Photo by Bill Watts

Greetings!

Welcome to the Mid-Atlantic $500,000. This will be the 20th year that my colleagues and I have collected biological samples from the fish brought to the weigh stations at Canyon Club and Ocean City. We've used these samples in a variety of research projects in our laboratory at the Virginia Institute of Marine Science and we have shared samples with colleagues around the world. Each year I've produced this newsletter to provide feedback on what we've learned from the samples and to give an update on current issues in billfish research and management. Inasmuch as this is the 20th anniversary of the Mid-Atlantic $500,000, I thought it might be a good time to look back at some of the billfish research projects that have been facilitated by the tournament.

I have updated a few studies that appeared in previous newsletters and added some new ones. As in prior newsletters, I've included a summary of the Mid-Atlantic $500,000 catch statistics, and a look at some trends with the white marlin catch data over the past 20 years.

If you would like to know more about our current research (we do more than billfish), get additional information about any of the billfish studies, domestic or international management of billfish and other highly migratory species, or graduate education in marine science, please drop by to talk. I'll be down at the Canyon Club weigh station in the early evenings and under the tent after that, and my colleague, Dr. Jan McDowell, will be at the Ocean City weigh station. We'd love to meet you.

Tight lines,

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Shaking Up the Family Tree

The billfishes, marlins, sailfish, and spearfishes, are all members of the family Istiophoridae and as a group, are most closely related to the swordfish, the only member of the family Xiphiidae. Using tissue samples collected at the Mid-Atlantic $500,000 along with others collected from billfishes around the world, Drs. Bruce Collette, Jan McDowell and I investigated the evolutionary relationships within the billfishes, focusing on nuclear and mitochondrial DNA sequences. What we found was that the existing taxonomy based on morphological characters was not entirely consistent with the genetic data. Heck, there were some big surprises!

Figure 1. A juvenile blue marlin. Note the very short bill. Unlike other billfishes, blue marlin do not have an elongate bill at small sizes (photo by Guy Harvey).

Our DNA analyses revealed that blue marlin are much more closely related to sailfish than they are to black marlin. In fact, the genetic differences between blue marlin and black marlin, which were both in the genus *Makaira*, are greater than those between almost any other pair of billfishes. It is true that blue marlin and black marlin look very much alike, and both species exhibit a strong sexual dimorphism where the males stop growing at around 200 – 250 lbs., while females can grow to well over 1,000 lbs. Despite these similarities, there are several morphological differences between the blue marlin and black marlin that are consistent with the large genetic distance between the two species. Probably the most significant difference is an early life history character. While all other billfishes have an elongate bill at small sizes (inches long), blue marlin do not get a bill until they are more than three feet in length (Figure 1). As a result of the morphological and genetic differences, black marlin were moved into their own genus *Istiompax*.

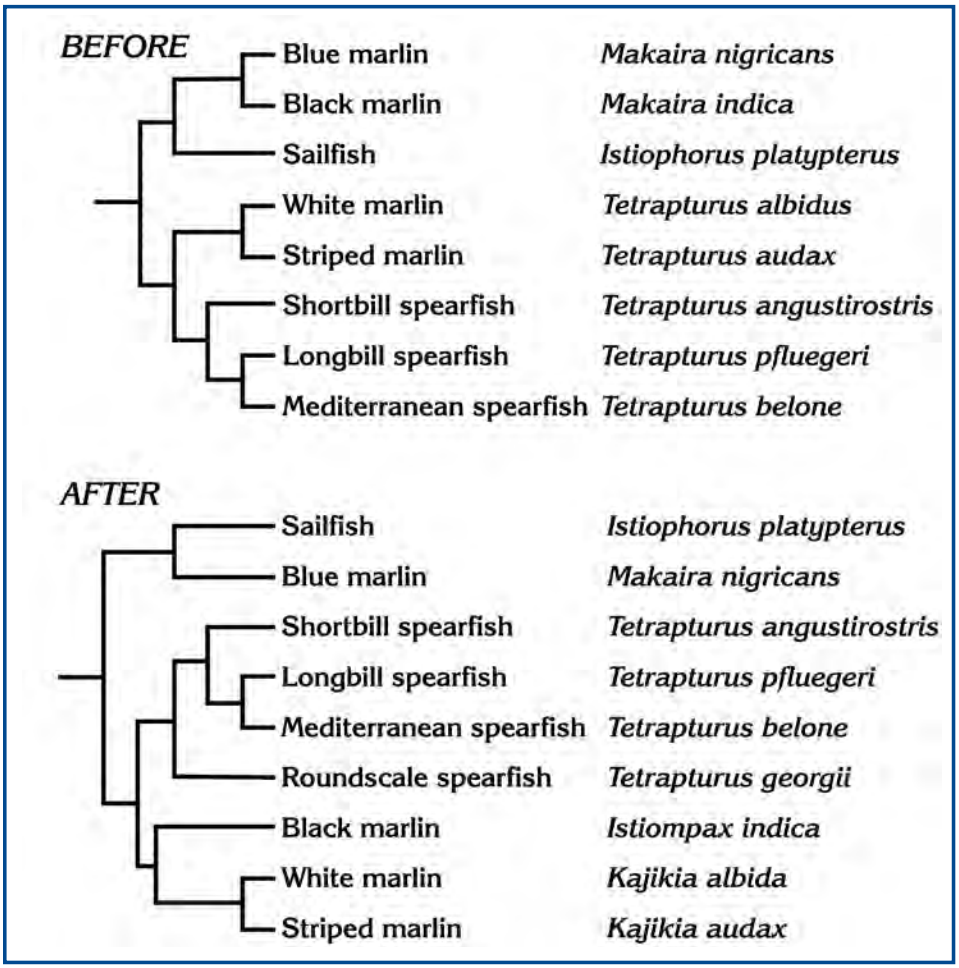

Figure 2. The billfish family tree showing relationships among the species, before and after the genetic analyses.

We also found some big differences between the spearfishes and white and striped marlin, suggesting that these groups do not all belong in the genus *Tetrapturus*. As a result, white marlin and striped marlin are now in the genus *Kajikia*. We also realized that there was another species in the mix, the roundscale spearfish, but that's another story (see next page). The changes in scientific nomenclature have been accepted and the old and new family trees are shown in Figure 2.

