

**A WHITE PAPER**  
**ON THE STATUS AND NEEDS OF**  
**HYBRID STRIPED BASS AQUACULTURE**  
**IN THE NORTH CENTRAL REGION**

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## **INTRODUCTION AND JUSTIFICATION OF THE DOCUMENT**

The hybrid striped bass is a cross between the anadromous striped bass *Morone saxatilis* and the freshwater white bass *M. chrysops*. Hybrid striped bass are grown in several states in the North Central Region (NCR), and the group has been designated as high priority by the North Central Regional Aquaculture Center (NCRAC) Industry Advisory Committee (IAC). Each year priority research areas are identified by the NCRAC IAC and presented in consultation with the Technical Committee to the NCRAC Board of Directors. Concern has emanated among the various NCRAC constituencies that work plans could potentially lose focus over time and not always address the most critical factors limiting the economical and sustainable production of important species in the region. After discussions were held among members of various committees and the Board at its June 1999 meeting, it was decided that a white paper should be developed on hybrid striped bass. The Board directed that the white paper not be an exhaustive literature review, but rather be a working document that clearly defines the current status of hybrid striped bass aquaculture, the critical factors limiting its economical and sustainable commercial production, and recommendations as to the research agenda that should be considered in future work plans. It is recognized that this will be a “living document” in that priorities may change based on new developments, new problems encountered, or other externalities. Industry participation and peer reviews are critical components of the process.

## **CURRENT STATUS OF HYBRID STRIPED BASS AQUACULTURE**

The identification of the hybrid striped bass as a candidate for commercial aquaculture development in the NCR is appropriate because: (1) the fish has been identified by the IAC as a high priority species; (2) a number of fish farmers are producing this fish; and (3) much of the southern half of the region is at approximately the same latitude and has about the same seasonal water temperature conditions as the mid- and southern Atlantic states where hybrid striped bass culture is being pursued. Indeed, the potential for future collaboration among the North Central, Northeastern, Southern, and Western Regions in the development of a national hybrid striped bass industry seems clear, particularly in light of the fact that the white bass is a native species and fairly common in the NCR.

Hybrid striped bass is a cross between the anadromous striped bass *Morone saxatilis*, which is native to the east coast of the North America, and the white bass *M. chrysops*, which is native to the Mississippi drainage (Kohler 2000; Hodson 1995; Harrell 1997). Both species have been widely introduced elsewhere. The resulting hybrid is similar in appearance to the parental stock, but due to hybrid vigor, possesses superior traits for aquaculture. For example, hybrids grow faster in the first two years of life, readily adapt to dry formulated feeds, and are more resistant to diseases than their parentals. The original cross, produced by Bob Stevens in 1965, is referred to as the palmetto bass. It is a cross between the female striped bass and the male white bass. The female striped bass reaches sexual maturity in the wild at five to seven years of age and will weigh in excess of ten pounds. The male white bass, on the other hand, reaches sexual maturity at one to two years of age and will weigh less than two pounds. The reciprocal cross is referred to as the sunshine bass. It is a cross between the male striped bass and the female white bass. Both of these fishes reach sexual maturity at two to three years of age, and both fish will weigh two pounds or less when they first reach sexual maturity. Due to the difficulty in obtaining and maintaining large female striped bass brood stock, over 80% of the hybrid striped bass produced in the United States are the reciprocal cross, or sunshine bass (Kohler 2000).

Hybrid striped bass have been increasing in popularity since first being produced in 1965 (Van Olst and Carlberg 1990). It was initially used for stocking reservoirs as a sportfish, a purpose for which it is still used to this day. Hybrids began to be raised as a foodfish in aquaculture by the mid-1980s. By 1990, over one million pounds were produced. This figure rose to six million pounds by 1993 and in excess of 11 million pounds today. It is one of the fastest growing aquaculture sectors in the nation. The high interest in hybrid striped bass aquaculture has corresponded with the precipitous decline of the wild striped bass commercial fishery. Although the striped bass fishery has rebounded in recent years, the demand for the hybrid as a foodfish continues to grow.

