

HOOK AND LINE MODIFICATIONS

HOOK AND LINE MODIFICATIONS MEMO

HOOK MODIFICATIONS IN COASTAL FISHING
WATERS ISSUE PAPER



ROY COOPER
Governor

MICHAEL S. REGAN
Secretary

JOHN G. BATHERSON
Acting Director

February 1, 2021

MEMORANDUM

TO: N.C. Marine Fisheries Commission

FROM: Steve Poland, Executive Assistant for Councils

SUBJECT: Hook and Line Modifications

Issue

At its May 2020 business meeting, the Marine Fisheries Commission (MFC) directed staff to initiate rulemaking to “require the use of barbless non-offset circle hooks when hook size relates to 2/0 or larger while using natural bait. In addition, barbs on treble hooks must be bent down.” This motion followed the presentation and discussion of an information paper titled “Information on requiring the use of circle hooks and bent-barbed treble hooks in North Carolina.” The paper summarized the available science on the efficacy of requiring circle hooks and barbless treble hooks to reduce hook trauma and dead discards in hook and line fisheries and provided policy and enforcement considerations for potential modifications to hook requirements in North Carolina. Commentary in the paper included a discussion on the enforceability of hook requirements, summary of current circle hook management in North Carolina and within neighboring jurisdictions, and potential social and economic impacts from hook size and style requirements.

Findings

- Circle hooks are defined in rule 15A NCAC 03J .0306 as hooks with the point bent perpendicularly back towards the shank and the barb compressed or removed. However, this definition does not include a requirement for non-offset hooks. Both proposed rule options modify this definition to include the criteria requested by the MFC.
- The motion passed by the MFC would require the use of barbless, non-offset circle hooks to be used when fishing with natural bait that are equivalent to “2/0 or larger.” Hook sizes are not standardized by the industry and often vary greatly across and within manufacturers. Gap width, the distance from the point of the hook to the shank, is a discrete measurement that can be used as a proxy for size requirements.
- The division provided information on the common gap width for 15 circle hooks sized 2/0 by the manufacturer and 11 j-hook style weighted jig heads. The maximum gap size measured across both hook types was 0.69-inches.
- Rule 15A NCAC 03J .0306 currently requires 4/0 circle hooks be used in areas of Pamlico sound during the late summer red drum breeding season overnight. If the MFC decides to modify the rule to require circle hooks greater than a discrete gap width, they may want to consider modifying the 4/0 requirement for red drum. Additional evaluation on the appropriate size of 4/0 equivalent hooks is needed.
- Rule 15A NCAC 03J .0306 includes definitions for four terms: “circle hook”, “non-offset”, “gap width”, and “natural bait”. Under the rule readoption process and as part of an examination of all defined terms in MFC rules, DMF staff may recommend these four definitions ultimately be placed

in Rule 15A NCAC 03I .0101, Definitions, where they would apply to all rules within Chapter 03. This work will be completed before the formal rulemaking process begins later this year. The content of the definitions will be preserved, consistent with the MFC's selection of its preferred management option.

- Option 1 would provide status quo; no mandatory circle hook when fishing with natural bait or pinched barb/barbless treble hook requirement.
- Option 2 would require the use of barbless, non-offset circle hooks when fishing with natural bait and pinched barb/barbless treble hooks statewide.
- Option 3 would require the use of barbless, non-offset circle hooks when fishing with natural bait and pinched barb/barbless treble hooks statewide but exclude the hook requirements for anglers trolling with natural bait and using trot lines.
- Trolling is a difficult activity to define for enforcement and an exclusion for trolling with natural bait will need to be carefully developed. The definition of trolling will need to be further refined and explored with MFC input to ensure 'work-arounds' or 'loop holes' to the requirement are not inadvertently permitted.
- A delayed effective date of the proposed rules will allow additional time for manufacturers and retailers to produce and stock compliant gear and provide time for outreach and education to the angling public to ensure a high likelihood of compliance.

Action Needed

- The Division requests a confirmation on the intent of the scope of their motion from the May 2020 meeting. The motion passed by the MFC would require the use of circle hooks and barbless treble hooks for all activities, regardless of sector, except for specific exclusions defined in the proposed rule.
- The Division requests that the MFC provided input on the following:
 - Gap width measurement for circle hook requirements and potential exclusions for circle hook and treble requirements in option 3, including input for a potential definition of "trolling" if option 3 is selected.
 - The red drum specific hook size requirement of 4/0 and the modification of said requirement to be consistent with discrete gap width measurements.
 - Delaying the effective date of the proposed rules to ensure greater compliance of the gear requirements.
- The MFC can potentially vote on the preferred management option.

For more information, please refer to the full document titled ["Hook Modifications in Coastal Fishing Waters Issue Paper"](#) that is included in the briefing materials.

Hook Modifications in Coastal Fishing Waters Issue Paper

Feb. 4, 2021

I. ISSUE

Require the use of barbless, non-offset circle hooks greater than 2/0 while fishing with natural bait and the use of barbless or pinched barbed treble hooks in coastal fishing waters.

II. ORIGINATION

At the request of the N.C. Marine Fisheries Commission (MFC), an information paper was presented on the current science and efficacy of modifying hook requirements to reduce release mortality of finfish at the May 2020 meeting. After review and deliberation, the MFC voted in favor of directing the Division of Marine Fisheries (DMF) to initiate the rule making process to require the use of barbless, non-offset circle hooks when hook size relates to 2/0 or larger while fishing with natural bait and also require that treble hooks must have barbs compressed or removed.

III. BACKGROUND

The location and severity of hook-related injuries is an important factor in determining catch-and-release mortality. A number of studies have shown the use of circle hooks in marine recreational fisheries reduces deep hooking and release mortality in marine finfish species (Grover et al. 2002; Lukacovic and Uhhoff 2002; Skomal et al. 2002). The basic mechanics of a circle hook are explained by Johanes (1981). As a fish consumes a baited-circle hook and moves away, the hook naturally slides to the edge of the mouth in an orientation that allows for the gap to position around the jaw (Figure 1). As the pressure begins to increase, the hook point begins to “bite” against the soft flesh around the mandible or hinge. As pressure further increases, the hook rotates fully around and the fish is hooked. The circular design with the hook pointed back towards the shank prevents the hook from backing out completely while steady pressure is applied. Because the orientation of the hook point is not the same as the shank (Figure 1), when pressure is applied to the hook via the fishing line, the point does not catch as it would with a traditional style “J” hook. This reduces the chance of deep hooking when a hook is swallowed past the esophageal sphincter (Kerstetter and Graves 2006).

