Frequently Asked Questions about

Florida Bass

Introduction

The Kentucky Department of Fish Wildlife Resources (KDFWR) is often asked about Florida Bass and whether they would be a good fit for stocking in Kentucky waters. The Department has considered this proposition over many years, and at this time we have no plans to stock Florida Bass or their hybrids into Kentucky waters. This position is based on decades of research in other states, and with both Kentucky bass anglers and our native bass populations in mind. Although the research does suggest there is a very small chance of growing some larger bass initially, the best available evidence suggests that Florida Bass and their hybrids would grow more slowly than our native northern Largemouth Bass in our Kentucky climate. In fact, a small pilot study conducted at our Minor Clark Fish Hatchery in Morehead, Kentucky showed that northern Largemouth Bass grew faster than the Florida Bass when placed in the same ponds. Furthermore, Florida Bass will readily hybridize with northern Largemouth Bass and the large body of research conducted in other states suggests that mixing the genetics of our bass with non-native Florida Bass would negatively and irreversibly affect the growth, survival, and reproductive ability of our bass populations in the long run.

There are always new revelations in science so the KDFWR's position on Florida Bass will be continuously re-evaluated as new research is conducted both in our state and in other states. Currently, the department is conducting studies to more precisely determine the genetics of the Largemouth Bass in our public waters, and we have a team of biologists set up and reviewing that information as it comes available. Stocking of new or different genes into Kentucky waters is a topic the Department takes very seriously as stewards of the Commonwealth's fish and wildlife resources. Once non-native fish species that will hybridize with native species are released, the results are irreversible. Based on research to date, the risk outweighs any potential benefit.

KDFWR compiled the following frequently asked questions with answers about Florida Bass for those wishing to learn more about the biological background on this topic. At the end of many of the questions and answers, there is a link to a Scientific Basis section that references peer-reviewed studies (research projects that followed standard scientific protocols and whose results were reviewed and approved by outside experts) summarizing the biological basis for the answer. This information was researched and produced by a team of KDFWR fisheries biologists with expertise in biology and management of black bass. If you have further questions about Florida Bass, please contact your local district fisheries biologist .

Thank you for your interest in bass fishing and conservation. We wish you great fishing!

Frequently Asked Questions

1. What is a "Florida Bass"? Is it a separate species from northern Largemouth Bass?

Answer: Yes. Florida Bass are a distinct species. While there has been some disagreement in the past about whether Florida Bass are separate from northern Largemouth Bass, ichthyologists (biologists who study fish genetics and taxonomy) now recognize them as two distinct species. Florida Bass are native to peninsular Florida and some areas of the coastal plain in Georgia, South Carolina, and North Carolina.

Scientific Basis:

- Though some recent fish identification books list Florida Bass as a subspecies of northern Largemouth Bass (Page and Burr 2011, Robins et al. 2018, Robison and Buchanan 2020), these publications simply repeat the accepted science at the time of publication. In more recent studies, ichthyologists who are specifically researching the genus *Micropterus* have concluded they are two distinct species.
- Kassler et al. (2002) concluded that they are separate species and suggested *Micropterus floridanus* to refer to the Florida Bass, and *Micropterus salmoides* to refer to the northern Largemouth Bass. Their genetic analysis comparing these two species showed fixed allelic differences on several different loci, differences in haplotypes and the mitochondrial DNA showed a greater divergence than has been observed between Smallmouth Bass (*M. dolomieu*) and Spotted Bass (*M. punctulatus*; Kassler et al., 2002). The study by Kassler et al. examined five Florida water bodies as Florida Bass were generally considered to be native to peninsular Florida with the mouth of the St. Johns River forming its northern-most range.
- More recently, Kim et al. (2022) conducted a large-scale genetic analysis of the black bass species (*Micropterus* genus) using modern collections as well as museum specimens and concluded that 19 distinct black bass species exist, including Florida Bass and Largemouth Bass. The study authors also investigated the historical origins of their scientific names and suggested that the most appropriate nomenclature would be *Micropterus salmoides* to refer to the Florida Bass, and *Micropterus nigricans* to refer to the northern Largemouth Bass. They described the native range of Florida Bass to extend from peninsular Florida to the Atlantic coastal plain in Georgia, South Carolina, and part of North Carolina, with intergrade zones (natural or introduced) to the north and west.
- The American Fisheries Society (AFS) and American Society of Ichthyologists and Herpetologists (ASIH) joint Committee on Names of Fishes recognizes Florida Bass and Largemouth Bass as two distinct species and have adopted the nomenclature as suggested by Kim et al. (2022). The two species will be included in the forthcoming 8th edition of the list of common and scientific names of fishes (Page et al., in press), which is the authoritative reference for all described and taxonomically valid fish species in North America.

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2. Do we have Florida Bass in Kentucky?

Answer:

Generally no, we do not have pure Florida Bass in Kentucky; however, some genetics from Florida Bass are present in bass populations here. In recent years, the Tennessee Wildlife Resources Agency (TWRA) has been stocking pure Florida Bass in several locations throughout the Tennessee River system (including Kentucky Lake), so it is highly likely that some individuals (or their offspring) have crossed into Kentucky waters and hybridized with our native northern Largemouth Bass. Also, it is possible that individuals have unlawfully put Florida Bass or Florida Bass hybrids in other waterbodies in Kentucky.

Scientific Basis:

- Past genetic testing performed by KDFWR has revealed an extremely low frequency of Florida Bass genes in some of our bass populations in Kentucky. This indicates there were likely a few Florida Bass (or hybrids of Florida Bass crossed with northern Largemouth Bass) stocked into Kentucky waters several generations ago. Additionally, some genetic testing in 1991 revealed a low frequency of Florida Bass genetics in the broodfish at the department's Minor Clark Fish Hatchery at the time of testing. Escapes of stocked bass from private ponds are also a possibility because fish stocked from out-of- state hatcheries could have been Florida Bass or hybrids of them.
- Additionally, state and federal governments began stocking various species of black bass across the United States in the mid 1800's (Long et al. 2015) It is very likely that those stocking efforts resulted in a widespread mixing of genetics from different stocks of bass, some of which may have been Florida Bass.

