**Florida Fish and Wildlife Conservation Commission**

**Annotated Bibliography for Fishing and Boating Advice**

This is a supplement to the Florida Fish and Wildlife Conservation Commission's "Image Guidelines for Fishing and Boating Scenes" (MyFWC.com/docs/Newsroom/PhotoGuidelines.pdf). It is an effort to help provide the rationale and science behind the fish handling and water safety advice provided in those guidelines.

Fish respond to handling as a stress; adrenaline surges into the bloodstream followed by steroids such as cortisol, which prepare the fish for "fight or flight" (Mazeaud and Mazeaud, 1981). In response, glucose levels, red blood cell counts, heart and ventilation rates increase, and digestive processes may stop temporarily. Even a brief stress such as being dipnetted from one tank to another or chased by a predator can trigger these effects.

The severity of the stress can be routine and transient, or life threatening. Loss of appetite can persist following a severe handling stress (Wedemeyer 1976), and normal reproductive functions may be suppressed for considerable time (Carragher and Sumpter 1990). Both adrenaline and cortisol affect a fish's ability to osmoregulate, which is the system that keeps the body fluids and salt levels in balance with their outside environment (Mazeaud et al. 1977; Folmar and Dickhoff 1980). Trying to restore balance diverts energy, which may leave the fish less capable of fighting pathogens, and is exacerbated because cortisol suppresses immune responses (Barton et al., 1987; Maule et al., 1987). A frequent sign of stress in fish is infection and weight loss, and as previously discussed wounds and removal of the fish's protective slime coat leave the fish even more susceptible.

The literature cited at the end of this summary provides an annotated bibliography including a broader array of tips for fish handling that are not as likely to be seen in photographs. Look to those sources for information on use of barbless hooks, circle hooks (for certain applications), minimizing the use of treble hooks, use of dehooking tools, landing a fish promptly to reduce build up of stress factors and physiological impacts on the fish, how and when to fizz fish (release body gases from fish taken from deep water), and in cases where a livewell is being used (e.g., for tournaments) the use of aeration, temperature control, water additives and livewell design and capacity. In all cases, minimizing the time a fish is out of the water is critical, so plan photos ahead and be prepared to take the shot and get the fish back in the water quickly, if it is to be released. Although some of these tips are not well documented by formal research, they are broadly considered important by fisheries professionals to helping sustain our fisheries.

1) FISH HANDLING ADVICE FOR CATCH-AND-RELEASE
   a) Handling fish by the jaw can be very damaging. Large fish should never be suspended by the jaw, not even to weigh them, if they are going to be released. *Note: this advice is commonly provided in catch-and-release guidelines by fisheries agencies, tournament*

*groups and recreational fishing advocates. Hard research does not exist to define what species are most susceptible or how heavy the fish needs to be before this type of injury becomes eminent. However, there are a variety of observations from hatchery managers, tournament anglers and recreational fishermen describing fish with dislocated lower jaws (luxated or subluxated mandibles) that could not feed and thus would starve.*

b) To protect the slime layer, use wet hands to handle fish—gloves and towels tend to erode the fish's protective slime layer and can cause scales to fall off. *Note: this advice is commonly provided in catch-and-release guidelines by fisheries agencies, tournament groups and recreational fishing advocates. Hard research does not exist to define what species are most susceptible or where the tradeoffs exist when using gloves. In some cases, the use of smooth gloves may help an angler keep hold of a fish without either squeezing it too tightly or dropping it, which can be more damaging than removing a minimal amount of slime. A fish's slime layer is full of glycoproteins secreted by cells in the fish's skin that help protect against parasites, protect wounds from secondary infections and fungus, help retain electrolytes, and may help the fish swim faster with less water resistance. In fact, fish slime is being studied by pharmaceutical labs to create new antibiotics. Since the fish slime is so important, the fish should be handled as little as possible with a minimum of rubbing, rough or absorbent surfaces contacting the fish.*

c) Similarly, use of knotted nets can injure the fish; knotless rubber coated nets are preferred. *Note: this advice is commonly provided in catch-and-release guidelines by fisheries agencies, tournament groups and recreational fishing advocates. Limited research exists to point to the superiority of rubber nets over knotted nets, but does not define what species are most susceptible or a single best net design. However, it is clear that knotted nets tend to remove the most scales and with them the most slime, so smoother nets that don't have knots and use non-absorbent material are preferable, if they must be used at all. Another advantage of rubber nets is that fish spines and bait hooks (especially treble hooks) don't get ensnared as frequently, thus allowing the fish to be removed less stressfully. Also be sure that the frame does not have any sharp edges, rivets or bolts that might injure the fish.*

d) Never touch the eyes and gills. *Note: this advice is commonly provided in catch-and-release guidelines by fisheries agencies, tournament groups and recreational fishing advocates. Hard research does not exist to define the exact susceptibilities; however, as with our own eyes the cornea is delicate and susceptible to scrapes and secondary infections that could prevent a fish from finding adequate forage or escaping predators. The gills are extremely rich in blood vessels and tend to be engorged after the stress of landing, so even a small cut can bleed excessively.*

e) The proper way is to hold the fish is horizontally with its weight distributed as evenly as possible. *Note: this advice is commonly provided in catch-and-release guidelines by fisheries agencies, tournament groups and recreational fishing advocates. It is based on the biology of the fish and simple physics. The internal organs of fish are evolved for an*

