

NOTE

**CHARACTERIZATION OF THE WHITE MARLIN
(*TETRAPTURUS ALBIDUS*) RECREATIONAL
FISHERY OFF MARYLAND AND NEW JERSEY**

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The white marlin (*Tetrapturus albidus* Poey, 1860) is an oceanodromous species that is endemic to the Atlantic Ocean. It makes seasonal ventures into higher latitudes during warm seasons, which are thought to be associated with feeding or reproduction (Mather et al., 1975). The species is one of 30 that are termed Highly Migratory Species (HMS) (as listed in Annex I of the 1982 United Nations Convention on the Law of the Sea) and present numerous challenges for fishery scientists and managers. White marlin are sought by recreational anglers but are unintentionally harvested by domestic and international commercial longline fishers targeting tuna (*Thunnus* spp.) and swordfish (*Xiphias gladius* Linnaeus, 1758) (Uozumi, 2003; Serafy et al., 2004). To implement conservation measures, the National Marine Fisheries Service (NMFS) approved the first Atlantic billfish fishery management plan (FMP) in 1988, which effectively reserved directed fishing effort to the recreational fishing sector (NMFS, 1988). A summary of domestic and international conservation measures for white marlin can be found in NMFS (2006). Despite voluntary conservation measures, mandated minimum size limits, and wide acceptance of catch-and-release, white marlin is currently considered to be severely overfished with overfishing continuing. To reduce fishing mortality, NMFS has identified preferred alternatives for implementation; one of these alternatives requires anglers fishing from HMS-permitted vessels and participating in billfish tournaments to use only non-offset circle hooks when deploying natural bait or natural bait/artificial lure combinations (NMFS, 2006). Circle hooks are defined in 50 CFR §635.2 as “a fishing hook originally designed and manufactured so that the point is turned perpendicularly back to the shank to form a generally circular, or oval, shape.”

To ascertain current recreational fishing practices for white marlin, we surveyed participants of two popular white marlin tournaments in the middle-Atlantic region of the US in August 2005: the White Marlin Open (WMO) in Ocean City, MD and the Mid-Atlantic \$500,000 (MA) in Cape May, NJ. In 2005, 449 vessels participated in the WMO, fished a total of 9457 boat-hours and caught 514 white marlin of which 98% were released (Table 1). The WMO during each of the last 3 yrs has had prizes that exceeded \$2,000,000 and over \$1,000,000 for the largest white marlin caught (J. Motsko, tournament president, pers. com.). A total of 165 vessels participated in the MA, expended 3500 boat-hours, and caught 211 white marlin of which 96% were released (R. Weber, tournament president, pers. com.). The MA started in 1994 and in 2005 awarded over \$570,000. Venizelos (2003) reported the total number of white marlin caught (landed and released) in all tournaments in the US and the Caribbean (St. Croix, St. Thomas, Puerto Rico, and Bahamas) from 1998 to 2002; these two tournaments contributed 46% (range 25%–64%) of all tournament-caught white

Table 1. Summary of catch information at the White Marlin Open and Mid-Atlantic \$500,000 tournaments.

Category	White Marlin Open ^a	Mid-Atlantic \$500,000 ^b
Total number of vessels registered	449	165
Total hours fished	9,457	3,500
Number of white marlin caught	514	211
Number of white marlin docked (% released)	13 (98%)	11 (96%)
Catch per hours fished	0.054	0.060
% of boats catching a white marlin	50.1%	52.1%
Entry fee	\$900	\$15,000
Total prizes	\$2,700,000	\$1,700,000

^a J. Motsko, pers. comm.

^b R. Weber, pers. comm.

marlin during those years (A. Venizelos, NOAA Southeast Fisheries Science Center, Miami, unpubl. data).

In this study, we examined general fishing practices of the recreational fishery targeting white marlin in Maryland and New Jersey waters. Lucy et al. (1990) described characteristics of nearby Virginia's recreational pelagic fishery and certain boat-owner expenditures associated with marlin-tuna fishing trips in the late 1980s. However, the fishery regulations have changed since 1988 and the fishery largely is catch-and-release except for a small number of tournaments. To identify and encourage techniques enhancing post-release survival, we sought to: (1) describe the demographics of the fishery; (2) determine the extent to which various hook types are used; (3) describe the types of fishing gear used, and (4) determine if practices are essentially the same during tournament and non-tournament fishing.