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3. How do I know if I have caught a Florida bass?

Answer:

The only way to know for sure is with a genetic analysis. Physical features like coloration, size, or other features are unreliable indicators. This is particularly true if it is a hybrid between a northern Largemouth Bass and a Florida Bass.

Scientific Basis:

- Technically speaking there is a difference between Florida and Largemouth basses in the number of lateral line scales along their sides. A Florida Bass has 69-73 scales, whereas a northern Largemouth Bass has 59-65 scales (Phillipp et al, 1983). However, because these species readily hybridize their offspring have an intermediate number of scales, which is why biologists rely almost exclusively on genetic testing to identify Florida Bass, northern Largemouth Bass, or hybrids. There isn't a quick way to accurately identify them based simply on coloration or size.

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4. Do Florida Bass grow bigger and faster than our native northern Largemouth Bass?

Answer:

Sometimes yes, sometimes no. This has been evaluated in several scientific studies over the years and the results have been mixed. The general conclusion is that it depends on the geographic location and is strongly influenced by prey availability. Generally speaking, Florida Bass tend to grow better in the southern U.S., while northern Largemouth Bass tend to grow better in the northern U.S.

Scientific Basis:

- Due to the larger maximum sizes of Florida Bass observed in their native range of Florida, they have intentionally been stocked into areas outside of that native range since the 1950s (Maceina et al. 1992). However, the results of studies comparing Florida Bass growth with northern Largemouth Bass growth outside of peninsular Florida have been mixed.
- Studies showing Florida Bass growing larger or faster:
  - Some studies in the southern U.S. have found that Florida Bass or fish with some degree of Florida Bass genetics make up the majority of trophy bass reported by anglers (Forshage et al. 1989; Horton and Gilliland 1993; Lutz-Carrillo and Dumont 2012)
  - Likewise, in Aquilla Lake in Texas, Florida Bass were shown to have higher survival relative to northern Largemouth Bass and reached larger sizes by age 3 (Maceina et al. 1988).
- Studies showing northern strain Largemouth Bass growing larger or faster:
  - When placed together in the same ponds in Illinois, northern Largemouth Bass were shown to spawn earlier and grow larger than Florida Bass during their first year of growth (Isely et al. 1987). It is important to note that achieving good growth in the first year has been shown to be a critical factor for overwinter survival in several Kentucky Lakes (Buynak and Mitchell 1998), as well as other systems (Miranda and Hubbard 1994 a, b)
  - Another study in San Marcos, Texas also found that Florida Bass grew slower and had poorer body condition than northern Largemouth Bass when placed in the same ponds (Kleinsasser et al. 1990).
  - When both species were placed in study ponds in Champaign, Illinois, northern Largemouth Bass exhibited greater second- and third-year growth than Florida Bass (Philipp and Whitt 1991).
- Studies in Kentucky:
  - KDFWR did a pilot study of the growth rates of 262 Florida Bass and 262 northern Largemouth Bass at Minor Clark Hatchery in Morehead. Results showed slower growth of the Florida Bass in this climate over the course of three years (KDFWR, Unpublished data).

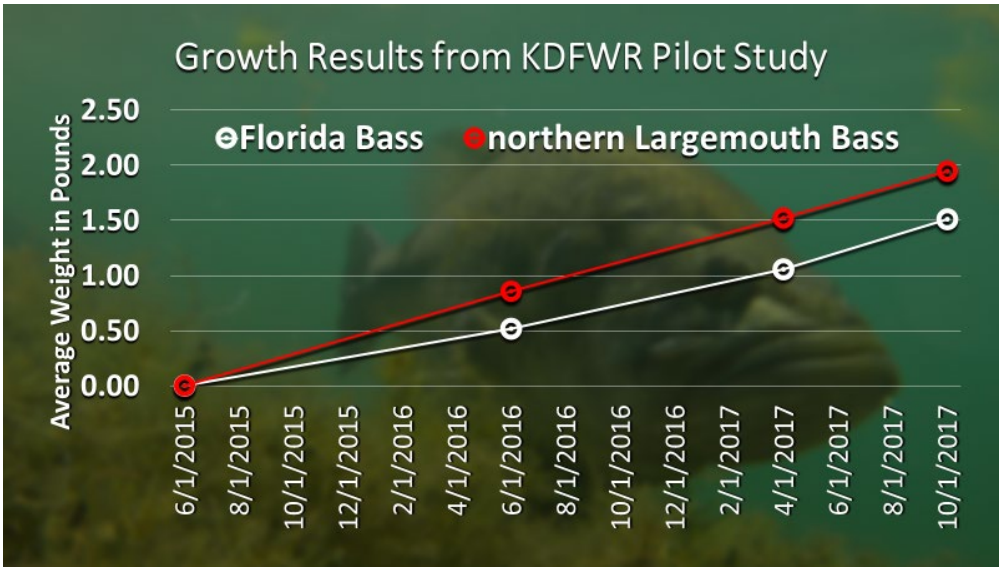

Figure 1. Average weight in pounds of Florida Bass and northern Largemouth Bass living in the same ponds at Minor Clark Fish Hatchery in Morehead, KY.