*aquatic environment in which the fish body weight is borne by the water in a horizontal position. Removing it from the water immediately exposes it to greater stress—much as a person would experience stepping on to another planet with a stronger gravitational field. Combined with being held in a vertical position and efforts to twist loose the fish becomes subject to additional internal injuries. These are minimal with small fish, but nonetheless should be considered. The simplest guidance is to hold the fish horizontally and support as much of its weight from underneath as possible, while avoiding pressure on the soft part of the belly, which may damage internal organs.*

f) Lip grips tools can be damaging if the jaw is hyper-extended; however, holding and supporting the fish horizontally with both hands can help to control the fish and keep it from thrashing around or getting loose. *Note: There is not an abundance of scientific information about lip grips related to fish survivability. Lip grips are good tools when used properly, because they can help keep the fish controlled and prevent it from being dropped and may somewhat reduce the slime removal. However, the advice presented above pertaining to both the fragility of the lower jaw in some species and the stress on internal organs when a heavy fish is held vertically should be remembered. Obviously, the use of gaffs or stringers is totally unacceptable with any fish that is going to be released, so lip grips are the only mechanical control currently available.*

2) WATER SAFETY and BOATING GUIDELINES

a) Florida is the Boating Capital of the Nation with more registered boats, manufacturers and marinas than any other state. However, with that comes the ignominy most years of also having the most boating fatalities. Boating experts stress that the way to minimize accidents is to always be alert to the situation all around you, to be familiar with the water and bottom conditions, and be alert to weather changes. Being alert requires that you be unimpaired both physically and in your environment. Alcohol and drugs that cause drowsiness don't mix with piloting a boat of any size, even a one-person kayak. In the event of a sudden and unexpected accident—aren't they all?—having a floatation device on the boat isn't enough. "Wear-It Florida," don't just carry it! For kids that is even more imperative and Florida law requires youth under the age of six must wear an approved personal floatation device (life jacket) while onboard any vessel shorter than 26 feet in length while underway. Proper photos can help reinforce these important considerations and help ensure public safety on the water. Please keep these considerations in mind when taking photos.

b) Ensure that boating safety equipment is evident in the photo; for instance, life jackets should always be on children in a boat and on anglers in small vessels that are underway.

c) Vessel registration--except for nonmotor-powered vessels less than 16 feet in length, or any nonmotor-powered canoe, kayak, racing shell, or rowing scull, a vessel should have 3" high registration numbers displayed on the forward half. The vessel should also show a registration decal within six inches of the registration numbers on the port (left) side.

d) Airboats must have a mast displaying an International Orange flag at least 10’ above the bottom of the boat that is at least 10” x 12”.
e) Water ski boats must have an observer watching the skier, and the skier must be wearing a personal flotation device.
f) Each person riding a personal watercraft (jet ski) is required to wear an approved non-inflatable personal flotation device (PFD). Inflatable personal flotation devices are prohibited for personal watercraft use. The engine cutoff lanyard must be properly attached to the operator. It is illegal for anyone under the age of 14 to operate a personal water craft.
g) Markers or buoys cannot be used for mooring and it is illegal to tamper with them.
h) Divers-Down Flag displayed on vessels must be at least 20 inches by 24 inches, and a stiffener is required to keep the flag unfurled. Dive flags carried on floats must be at least 12 inches by 12 inches. Also, divers-down flags on vessels must be displayed above the vessel's highest point so that the flag's visibility is not obstructed in any direction. Other vessels should stay at least 300 feet from divers-down flags on open waters and at least 100 feet from flags on rivers, inlets, or navigation channels. When divers are out of the water, a dive flag may not be displayed.
i) Equipment and lighting requirements--vessels longer than 16 feet must also have on board at least one throwable Type IV PFD that is immediately available.
j) Vessels with built-in fuel tanks or enclosed compartments where gasoline fumes can accumulate are required to carry at least one fire extinguisher.
k) All vessels are required to carry an efficient sound producing device, such as a referee's whistle.
l) Vessels less than 16 feet in length are required to carry at least three visual distress signals approved for nighttime use when on coastal waters from sunset to sunrise. Vessels 16 feet or longer must carry at least three daytime and three nighttime visual distress signals (or three combination daytime/nighttime signals) at all times when on coastal waters.
m) Vessel lighting on recreational vessels must be illuminated between sunset and sunrise and during periods of reduced visibility. The US Coast Guard establishes the type, size and location of all such lights.
n) Maximum loading and horsepower--monohull boats less than 20 feet in length should have a placard designating the maximum weight, persons, or horsepower capacity that should never be exceeded.
o) Boat liveries must display boating safety information in a place visible to the renting public in accordance with FWC guidelines.
p) Manatee awareness--It is illegal to harass, hunt, capture, or kill any marine mammal, including manatees. Anything that disrupts a manatee's normal behavior is a violation of law and should never be depicted in photos (except for educational purposes with a specific notice of the illegality).

q) Sea grasses are the principal food for endangered marine herbivores such as manatees and green sea turtles, act as natural filters to help purify the water, and provide a suitable environment for a wide variety of marine life. Boaters should make all available attempts to avoid running through sea grass beds.