Sunshine bass is the principal cross being produced in the NCR. They are raised in earthen ponds, indoor recirculating aquaculture systems (RASs), cages in existing farm ponds and, more recently, in large pens in surface coal mine lakes. Hybrid striped bass pond grow out is described in three phases. Phase I is from fry to one-inch fingerlings; phase II is fingerling to a six-inch juvenile; and phase III is a six-inch juvenile to market size (~ 1.5 pound). Phases I and II occur during year one and phase III during year two. Accordingly, pond grow out occurs over 18 months. Market-size fish can be raised in less than 12 months when the fish are raised in temperature-controlled indoor systems. Cage and pen culture is generally limited to phases II and III. The time element will be identical to fish grown in culture ponds. Only a few NCR aquaculture enterprises spawn their own fry. Fry and/or fingerlings are mostly purchased from producers in Arkansas (Posadas and Homziak 1991).

The FOB farm price was \$2.53 for fresh product and \$3.06 for live product in 1997 (Kahl 1997). Producers in southern Illinois received \$2.50 at the pond bank for live product in 2004 (Chris Bredin, Illinois Fish Farmers Cooperative; personal communication).

Wholesalers and retailers have an overwhelming preference for fresh rather than frozen hybrid striped bass. Wholesalers prefer whole fish, gutted fish, and skin-on fillets (in that order) while retailers prefer gutted fish, whole fish, and skin-off fillets (Kahl 1997). Both wholesalers and retailers were also reported to prefer whole hybrid striped bass between 1.5 and 2.0 pounds and fillets between 6 and 8 ounces. About 75-80% of the product is sold as iced whole fish, 10-15% is sold live, and 5% is processed into fillets (Rawles et al. 1997). Kahl (1997) found that the NCR appears to be the most receptive region for marketing hybrid striped bass to wholesalers. She found the NCR to have the largest percentage of wholesalers selling hybrid striped bass (50%), and to have the largest percentage of non-sellers (80%) expressing some interest in selling hybrid striped bass in the future.

## **CRITICAL FACTORS AND RECOMMENDATIONS**

The hybrid striped bass industry has displayed impressive growth throughout the 1990s and early 2000s. Two hundred thousand pounds of market size hybrid striped bass were produced and sold in southern Illinois in 2004 (Chris Bredin, Illinois Fish Farmers Cooperative, personal communication). NCR producers are clearly geographically positioned to capitalize on the huge market potential of the region. Past NCRAC-supported research has yielded several advances for hybrid striped bass aquaculture, including demonstration of the feasibility of raising these fish to marketable size in the NCR. The factors most critical to the hybrid striped industry in the NCR, in particular, and the nation, in general, are categorized below. Specific recommendations are provided under each topical heading.

## *MARKETING*

### Market Directory

Kahl (1977) found that the NCR appears to be the most receptive region in the nation for marketing hybrid striped bass. Half of the region's wholesalers that answered her survey indicated they already sell the fish while 80% of the non-sellers expressed some interest. This survey is now several years old and needs to be updated. Moreover, a directory of NCR wholesalers, brokers, distributors, etc., interested in purchasing hybrid striped bass needs to be developed and distributed to NCR producers. The survey should also provide some general pricing information, recognizing that such prices are always subject to change. A month-by-month average price covering the most recent year would serve to illustrate pricing fluctuations, as well as to provide guidance on the best time to market the product.

### *Recommendation*

Survey brokers, wholesalers, and distributors of fish for interest, needs, and pricing of hybrid striped bass.

### Identify Niche Markets

A live market for hybrid striped bass has developed in New York City and Toronto over the past several years. Asians appear to be the primary target. Live markets should also be available in Chicago and other NCR municipalities where large Asian populations reside. The market should essentially mirror the tilapia market. Prices are currently in the neighborhood of \$2.50 to 3.00/pound live weight.

Marketing directly to restaurants, independent grocers, social clubs, etc., and thereby circumventing the middleman, is the most profitable channel for selling fish, at least on a small scale. Niche markets need to be developed directly by producers. A compendium of case histories where niche markets have been developed could serve as a primer for producers on niche marketing. Many producers will require training in marketing their products.