- Studies showing no difference or mixed results:
  - In South Carolina, researchers have found that the coastal plain contains primarily Florida Bass genetics, but the Piedmont Region of the state contains mostly northern Largemouth Bass. To compare growth rates, they stocked 36 new or newly renovated ponds across the state with either the coastal plain fingerlings, or the Piedmont Region fingerlings. They found no overall difference between the growth rates of the two regional bass strains at age 1 or age 3 (Leitner et al. 2002), and suggested growing season length was the most important factor determining differences in growth rates observed between the bass from these two regions.
  - Florida Bass have been shown to outgrow northern Largemouth Bass in test ponds in Florida. Likewise, in that same study, northern Largemouth Bass from Illinois outgrew Florida Bass in test ponds in Illinois (Philipp et al. 2002) The general conclusion was that each species performed best when in its native environment.
  - In 2008, an Auburn University study found that Florida Bass grew faster in one year, while northern Largemouth Bass grew faster in the second study year. They suggested that factors like prey availability were more important than genetics (Slaughter et al. 2008).
- Studies examining the mechanisms behind differences in observed growth rates:
  - The inconsistencies observed between growth studies across the U.S. may be partially explained by differences in water temperature and growing season length. In laboratory studies in South Africa, where both species of bass are invasive, they found that Florida Bass exhibited higher maximum feeding rates at an 86°F water temperature, but by contrast northern Largemouth Bass had higher maximum feeding rates when water temperatures were only 64°F (Khosa et al. 2020). These results support the idea that northern Largemouth Bass are better adapted and feed more efficiently in northern latitudes and that Florida Bass feed more efficiently at warmer water temperatures like those occurring in their native range.

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5. How quickly do Florida Bass grow?

Answer:

There is no standard or reliable average growth rate for Florida Bass. The most important factors are prey availability and water temperature. It is common to hear claims of two pounds or more of growth per year when discussing Florida Bass. In many cases, these are unique examples designed for marketing purposes where the bass were raised in unrealistically ideal situations, such as ponds with a super-abundance of prey fish or ponds with only female bass, which have been shown to reach larger sizes than males and will grow even faster when the female can't reproduce. In reality, growth rates of Florida Bass in natural systems will vary based upon location, water temperature and prey availability.

Scientific Basis:

- There is some evidence to suggest they can achieve larger maximum sizes than northern Largemouth Bass at southern latitudes (Horton and Gilliland 1993; Lamothe and Johnson. 2013; Lamothe et al. 2016); however, studies show slower growth than northern Largemouth Bass at northern latitudes (Philipp and Whitt 1991; Philipp et al. 2002). Other studies have found that environmental conditions (Leitner et al. 2002) or density dependent growth (Slaughter et al. 2008) can override any genetic influence on growth.

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6. Are Florida Bass harder to catch than northern Largemouth Bass?

Answer:

Yes, this has been demonstrated in many studies.

Scientific Basis:

- Several studies have concluded that Florida Bass are more difficult for anglers to catch than northern Largemouth Bass. Hybrids between the two species show intermediate levels of catchability (Kleinsasser et al. 1990; Lutz-Carillo and Dumont 2012; Zolczynski and Davies 1976). This has led to some speculation that the larger maximum sizes observed in some populations of Florida Bass are simply the result of them being less vulnerable to angling mortality.

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7. Will Florida Bass hybridize with native northern Largemouth Bass in Kentucky?

Answer:

Yes, the two species will readily interbreed in the wild. There are some differences in the timing of their spawns (Isely et al 1987; Rogers et al. 2006,) which might influence the extent to which they will hybridize, but if they are in the same body of water, some of them will naturally interbreed and produce offspring.

Scientific Basis:

Several studies have demonstrated that stocking Florida Bass into an existing population of northern Largemouth Bass will result in some degree of hybridized offspring, (Horton and Gilliland 1993; Lamothe et al 2012; Lamothe et al. 2016; Lutz-Carrillo and Dumont. 2012; Maceina et al. 1988).

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8. What is an "F1"? What does a "hybrid" mean? What are "tiger bass"?

Answer:

An F1 is the first generation resulting from the cross of two different parent species. For instance, when a pure northern Largemouth Bass breeds with a pure Florida Bass, the offspring will be considered F1's. If those F1's then breed, their offspring will be considered F2, then the F2 offspring would be F3, and so on. After many generations of breeding and backcrossing, the exact generation number is often unknown.

A "Tiger bass" is simply a trademark name for the Florida Bass x northern Largemouth Bass F1's developed by a specific private hatchery in Alabama.

A "hybrid" is a less specific term and could refer to any mix of two or more species, such as a Florida Bass x northern Largemouth Bass hybrid, or a "meanmouth" Largemouth Bass x Smallmouth Bass hybrid. A hybrid could even be a mix of two stocks of the same species from two different geographic areas, such as the offspring of a northern Largemouth Bass from Illinois and northern Largemouth Bass from Wisconsin. A hybrid could be an F1 with an even mix of both species or stocks, or it could be a later generation with much more mixed genetics.

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9. Are Florida Bass x northern Largemouth Bass hybrids better than the two parent species?

Answer:

In some cases, yes, in others no. It depends on where the fish is located and whether it is an F1 or the later generations of back crosses. F1's have been shown to perform better in some locations, but in most studies the later generations lose that advantage and exhibit slower growth, survival, or reproduction. In lakes with existing populations of Florida Bass or northern Largemouth Bass, this creates a situation where short-term advantages from stocking F1 hybrids turn into long-term disadvantages when they breed with the existing population and create inferior offspring in later generations.

Scientific Basis:

- Studies showing hybrids perform better.
  - There is some evidence suggesting that the first generation or F1 hybrids experience what is called "hybrid vigor" and will experience faster growth rates in some situations. Two-year-old F1 hybrids were shown to grow faster than pure Florida Bass or pure northern Largemouth Bass in test ponds in Texas (Kleinsasser et al. 1990).
- Studies showing hybrids perform worse.