Of Hatchet Marlin and Roundscale Spearfish

For many years, offshore anglers along the U.S. mid-Atlantic coast have been aware of the hatchet marlin, a fish that looks very much like a white marlin but differs in fin shape. While white marlin have nicely rounded dorsal and anal fins, the fins of a hatchet marlin are truncated, looking as if they were sheared off with a knife. Over the past 19 years we have collected genetic samples and morphological measurements from almost all white marlin and hatchet marlin brought to the Mid-Atlantic $500,000 weigh stations, allowing us to investigate the specific relationships of these fish. Working with Drs. Bruce Collette and Jan McDowell on a genetic analysis of billfish evolutionary relationships, we found that many, but not all, hatchet marlin were genetically distinct from white marlin, and that these individuals were more closely related to the spearfishes than to white marlin. At the same time, Dr. Mahmood Shivji of Nova Southeastern University in Florida and colleagues analyzed samples of hatchet marlin collected from observers on U.S. pelagic longline vessels. Their morphological and genetic analyses indicated that hatchet marlin were probably roundscale spearfish, a supposedly rare species of billfish described from a single specimen collected off the Island of Madeira in the eastern Atlantic in the late 1800s. It had been hiding out in plain sight for a long time!

Using samples of white marlin and hatchet marlin collected at the Mid-Atlantic $500,000, we found that the shape of the dorsal and anal fins alone do not discriminate between the two species. Both white

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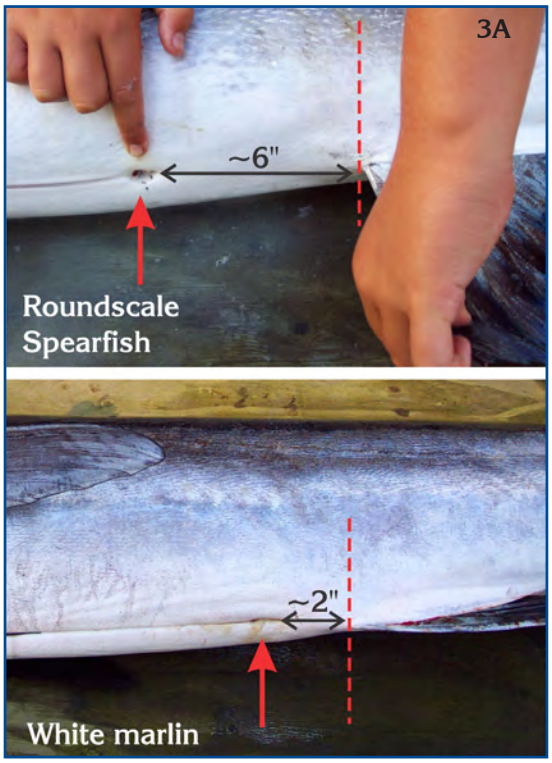


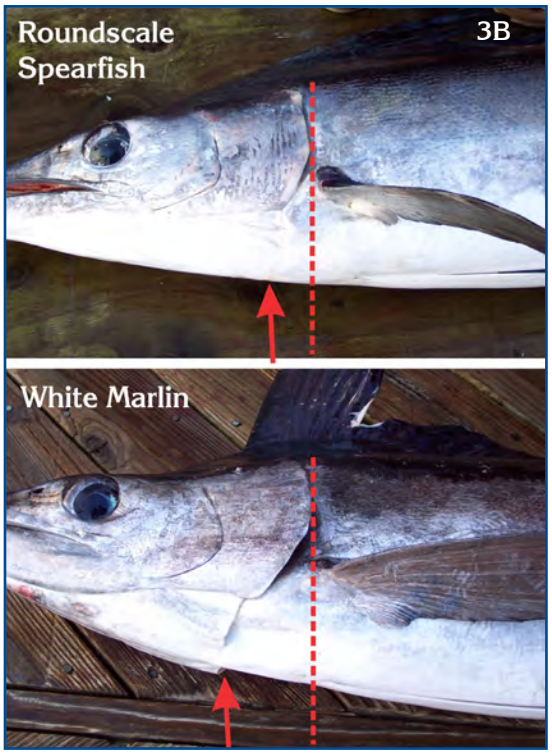
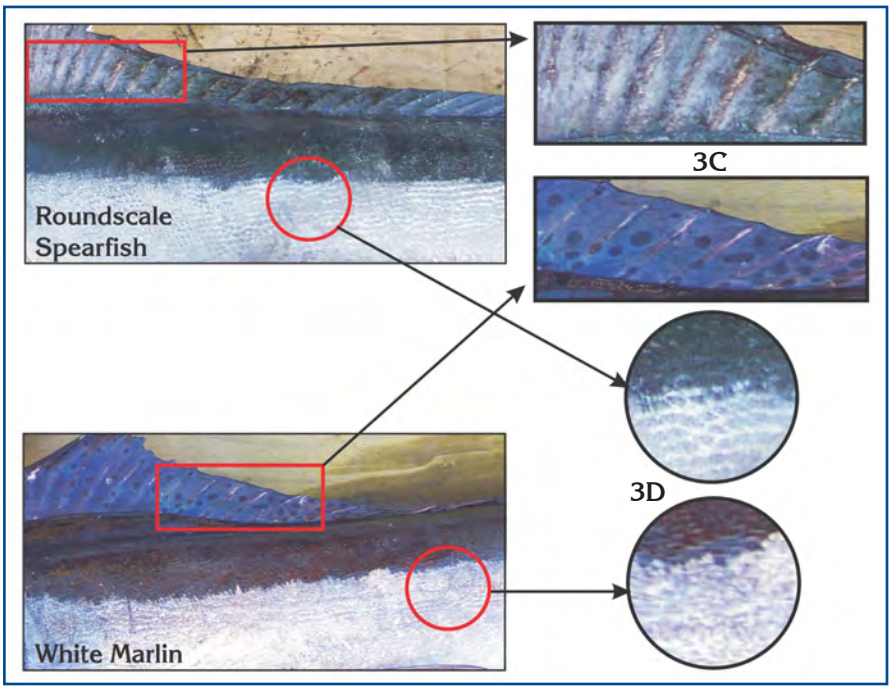


Figure 3. Roundscale spearfish can be distinguished from white marlin by several characters. (A) In roundscale spearfish the vent is 5-6 inches forward of the anal fin, while in white marlin the vent is less than 2 inches forward. (B) The branchiostegals are longer in roundscale spearfish, extending almost to the edge of the gill cover, while they are shorter in white marlin. (C) White marlin typically have spotted dorsal fins, while the dorsal fins of roundscale spearfish do not have spots. (D) The shape and pattern of the scales are different between roundscale spearfish and white marlin.



marlin and roundscale spearfish can have truncated dorsal and anal fins, although the cut-off fin shape is more common in roundscale spearfish. In other words, a hatchet marlin can be either a white marlin or a roundscale spearfish. Great! The best way to tell the two species apart is not to look at the shape of the fins, but to look at the location of the vent. In a white marlin the vent is about two inches forward of the start of the anal fin, while in roundscale spearfish the vent is five or six inches forward of the anal fin (Figure 3A, on previous page). There are other diagnostic characters as well including the relative length of the branchiostegals (rays below the gill cavity), shape of the scales, and spots on the dorsal fin (Figure 3B, C, & D).