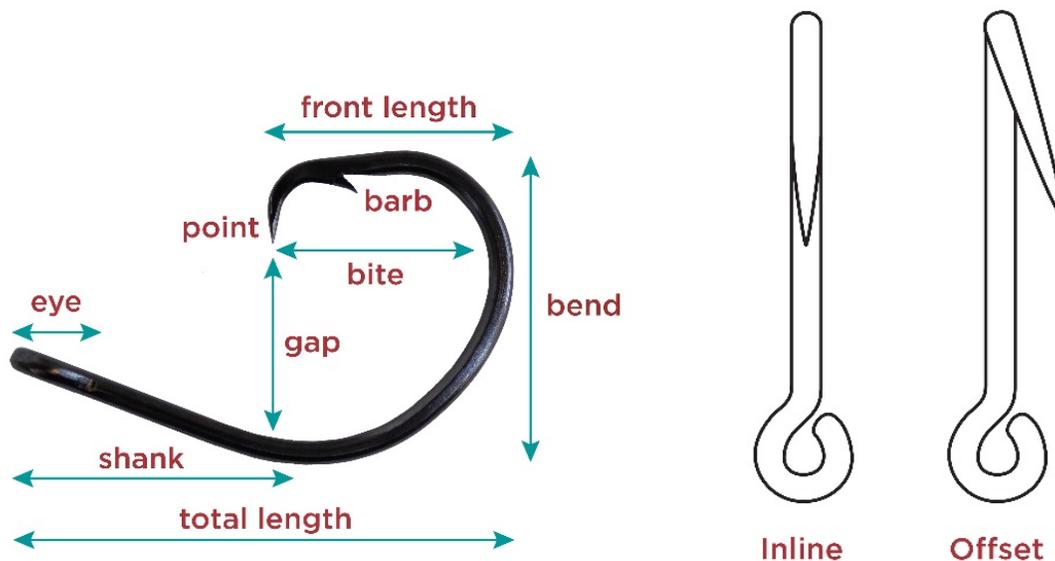


Figure 1. Basic hook anatomy and barb orientation. Reproduced from: www.in-fisherman.com/editorial/all-about-hooks/154924.

Hook size, fishing style, fish feeding mode, and mouth morphology are all elements that contribute to the effectiveness of circle hooks. In a study on bluegills, circle hooks permanently impaired vision of up to 22% of the fish, much more than J-hooks (Cooke et al. 2003). Conversely, Graves and Horodysky (2008) state that the post-release survival of white marlin captured using circle hooks is significantly higher than J-hooks. There was no significant difference in survival among different configurations of non-offset circle hooks commonly employed in the white marlin troll fishery (i.e. offset, bite, gap, bend, etc.) suggesting that the use of a non-offset circle hook, regardless of configuration, is better. These varying factors make the implementation of circle hook regulations as a universal solution to reduce release mortality for all fisheries in coastal waters complex. Several studies have recommended that management agencies focus on recommending circle hooks only for instances for which appropriate scientific data exist (Cooke and Suski 2004, Serafy et al. 2012). While the use of circle hooks may present a conservation benefit in some of these fisheries, only the adult red drum fishery in Pamlico Sound has been fully evaluated comparing large J-hooks to circle hooks in our coastal waters (Beckwith and Rand 2005).

Literature for the effects of treble hooks on the survival of captured and released fish is limited and at this time, few studies have been reviewed for species that occur in the state. Studies in Texas showed no significant differences in release mortality for red drum and spotted seatrout between J-hooks and treble hooks (Matlock et al. 1993; Stunz and McKee 2006). Unfortunately, these studies did not include circle hooks as a gear type for comparison.

A growing body of literature suggests that the use of circle hooks by recreational saltwater anglers reduces discard mortality (Cooke et al. 2012). Despite this general consensus, inconsistency exists regarding the definition of a circle hook among federal, regional, and state management authorities (Table 1). This complicates the implementation of management actions across regulatory jurisdictions. However, an overlapping characteristic across all circle hook definitions include “the point turned perpendicularly back to the shank”.

Table 1. Definitions of a “circle hook” across multiple management authorities.

<i>National Marine Fisheries Service (NMFS) Highly Migratory Species Division (HMS): A circle hook is defined as “A hook with the point turned perpendicularly back to the shank to form a generally circular or oval shape.” An offset circle hook is further defined as “a circle hook originally designed and manufactured so that the barbed end of the hook is displaced relative to the parallel plane of the eyed-end, or shank, of the hook when laid on its side.” (50 C.F.R. § 635.2)</i>
<i>Atlantic States Marine Fisheries Commission (ASMFC): A circle hook is defined as “Non-offset hook with the point turned perpendicularly back to the shank.”</i>
<i>Gulf of Mexico Fishery Management Council (GMFMC) and South Atlantic Fishery Management Council (SAFMC): A circle hook is defined as “A fishing hook designed and manufactured so that the point is turned perpendicularly back to the shank to form a generally circular, or oval, shape.” (50 C.F.R. § 622.2)</i>
<i>N.C. Marine Fisheries Commission (MFC): A circle hook is defined as “A hook with the point of the hook directed perpendicularly back toward the shank, and with the barb either compressed or removed”. (15A NCAC 03J .0306)</i>

Inconsistency among management authorities is further complicated by non-uniformity in circle hook design among and within major hook manufacturers. While hooks may have the same basic anatomy (Figure 1), extensive combinations of attributes (gap, bite, shank length, total length, eye, barb, bend), and barb orientation (offset or inline) make it almost impossible to adequately classify a hook by the manufacturer sizing.