- Negative effects have also been shown from hybridizing Florida Bass and northern Largemouth Bass, as well as, simply mixing stocks of northern Largemouth Bass from different geographical areas. This evidence suggests that mixing any bass from different states results in a wide variety of negative effects known as outbreeding depression (see Question 10). Researchers in Illinois tested this by collecting northern Largemouth Bass from Wisconsin, Illinois, and Texas, as well as Florida Bass from Florida. They then placed equal numbers from all states into test ponds located in Wisconsin, Illinois, Texas, and Florida to see how well each of those stocks of fish would do when stocked together in different areas of the country. In each location, the native fish stock had superior rates of growth, survival, and reproductive fitness (Philipp et al 2002). In other words, in Florida, the Florida Bass outperformed the fish from the other three states. In Texas, the Texas northern Largemouth Bass outperformed the bass from the other three states. In Wisconsin, the bass from the other three states didn't even survive long enough for growth to be estimated. In the Illinois ponds, they were also able to monitor the results of the bass from all four states after interbreeding. The resulting "interbred" population had a more than 50% reduction in reproductive fitness compared to the pure Illinois sourced northern Largemouth Bass. In other words, the locally adapted bass, even if they were technically the same species as bass from other areas, performed the best because they were the most adapted to the local conditions.
- In test ponds in Champaign, Illinois, the native northern Largemouth Bass were shown to survive better and exhibited faster second and third year growth than pure Florida Bass and F1 hybrids (Philipp and Whitt 1991).
- In another study, the hybrid offspring of northern Largemouth Bass from two different geographic locations were found to have a higher susceptibility to Largemouth Bass Virus than the two parent populations, suggesting that the mixing of those two bass stocks compromised the immune system of their offspring (Goldberg et al. 2005).
- A similar study, by Cooke and Philipp in 2005, found that the offspring of northern Largemouth Bass transplanted from Wisconsin which interbred with an Illinois northern Largemouth Bass required longer times to recovery after cardiovascular activity.

- Studies showing mixed results:
  - While some studies have shown better growth in the first generation crosses, once those F1's breed and produce F2 or later generations, the growth benefits seem to disappear. An extensive study of reservoirs previously stocked with Florida Bass in Arkansas was able to compare the ages and sizes of pure Florida Bass and their hybrids within Lake Monticello. They found evidence that the pure Florida Bass reached the largest sizes, and that F1 female bass grew larger and lived longer, but the later generation crosses did not grow as large or live as long. They speculated that the smaller sizes seen in the later backcrossed generations could be caused by outbreeding depression (Lamothe et al. 2016). This supports the idea that the F1's can grow faster when in a suitable climate, but the short-lived gains seem to go away or reverse with the later generational backcrosses. Unfortunately, there is no way to prevent the natural creation of these later generational back crosses if two species or stocks of bass are living in the same water body.

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10. What is outbreeding depression, and is there evidence that it occurs when Florida Bass are stocked where northern Largemouth Bass already exist?

Answer:

While it is common to hear that increasing genetic diversity is a good thing, that is not always the case. Outbreeding depression is when cross-breeding of two genetically distant groups or populations (such as northern Largemouth Bass and Florida Bass) results in a reduction of fitness among offspring. Basically, if two parent individuals are too distantly related, their offspring may be poorly adapted to their immediate environment. There are several studies that have shown outbreeding depression occurs when different bass species or geographically distant strains of the same bass species are crossed, resulting in offspring that grow slower, have lower survival, compromised immune systems, and reduced reproductive ability. Typically, these negative effects are most obvious in the second or later generations of offspring.

Scientific Basis:

- Outbreeding depression occurs in one of two ways 1) either through loss of adaptive capability or 2) the disruption of coadapted gene complexes (Cooke and Philipp 2006; Hallerman 2003; Philipp et al. 2002; Templeton 1986; Thornhill 1993). For example, when non-native Florida Bass were stocked along with native northern Largemouth Bass in Illinois, their offspring showed reduced growth rates and a 50% drop in reproduction compared to the pure native northern Largemouth Bass (Phillip et al. 2002). Outbreeding depressions can cause loss of genomes that assist the stock into adapting to local conditions (Fields et al. 1987; Philipp and Claussen 1995; Koppelman et al. 1988 cited by Philipp et al. 2002), and increased susceptibility to infectious diseases (Goldberg et al. 2005). Outbreeding depression is the opposite of "hybrid vigor" or increased fitness resulting from hybridization. Predicting which crosses will be successful has proven difficult and is considered a "hit or miss proposition" (Edmands and Timmerman 2003; Tave 1992).
- In general, translocated populations of a species (such as Florida bass in Kentucky) perform more poorly than native populations. Illinois tried to introduce Florida bass in the late 1980s into the early 1990s which did provide a short-term boost to their populations, but over time there has been documentation that the local adaptations and fitness levels are reduced compared to stocks of largemouth bass that are geographically close, but which have no introduced Florida genomes (Phillip and Claussen 1995). Similar results were found in Texas and Minnesota. When crossed, the hybridized individuals typically show impaired performance at the F2 generation (Templeton 1986; Burke and Arnold 2001).
- Outbreeding depression has also been observed in other freshwater fish species. Black Crappie and White Crappie often hybridize naturally, but their offspring have been shown to have much lower reproductive ability (Hooe et al. 1994). Hybrids of sunfishes have also shown very strong outbreeding depression. Redear Sunfish x Green Sunfish hybrid offspring have been shown to be 99% male, which results in extremely reduced reproduction in the F2 generation (Heidinger and Lewis 1972).

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11. Does a higher percentage of Florida Bass genetics in a population mean it is going to grow bigger bass?