Fortunately, we archived all of our tissue samples collected at the Mid-Atlantic $500,000, allowing us the opportunity to genetically determine the number of white marlin and roundscale spearfish brought to the weigh stations each year. The relative abundance of the two species has varied dramatically (Table 1). Of course, it is difficult to make any broad inferences from these observations as the tournament only samples a very small part of the Atlantic Ocean, and just a few percent of the "white marlin" caught in the tournament (the largest fish) are brought to the weigh station. Still, there are some pretty interesting trends. Roundscale spearfish were rarely landed in the tournament during the 1990s. In fact, roundscale spearfish comprised only 2 of 96 (2.1%) of the white marlin samples collected from 1992 - 2000. Beginning in 2002, the frequencies of roundscale spearfish at the weigh stations dramatically increased. In 2003, 2005, and 2010, the majority of "white marlin" brought to the weigh stations were, in fact, roundscale spearfish. For the period from 2002 through 2010, roundscale spearfish comprised 57 of 175 (32.6%) putative white marlin. For the entire sampling period (1992 – 2010), roundscale spearfish comprised 57 of 271 (21.8%) of the landings. They are out there.

Table 1. Species composition of "white marlin" landed at the Mid-Atlantic $500,000 Billfish Tournament. The fish brought to the weigh stations represent the largest 5% of the catch.

Year	White Marlin	Roundscale Spearfish	%Roundscale Spearfish
1992	13	0	0
1993	18	2	10.0
1994	21	0	0
1995	10	0	0
1996	18	0	0
1998	11	0	0
2000	3	0	0
2002	6	3	33.3
2003	3	9	25.0
2004	12	2	14.3
2005	4	10	71.4
2006	11	3	21.4
2007	16	7	30.4
2008	29	2	6.5
2009	24	4	14.3
2010	13	17	56.7
1992 – 2000	**94**	**2**	**2.1**
2001 – 2010	**118**	**57**	**32.6**
Total	**212**	**59**	**21.8**

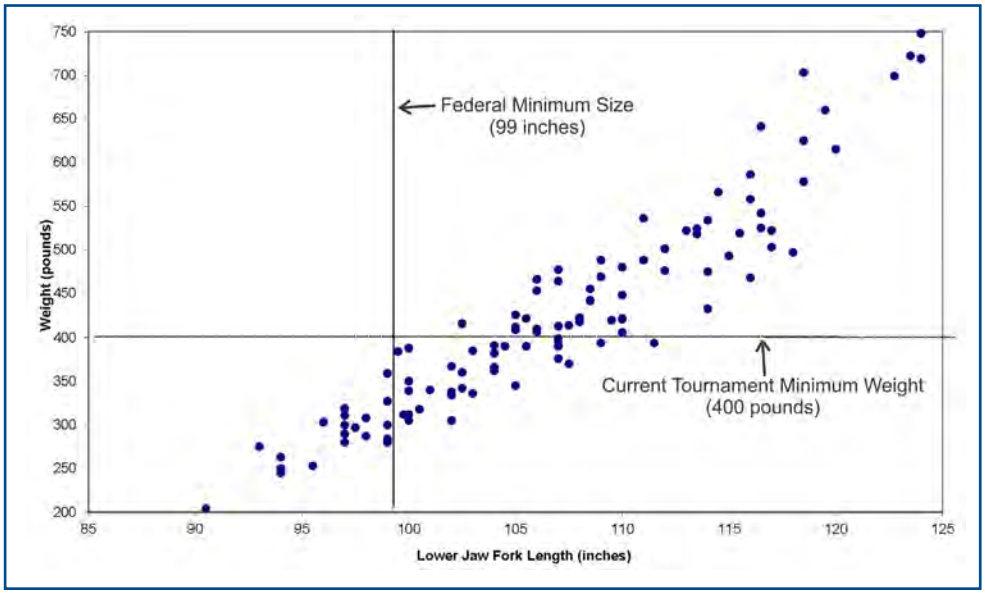
Continuing Research on Roundscale Spearfish and White Marlin

The Mid-Atlantic $500,000 tournament data show a big change in the relative abudance of white marlin and roundscale spearfish over the past 19 years. But these data are for a limited area (125 nmi from the Cape May sea buoy) and represent the largest fish (only the top 4 – 5% are brought to the weigh stations). What are the relative proportions of the two species of all sizes along the mid-Atlantic throughout the summer and fall? To address these questions graduate student Emily Loose is working with cooperating captains and mates to have them identify their catches of white marlin and roundscale spearfish whenever possible. She hopes to compile a database of relative abundance by size class and area. In addition, with support from the Guy Harvey Ocean Foundation and proceeds from last year's Mid-Atlantic $500,000 raffle, Emily is putting long term satellite tags (programmed to pop up after 6 or 12 months) on white marlin and roundscale spearfish to determine their seasonal movements and gain insights into their habitat utilization.

If you would like to help out with Emily's research we would be happy to provide you with a laminated sheet showing the morphological differences between white marlin and roundscale spearfish, as well as a data collection sheet. All Emily needs is for you to identify a "white marlin" as a true white marlin or roundscale spearfish. We realize that you won't be able to check the placement of the vent on every fish you catch, but for those that you can identify, we'd like to know where you were and the approximate weight of the fish. Emily also has 12 satellite tags to deploy in a specific order (one on a white marlin, one on a roundscale, etc.) so if you have room for a ride-along, she would greatly appreciate the opportunity to get all of her tags out this season.