### *Recommendations*

- (1) Develop case histories on niche marketing of hybrid striped bass.
- (2) Sponsor workshop for producers on niche marketing of hybrid striped bass.

### Promotion

Consumers need to be educated about hybrid striped bass. Fortunately, the name sounds good whether one has ever eaten the fish or not. Detailed literature for seafood counters, demonstrations, taste tests, etc., should be developed.

### *Recommendations*

- (1) Work with Striped Bass Growers Association to develop detailed literature for seafood counters.
- (2) Promulgate recipes for hybrid striped bass dishes for display and distribution at seafood counters.
- (3) Develop a promotional video for seafood counters and other venues.

## *BUSINESS DEVELOPMENT/EXTENSION*

New producers and existing producers planning to expand often need assistance in developing business plans and getting financials together to obtain loans. Other issues include use of RASs for culturing hybrid striped bass and bird control on fish farms.

### *Recommendations*

- (1) Sponsor workshop to train aquaculture extension personnel on developing business plans and financials for hybrid striped bass producers.
- (2) Develop hybrid striped bass template for business plans and financials.
- (3) Produce an extension manual on rearing hybrid striped bass in RASs.
- (4) Produce an extension manual on bird control at fish farms.

## *GENETIC IMPROVEMENT/BROOD STOCK DEVELOPMENT*

The hybrid striped bass industry is largely based on brood fish captured from the wild. A limited amount of domestication has occurred at a few research stations and by a few commercial producers. There is a critical need to coordinate the work being done in all regions of the nation, as well as to promote exchange of brood stock. The NCR contains the vast majority of the natural range of white bass and is consequently geographically positioned to take the lead on white bass while the east and west coasts largely focus on striped bass. However, crossing the “best” selectively bred striped bass with the “best” selectively bred white bass may not yield the “best” hybrid. The hybrid is the end product that will be produced and thus all combinations of crosses among domesticated brood stock need to be evaluated. Exchange of expertise, information, and fish among regions is clearly warranted and absolutely necessary to move the industry forward.

### *Recommendations*

- (1) Establish an inter-regional *Morone* brood stock program with the NCR focused on:
  - (a) conducting strain evaluations of white bass collected from throughout its natural geographic range,
  - (b) identifying genetic markers for white bass strains, and
  - (c) domesticating and selectively breeding white bass brood stock.
- (2) Evaluate various crosses of striped bass and white bass strains to determine those most suitable for aquaculture in the NCR.

## *YEAR ROUND FRY PRODUCTION*

Techniques for effecting year-round fry production of white bass in Recirculating Aquaculture Systems (RASs) were developed through past NCRAC funding (Kohler et al. 1994). Techniques for *Morone* semen storage were also developed, and additional research in this regard is being pursued at the University of Maryland (Woods, III, University of Maryland, personal communication). There is a need for on-site industry extension/demonstration of these techniques. Because producers may not want to tie up one or more RASs for year-round brood stock holding, a need exists to develop a procedure to combine the use of culture ponds to hold brood fish with a RAS being used solely for the final photothermal manipulation to spawn fish both in and out of season.

### *Recommendations*

- (1) Conduct on-site industry extension/demonstrations of out-of-season spawning and semen storage techniques.
- (2) Develop procedures for maintaining a pool of brood stock in culture ponds bringing fish into a RAS for final photothermal manipulation to spawn them both in and out of season.

### *INTENSIVE LARVAL REARING*

Intensive rearing of reciprocal cross hybrid striped bass (sunshine bass) has yet to be perfected on a commercial scale. Switching larval sunshine bass from live to prepared feed more rapidly, or possibly even eliminating the use of live feed, is critical if year-round fry production is to be successful. Procedures for production of fry through phase I in RASs need development. Alternatively, procedures need to be developed to prepare ponds in autumn for fry production (from out-of-season spawns). This would entail draining ponds and fertilizing them upon filling in a similar manner as is currently done in spring to encourage rotifers as the initial dominant zooplankton.

### *Recommendations*

- (1) Develop procedures to more rapidly switch larval hybrid striped bass to prepared feed, possibly even eliminating any use of live foods.
- (2) Develop procedures to rear larval hybrid striped bass in RASs through phase I.
- (3) Develop procedures to effect autumn phase I production of hybrid striped bass.