Answer:

The overall percentage of Florida genetics within a population of bass can be determined by testing a large sample size of bass in a water body. This has become a popular way of determining the survival and contribution of Florida Bass stocked into northern water bodies. The percentage of Florida Bass genetics in a water body is commonly expressed as the "average percentage of Florida Bass alleles" (Hargrove et al. 2019). A higher percentage of Florida alleles in a population doesn't necessarily lead to bigger bass in that water body. There are many lakes with more than 50% Florida Bass alleles that have never produced big bass, whereas other lakes with a relatively high percentage of Florida Bass alleles have shown an increase in the number of trophy bass after supplemental stockings of Florida Bass. Furthermore, stockings in some water bodies fail to show any results at all. However, most studies have indicated that only the pure Florida Bass or first-generation hybrids contribute to higher numbers of trophy bass, and only when they are stocked in suitable climates and with adequate prey populations (food availability). Whereas the F2 and later-generation hybrids do not grow as quickly and may grow slower than either parent species

Scientific Basis:

- Researchers in Oklahoma evaluated effects of non-native Florida Bass stockings that had been occurring regularly since 1973. They analyzed the top 20 largest bass caught in Oklahoma by water body and found no difference in Florida Bass allele frequencies between lakes producing trophies and lakes that did not produce trophies (Acy, 2017).
- In a survey of every reservoir >40 hectares in Texas, researchers found that reservoirs stocked with Florida Bass were more likely to produce a trophy bass. However, trophy bass catch occurrence was not related to Florida Bass stocking frequency or duration. They instead found that the age of the reservoir and the proportion of shoreline length to total reservoir size were better determinants of trophy bass production (Myers and Allen 2005). In other words, changing the bass population genetics by adding Florida Bass wasn't as important as habitat, so no amount of Florida Bass stocking can turn a lake with poor habitat into a trophy bass lake.
- For a nearby example, we can look to the Tennessee portions of Kentucky Lake (which have 16% Florida genetics) and neighboring Lake Barkley (which has only 7% Florida genetics), where the northern Largemouth Bass population in Lake Barkley routinely produces heavier and faster-growing bass than Kentucky Lake despite the higher prevalence of Florida Bass genetics there.

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12. Can Florida Bass survive in Kentucky? What about the F1's?

Answer:

It is likely that if pure Florida Bass or F1's were to be stocked in Kentucky, then some percentage would survive, based on studies in other states like Illinois (Philipp et al 2002), Oklahoma (Gilliland 1992), and Virginia (Dan Wilson, personal communication). However, based on those same studies, it is also likely that they would have lower survival and reproductive potential than our locally

adapted northern Largemouth Bass. The evidence also suggests that they might grow slower than our native strains. Survive? Yes. Thrive? Not likely.

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13. Is Kentucky stocking Florida Bass or F1's into any of its lakes?

Answer:

No, KDFWR has not intentionally stocked Florida Bass or F1 hybrids nor does the department have plans to stock Florida Bass (or any other non-native black bass species) into Kentucky waters.

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14. Have stockings of Florida bass or F1's by other states been successful?

Answer:

Yes and no. Successes have been predominantly limited to lower latitudes (southern states) and results have varied greatly between water bodies. Short-term success has been linked with climate as well as the productivity and prey resources of the water body. The evidence for long term success is sorely lacking, with several studies suggesting diminishing returns or even possible negative long-term effects on native bass populations.

Scientific Basis:

- Many southern states are stocking Florida Bass or F1's into their water bodies. States like Texas and Oklahoma have been stocking them since the 70s, Tennessee since the late 90s, and more recently Virginia and North Carolina have stocked F1 bass into some select waterbodies. The goal for most states who have stocked Florida Bass (or fish with some extent of Florida Bass genetics) is to increase the numbers of trophy bass within a water body. The evidence strongly suggests that there can be some short-term gains at southern latitudes where many of the largest bass have been tested and shown to be pure Florida Bass or their F1 hybrids (Horton and Gilliland 1993; Lamothe and Johnson 2013). However, even in states like Oklahoma, Arkansas, and Texas, Florida Bass stocking success has been limited to the southern portions of their states (Gilliland 1992; Lamothe et al. 2016; Tibbs 2008). The greater success at lower latitudes (southern sites) is not surprising given that Florida Bass are native to peninsular Florida and in fact they are more dominant in the southern portions of Florida than in the northern portions of the state (Philipp et al. 1983; Rogers et al. 2006).
- Texas has arguably seen the most promising results from their Florida Bass stocking program, which began in the 1970s. Researchers there have found increases in the number of trophy bass caught by anglers and that the majority of those trophy fish were Florida Bass or hybrids (Forshage et al. 1989). Even in Texas, the success of the program has been mixed, and they have observed much higher prevalence of Florida Bass genetics in the southern half of the state despite widespread attempts at stocking statewide (Tibbs 2008). It is difficult to accurately evaluate the importance of genetics to trophy bass production in Texas reservoirs because of the way reservoirs are selected for stocking. Lakes pre-designated as having trophy potential are preferentially chosen as better candidates for stocking Florida Bass. This has created a feedback loop that makes it difficult to determine whether stocked Texas lakes are producing more

trophy fish than unstocked Texas lakes because a given lake's natural ability to produce trophy fish is one of the primary selection criteria (Tibbs 2008). This issue was investigated by Myers and Allen in 2005, who analyzed angler reports of trophy catches across Texas in comparison with reservoir variables like stocking history, reservoir age, and the ratio of shoreline length to surface area. Myers and Allen found that lakes that had been stocked with Florida Bass were seven times more likely to produce a trophy than non-stocked lakes, which is a stunningly positive result. However, when reservoir conditions were included in the analysis, they were unable to show a relationship between a lake's stocking history and its ability to produce trophy fish. In other words, the trophy bass potential in Texas reservoirs was determined mostly by the conditions in the reservoir, not the prevalence of Florida Bass genetics. Similar evaluation issues arise when newer reservoirs are preferentially stocked with Florida Bass (Hughes and Wood 1995) over older reservoirs, because new reservoirs are known to experience higher levels of fish productivity (Kimmel and Groeger 1986). Because of this initial boom and eventual decrease in productivity, it is difficult to determine whether new genetics or new reservoir conditions associated with recent impoundment actually led to the increased catch of trophy bass.