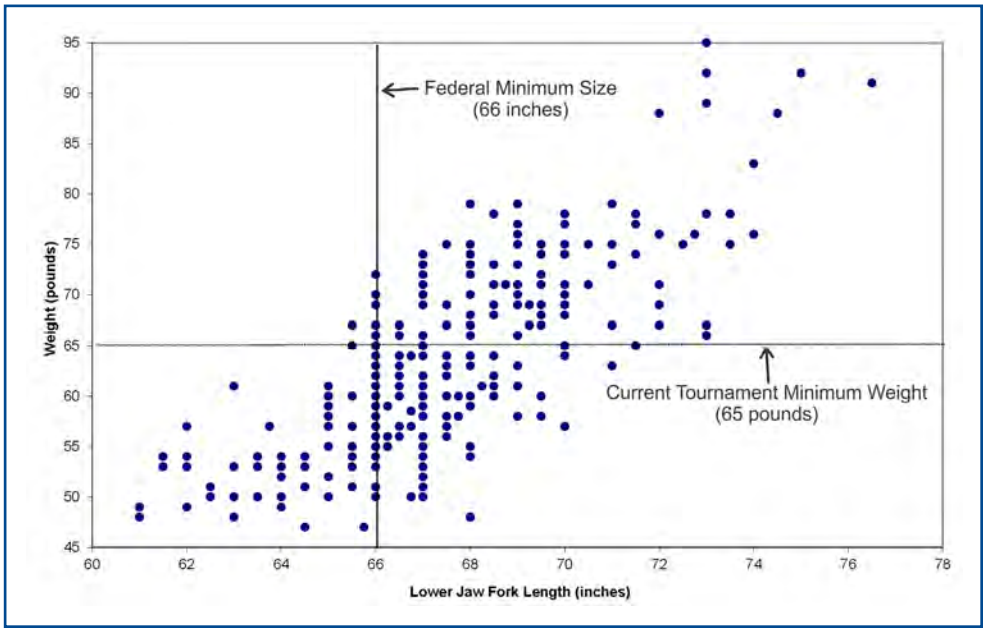
Mid-Atlantic $500,000 — Facts & Figures

Blue Marlin Length-Weight Relationships (1992-2010)



There is a good relationship between length and weight for blue marlin. Fish need to be about 5 inches over the federal minimum size of 99 inches lower jaw fork length (LJFL) in order to meet the tournament minimum weight of 400 pounds. It's a different story for white marlin. The federal minimum size is 66 inches LJFL, but white marlin landed at the Mid-Atlantic $500,000 with a LJFL of 67 inches have weighed anywhere from 51 to 74 pounds! The best way to tell if a legal white marlin will make the tournament minimum weight is to see if it "carries the weight" all the way to the tail. Long, thin fish won't make weight!

White Marlin Length-Weight Relationships (1992-2010)



Winning Fish (weight in lbs.)

		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	200
White Marlin	1st	86	69	69	69	77	89	74	78	68	69	75	91	75	7
	2nd	83	68	65	68	69	76	71	67	61	63	61	79	74	6
	3rd	76	61	65	64	66	72	68	63	---	63	60	79	71	6
Blue Marlin	1st	466	615	586	746	455	748	534	522	566	578	558	433	518	69
	2nd	384	488	542	660	410	493	468	480	476	421	---	---	---	52
	3rd	359	435	522	519	407	448	412	464	---	---	---	---	---	41
Tuna	1st	109	254	242	205	153	120	221	204	172	114	147	82	182	19
	2nd	102	218	213	166	142	103	181	185	153	114	136	72	150	7
	3rd	95	200	139	108	126	99	105	185	141	112	81	61	132	6
Dolphin	1st	36	42	53	33	34	33	33	43	39	29	34	43	44	4
Wahoo	1st	44	67	73	47	79	69	38	72	86	76	75	95	58.5	7

Billfish Releases

White Marlin	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	200
Boated	15	20	23	16	18	13	10	14	3	10	10	13	14	
Released	84	136	174	177	153	124	231	432	58	220	182	144	313	24
% Released	85%	87%	88%	92%	89%	91%	96%	97%	95%	96%	95%	92%	96%	95

Blue Marlin	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	200
Boated	9	7	11	14	7	15	8	10	2	3	3	4	3	
Released	3	8	13	16	11	26	17	29	32	10	18	15	22	2
% Released	25%	53%	54%	53%	61%	63%	68%	74%	94%	77%	86%	79%	88%	84

Catch Per Unit Effort (CPUE)

White Marlin	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	200
# Fish Caught	99	156	197	193	171	137	241	446	62	203	192	157	327	25
# Boats x # Days	393	408	426	417	435	381	393	411	399	378	393	384	429	50
CPUE (fish/boat-day)	0.25	0.38	0.46	0.46	0.39	0.34	0.61	1.09	0.15	0.61	0.49	0.41	0.76	0.5

Blue Marlin	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	200
# Fish Caught	12	15	24	30	18	41	25	39	34	13	21	19	25	3
# Boats x # Days	393	408	426	417	435	381	393	411	399	378	393	384	429	50
CPUE (fish/boat-day)	0.03	0.04	0.06	0.07	0.04	0.11	0.06	0.09	0.09	0.03	0.05	0.05	0.06	0.0
Marlin/Boat-Day	0.28	0.42	0.52	0.53	0.43	0.45	0.67	1.18	0.24	0.64	0.54	0.46	0.82	0.5

05	2006	2007	2008	2009	2010
75	88	92	92	95	88
68	79	77	88	78	88
67	77	69	79	78	82
99	722	536	719	453	---
25	641	524	625	---	---
18	469	414	501	---	---
93	184	212	80	69	177
78	123	172	78	69	105
60	118	168	77	67	84
47	44	39	43	37	56
74	93	77	74	97	49

05	2006	2007	2008	2009	2010
14	18	23	31	28	31
44	444	274	423	322	526
5%	96%	92%	93%	92%	94%
05	2006	2007	2008	2009	2010
5	6	3	3	2	2
25	19	23	11	14	11
4%	76%	88%	79%	88%	85%

05	2006	2007	2008	2009	2010
58	462	297	454	350	557
07	528	462	423	408	402
51	0.87	0.64	1.07	0.86	1.39
05	2006	2007	2008	2009	2010
31	25	26	14	16	13
07	528	462	423	408	402
06	0.05	0.06	0.03	0.04	0.03
57	0.92	0.70	1.10	0.90	1.42

How's Fishing?

The Mid-Atlantic $500,000 white marlin catch data for the past 19 years are encouraging. As you can see in Figure 4 below, there has been a general increase in white marlin catch per unit effort as well as the aggregate weight of the 1st, 2nd, and 3rd place white marlin (white marlin/boat-day) over the past 19 years. Clearly, there is some variability from year to year, but because the tournament is of a limited duration, short term events such as storms can have a large effect in any given year. The apparent increase in CPUE and weight of the largest fish is consistent with a rebuilding population. Not only are there more fish (higher catch rates), but fish are living longer and reaching a larger size. These observations suggest a reduction in fishing mortality, and that has come about through the Atlantic-wide release of live white marlin from pelagic longline gear, the reduction in the U.S. Atlantic coastal pelagic longline fleet, and the widespread use of circle hooks in the recreational white marlin fishery. The past few falls have seen some incredible white marlin fishing with some boats releasing more than 40 white marlin in a day. Who knows, these just may be the "good old days" for white marlin.