### *NUTRITION/FEEDING*

Fingerling hybrid striped bass producers generally harvest fish at the end of phase I, grade them by size, and then feed-train them in raceways, followed by additional grading. These feed-trained fish are then sold to grow-out producers. For producers that grow hybrids through all three phases, the handling involved between phases I and II can be costly both in terms of personnel/facilities and survival of fish. Development of procedures for pond feed training during phase I would reduce costs and increase survival of fish. Complete diets for all phases of hybrid striped bass grow out are still needed (Gatlin 1997). Likewise, there is a need to develop brood stock diets specific for hybrid striped bass. Fatty livers are a common phenomenon in cultured hybrid striped bass. Whether fatty livers present a health problem for hybrid striped bass remains unknown.

### *Recommendations*

- (1) Develop procedures for in-pond phase I feed training of hybrid striped bass.
- (2) Quantify critical nutritional requirements for all grow-out stages of hybrid striped bass.
- (3) Develop hybrid striped bass brood stock diets.
- (4) Determine the health effects, if any, of fatty livers in hybrid striped bass.
- (5) Improve feed management procedures (# feedings/day, use of feeding rings, etc.) to improve feed conversion ratios of hybrid striped bass.

### *TRANSPORT/HANDLING STRESS*

Critical handling times for hybrid striped bass are between phases I and II, between phase II and III, and all live-hauling stages beyond the larval stage. Procedures need to be developed to reduce stress and improve survival at all live hauling stages beyond the larval stage.

### *Recommendation*

Develop procedures to reduce stress between phases, at harvest, and during live hauling of hybrid striped bass to market.

### *DISEASE/THERAPEUTANTS*

*Streptococcus spp.* infections periodically plague hybrid striped bass raised in high densities at relatively high temperatures (Plumb 1997). Currently, no registered therapeutants are available to treat this disease in hybrid striped bass.

### *Recommendation*

Work with the NADA coordinator and the Striped Bass Grower's Association to conduct necessary studies to obtain FDA approval for an effective therapeutant for *Streptococcus* (note: this effort should be conducted in coordination with tilapia workgroups).

### *GRUB CONTROL*

Hybrid striped bass grown in ponds are sometimes afflicted with yellow grubs *Clinostomum spp.* The grub does not appear to harm the fish, but their presence can render the fish unsellable. Procedures need to be developed to control the other hosts (birds and snails). The redear sunfish *Lepomis microlophus* and the black carp *Mylopharyngodon piceus* have shown potential to control snail populations in ponds (Anonymous 1999). Research should initially focus on redear as a control agent because the species is native to the NCR. Studies are needed to confirm that the triploid black carp is sterile before initiating studies with it as a snail control agent.

### *Recommendation*

Develop procedures (biological and/or chemical) to control snails in hybrid striped bass culture ponds.

### *PHASE III PRODUCTION*

More producers in the NCR would be inclined to grow hybrid striped bass if they could obtain phase III fish in the spring. The producers could stock the fish in spring, grow them out into autumn, and then harvest them for market. The additional handling between phases I and II, and between phases II and III, would be eliminated. This scenario would be similar to catfish producers that start with 8 to 10 inch fingerlings in spring and have marketable size fish the following fall.

### *Recommendation*

Compare technical and economical feasibility of rearing phase III hybrid striped bass in culture ponds, cages, and floating raceways/pens.

### *RECIRCULATING AQUACULTURE SYSTEM PRODUCTION*

Hybrid striped bass are amenable to intensive rearing in RAS's (Hochheimer and Wheaton 1997). Such production has recently been demonstrated in the NCR (Kasper and Kohler, unpublished NCRAC project). Cost of production information also needs to be generated. Best management practices need to be developed for rearing hybrid striped bass in RASs. Once generated, the information needs to be presented in an extension manual.



### *Recommendations*

- (1) Determine best management practices for rearing hybrid striped bass in RASs.
- (2) Produce an extension manual for rearing hybrid striped bass in RASs.

