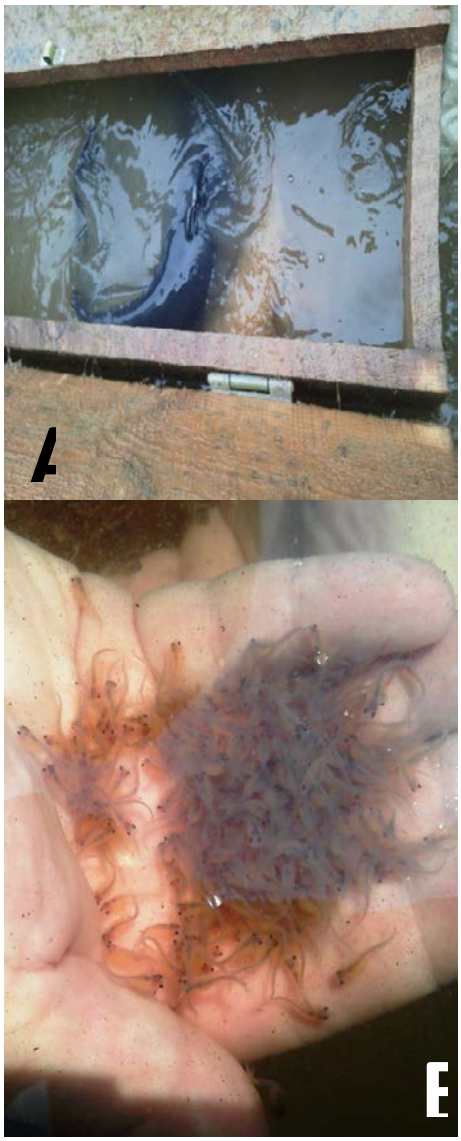

Figure 4. Photographs of (A) an adult male catfish guarding an egg mass, and (B) Channel Catfish sac fry in a catfish spawning box in F.J. Sayers Lake during the catfish spawning box evaluation study from 1 June – 20 July, 2012.