METHODS

Data on white marlin recreational fishing practices were obtained through questionnaires completed by participants of the WMO August 8–12, 2005 and the MA August 22–26, 2005. Respondents completed questionnaires while waiting to register or within 2 wks of the end of the tournament. Because some individuals fished both tournaments, no individual was asked to complete a form twice. Questionnaires were either self-administered or conducted by a member of the research team, depending on time constraints or respondent preference. Using 2004 as their reference year, anglers were asked 26 questions designed to characterize fishing effort and preferred fishing gear (Appendix). A total of 398 respondents turned in questionnaires representing 350 different vessels.

To clarify potentially confusing terms, we considered "natural dead bait" to refer to a dead bait (e.g., fish or squid) rigged with a hook. A "lure" is an artificial bait frequently made of plastic and rigged with a hook. We used the term "attractant" to mean an artificial embellishment such as a colored skirt that is placed before or over a natural dead bait. A "teasers" is a string of artificial lures without hooks trolled on the surface, and a "dredge" is a subsurface teaser comprised of hookless-lures or natural dead baits without hooks hanging from a central structure (i.e., similar to an umbrella). A "spread" refers to the total array of baits and lures trolled behind the boat.

Some self-administered questionnaires were incomplete. Analyses were based on the total number of responses to questions pertaining to vessels and to individual anglers. Survey data were sorted to ensure that vessels and individuals were not double-counted. A second or third person from the same vessel may have completed a questionnaire and these were included in the appropriate analyses. Their vessel was not double-counted, but their responses were

included, for example, in determining terminal tackle preferences or in calculations of the number of days fished offshore. To examine responses, means and standard deviations were calculated and responses in numbers of anglers using particular hook types and drop-back times between tournament and non-tournament fishing were compared using Student's t-test performed with SAS software (SAS Institute 1992, Version 8, Cary, NC). Statistical significance was declared at $P < 0.05$.

RESULTS

Of 389 respondents, 58% were owners, 34% were captains, 19% were anglers, and 8% were mates. These groups possessed an average of 10, 15, 20, and 10 yrs of fishing experience, respectively. Classes of respondents were not exclusive and a number of respondents were both captain and owner, or owner and angler. Average vessel size was 13.4 m (SD = 3.6, $n = 350$). The mean year that vessels were built was 1995.7 (SD = 9.67, $n = 244$) and vessel length was not related to year built ($r^2 = 0.02$, $P > 0.05$, $n = 244$). The homeport for most vessels was in Maryland (52%) and other homeports that comprised at least 5% of the respondents included ports in New Jersey (16%), Delaware (10%), and North Carolina (9%).

Fishing effort was classified according to: (a) the number of days respondents fished offshore; (b) the percentage of their offshore fishing days that billfish were targeted; and (c) the percentage of their white marlin trips that took place in tournaments. The majority (58%, $n = 355$) fished from 10 to 50 d offshore and 9% fished more than 100 d offshore. A slight majority (37%) spent $< 25\%$ of their offshore fishing days targeting billfish; however, 25% indicated that billfish were targeted on $\geq 75\%$ of their offshore fishing days (Table 2). A majority of respondents (58%) participated in tournaments for 25% or less of their white marlin fishing trips; however, 14% participated in tournaments on 75% or more of their white marlin fishing days (Table 2).

Most survey respondents (71%) indicated that they fished for white marlin only off the Middle Atlantic States ($n = 361$). Of the remaining 29%, in addition to this region, 46% also fished in the Bahamas, 30% in the western Caribbean, 9% in Venezuela, 9% in the Gulf of Mexico, 5% off Punta Cana, Dominican Republic, and 1% fished off Ft. Lauderdale, Florida.

The majority (59%) of respondents used 30 lb rod-and-reel class (Fig. 1A), 20 lb and 30 lb test for the main line (Fig. 1B), and 74% preferred 80 lb or 100 lb test leaders (Fig. 1C). Most (87%) respondents never used live bait when fishing for white marlin (Fig. 2A). Survey participants were asked about their preferred natural dead baits for white marlin and a few chose more than one type. Virtually all respondents (98%) indicated a preference for ballyhoo (*Hemiramphus brasiliensis* Linnaeus, 1758), (Fig. 2B) and the preferred bait sizes were small and medium (Fig. 2C). A total of 78% of the respondents indicated use of an attractant at least some of the time (Fig. 3A). The

Table 2. Percentage of respondents within each of four categories of offshore fishing days targeting billfish and white marlin fishing days in a tournament.