### ***PLOIDY MANIPULATION***

Hybrid striped bass are not legal in all states of the NCR. A need exists to perfect triploidy of the hybrid striped bass and demonstrate that these triploids are sterile. If these fish prove to be functionally sterile, the regulatory agencies of some states might be persuaded to allow triploid hybrid striped bass production within their borders. Curtis et al. (1987) only obtained 50% triploidy induction using pressure shocks so additional research is obviously needed. The use of all-female triploid hybrids needs to be evaluated to determine if the same advantage found with trout hold for this fish.

### *Recommendations*

- (1) Perfect procedures for producing triploid hybrid striped bass and determine if they are functionally sterile.
- (2) Compare the aquaculture performance of all-female triploid hybrid striped bass to diploids.

## **PRIORITIZATION**

A number of issues concerning hybrid striped bass production in the NCR have been identified and described in the present document. Prioritizing such a list is not only difficult, but could be counter-productive. Prioritizations are largely subjective and it is unlikely that any ordering would reach consensus among hybrid striped bass producers. I have placed them in an order that I believe is reasonable based on the input I have received, but the ordering of the list is likely affected by my biases. The list should therefore only be viewed as a guide.

### ***TECHNOLOGY***

- Improve feed management procedures (# feedings/day, use of feeding rings, etc.) to improve feed conversion ratios of hybrid striped bass.
- Develop procedures (biological and/or chemical) to control snails in hybrid striped bass culture ponds.
- Develop procedures to reduce stress between phases, at harvest, and during live hauling of hybrid striped bass to market.
- Establish a *Morone* brood stock program for the NCR focused on conducting strain evaluations of white bass collected from throughout its natural geographic range, identifying genetic markers for white bass strains, and domesticating and selectively breeding white bass brood stock.
- Evaluate various crosses of striped bass and white bass strains to determine those most suitable for aquaculture in the North Central Region (NCR).
- Develop procedures for maintaining a pool of brood stock in culture ponds bringing fish into a recirculating aquaculture system (RAS) for final photothermal manipulation to spawn them both in- and out-of-season.
- Develop procedures to more rapidly switch larval hybrid striped bass to prepared feed, possibly even eliminating any use of live foods.

- Develop procedures to rear larval hybrid striped bass in RASs through phase I.
- Develop procedures to effect autumn phase I production of hybrid striped bass.
- Develop procedures for in-pond phase I feed training of hybrid striped bass.
- Quantify critical nutritional requirements for all grow-out stages of hybrid striped bass.
- Develop hybrid striped bass brood stock diets.
- Determine the health effects, if any, of fatty livers in hybrid striped bass.
- Compare technical and economical feasibility of rearing phase III hybrid striped bass in culture ponds, cages, and floating raceways/pens.
- Determine best management practices for rearing hybrid striped bass in RASs.
- Perfect procedures for producing triploid hybrid striped bass and determine if they are functionally sterile.
- Compare the aquaculture performance of all-female triploid hybrid striped bass to diploids.
- Work with the NADA coordinator and the Striped Bass Grower's Association to conduct necessary studies to obtain FDA approval for an effective therapeutant for *Streptococcus* (note: this effort should be conducted in coordination with tilapia workgroups).

### *ECONOMICS/MARKETING*

- Survey brokers, wholesalers, and distributors of fish for interest, needs, and pricing of hybrid striped bass.
- Identify niche markets
  - Develop case histories on niche marketing of hybrid striped bass.
  - Sponsor workshop for producers on niche marketing of hybrid striped bass.
- Work with the Striped Bass Growers Association to develop detailed literature for seafood counters.
- Promulgate recipes for hybrid striped bass dishes for display and distribution at seafood counters.
- Develop a promotional video for seafood counters and other venues.

### *EXTENSION*

- Sponsor workshop to train aquaculture extension personnel on developing business plans and financials for hybrid striped bass producers.
- Develop hybrid striped bass template for business plans and financials.
- Conduct on-site industry extension/demonstrations of out-of-season spawning and semen storage techniques.
- Produce an extension manual for rearing hybrid striped bass in RASs.
- Produce an extension manual on bird control at fish farms.

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