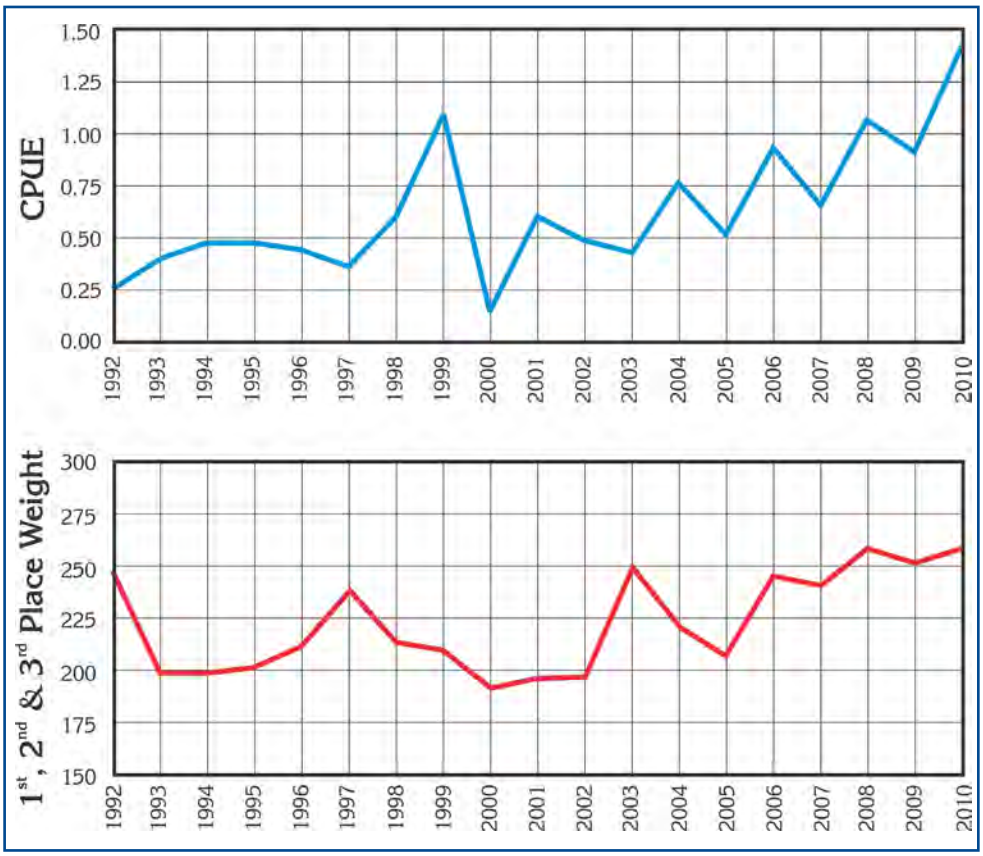


Figure 4. These data show the catch per unit effort (CPUE) in white marlin/boat-day and the aggregate weight of the 1st, 2nd, and 3rd place white marlin at the Mid-Atlantic $500,000 for each of the past 19 years. Note the strong upward trends over the last 10 years.

It's All About the Hook

At the time of the first Mid-Atlantic $500,000 in 1992, little was known about the fate of billfish released from recreational or commercial fishing gears. Results from conventional tagging studies using dart ("spaghetti") tags were not encouraging. Typically less than 1% of the tags put out were recovered and reported. The low recovery rates could be indicative of high post-release mortality, but they also could result from tag shedding or simply a lack of motivation of fishers to return recovered tags. The development of pop-up satellite archival tag (PSAT) technology has provided a tool that allows us to follow the fate of billfish without relying upon someone to recapture the animal and send in the tag. Today's PSATs collect temperature, depth, and light level information every few minutes, pop off the animal at a pre-programmed time, float to the surface, and transmit the archived data to satellites of the ARGOS system. Over the past fifteen years there has been a rapid evolution in PSAT technology. Our original tags collected only 61 temperature readings, while current tags collect literally thousands of temperature, depth, and light level readings. Unfortunately, there has not been a big reduction in price. Tags go for $3,000 - $4,000 each and the satellite time is another $500 per tag. Ouch!

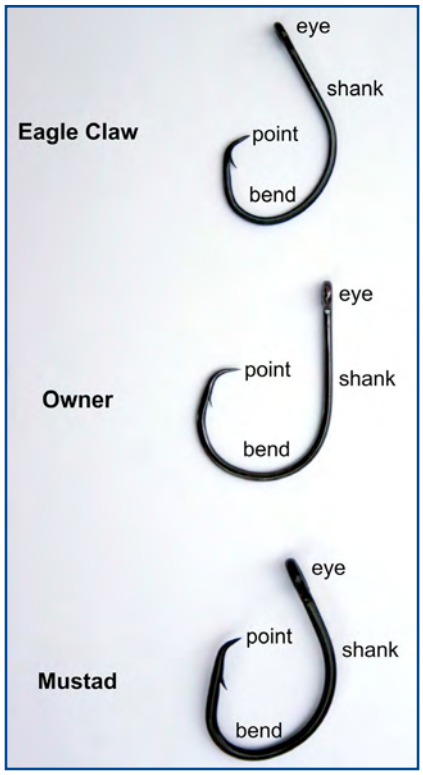


Figure 5. Three models of circle hooks used in our study of white marlin post-release survival. Relative to J hooks, all 3 models significantly reduced the incidence of deep hooking, bleeding and post-release mortality.

Drs. Eric Prince, Brian Luckhurst, and I first deployed PSATs on blue marlin caught in the high speed troll fishery off Bermuda in 1999. Eight of the nine tags we deployed reported back, and the temperature information indicated that all eight fish for which we had data survived — a solid confirmation that catch-and-release fishing for billfish has a strong conservation benefit. Shortly after that, my M.S. student (now professor) Andrij Horodysky and I investigated post-release mortality of white marlin caught on natural baits rigged with J hooks or circle hooks in the slow troll, drop-back fishery. The results were striking. Seven of 20 (35%) white marlin caught on J hooks died within ten days of release, while none of the 20 white marlin caught on circle hooks died. That's a huge difference! Overall, circle hooks resulted in a significant decrease in deep hooking, bleeding, and post-release mortality. In a subsequent study we compared the performance of three different models of circle hooks (Figure 5), and found no significant differences in hooking location or survival among the hook types. Only one fish in the total sample of 59 died (1.7%). Clearly, circle hooks have a major conservation benefit for white marlin.