Hooks are manufactured from a myriad of metal and alloys (vanadium, high-carbon steel, stainless steel, etc.) and may come with an assortment of coatings for color preference and/or corrosion resistance. Most importantly, there is no size standardization within and among manufacturers. Figure 2 presents 4/0 hooks from three manufacturers (Eagle Claw, Mustad, Owner) with gap measurements ranging from 10mm to 14mm. The largest difference in gap shown is from two separate models of Eagle Claw 4/0 hooks. The same holds true for J-hook sizing as well. Although offerings are limited at this time, most hook manufactures do offer barbless versions of circle hooks and treble hooks.

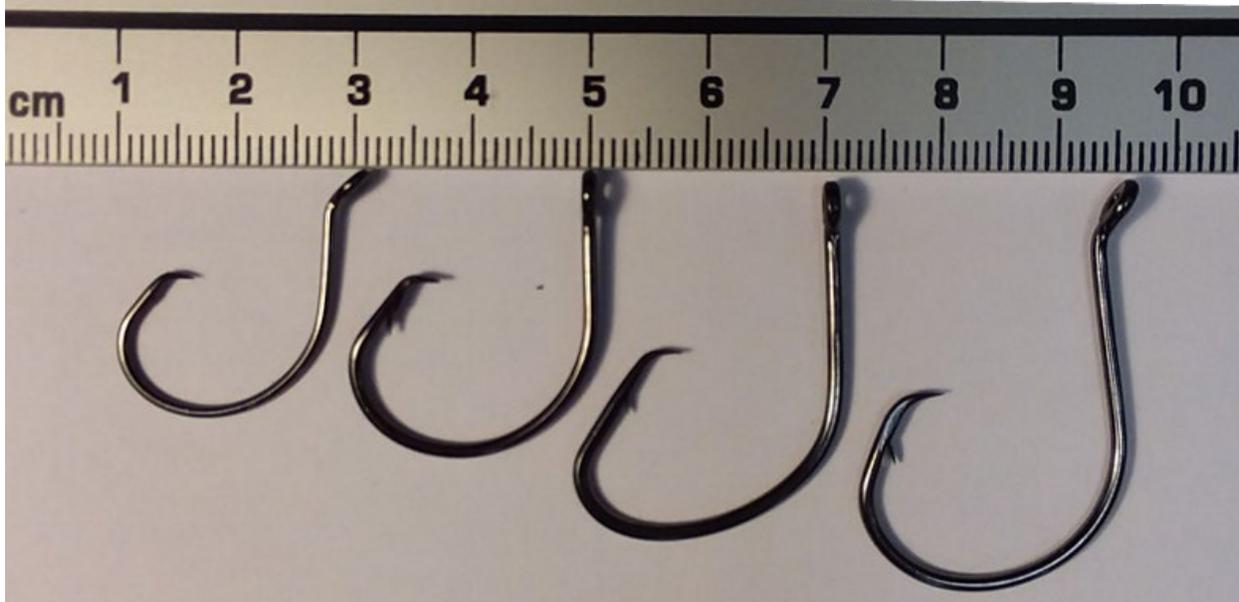


Figure 2. Example 4/0 circle hooks from 3 manufacturers displaying the differences in gap width. Left to right; Eagle Claw L2004EL, Mustad 3994-BN, Owner 5114T-141, Eagle Claw L7228BPG.

Currently, circle hook requirements exist in rule for specific areas and times primarily to protect spawning aggregations of red drum. Catch and release mortality of adult red drum has been shown to be a conservation concern of the species and was addressed in Amendment 1 to the N.C. Red Drum Fishery Management Plan (FMP). Specific research was conducted in the Pamlico Sound adult red drum fishery to estimate recreational release mortality, determine factors contributing to release mortality and determine the differences in deep hooking events between circle hooks and J-hooks (Aguilar 2003, Beckwith and Rand 2004a, Beckwith and Rand 2004b). Studies by Aguilar (2003) and Beckwith and Rand (2004a) had overall mortality rates ranging from 3.8% to 6.7% based on adult red drum that were held for three days after being caught using either circle hooks or J-hooks. Considering just fish that were deep hooked, mortality rates were much higher (>15%) and all mortalities in the study showed evidence of internal bleeding from being deep hooked (Aguilar 2003, Beckwith and Rand 2004a). Aguilar (2003) found that circle hooks had a significantly lower incidence of deep hooking than J-hooks when both were fished on standard bottom fishing rigs. Beckwith and Rand (2004b) advanced these findings and found that a large (Mustad 14/0 and 16/0 circle hook (Style: 39960D)) or intermediate (Eagle Claw 8/0 circle hook (Style: L2004EL)) sized circle hook combined with a short leader and a fixed weight resulted in the lowest incidence of deep hooking (4%) in the study. This was compared to greater than 50% deep hooking with a 7/0 J-hook rigged with a standard leader and a slip weight (Beckwith and Rand 2004a).

Amendment 1 to the N.C. Red Drum FMP considered the issue of targeting adult red drum and the associated release mortality in light of this research. Management options included hook requirements (size and type), seasonal closures and area closures. The primary focus was in protecting spawning aggregations of red drum in Pamlico Sound where catch rates were high and deep hooking and elevated mortality was known to be an issue. Impacts to other fisheries both in terms of species affected, seasons, and areas played a major role in crafting the final rule that was adopted by the MFC. Also, because the majority of the effort in the adult red drum fishery using bait occurred primarily at night, the final rule limited the circle hook requirements to nighttime fishing to avoid conflicts with anglers using J-hooks to target tarpon. A further concern in rule adoption was the enforceability of a specific hook size given the lack of standardization in the tackle industry and the need to specifically define what constituted a circle hook. The benefit to the stock however was given paramount importance over these obstacles at the time the rule was adopted. Efforts were made to educate the public on what constituted a legal rig both by giving rigs away at boating access points and by publishing the rig configuration on the DMF website.

To date, red drum is the only species under the management authority of the MFC on which a comprehensive evaluation on the efficacy of using circle hooks to reduce deep hooking and catch and release mortality has been conducted. No empirical information is available on the size of hooks relative to the incidence of deep hooking and

rate of discard mortality or any other species. Additionally, there have been no studies conducted in North Carolina on the effects of treble hooks on the catch and release mortality of finfish.