Percentage of days	Offshore days targeting billfish	White marlin fishing days in a tournament ($n = 393$)
< 25	36.8	58.0
25–50	21.7	17.7
50–75	16.1	10.3
75–100	25.4	14.1

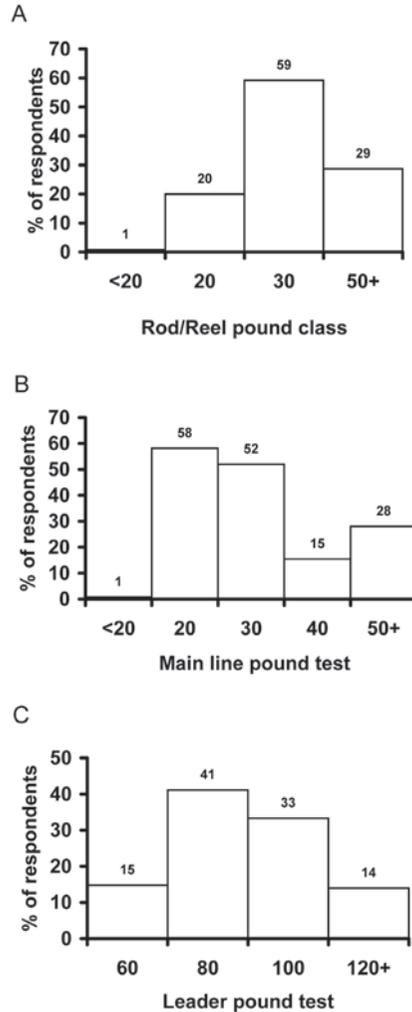


Figure 1. Angler preferences for: (A) rod and reel class; (B) pound test line used for the main line; and (C) pound test line used for the leader when fishing for white marlin ($n = 380, 375, 372$, respectively).

use of lures alone for white marlin fishing was rare; more than half (53%) reported never having done so (Fig. 3B). A combination of natural dead baits and artificial lures in the spread was more common, with 30% of the respondents using a combination of lures and baits in the spread at least half the time (Fig. 3B). Almost all respondents (96%) reported that they usually troll a teaser, and 73% reported usually using a dredge. When fishing for white marlin, most respondents (91%) trolled with six or more fishing rods with natural dead baits and/or artificial lures (Fig. 4). Estimates of drop-back times were typically for 10 s or less and no difference was detected in drop-back time between tournament and non-tournament fishing (Fig. 5; $t = 1.763$, $n = 297$, $P > 0.05$). A total of 303 respondents answered questions pertaining to their typical hook types when fishing for white marlin in 2004 (Table 3). Most of the respondents indicated that they used the same hook type in tournaments as in non-tournaments: 77.9% indicated they used "J" hooks (primarily short shank, 55.4%) and

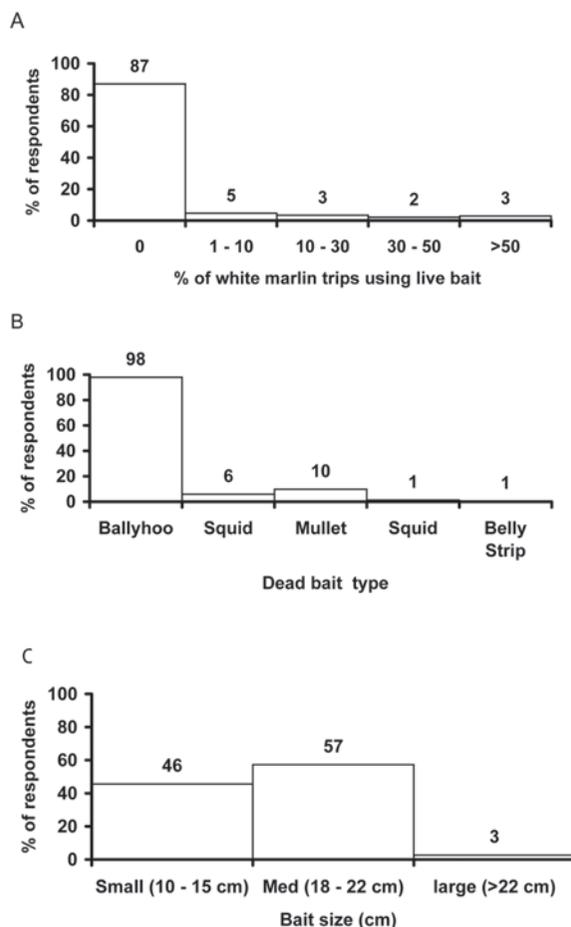


Figure 2. Angler preferences for: (A) use of live bait; (B) types of natural dead bait; and (C) bait size used to catch white marlin ($n = 385, 388, 379$, respectively).