Based on these studies, the National Marine Fisheries Service enacted a measure requiring the use of circle hooks in natural baits in Atlantic billfish tournaments. During the rule making process, many anglers noted that the rule would do little to conserve blue marlin as most blue marlin were hooked externally with J hooks. Unfortunately, there were few data to support this, so with the help of three charter captains we recorded hook type and hooking location for 123 blue marlin, 272 white marlin, and 132 sailfish caught on ballyhoo rigged with J hooks or circle hooks. While ~40% of white marlin and sailfish caught on ballyhoo rigged with J hooks were hooked internally (inside the mouth or deeper), only 14% of blue marlin taken on the same baits and hooks were hooked internally (Table 2). For

Table 2. Hooking locations of blue marlin, white marlin, and sailfish caught on ballyhoo baits rigged with either circle hooks or J hooks.

		Hooking Location	
Species	Hook Type	Internal	External
Blue marlin	Circle	2% (1)	98% (54)
	J	19% (13)	81% (55)
White marlin	Circle	2% (4)	98% (196)
	J	44% (32)	56% (40)
Sailfish	Circle	6% (5)	94% (76)
	J	41% (21)	59% (30)

all three species, circle hooks resulted in a significant decrease in internal hooking locations, but the difference was much smaller for blue marlin than for white marlin and sailfish.

One cannot estimate post-release survival from hooking location data alone, and we used PSATs to study the fate of 59 blue marlin caught on llander/natural baits with J hooks or natural baits with circle hooks (Figure 6). All 29 blue marlin caught on natural baits with circle hooks survived for ten days following release, while 2 of 30 blue marlin caught on llander/natural bait /J hook combinations died following release. That resulted in a post-release mortality for blue marlin caught on J hooks of 6.7%, a lot lower than the 35% post-release mortality we found for white marlin caught on natural baits with J hooks. The bottom line is that while the magnitude of the benefit may vary among species, circle hooks have a significant conservation benefit for all billfish.

Figure 6. Attaching a PSAT to a blue marlin caught off Venezuela (photo by Bill Watts).

A Bigger Impact: Post-Release Survival of Billfish Caught on Pelagic Longline Gear

The recreational fishery for billfishes represents a minor fraction of the overall fishing mortality for these species, with the pelagic longline fishery and artisanal fisheries accounting for the vast majority of removals. While changes in fishing practices in the recreational fishery, such as catch-and-release fishing and the use of circle hooks, have reduced billfish fishing mortality, much greater gains can be made by changing practices in the pelagic longline and artisanal fisheries. The trouble has been getting international agreement to implement such measures. Because stocks of the major species targeted by the pelagic longline fleet (yellowfin tuna, bigeye tuna, and swordfish) are in relatively good shape, there has been little motivation for many countries to agree to measures to protect billfish, especially if those measures would decrease catch rates of target species. Typically, more than half of the billfish taken on pelagic longline gear are alive at the time of haulback, so release of live billfish could significantly reduce fishing mortality, if released fish survive. Several years ago the United States proposed a measure at ICCAT promoting live release of billfish. However, several countries took issue with the proposal, noting that the very low rates of conventional tag returns for billfishes (typically less than 1%) was consistent with high post-release mortality. But that was only one side of the story.

Working with my graduate student (now professor) Dave Kerstetter, we used pop-up satellite archival tags (PSATs) to look at the survival of billfish released from pelagic longline gear. Contrary to inferences made from conventional tagging data, the PSATs demonstrated high post-release survival of blue marlin (78%), white marlin (76%), and sailfish (88%). In our initial study on blue marlin, we heard back from seven of nine tags, and the data from each of the seven reporting tags was consistent with survival. While not a huge sample size, these data were sufficient to convince ICCAT nations of the potential conservation benefits of live release and a binding measure requiring live release of blue marlin and white marlin was implemented in 2001. Overall, those seven reporting tags have had a huge impact!

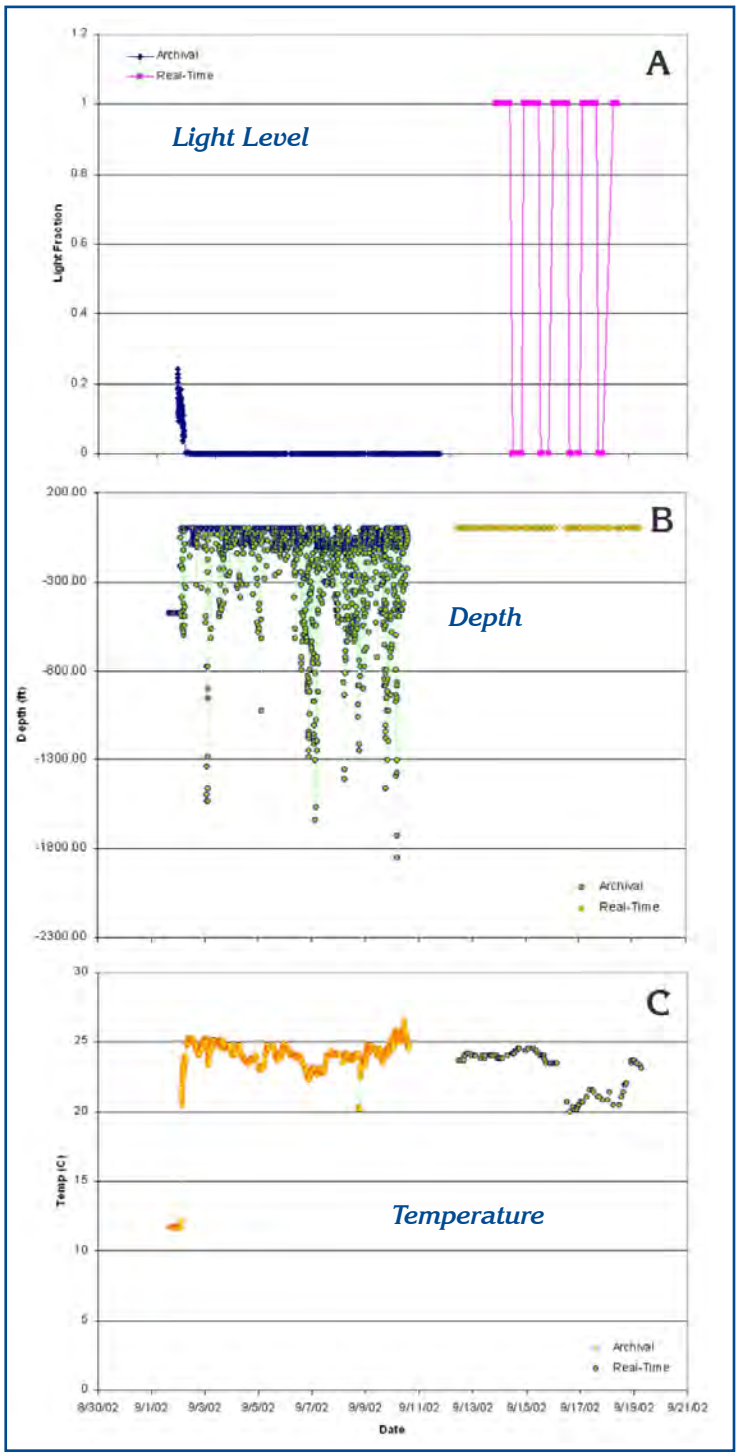
Reduce, Reuse, Recycle?