- Stockings of Florida Bass x northern Largemouth Bass F1 hybrids into Lake Norman in North Carolina and Smith Mountain Lake in Virginia are much more recent and unique. Along the Southeast coast, most states have an intergrade population, with more northern Largemouth Bass genetics in the western regions, and more Florida Bass genetics along the coastal plain in each state (Leitner and Bulak 2008; Philipp et al. 1983). It's difficult to determine now, but this intergrade effect exists in part because of natural species interactions and in part due to prior stockings over the last 100+ years. This intergrade zone creates some unique situations. In the case of Virginia's stockings in Smith Mountain Lake, whether natural or not, they already have a population with roughly 50% Florida Bass and 50% northern Largemouth Bass genetics (Dan Wilson, personal communication). By stocking F1's (50% Florida Bass and 50% northern Largemouth Bass genetics), they are hoping to get the potential upside of the F1 hybrid growth with less concern about the downsides of outbreeding depression (negative effects of slow growth, reduced reproduction, and compromised immune system) in the later generations. They already have a mixed and diluted gene pool with many generations of back-crosses, so in a sense they have less to lose by trying F1's. In the case of North Carolina's Lake Norman, they are dealing with a very unfortunate introduction of Alabama Bass (*Micropterus henshalli*), another species of black bass which does well in its native waterbodies but has a small maximum size and outcompetes Largemouth Bass in areas where it has been stocked outside of that native range. Prior to this experimental Lake Norman stocking, the state of North Carolina did not stock bass anywhere; however, with the increasing threat to their native Largemouths from Alabama Bass, they are experimenting with F1's provided by local anglers in the hope that they can survive and improve the fishery.
- California has also stocked Florida Bass and northern Largemouth Bass into their waterbodies, resulting in a lot of trophy fish caught over the years. Both species are non-native to California. According to the California Department of Fish and Wildlife, northern Largemouth Bass were first introduced in 1891, and the first Florida Bass were introduced in 1959. We were unable to find any published research on the success of the program in California, but anecdotally the stocking of Florida Bass in California is popularly believed to have increased the number of

trophy fish in that state. This result is somewhat expected, as both Florida and southern California have mild winters with lengthy growing seasons.

- The long-term success of all these stocking programs is also in question, as the back crosses were shown to exhibit smaller sizes in Arkansas (Lamothe et al. 2016) and have been shown to have a reduction in reproductive fitness of more than 50% in test ponds in Illinois (Philipp et al. 2002). Because the trophy potential is primarily seen with the pure Florida Bass or F1's, several researchers have concluded that in order to succeed these stockings need to be continuous (Horton and Gilliland 1993; Lamothe et al. 2016). Unfortunately, this means for stockings of Florida Bass or F1's to be successful even in conducive water bodies, they would need to be done annually. Given limited resources available for stocking and other fisheries management activities, this would result in significant costs that could result in cuts to other fisheries improvements.
- The lower trophy potential seen in later generations of hybrids is also problematic in waterbodies that have been stocked with pure Florida Bass in the hopes that they will breed with an existing native northern Largemouth Bass population and produce high numbers of F1 hybrids. Initially, this can be an efficient way to produce high numbers of F1 hybrids with minimal stocking costs. Unfortunately, as the numbers of native Northern Largemouth Bass are depleted over time in those water bodies, the potential for F1's to be naturally produced is reduced by the same proportion. This suggests that over time the stockings of pure Florida Bass may be less and less beneficial to trophy bass production in those waterbodies.
- Taken as a whole, these data suggest that the short-term gains made from stocking pure Florida Bass or F1's may result in long term losses in growth or reproductive fitness in native bass populations due to outbreeding depression in subsequent generations.

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15. How are Tennessee and other states deciding where to stock Florida Bass?

Answer:

Stocking decisions are often based on some combination of science, and constituent desires with each state and even each water body being somewhat unique. Generally speaking, bass stocking sites are chosen based on existing trophy fish potential, meaning lakes with poor bass growth potential *are not* targeted for stocking (Tibbs 2008), and/or new or newly renovated lakes *are* usually given priority (Hughes and Wood 1995). Climate is also an important factor fisheries biologists use in prioritizing stocking locations. Arkansas, Oklahoma, and Tennessee have focused stockings in portions of their states thought to have suitable climates for Florida Bass. Whereas more northern states like Missouri, Illinois, and Ohio have all stated that they will not be stocking Florida Bass into public waters (personal communication). While high trophy potential is the primary reason for most stocking site selections, there are likely some biologically unsuitable waterbodies that have been stocked mainly due to pressure from constituents.

Scientific Basis:

- In the early days of Florida Bass stockings, they were done experimentally without much knowledge of whether they would succeed or about the potentially harmful genetic impacts, but as the years have gone by, biologists have learned much about the conditions that can lead

to successful Florida Bass stockings. The best experimental work was done in Oklahoma by Gene Gilliland in 1992, and what he found was that the Florida Bass stockings worked well in the southern portion of Oklahoma but not in the northern portion. The climate metric he recommended for determining future stockings was the cumulative number of heating-degree days in a year. If a lake experienced an average cumulative number of heating degree-days less than 3,400, then the climate was likely warm enough to see good survival and growth of Florida Bass. If a lake often has more than 3,400 cumulative heating degree days (meaning a colder climate), then the Florida Bass are less likely to survive or grow faster. He also found that young-of-the-year Florida Bass were thinner than the northern Largemouth Bass and speculated that a brief harsh period in winter could be a significant source of mortality even if the winters were otherwise mild. This same climate threshold of 3,400 heating degree-days or a minimum water temperature of 41°F is also still used by Arkansas which is why they do not stock Florida Bass in the northern half of their state unless it's a power plant lake with a thermal discharge (Lamothe et al. 2016).