3) For More Information see the following Web sites:
   a) Saltwater fish handling tips can be found at:
      (1) MyFWC.com/docs/RulesRegulations/Catch_Release.pdf
      (2) MyFWC.com/Marine/photo_contest.htm
      (3) MyFWC.com/RulesandRegs/Saltwater_Regulations_Gear_index.htm
      (4) Research.MyFWC.com/features/view_article.asp?id=5913
      (5) MyFWC.com/docs/RulesRegulations/2007GoliathGrouperConservation.pdf
   b) Freshwater fish handling tips can be found at:
      (1) MyFWC.com/Recreation/FW_Fishing_Tips.htm.
      (2) MyFWC.com/docs/Freshwater/fb25_catch_and_release_formatted.pdf
      (3) MyFWC.com/docs/Freshwater/fb21_Ethical_Anglers_formatted.pdf
   c) Boating safety regulations can be found at: MyFWC.com/RulesandRegs/Rules_Boat.htm
   d) Some key labs conducting catch-and-release research with links to reports
      (1) Dr. Steven Cooke (Carleton University, Ottawa): www.carleton.ca/fecpl/papers.html
      (2) Dr. Robert Arlinghaus (IGB, Berlin): www.igb-berlin.de/abt4/mitarbeiter/arlinghaus/index_e.shtml
      (3) Dr. Cory Suski (University of Illinois): fishlab.nres.uiuc.edu/Publications.html

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Bartholomew, A. and J.A. Bohnsack. 2005. A review of catch-and-release angling mortality with implications for no-take reserves. Reviews in Fish Biology and Fisheries 15:129–154. *Notes: This excellent report concluded that further research is needed to better understand the impacts of C&R fishing. General needs are to: (1) provide more accurate mortality estimates for different species, conditions, and fishing practices, including predation during capture and after release; (2) improve technology to avoid injury and capture of unwanted individuals; (3) develop better techniques to increase release survival; (4) determine cryptic mortality from predation during capture and after release; (5) assess angling encounter probabilities and the cumulative effects of multiple hookings; and (6) evaluate sub-lethal effects on behavior, physical condition, growth, reproduction, and vulnerability to disease and parasites after release.*

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Cooke S.J., Philipp D.P., Dunmall K.M., and J.F. Schreer. 2001. The influence of terminal tackle on injury, handling time, and cardiac disturbance of rock bass. North American Journal of Fisheries Management 21:333–342. *Notes: Effectively demonstrated the use of barbless hooks reduces handling time and tissue damage enhancing survivability.*

Cooke, S.J., C.D. Suski, B.L. Barthel, K.G. Ostrand, B.L. Tufts, and D.P. Philipp. 2003. Injury and mortality induced by four hook types on bluegill and pumpkinseed. North American Journal of Fisheries Management 23:883–893.

Cooke, S., C. Suski, M. Siepker, and K. Ostrand. 2003. Injury rates, hooking efficiency and mortality potential of largemouth bass (Micropterus salmoides) captured on circle hooks and octopus hooks. Fisheries Research (Amsterdam) 61:135–144.

Cooke, S.J. and C.D. Suski. 2004. Are circle hooks an effective tool for conserving marine and freshwater recreational catch-and-release fisheries? Aquatic Conservation: Marine Freshwater Ecosystems 14:299–326. *Note: Overall circle hooks reduced mortality by about 50% over J hooks, but in some instances caused more tissue damage (e.g., with bluegill). The major advantage was jaw vs. gut hooking, but the offset on some circle hooks can reduce effectiveness for catch and release. They were most promising with large pelagic fish (e.g., tuna and billfish); in fresh water, black bass fisheries tended to have minimal benefits from the use of circle hooks (http://www.carleton.ca/fecpl/pdfs/Circle%20Hook%20Review.pdf)*

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Cooke, S.J. and C.D. Suski. 2005. Do we need species specific guidelines for catch-and-release recreational angling to effectively conserve diverse fishery resources? Biodiversity and Conservation 14:1195–1209. *Notes: Summarized their findings with five general truths that cross species: (1) minimize angling duration, (2) minimize air exposure, (3) avoid angling during extremes in water temperature, (4) use barbless hooks and artificial lures, and (5) refrain from angling during the reproductive period.*
*(http://www.carleton.ca/fecpl/pdfs/Cooke%20and%20Suski%20Biodiv%20and%20Cons%20MS.pdf)*

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