Pop-up satellite archival tags (PSATs) are quite expensive at $3,000 - $4,000 each. However, if we are lucky enough to get a tag returned, not only can we recover 100% of the archived data, we can get the tag rebuilt for a mere $800. Of course, wouldn't it be great if we could get information from more than one fish with a single tag? Sometimes, we can.

On 1 September 2002 we attached a PSAT to a 50-lb. white marlin caught on pelagic longline gear off the southwest corner of Georges Bank. The tag was programmed to collect light level, pressure (depth) and temperature data every four minutes, and release from the fish after ten days. The light level data collected by the tag suggest the white marlin quickly died and sank to the bottom where it was constantly dark. The fish apparently remained on the bottom for ten days when the tag released and floated to the surface, producing the day/night differences (Figure 7A). However, the depth data indicate the tag was only on the bottom at 400 feet for ten hours, not ten days. After ten hours the tag began moving throughout the water column between the surface and 1800 feet (well below the maximum depth of 800 feet that we have seen other white marlin dive). The temperature data show the tag was in 12°C water for ten hours, but then the temperature rapidly increased to 26°C (higher than the local sea surface temperature). The temperature remained elevated for the next nine days, even during the extended dives into cool waters (typically the temperature drops significantly on deep dives).

What happened? Apparently, the white marlin died shortly after it was tagged and sank to the bottom at 400 feet. After ten hours, the dead white marlin (with PSAT attached) was scavenged by a large shark, and the tag continued to collect data from inside the dark confines of the shark's stomach. Only two species of sharks found in the area maintain elevated temperatures, so the culprit was either a great white or short-fin mako (the temperature was too low to be a cetacean). The tag probably released from the white marlin on schedule but had nowhere to go. It took another day and a half for the shark to regurgitate the tag. One tag, two tracks.

Since that first case of scavenging, we have noted two others. We've also inferred predation when the behavior of a blue marlin released off the North Drop of St. Thomas changed dramatically a few hours after release, coincident with an early onset of night and the loss of day/night light differences. Shark predation of released billfish can be a problem in the waters off the North Drop, and this blue marlin appeared to lose the battle against the "men in gray suits." Remarkably, we have had four tags that were ingested and regurgitated by sharks and still managed to function. We haven't had many non-reporting tags, but one wonders if some of those non-reporting tags didn't make it through the sharks' jaws in working order.



Figures 7A-C. Graphs of light (A), depth (B), and temperature (C) data for the white marlin PSAT tag deployment. Data to the left of the break are archival (tag attached to the fish) and to the right are real-time (tag floating at the surface).

Billfish Management

International Management

At the 2000 commission meeting, the International Commission for the Conservation of Atlantic Tunas (ICCAT) approved a management measure requiring the release of live blue and white marlins caught on pelagic longline gear. The measure also required each country to reduce landings of blue marlin by 50% and landings of white marlin by 67% from the amount they reported in 1996 or 1999 (whichever was higher). This management measure also restricted the U.S. recreational landings of blue marlin and white marlin to 250 fish combined. The measure took effect in 2001 but it took a few years for most countries to implement domestic management measures for live release. For the past several years, reported landings Atlantic-wide have reflected the mandated reduction, indicating good compliance. The management measure requiring live release was set to expire at the end of 2010, so one of the United States' objectives at last year's ICCAT meeting was to extend the measure. Brazil was also keenly interested in extending the measure, and they originally tabled a proposal that increased the reduction in blue marlin harvest from 50% to 67% of levels reported in 1996 or 1999, putting it on par with the reductions for white marlin. Unfortunately, there was considerable push-back to a more stringent measure; in fact, it was difficult to get consensus on extending the measure for one more year, allowing time to consider the results of an assessment of Atlantic blue marlin conducted by ICCAT fisheries scientists this spring. Opposition to the live release measure was voiced from some of the major pelagic longline nations who wanted to know why the pelagic longline fishery was being singled out, while artisanal fisheries, which can have high catches of billfish, were not addressed. Also, some developing nations such as Trinidad and Tobago noted that marlins are an important food source in their countries.

Unfortunately, the results of the 2011 blue marlin assessment are not encouraging. In 2006 ICCAT scientists conducted an analysis of blue marlin catch and effort trends which suggested that the consistent decline in stock levels of blue marlin going back to the early 1960s had been arrested, and there was hope that further implementation of the live release measure would allow some rebuilding. However, the full assessment conducted this spring indicates that stock levels have continued to decline. While the mandated reductions have occurred in the pelagic longline fishery, these appear to have been more than offset by increases in catches by small scale artisanal fisheries, many of which do not report landings. Getting these fisheries under control will be a major challenge at this year's ICCAT meeting. Without some meaningful reductions in the effort of artisanal fisheries, there will be little or no chance of pelagic longline fisheries taking further reductions, and continuation of the live release measure could be in jeopardy.

Domestic Management

Over the past 20 years there have been some significant changes in the domestic management of Atlantic billfish fisheries. The National Marine Fisheries Service (NMFS) made an effort to get more public input into the management process, establishing the Billfish Advisory Panel in 1997, which was then merged with the advisory body of the Highly Migratory Species Advisory Panel in 2003. In 2001, the United States was required to implement the ICCAT management measure limiting our recreational landings of white marlin and blue marlin to 250 fish combined. This was accomplished by increasing the minimum size of white marlin to 66 inches and blue marlin to 99 inches. With these minimum sizes, and the strong release ethic of most billfish fishers, reported billfish landings have not approached the annual limit of 250 fish. NMFS also implemented a requirement to use circle hooks with natural baits in Atlantic billfish tournaments in 2007, a measure aimed at reducing post-release mortality. And most recently, NMFS recognized the roundscale spearfish as a valid species, and placed it under the same management measures as white marlin.