IV. AUTHORITY

North Carolina General Statutes

G.S. § 14-4.1.	Legislative review of regulatory crimes.
G.S. § 113-134.	Rules.
G.S. § 113-182.	Regulation of fishing and fisheries.
G.S. § 143B-289.51.	Marine Fisheries Commission – creation; purposes.
G.S. § 143B-289.52.	Marine Fisheries Commission – powers and duties.

Marine Fisheries Commission Rules

15A NCAC 03J .0306	Hook and line
--------------------	---------------

V. DISCUSSION

Compliance with regulations requiring the use of circle hooks and bent barbs on treble hooks can only be achieved if the following factors are met: 1) enforceable rules for the use and modification of the gear including clear and quantifiable definitions of circle hooks and barbless treble hooks, 2) readily available gear that complies with the aforementioned definition, 3) reasonable exclusions for fisheries and activities where catch rates may be disproportionately affected using the new required gear, 4) extensive public education on the proper use of new gear, and 5) clearly articulated benefits relative to current conservation and management strategies employed for our marine resources. Failing to consider or act on these factors will significantly curtail compliance with any regulations prescribing the use of circle hooks and bent barbed treble hooks and potentially undermine the conservation benefits of employing such practices.

To ensure effective and enforceable regulations, a definition of a circle hook including quantifiable metrics must be established. Numerous management agencies, including the DMF, already define what a circle hook is in rule, with some variation. The circle hook requirements for sharks and striped bass are based on the ASMFC's circle hook definition (Table 1). The current MFC rule (15A NCAC 03J .0306) that defines a circle hook does not require the use of a non-offset hook but does require that the barb be pinched down. Research evaluating the effectiveness of circle hooks in reducing deep hooking suggests that the gear loses its intended effectiveness if the point is offset (Prince et al 2002). Additionally, rule 15A NCAC 03J .0306 requires the use of a circle hook for hooks larger than 4/0 in areas of Pamlico sound and its tributaries during certain times of the year and nighttime hours. As described previously, hook manufacturers do not standardize the sizes of their hook offerings. If hook size is to be considered, a definition including "the point turned perpendicularly back to the shank" and establishing discrete measurements for gap and offset should be included. In order for officers to testify in a court of law to the size of a circle hook, a gauge or measuring device will be needed similar to what is currently used for crabs, oysters, clams, and finfish. The current MFC rule defining a circle hook and prescribing its use is considered un-enforceable as written given the aforementioned inconsistencies in hook size. Officers can inspect the tackle relative to rig requirements listed in the rule, but are unable to enforce hook size requirements.

The MFC desires to require non-offset circle hooks be used that are equivalent to 2/0 or larger while fishing with natural bait. To base a circle hook requirement off of size, a discrete measurement that Marine Patrol and anglers can verify is needed. Gap width, the distance between the point of the hook and the shank, offers the best and most consistent attribute to standardize size. Functionally, the gap is also the aspect of the hook that controls for fish size and hookset the most. Table 2 summarizes the gap width of 15 readily available 2/0 circle hooks by gap width from five manufacturers. It was noted by some members of the MFC that anglers, especially in for-hire operations, will use weighted hooks or jig heads with live or natural bait to reduce the incidence of deep hooking. Because a weighted hook or jig is more difficult for a fish to manipulate and swallow before an angler has the opportunity to set it, it is assumed that this configuration offers more of a conservation benefit than a J-hook with a weighted leader. Table 3 summarizes the gap width of eight common and readily available jig heads from two manufacturers. If requiring the use of circle hooks while fishing with natural bait using hooks equivalent to 2/0 or higher, then it may be prudent to designate the minimum gap width to the upper end of the range of the weighted hook and jig heads commonly available in the marketplace. A gap width measurement of three-fourths of an inch would allow for all of the jig heads measured

in Table 3. to be fished and provides Marine Patrol and the angling public a common and easily distinguished measurement for compliance.

Table 2. Hook manufacturer, hook style, and hook gap width in centimeters and inches for circle hooks.

Brand	Style	Gap Width (cm)	Gap Width (inches)
Eagle Claw	L8197F	1.15	0.45
Eagle Claw	TK619R	1.13	0.44
Eagle Claw	TK4	1.15	0.45
Eagle Claw	L197BKG	1.15	0.45
Eagle Claw	L2222G	1.05	0.41
Gamakatsu	208412	1.2	0.47
Gamakatsu	42412	1.05	0.41
Gamakatsu	265412	1.2	0.47
Mustad	39944-BN	1.05	0.41
Mustad	39951NP-RB	1.02	0.40
Mustad	39954NP-BN	0.99	0.39
Mustad	39951NP-BN	1.1	0.43
Mustad	39940NP-BN	0.97	0.38
Owner	5114-121	1.15	0.45
VMC	7381CB	1.24	0.49

Table 3. Hook manufacturer, hook style and jig head weight in ounces, and hook gap width in centimeters and inches for jig heads.

Brand	Style	Gap width (cm)	Gap width (inches)
Bluewater Candy	X-eyed ball jig 1/16 oz.	1.5	0.59
Bluewater Candy	X-eyed ball jig 1/8 oz.	1.5	0.59
Bluewater Candy	X-eyed ball jig 3/16 oz.	1.5	0.59
Bluewater Candy	X-eyed ball jig 1/4 oz.	1.75	0.69
Bluewater Candy	After Shock 1/16 oz.	1.4	0.55
Bluewater Candy	After Shock 1/8 oz.	1.4	0.55
Gotcha	1/8 oz.	1.2	0.47
Gotcha	1/4 oz.	1.2	0.47
Gotcha	3/8 oz.	1.45	0.57
Gotcha	1/2 oz.	1.45	0.57
Z Man	Trout Eyes 1/4 oz.	1.2	0.47

Circle hooks outperform J-hooks in reducing deep hooking of fish when using natural baits due to the manner in which natural bait is typically fished. These baits are often fished suspended or on the bottom with slack line which allows the fish to swallow the bait and hook without the tension or movement of the line or bait rig spooking or otherwise preventing the fish from consuming the bait. To aid in enforcement and ensure that anglers are using circle hooks when fishing with such bait, a clear definition of what does and does not constitute natural bait is needed. Other jurisdictions have defined natural and artificial bait for the purpose of requiring or excluding their use in certain fisheries or areas. The Wildlife Resources Commission defines bait in mountain trout waters as “any living or dead organism (plant or animal), or parts thereof, or prepared substances designed to attract fish by the sense of taste or smell” (15A NCAC 10C .0205). Anglers are prohibited from using natural bait in mountain trout waters, which

includes not only live or dead bait, but also prepared or synthetic baits and attractants. A definition this broad applied to coastal waters could impact access to certain fisheries by limiting certain bait and lure configurations or undermine any conservation benefits to circle hooks by creating unintentional “loop holes” to avoid their use. The burden would fall on Marine Patrol and anglers to determine if the bait, lure, or attractant they are using contains natural parts of animal or plants, which may cause confusion and inability to enforce the requirements. Some manufactures may not disclose on the packaging of the lure or attractant if it is plant or animal based or synthetically derived. Additionally, it could go beyond the intent of the MFC by prohibiting fishing practices that do not pose a conservation concern.