8.6% indicated circle hooks (mostly offset circle, 5.0%). There were minimal changes in hook type between tournament and non-tournament fishing efforts (Table 3). The few anglers who changed (5% of respondents) switched from circle hooks for non-tournament fishing to “J” hooks for tournaments.

DISCUSSION

The recreational billfish fishery of the Middle Atlantic States is largely catch-and-release, with a small number of tournaments that require fish to be docked for monetary prizes. We interviewed mostly owners and captains and some anglers and mates of offshore fishing vessels with homeports located predominantly in Maryland and New Jersey to document their usual gear and techniques used for white marlin fishing in 2004, our reference year. These survey respondents were all participants in two tournaments with substantial monetary awards given for the largest white marlin. Lucy et al. (1990) described that the marlin-tuna fishery off Virginia as primarily a trolling fishery that operated from June through August out to 128 km offshore. Similarly, Ocean City Marlin Club records from 1947 through 2005 (W. Reagan,

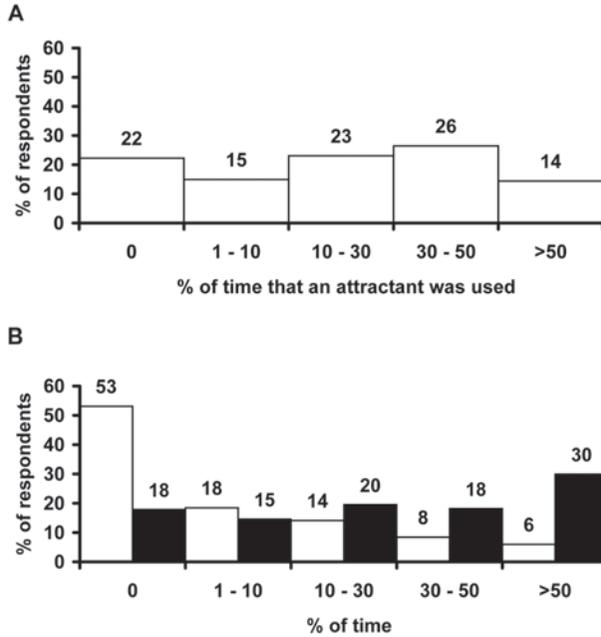


Figure 3. Percent of time that anglers: (A) used an attractant (n = 382); and (B) trolled lures alone (open bars) (n = 369) and with a combination of natural dead baits and artificial lures (closed bars) (n = 364).

president Ocean City Marlin Club, pers. comm.) indicate that white marlin is caught from late May through August. We report that average boat size in our survey was 13.4 m, which is 50% larger than that reported by Lucy et al. (1990) for the recreational marlin-tuna fleet (8.5 m). Lucy et al. (1990) reported that the average boat was 7 yrs old, whereas vessels in our study were an average 9 yrs old. Additionally, it was generally found that most saltwater anglers and tournament participants were from the local or regional area (Falk et al., 1989; Lucy et al., 1990) which is consistent with the results of our study. Lucy et al. (1990) found an average 6 fishing rods were used, but made no mention of terminal gear, type of baits, or fishing techniques.

In the present study, fishing for white marlin typically involved trolling small or medium sized natural dead baits (ballyhoo) that were sometimes fitted with artificial embellishments, from at least six light-tackle fishing rods (30 lb rod/reel class) rigged

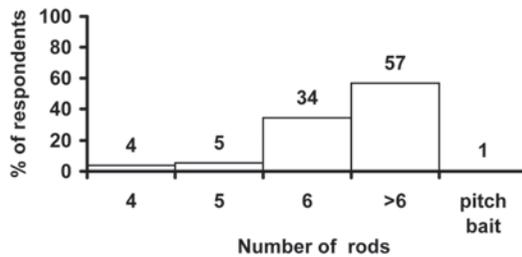


Figure 4. Percent of anglers who used 4 to > 6 baits or lures trolled in the water when fishing for white marlin. The “pitch bait” category represents the use of teasers and a baited hook that is substituted for the teaser when a billfish is raised behind the vessel (n = 369).

Table 3. Change in hook type used in tournament and non-tournament fishing for white marlin.