- Below is a map of Kentucky with the average number of heating degree days plotted across the state. No portion of the state is below that 3,400 heated degree day metric. According to the best available data, our entire state is too cold for optimal Florida Bass growth and survival.

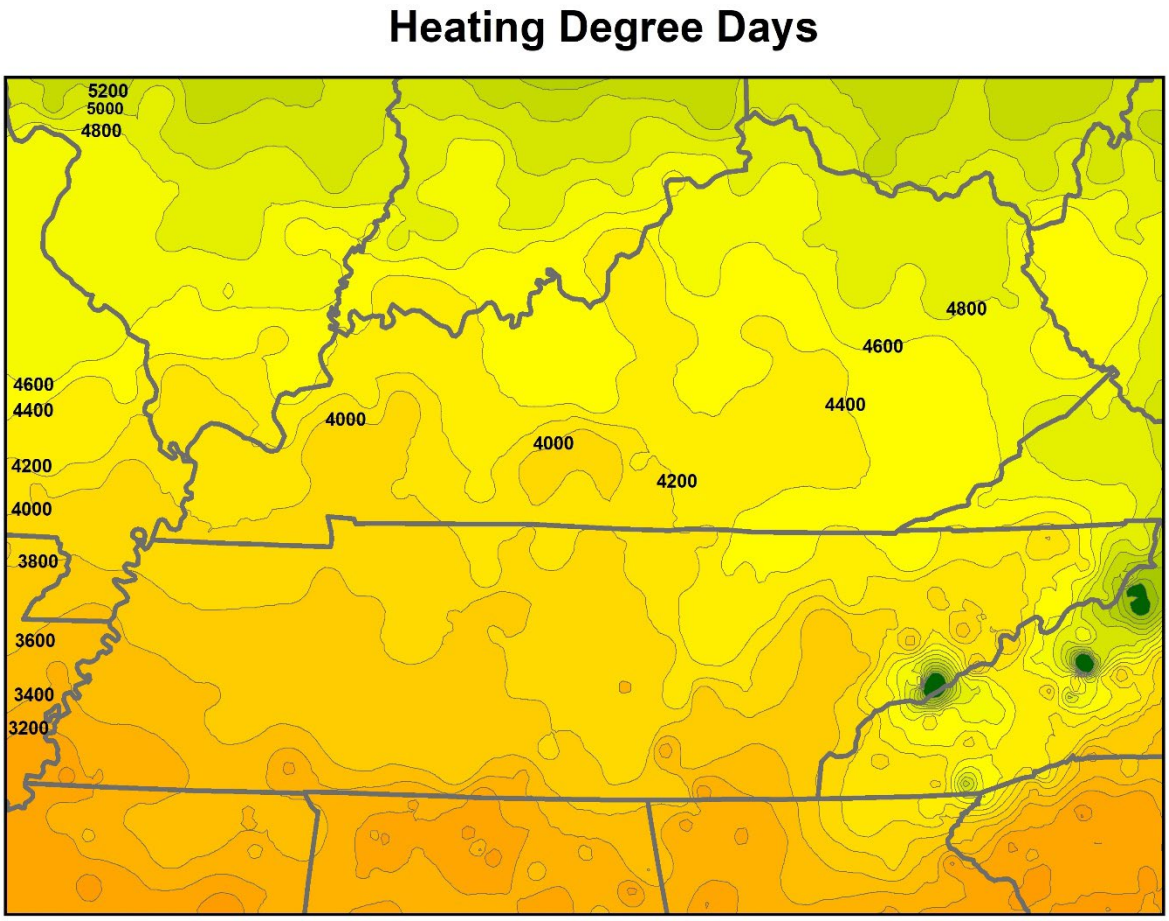

Figure 2: Map of the average number of heating degree days across the state of Kentucky. (Created from data collected between 1990 and 2020 at 571 weather stations; source: https://www.ncei.noaa.gov/)

- Tennessee also uses this 3,400 heating degree days metric to guide their stockings. You can learn more about Tennessee's reasoning on their website https://www.tn.gov/content/dam/tn/twra/documents/fishing/FLMBstocking.pdf. Note, this policy apparently changed recently despite no changes in the science. In recent years, Tennessee has allowed a private entity to stock Florida Bass into Kentucky Lake in areas well north of the 3,400 heating degree day line. KDFWR strongly opposes these stockings. TWRA is also conducting their own stockings of Florida Bass in the southern end of Kentucky Lake at sites they believe to be below the 3,400 heating degree day line. Although the official TWRA stocking sites in Kentucky Lake are farther south than the privately funded stocking sites, KDFWR remains opposed to any Florida Bass stockings in Kentucky Lake because it is likely that those introduced Florida Bass genetics will spread north to the Kentucky end of Kentucky Lake over time as fish move naturally or are transported by anglers.

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16. Why not stock Florida Bass or F1's in Kentucky? What have we got to lose?

Answer:

Based on the evidence, stocking Florida Bass or F1 hybrids would be a bad idea for Kentucky. Each fisheries management decision involves estimating the risk versus reward. In the case of stocking Florida Bass or F1's, the risks greatly outweigh the rewards.

Scientific Basis:

- Not only are they harder for anglers to catch, but the best evidence also suggests that with our climate, the Florida Bass and F1's will have lower survival, less reproductive fitness, and potentially slower growth than our native northern Largemouth Bass. Most of this evidence comes from studies in Illinois, so there is an outside chance that the F1's could exhibit faster growth in some areas of Kentucky. You might be asking, "If there is at least a small chance of success, why not try it?" The most compelling reason we are not stocking Florida Bass is because the effects are essentially irreversible. If we negatively affect our native bass's survival, growth, or reproduction by mixing multiple genetic stocks, then those negative effects will be felt in our fisheries for generations. In a study of bass genetics in Alabama, researchers found that the non-native genetics remained in the system even after stocking had ceased (Maceina and DiCenzo 1995). Once different genetics are released into a system, there is no reversing the damage. Furthermore, because our waterbodies are interconnected, once you release the genetics into a system, they have the potential to spread well beyond managed reservoirs. The effects of stocking different genetics or different species into a water body are far ranging and not subjects to take lightly. Even in states where the climate is more suitable, the best evidence suggests that the positive benefits of stocking pure Florida Bass or F1's may be temporary, while

the negative long-term effects of outbreeding depression in the later generations may be permanent.