Catch rates are another factor to consider with the implementation of circle hook regulations. Depending on the species targeted and style of fishing, rates of hook-up and landings can differ greatly between J-hooks and circle hooks. In a Maryland striped bass study, anglers using J-hooks landed a fish 42% of the time they detected a strike. When using non-offset circle hooks, anglers landed a fish 27% of the time. J-hooks were 52% more efficient than non-offset circle hooks in landing a fish once a strike was detected (Lukacovic and Uphoff 2002). The reduction in catch especially in trolling fisheries may present a significant concern with compliance. Trolling for king mackerel with strip baits or dead ballyhoo requires the use of 7/0 to 9/0 J-hooks. Catch rates for king mackerel using circle hooks while trolling has been shown to be reduced significantly (Rudershausen et al. 2011). Additionally, live bait trolling using barbed and barbless treble hooks have not been evaluated for differences in catch rates. Option 3 for the proposed rule would allow for anglers to use J-hooks while fishing with natural bait as long as they are trolling and would allow the use of barbed treble hooks. The MFC could consider an exemption only for the circle hook requirement and maintain the barbless requirement for treble hooks while trolling. Sheepshead are typically targeted using natural baits and either small, short shanked J-hooks or small treble hooks. Their hard mouth and dentition often require anglers to forcibly set the hook to ensure proper hooks set. A circle hook in this situation would not set. The equivalent 2/0 or larger aspect of the proposed rule would still allow anglers to fish smaller J-hooks with natural bait as long as those J-hooks’ gap widths measure less than the equivalent 2/0 size decided on by the MFC. Catch rates may not differ using barbless treble hooks but there has been no research to evaluate the effectiveness of different hook types or the incidence of deep hooking using traditional methods and gear for this species. Another notable species that some anglers target in North Carolina using natural bait are flounder. They can be harvested drifting cut bait, fishing live bait, and with jigs in combination with natural or synthetic baits. Flounder are ambush predators and engulf baits and prey as they drift or swim by and do not typically swim off after consuming a bait. It is up to the angler to set the hook either actively or passively by drifting by. The effectiveness of circle hooks for flounder will depend on the fishing method with which circle hooks are employed. For example, circle hooks will likely be more effective when anchored or shore fishing with natural bait than when used from a boat at drift. No studies have evaluated the efficacy of circle hooks on the capture and survival of flounder in North Carolina. A study conducted on summer flounder in New York and Virginia tested for difference in hook type and survival in the recreational fishery and observed no significant difference between circle hooks and J-hooks (Malchoff and Lucy 1998).

The effective implementation of new gear regulations and best fishing practices will require an extensive public outreach and education campaign to educate anglers on the correct use of the new gear. A Texas study that evaluated hook types as well as rig configurations, bait, and angler experience level found that the only significant predictor of post release mortality was angler skill level with higher mortality associated with beginner/novice fishermen (Stunz and McKee 2006). The DMF has long prompted the use of ethical angling practices including the use of circle hooks. The DMF publishes and distributes a pamphlet titled “Ethical Angling: A Guide to Responsible Fishing”, which details the use of circle hooks, catch and release, and proper handling of fish. The DMF also distributes bumper stickers depicting a red drum and circle hook encouraging anglers to fish responsibly. Partnerships with the SAFMC, the FishSmart program supported by the Angler Action Foundation, and others have provided numerous other informational brochures and tackle giveaways to promote the use of circle hooks and other gears, such as fish descending devices, and information on best handling practices. DMF staff have distributed over 500 red drum short leader rigs (with circle hook) obtained through its partnership with FishSmart. In addition to efforts by FishSmart, the NMFS Recreational Fisheries Policy Program provided 7,000 circle hooks of various sizes for distribution by the DMF. Staff assembled these hooks into “inshore” and “offshore” packages along with informational pamphlets for distribution. Over half of these were distributed during 2019. While it is challenging to quantify the impacts of information campaigns on angler use of circle hooks, anecdotal reports by Marine Patrol indicate that most anglers are using circle hooks while bait fishing in Pamlico Sound for red drum during the day, while regulations only require use at night. Any modifications to hook requirements for North Carolina anglers should be accompanied with an extensive public outreach and education campaign to educate anglers on the new regulations, the benefits of complying with the new regulations, and the proper techniques for utilizing the required gear.

The promotion of barbless treble hooks as a conservation measure has largely been replaced by the use of single inline hooks. The eye of this style of hook is turned inline and is meant to replace treble hooks on topwater and suspending hard baits. Their use has been promoted for a variety of reasons: less damage to fish, ease of unhooking, fish hooked more securely, less likely to collect grass or debris, and angler safety. This trend is gaining ground in the industry. Many manufacturers have started selling lures already rigged with single hooks. A local tackle shop in Eastern North Carolina advertised a promotion in June 2019 where anglers could bring five lures and have the trebles swapped out for inline single hooks. This trend is being driven by the tackle industry, retailers, and conservation-minded anglers. A coordinated public information campaign by the DMF and tackle shops may shift the needle toward the use of single inline hooks in specific fisheries such as artificial lures for speckled trout.