Category	Number	%
Hook type same in tournament and nontournament fishing		
“J” hook	236	77.9
Short-shank “J” hook	168	55.4
Long-shank “J” hook	53	17.5
Combination of short and long shank “J” hook	15	5.0
Circle hook	26	8.6
Non-offset circle	10	3.3
Offset circle	15	5.0
Combination of non-offset and offset	1	0.3
Various combinations circle and “J” hooks	15	5.0
Total same hook type	277	91.4
Hook type changes from tournament to nontournament		
Change in long shank or short shank	3	1.0
Change from circle in nontournament to “J” in tournament	15	5.0
Change from “J” in nontournament to circle in tournament	5	1.6
Change in types of circle hooks	3	1.0
Total change in hook type	26	8.6
Total all categories	303	100.0

with 20 and 30 lb test line. Use of surface and subsurface teasers was also common. Baits were usually rigged with short shank “J” hooks, and the use of offset and non-offset circle hooks was uncommon (i.e., < 10%). Most anglers reported that their fishing practices did not change for tournaments, with no difference in their choice of hook types or drop-back times during tournament and non-tournament fishing.

Most anglers we interviewed reported that a short drop back (≤ 10 s) was used when attempting to hook a white marlin. Prince et al. (in press) report that extended drop-back times (> 10 s) can increase deep hooking and mortality in sailfish caught on “J” hooks. The short drop back times used by Maryland and New Jersey anglers probably benefit these fish and should be encouraged.

The use of circle hooks during tournament competition is relatively uncommon, with < 10% of the anglers reporting their use. Several anglers expressed lack of confidence with and/or experience in the use of circle hooks, especially under tournament conditions, when pressure to land fish is extreme. Efforts to educate anglers with the conservation benefits and increased catch rates associated with the correct use of circle hooks could result in a broad adoption of the hook type and a decreased post-release mortality for recreationally-caught white marlin.

The observation that the US mid-Atlantic white marlin fishery generally consists of trolling with dead natural bait (ballyhoo), and rigged with short shank “J” hooks, is almost identical to the fishing techniques reported by Prince et al. (2002) in their hook performance study of Pacific sailfish. Given that Prince et al. (2002) found that circle hooks had comparable or higher catch rates compared to “J” hooks, while significantly reducing deep hooking and almost eliminating bleeding, there is reason to believe similar results would emerge if circle hooks were the primary terminal gear used for this white marlin fishery. Horodysky and Graves (2005) observed a significantly higher post-release mortality for white marlin caught recreationally on “J”

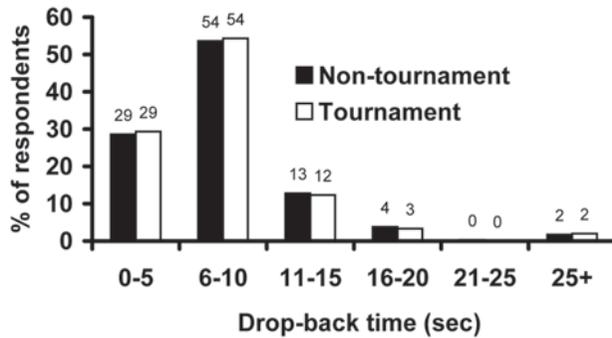


Figure 5. Time that anglers estimate that they typically drop-back (free spool prior to hooking a white marlin) during tournament and non-tournament fishing (n = 343).

hooks as compared with those caught on circle hooks. They reported 35% mortality of “J” hooked fish and no mortality of circle hooked fish.

Cooke and Suski (2004) reviewed the conservation benefits of circle hooks in the scientific literature. They concluded that high capture efficiency and reduced injury and mortality rates occur with use of circle hooks in certain marine fisheries including those for billfish, tuna, and striped bass. Although few in number, the studies present compelling evidence for the conservation benefits of circle hooks in dead bait billfish fisheries. Empirical studies are increasingly being conducted or planned to investigate the post-release survival of recreationally caught billfish. For these studies to be of greatest utility, the full range of rigging combinations and fishing techniques of each fishery require evaluation. Additionally, many of the conservation practices adopted by billfish anglers are voluntary and should be strongly encouraged through educational efforts emphasizing research results.