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17. Does Kentucky already have a low percentage of Florida Bass genetics in some of its lakes, and if so, doesn't that mean it wouldn't hurt to stock more Florida Bass in those lakes?

Answer:

Based on some very early studies, we know that some water bodies in the state contain low levels of Florida Bass genetics. However, even if Florida Bass genetics are already present this does not mean that stocking more Florida Bass would not have any effects. If the stocked fish are capable of surviving in a particular water body, then it is likely that they will further dilute our native northern Largemouth Bass population's gene pool resulting in greater levels of outbreeding depression.

Scientific Basis:

- Based on the distribution of Florida Bass genetics from other studies (Hargrove et al. 2019; Kim et al. 2022) as well as our own early studies, it is very unlikely that any of our water bodies contain a high (>25%) percentage of Florida Bass genetics, barring any recent illegal movement of Florida bass. However, even if Florida allele frequencies were 50% or higher, it would still not be a good decision to stock more. We know that stocking more Florida Bass will likely increase the percentage of Florida Bass genes (Hargrove et al. 2019). Logically speaking, if we were to add more non-locally adapted bass into our lakes, we would be likely to see a proportional increase in those potential negative effects (outbreeding depression).

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18. Did the low levels of Florida Bass genetics already in some Kentucky waters get here naturally?

Answer:

The exact origins of the low levels of Florida Bass genetics are unknown but based on the available evidence it is highly unlikely to be a natural phenomenon. There is a part of the country where the natural ranges of Florida Bass and northern Largemouth Bass meet and overlap, but that natural overlap region does not extend into Kentucky.

Scientific Basis:

- Genetic studies conducted by Phillip et al. (1983), and Kim et al. (2022) both suggest natural intergrade zones which do not extend into Kentucky. Kim et al. (2022) provides the largest intergrade zone which extends partially into Alabama, Georgia, South Carolina, and North Carolina.
- A study in nearby Tennessee which found low levels of Florida Bass genetics in some Tennessee lakes suggested possible contamination from escapement from private ponds during flooding events as the sources for those Florida Bass genetics (Hargrove et al. 2019)

- Much of the early stocking history in Kentucky is undocumented, although the federal government has been stocking bass into many public waters across the US since the 1800's (Long et al. 2015). It is highly likely that those historical stockings moved Florida Bass into the natural range of northern Largemouth Bass and vice versa.

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19. Is the percentage of Florida Bass genetics in Kentucky waters known?

Answer:

Although some very early studies have been conducted here, there have been major advances in the accuracy of modern genetic testing for black bass species. The department is in the process of conducting a more modern assessment of the levels of Florida Bass genetics in waterbodies across the state. However, we do know that there are some Florida Bass genetics in our water bodies and likely some amount of a newly identified strain of bass known as the delta strain (Silliman et al. 2021).

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20. Is it legal for private individuals to stock public waters (lakes, rivers, and streams) in Kentucky? What about stocking Florida Bass or F1s in private waters?

Answer:

No. It is illegal for private individuals or groups to stock public waterbodies in Kentucky. It is also now illegal to stock Florida Bass or F1 hybrids into private water bodies now that the Florida bass has been recognized by ichthyologists as a distinct species. Pursuant to KRS 150.180 (Section 7) "No person may at any time stock any species of fish secured from any source into the public waters of the Commonwealth without first securing a permit from the commissioner." Pursuant to 301 KAR 1:122 Section 1 "A person shall not buy, sell, possess, import, or release any aquatic species not native or established in Kentucky waters...".

Scientific Basis:

- As previously stated in Question 1, the American Fisheries Society, the American Society of Ichthyologists and Herpetologists and KDFWR recognize Florida Bass as a distinct species, and it is not native or established in Kentucky waters. Individuals seeking to stock private waters (such as farm ponds) should contact their local district fisheries biologist for stocking advice for legal species, recommendations, and a copy of the fish dealers list.
- In a quote from a 2019 article by Robert Montgomery on the Alabama Bass, the B.A.S.S. National Conservation Director Gene Gilliland stated "Transferring fish from outside a species native range and stocking them in public waters is illegal in almost every state. Yet we see this problem more and more with bass anglers moving fish in hopes it makes their fishing better. But in almost every case, unintended consequences catch up with them, and the results are far worse than what they started with." Gilliland also stated "Leave the fish stocking to the professionals who understand those systems and those interactions."

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21. Are there any other species of bass we can stock to improve our fishing in Kentucky?

Answer:

No, it is illegal, and the current evidence suggests that stocking non-native bass of any species would be a bad idea.

Scientific Basis:

- Depending upon who you ask, there are between 12 and 19 species of black bass (Kim et al. 2022; Taylor et al. 2019), each with its own home range and unique characteristics. There are great risks of irreversible damage involved anytime you stock a non-native species or even the same species from different geographical areas (Philipp et al. 2002). The greatest risk is that the negative effects can be irreversible. The introduction of the Alabama bass into Lake Norman in North Carolina is a stark example of the potential for negative effects. The state conservation agencies of Georgia, Maryland, North Carolina, South Carolina, Tennessee, and Virginia have all recently expressed concern about angler introductions of Alabama Bass into their waters. Outside of their native range, Alabama Bass reach smaller sizes, compete with northern Largemouth Bass, and readily interbreed with Smallmouth and Spotted Bass resulting in irreversible losses in the genetic integrity of those native species.

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