Several N.C. General Statutes (NCGS) address the authority for and requirements of implementing MFC rules. NCGS 113-134 authorizes the MFC to adopt rules to implement requirements of NCGS 113, Subchapter IV, Conservation of Marine and Estuarine and Wildlife Resources. The N.C. Fisheries Reform Act (FRA) of 1997 restructured the way North Carolina managed its coastal fisheries and enacted general statutes for the MFC, Coastal Habitat Protection Plan, Fishery Management Plans (FMPs), Marine Fisheries Law Enforcement, and Commercial Fishing Licenses. NCGS 143B-289.52 requires the MFC to adopt rules to be followed in the management, protection, preservation, and enhancement of the marine and estuarine resources within its jurisdiction, including commercial and sports fisheries resources. NCGS 113-182.1 requires the DMF to develop FMPs for adoption by the MFC with the goal of the plans to ensure the long-term viability of North Carolina's commercially and recreationally significant species or fisheries. The N.C. Administrative Procedure Act (APA; NCGS 150B) applies to an agency's exercise of its authority to adopt a rule and states a rule is not valid unless it is adopted in substantial compliance with the requirements of the APA.

Currently, there are six species on the N.C. FMP schedule that would be affected by changes in hook requirements. Estuarine Striped Bass, Kingfishes, Red Drum, Sheepshead, Southern Flounder, and Spotted Seatrout all support significant recreational fisheries and any changes to hook requirements could have potential impacts on the fisheries and associated anglers. Variations in size, location, and fishing techniques as they apply to the above species would require specific considerations when selecting appropriate hook size, shape, materials, etc. These variations make assigning one circle hook requirement across the board for various species problematic. What might work for one species may not be suitable for another. Additionally, given that paucity of research for state managed species and the current and potential future un-quantified metrics of use with circle hooks and barbless treble hooks, the DMF may be unable to incorporate the positive effects of these management measures into stock assessments. Rather, any conservation gains realized by the required use of these gears will have to be indirectly inferred from multiple assessments.

The FMP development process is a slow, deliberative process that requires significant public input and legislative review. Considering the significant variability in effectiveness of circle hook requirements, developing this issue within each state FMP may be a more effective approach. This would allow the DMF to evaluate existing literature, data, and current management to develop circle hook requirements that are specific to that species and associated fisheries and potentially evaluate their effectiveness directly. Development of FMP amendments for Estuarine Striped Bass, Southern Flounder, and Spotted Seatrout are currently underway, and consideration of circle hook and barbless treble hook requirements could be addressed in those upcoming amendments. Addressing hook requirements on a species-specific basis is also consistent with upcoming requirements for sharks and striped bass by the ASMFC and for snapper-grouper complex species by the SAFMC.

It is important to explain a few ancillary items of note regarding the proposed rule text. First, Rule 15A NCAC 03J .0306 currently requires 4/0 circle hooks be used in areas of Pamlico Sound during the late summer red drum breeding season overnight. If the MFC decides to modify the rule to require circle hooks greater than a discrete gap width, they may want to consider modifying the 4/0 requirement for red drum to relate to a corresponding gap width, consistent with the N.C. Red Drum FMP. Additional evaluation on the appropriate size of 4/0 equivalent hooks is needed. Second, Rule 15A NCAC 03J .0306 includes definitions for four terms: "circle hook", "non-offset", "gap width", and "natural bait". Under the rule readoption process and as part of an examination of all defined terms in MFC rules, DMF staff may recommend these four definitions ultimately be placed in rule 15A NCAC 03I .0101, Definitions, where they would apply to all rules within Chapter 03. This work will be completed before the formal rulemaking process begins later this year. The content of the definitions will be preserved, consistent with the MFC's selection of its preferred management option. Regarding option 3 for the proposed rule, it should be noted that trolling is a difficult

activity to define for enforcement and an exclusion for trolling with natural bait will need to be carefully developed if option 3 is selected. The definition of trolling will need to be further refined and explored with MFC input to ensure "work-arounds" or "loop holes" to the requirement are not inadvertently allowed. Next, a delayed effective date of the proposed rules will allow additional time for manufacturers and retailers to produce and stock compliant gear and provide time for outreach and education to the angling public to ensure a high likelihood of compliance. The date provided in the proposed rule text is for illustrative purposes and can be modified by the MFC for the final proposed rule text. Lastly, it should be noted that any rule about gear restrictions will be subject to legislative review under G.S. 14-4.1 due to a conviction under the rule carrying criminal penalties. Satisfying these requirements will take additional time before the rule can become effective.

VI. PROPOSED RULE(S)

Option 2

15A NCAC 03J .0306 HOOK AND LINE

(a) For the purpose of this Rule:

- (1) "circle hook" shall mean a hook with the point of the hook directed perpendicularly back towards the shank with the barb either compressed or removed.
- (2) "gap width" shall mean the shortest distance from the point of the hook to the shank.
- (3) "natural bait" shall mean any living or dead organism (animal or plant) and part thereof.
- (4) "non-offset" shall mean a hook with the point in the same plane as the shank.

(b) Effective April 1, 2023 or upon the effective date of this Rule, whichever is later, and except as provided in Paragraph (c) of this Rule, it shall be unlawful to use any hook with:

- (1) a gap width greater than three-fourths inch that is not a non-offset, non-stainless steel circle hook while fishing with natural bait; or
- (2) multiple points that do not have the barbs either compressed or removed.

(c) In It shall be unlawful to use any hook larger than 4/0 from July 1 through September 30 in the Internal Coastal Waters of Pamlico Sound and its tributaries south of the Albemarle Sound Management Area as defined in 15A NCAC 03R .0201 and north of a line beginning at a point 34° 59.7942' N – 76° 14.6514' W on Camp Point, running easterly to a point 34° 58.7853' N – 76° 09.8922' W on Core Banks, it shall be unlawful to use any hook larger than 4/0 from July 1 through September 30 while using natural bait from 7:00 p.m. to 7:00 a.m. unless the terminal tackle consists of:

- (1) a "circle hook", which for the purpose of this Rule shall mean a hook with the point of the hook directed perpendicularly back toward the shank and with the barb either compressed or removed; and
- (2) of a circle hook and a fixed sinker not less than at least two ounces in weight, secured not more than six inches from the fixed weight to the circle hook.

History Note: Authority G.S. 113-132; 113-134; 113-182; 143B-289.52;

Eff. April 1, 2009;

Readopted Eff. April 1, 2019;

Amended Eff. April 1, 2022 (Pending legislative review pursuant to S.L. 2019-198).