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Appendix

Mid-Atlantic Recreational White Marlin Angling Survey (WM = White Marlin)	
Please circle the answer that fits best, or fill in the blanks where indicated.	
1. How many days did you fish offshore last year (January – December 2004)? a. 10 or less, b. 10 – 50, c. 51 – 100, d. more than 100	
2. In 2004, what percentage of your offshore fishing days did you target <i>primarily</i> billfish? a. 25% or less, b. 25 – 50%, c. 50 – 75%, d. 75 - 99% e. 100%	
3. In 2004, what percentage of your billfish fishing days do you target <i>primarily</i> WM ? a. 25% or less, b. 25 – 50%, c. 50 – 75%, d. 75 - 99% e. 100%	
4. What percentage of your 2004 WM fishing trips were you participating in a tournament? a. 25% or less, b. 25 – 50%, c. 50 – 75%, d. 75 - 99% e. 100%	
5. In 2004, what percentage of your WHITE MARLIN trips took place in each of the following localities? (your PERCENTAGES should add up to 100%)	
a. The Middle Atlantic Bight (Massachusetts to North Carolina).....	_____%
b. Western Caribbean (Cancun, Isla Mujeres, Cozumel & Puerto Aventuras, Mexico; Belize).....	_____%
c. The Bahamas	_____%
d. Punta Cana, Dominican Republic	_____%
e. Venezuela (La Guaira Bank)	_____%
f. Gulf of Mexico	_____%
6. Your current status: a. Owner, b. Captain, c. Mate, d. Angler	
7. Describe the boat you usually use for fishing: Length (ft) _____ Builder/Year built _____ Boat # for this tournament _____	
8. Number of years experience as: (fill in blanks for all that apply): a. Charter boat captain _____ b. Private boat captain _____ c. Mate _____ d. Angler _____	
Preferred WM tackle: 9. Rod & reel class you prefer (lbs.): a. less than 20, b. 20, c. 30, d. 50+	
10. Pound test you prefer for the main line: a. less than 20, b. 20, c. 30, d. 40 e. 50+	
11. Pound test you prefer for the leader: a. 60, b. 80, c. 100, d. 120+	
12. What proportion of your WM trips in 2004 did you use live bait? a. 0 b. 1 - 10% c. 10-30% d. 30-50% e. > 50% Species used for live bait? _____	
13. What natural dead bait do you prefer for WM? a. ballyhoo, b. squid, c. mullet, d. belly strip bait, e. other (specify) _____	
14. What size natural dead bait do you prefer for WM? a. small (4-6 inches), b. medium (7-9 inches), c. large (> 9 inches)	
15. What % of the time do you add an "attractant" (e.g., a sea witch or colored skirt) to a natural dead bait? a. 0 b. 1 – 10% c. 10-30% d. 30-50% e. > 50%	

* Note: this question was quite often misinterpreted and, consequently was dropped from subsequent analysis.

16. What % of the time do you pull ONLY artificial lures when WM fishing? a. 0% b. 1 - 10% c. 10-30% d. 30-50% e. > 50%		
17. What % of the time do you pull a combination of natural dead baits & artificial lures? a. 0% b. 1 - 10% c. 10-30% d. 30-50% e. > 50%		
18. How many baits (rigged baits, lures or a combination) do you usually troll when fishing for WM? a. 4 b. 5 c. 6 d. > 6 e. 0 rods (I use the "bait and switch" method (the use of teasers and a pitch bait))		
19. Do you usually use (surface) teasers? a. Yes, b. No		
20. Do you usually use a dredge (subsurface teaser)? a. Yes, b. No		
21. When using natural dead bait, do you usually drop back (free spool) prior to hooking a WM? a. Yes, b. No		
22. If yes, estimate the time (seconds) that you typically drop back prior to hook up for WM for: Nontournament fishing: a. 0-5, b. 6-10, c. 11-15, d. 16-20, e. 21-25, f. 25+ Tournament fishing: a. 0-5, b. 6-10, c. 11-15, d. 16-20, e. 21-25, f. 25+		
23. In the boxes to the right, please check the hook type you usually use for WM bait. a. Short Shank J hook (e.g., Mustad 9175 7/0) b. Long shank J hook c. No offset circle hook (e.g., Eagle Claw 2004 7/0) d. Offset circle hook	Nontournament	Tournament
24. If you chose J hook, check the hook size you prefer for WM in tournament and nontournament fishing. a. 6/0 b. 7/0 c. 8/0 d. Other (please specify):	Nontournament	Tournament
25. If you chose circle hook, please indicate the size and type (brand & model no) that you prefer for WM in tournament and non-tournament fishing. a. 5/0 b. 6/0 c. 7/0 d. 8/0 e. other (please specify)	Nontournament	Tournament
26. In 2004, what proportion (%) of your WM fishing trips did you use each hook type in nontournament and tournament fishing? a. J hooks? b. circle hooks?	Non- Tournament	Tournament