Ten Days in the Life of a Mid-Atlantic White Marlin and Blue Marlin

Over the course of the past ten years we have deployed pop-up satellite archival tags (PSATs) on more than 100 white marlin and 80 blue marlin caught in the western Atlantic. In addition to letting us know whether or not a fish survived, the PSAT data give us a detailed picture (data points every two minutes) of how the animal spent their time for ten days. We now have a large data base of billfish depth and temperature utilization from as far north as Georges Bank and as far south as northern Brazil. Below (Figure 8), I present information for a white marlin and blue marlin released in the mid-Atlantic in late August 2006 and 2008, respectively.

White marlin 62119 was caught near the Baltimore Canyon on 24 August 2006. The 45 lb. fish ate a naked ballyhoo rigged with a circle hook on 20 lb. test, and it took 40 minutes to catch the fish and get it sufficiently calm at the boat to attach the tag. Blue marlin 36435 was caught on 17 August 2008 about 35 nautical miles southeast of Cape Hatteras. The 375 lb. fish took a Sea Witch/ballyhoo bait rigged with a J hook on 80 lb. test and was caught and tagged in 40 minutes. Both fish were in good condition at the time of release.

The tags for the two fish popped up after ten days. The white marlin had traveled 475 nmi to the northeast and the blue marlin had moved 380 nmi in a similar direction. These are fairly large movements relative to white marlin and blue marlin tagged in other areas, so it is likely that the Gulf Stream provided an assist.

However, large daily movements are not uncommon. Billfish, like tunas, must be moving forward to respire, so they are always on the go.

Both fish spent the vast majority of their time in the top 10 m (33 ft) in the warmest waters available. For white marlin 62119, the surface temperature was 27°C (81°F) for the first six days, but then increased to 30°C (86°F) for two days as it entered and exited the Gulf Stream. This fish made dives to 40 – 60 m (130 – 200 ft) every day, and there was no evidence of a shift in diving behavior from day to night. As the white marlin made dives, the water temperature dropped. However, in the Gulf Stream, the thermocline is much deeper, and so there was much less of a temperature change on dives when the fish was in the Gulf Stream.

Unlike most of the fish we have tagged, blue marlin 36435 did not immediately exhibit "normal" blue marlin behavior when released. For the first four days it stayed at or near the surface in waters that slowly cooled from 27 – 26°C (81 - 79°F). Late on the fourth day, the fish began exhibiting behavior that is typical of blue marlin, making daily dives to at least 110 m (360 ft), and some to depths of 170 m (560 ft), quite a bit deeper than the white marlin. Also there was a distinct day/night patterning to the dives. Almost all of the deep dives were made during daylight hours, while evenings were spent close to the surface. This pattern, which is typical of most blue marlin, is quite different from white marlin which typically dive during the day and night.

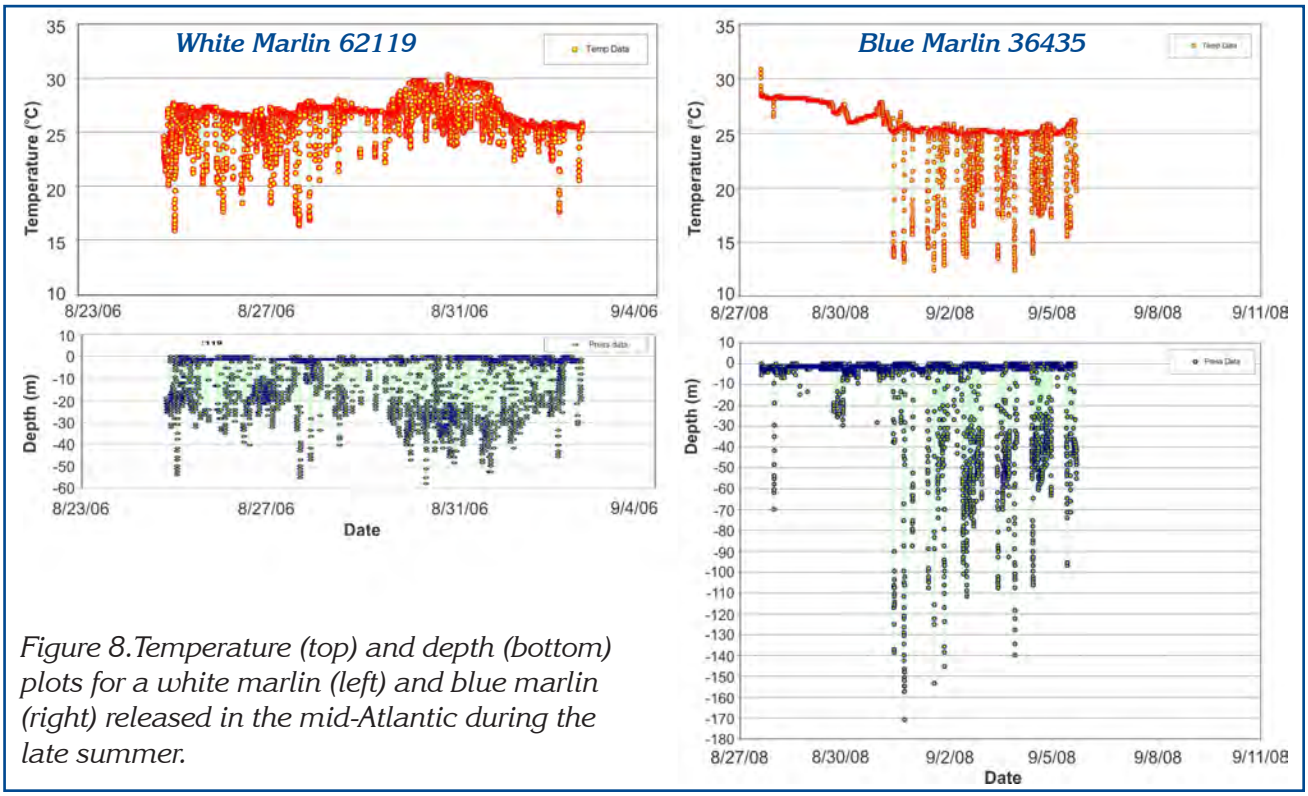


Figure 8.Temperature (top) and depth (bottom) plots for a white marlin (left) and blue marlin (right) released in the mid-Atlantic during the late summer.