Option 3

15A NCAC 03J .0306 HOOK AND LINE

(a) For the purpose of this Rule:

- (1) "circle hook" shall mean a hook with the point of the hook directed perpendicularly back towards the shank with the barb either compressed or removed.
- (2) "gap width" shall mean the shortest distance from the point of the hook to the shank.
- (3) "natural bait" shall mean any living or dead organism (animal or plant) and part thereof.
- (4) "non-offset" shall mean a hook with the point in the same plane as the shank.

(b) Effective April 1, 2023 or upon the effective date of this Rule, whichever is later, and except as provided in Paragraphs (c) and (d) of this Rule, it shall be unlawful to use any hook with:

- (1) a gap width greater than three-fourths inch that is not a non-offset, non-stainless steel circle hook while fishing with natural bait; or
- (2) multiple points that do not have the barbs either compressed or removed.

(c) In ~~It shall be unlawful to use any hook larger than 4/0 from July 1 through September 30~~ in the Internal Coastal Waters of Pamlico Sound and its tributaries south of the Albemarle Sound Management Area as defined in 15A NCAC 03R .0201 and north of a line beginning at a point 34° 59.7942' N – 76° 14.6514' W on Camp Point, running easterly to a point 34° 58.7853' N – 76° 09.8922' W on Core Banks, it shall be unlawful to use any hook larger than 4/0 from July 1 through September 30 while using natural bait from 7:00 p.m. to 7:00 a.m. unless the terminal tackle consists of:

- ~~(1) a "circle hook", which for the purpose of this Rule shall mean a hook with the point of the hook directed perpendicularly back toward the shank and with the barb either compressed or removed;~~
and
- ~~(2) of a circle hook and a fixed sinker not less than at least two ounces in weight, secured not more than six inches from the fixed weight to the circle hook.~~

(d) Effective April 1, 2023 or upon the effective date of this Rule, whichever is later, the use of trot lines and trolling are exempt from Paragraph (b) of this Rule.

History Note: Authority G.S. 113-132; 113-134; 113-182; 143B-289.52;

Eff. April 1, 2009;

Readopted Eff. April 1, 2019;

Amended Eff. April 1, 2022 (Pending legislative review pursuant to S.L. 2019-198).

VII. PROPOSED MANAGEMENT OPTIONS

1. Status quo: do not proceed with rulemaking to modify hook requirements and continue public outreach and education on best fishing practices and ethical angling to reduce the incidence of deep hooking and post release mortality of fish. If catch and release mortality is an issue identified for a managed species, consider hook requirements and other fishing practices within the framework of a Fishery Management Plan.

+ Avoids any economic impact to tackle manufactures, retailers, and the fishing public.

- + Does not impose terminal tackle requirements for fisheries that would not benefit from circle hook and barbless treble hook requirements and that research is not available to elucidate the potential benefits of the measure.
 - Does not reduce the potential for dead discards in some hook and line fisheries.
2. Amend MFC rule 15A NCAC 03J .0306 to require the use of non-offset circle hooks with a gap width of three-fourths inch or larger while fishing with natural bait and that all treble hooks must have the barbs compressed or removed.
- + Potentially increase the survival of captured and released fish by reducing the likelihood of deep hooking or hook trauma.
 - + J-hook sizes below the specified gap width specification may still be used with natural bait thereby not affecting fisheries where smaller hook sizes are needed with natural bait to be effective (i.e. sheepshead live bait fishery).
 - Economic impact to tackle manufactures, retailers, and the fishing public due to compliance with hook regulations.
 - In general, potential for a decrease in catch rates with barbless or pinched barb treble hooks and circle hooks. Fisheries where larger J-hooks are used with natural bait in an active style where research has not demonstrated a positive benefit to using circle-hooks (i.e. trolling strip baits/dead bait rigs for king mackerel) may be disproportionately affected contributing to greater angler dissatisfaction.
 - Potential for decreased catch rates for gear employing circle hooks that is not actively tended and fished (i.e. trotlines) due to bait and fish retention impacts from barbless requirement.
3. Amend MFC rule 15A NCAC 03J .0306 to require the use of non-offset circle hooks with a gap width of three-fourths inch or larger while fishing with natural bait and that all treble hooks must have the barbs compressed or removed with exceptions for the size requirement when trolling natural bait and using trot line gear.
- + Potentially increase the survival of captured and released fish by reducing the likelihood of deep hooking or hook trauma.
 - + J-hook sizes below the specified gap width specification may still be used with natural bait thereby not affecting fisheries where smaller hook sizes are needed with natural bait to be effective (i.e. sheepshead live bait fishery).
 - + No change in catch rate for troll and trotline fisheries.
 - +/- Defining and enforcing the act of trolling is difficult and may restrict and/or allow some activities that are not considered traditional trolling activities.
 - Economic impact to tackle manufactures, retailers, and the fishing public due to compliance with hook regulations.
 - In general, potential for a decrease in catch rates with barbless or pinched barb treble hooks and circle hooks contributing to angler dissatisfaction.

VIII. RECOMMENDATION

The DMF does not offer a recommendation for the options presented. However, the DMF would like the MFC to consider the following findings and requests feedback on the action items identified when deliberating the proposed management options.

- In general, the science supports the use of circle hooks as a means to reduce hook trauma and discard mortality
 - Aside from extensive research on red drum, few studies have been conducted in North Carolina that evaluate the effectiveness of circle hooks.
 - Studies suggests that off-set circle hooks negate the positive benefits of circle hooks.
- Very little research exists on the effects of hook trauma by treble hooks.
- No industry standard exists for circle hook style and size. If circle hook use is required:
 - a clear definition of what constitutes a circle is needed, and

- a discrete measurement is required for effective enforcement.
- A gap width measurement of three-fourths of an inch would allow for most common weighted jig heads to be fished and provides Marine Patrol and the angling public a common and easily distinguished measurement for compliance.
- Other management jurisdictions that require the use of circle hooks focus on single species/fisheries or complexes to implement hook requirements, which:
 - reduces unintended consequences of regulating terminal tackle that could affect activities that are not associated with high incidences of deep hooking (i.e. live bait trolling, exclusion of species with unique mouth physiologies, etc.), and
 - increases the likelihood of compliance and enforcement by specifying the exact type of activity allowed or prohibited and/or time and location that the gear can be used.
- Positive and negative social and economic effects from the proposed actions include:
 - potential decrease in angler satisfaction through decreased catch rates for some species,
 - positive impact to catch rates if population responds to reduced discard mortality, and
 - economic impact to anglers and tackle shops to purchase and procure compliant hooks.

Items identified as needing additional input from the MFC include:

- The DMF requests a confirmation on the intent of the scope of their motion from the May 2020 meeting. The motion passed by the MFC would require the use of circle hooks and barbless treble hooks for all activities, regardless of sector, except for specific exclusions defined in the proposed rule.
- The DMF requests that the MFC provided input on the following:
 - Gap width measurement for circle hook requirements and potential exclusions for circle hook and treble requirements in option 3, including input for a potential definition of “trolling” if option 3 is selected.
 - The red drum specific hook size requirement of 4/0 and the modification of said requirement to be consistent with discrete gap width measurements.
 - Delaying the effective date of the proposed rules to ensure greater compliance of the gear requirements.

IX. LITERATURE CITED

- Aguilar, R. 2003. Short-term post-hooking mortality and movement of adult red drum in the Neuse River, North Carolina. Master's Thesis. North Carolina State University, Raleigh, NC.
- Beckwith, Jr., G. H. and P. S. Rand. 2004a. Investigating post-hooking recovery and mortality of red drum in the Neuse River. North Carolina Sea Grant Fishery Research Grant Program, Final Report 02-FEG-03.
- Beckwith, Jr., G. H. and P. S. Rand. 2004b. Large circle hooks and short leaders with fixed weights reduce incidence of deep hooking in angled adult red drum. *Fisheries Research*. 71 (2005) 115-120.
- Cooke S. J., Suski C. D., Barthe B. L., Ostrand K. G., Tufts B. L., Philipp D. P., 2003. Injury and Mortality Induced by Four Hook Types on Bluegill and Pumpkinseed, *North American Journal of Fisheries Management*, 23:3, 883-893.
- Cooke S. J., Suski C. D., 2004. Are circle hooks an effective tool for conserving marine and freshwater recreational catch-and-release fisheries? *Aquatic Conservation: Marine and Freshwater Ecosystems*.14:299–326.
- Graves, J. E., & Horodysky, A. Z. 2008. Does hook choice matter? Effects of three circle hook models on postrelease survival of white marlin. *North American Journal of Fisheries Management*, 28(2), 471-480.
- Grover A. M., Mohr M. S., Palmer-Zwahlen M. L. 2002. Hook-and-release mortality of Chinook salmon from drift mooching with circle hooks: management implications for California's ocean sport fishery. In: Lucy J. A., Studholme, A. L., editors. *Catch and release in marine recreational fisheries*. Bethesda, Maryland. American Fisheries Society Symposium 30. p. 80–87.
- Johannes R. E. 1981. *Words of the Lagoon: Fishing and Marine Lore in the Palau District of Micronesia*. University of California Press, Los Angeles, CA.
- Kerstetter, D. W. and Graves, J. E., 2006. Effects of circle versus J-style hooks on target and non-target species in a pelagic longline fishery. *Fisheries Research*, 80(2-3), pp.239-250.
- Lukacovic R., Uphoff J. H. 2002. Hook location, fish size, and season as factors influencing catch-and-release mortality of striped bass caught with bait in Chesapeake Bay. In: Lucy J. A., Studholme, A. L., editors. *Catch and release in marine recreational fisheries*. Bethesda, Maryland. American Fisheries Society Symposium 30. p. 97–100.
- Malchoff, M. H., & Lucy, J. A. 1998. Short-Term Hooking Mortality of Summer Flounder In New York and Virginia. *Marine Resource Report No. 98-7*. Virginia Institute of Marine Science, College of William and Mary.
- Matlock, G. C., McEachron, L. W., Dailey, J. A., Unger, P. A. and Chai, P. 1993. Management Briefs: Short-Term Hooking Mortalities of Red Drums and Spotted Seatrout Caught on Single-Barb and Treble Hooks. *North American Journal of Fisheries Management*, 13(1), pp.186-189.
- Prince, E. D., Ortiz, M. and Venizelos, A. 2002. A Comparison of Circle Hook and "J" Hook Performance in Recreational Catch-and-Release. In: Lucy J. A., Studholme, A. L., editors. *Catch and release in marine recreational fisheries*. Bethesda, Maryland. American Fisheries Society Symposium 30 p. 66-79.
- Rudershausen, P. J., Buckel, J. A., Bolton, G. E., Gregory, R. W., Averett, T. W., and Conn, P. B. 2011. A comparison between circle hook and J hook performance in the dolphinfish, yellowfin tuna, and wahoo troll fishery off the coast of North Carolina. *Fishery Bulletin*, 110(2), pp. 156-175.
- Serafy J. E., Cooke S. J., Diaz G. A., Graves J., Hall M., Shivji M., and Swimmer Y. 2012. Circle hooks in commercial, recreational, and artisanal fisheries: research status and needs for improved conservation and management. *Bulletin of Marine Science*. 88:371-391.

Skomal G. B., Chase B. C., Prince E. D. 2002. A comparison of circle hook and straight hook performance in recreational fisheries for juvenile Atlantic bluefin tuna. In: Lucy J. A., Studholme, A. L., editors. Catch and release in marine recreational fisheries. Bethesda, Maryland. American Fisheries Society Symposium 30. p. 57–65.

Stunz, G.W. and McKee, D.A., 2006. Catch-and-release mortality of spotted seatrout in Texas. North American Journal of Fisheries Management, 26(4), pp.843-848.

Prepared by: Steve Poland, Steve.Poland@ncdenr.gov, 252-808-8011
Jan. 12, 2021
Revised: Jan. 27, 2021
Feb. 4, 2021

Notice of Text Attachment

#7 – Explain Reason for Proposed Rule(s):

15A NCAC 03X .#### NAME OF RULE

MFC Rulebook Index Worksheet

Rule	Subject	Index Entry (Bold major headings)	Add/Delete/ No Change

Ancillary Items: