IOTC Working Party on Billfish (WPB) Victoria, Seychelles

06-10 September 2016

A preliminary summary of billfish tagging in the Indian Ocean

Evgeny V. Romanov

CAP RUN (Centre Technique d'Appui à la Pêche Réunionnaise) – HYDRÔ REUNION, Magasin n°10, Darse de pêche hauturière, Port Ouest, 97420 Le Port, Île de la Réunion, France

* Corresponding author, e-mail: evgeny.romanov@ird.fr

ABSTRACT

A summary of billfish tagging experiments conducted by various research organizations in the Indian Ocean is presented.

Introduction

A summary of billfish tagging experiments conducted by various research organizations in the Indian Ocean is developed as a reference documents for further considerations of WPEB and IOTC Secretariat. Research programmes are grouped in alphabetical order of names of respective institutions.

Summary of tagging efforts

Australia

NSW DPI Game Fish Tagging Program

Species: Billfish, Tuna, Sharks, others

Goal: -

Area: Pacific Ocean, Indian Ocean.

Period: 1973-2016-ongoing

Funding: NSW Recreational Fishing Trust

Field operations:

Contacts: Julian Pepperell (gamefish.tagging@dpi.nsw.gov.au)

Table 1. Some tagging activities (tag-recaptures Indian Ocean) highly **incomplete** summary.

Species	Latin name	Tagged (recovered) by tag type					Total
		Acoustic	**Satellite**	**SPOT**	Archival	Conventional	
Black marlin	*Makaira indica*					4 (4)	4 (4)
Blue marlin	*Makaira mazara*					1 (1)	1(1)
Sailfish	*Istiophorus platypterus*					741 (20)	741 (20)
Total						746 (2)	746 (2)

References:

Anonymous, 2009a, 2009b, 2010, 2011.

CSIRO

Species: Swordfish

Goal: - Determining the nature and extent of swordfish movement and migration around Australia

Area: Pacific Ocean, Indian Ocean.

Period: 2000-2005

Funding: Australian Government

Field operations:

Contacts:

Table 2. Tagging activities summary for the program.

Species	Latin name	Tagged (recovered) by tag type					Total
		Acoustic	**Satellite**	**SPOT**	Archival	Conventional	
Swordfish	*Xiphias gladius*					422 (5)	422 (5)
Total						422 (5)	422 (5)

References:

Stanley, 2006.

France

IFREMER

Species: Swordfish

Goal: Behaviour, post-release survival rate

Area: Indian Ocean (Reunion Island, Seychelles)

Period: 1999-2000

Funding: EU

Field operations: Francois Poisson, Marc Taquet

Contacts: François Poisson (francois.poisson@ifremer.fr)

Table 3. Tagging activities

Species	Latin name	Tagged (recovered / data transmitted) by tag type					Total
		Acoustic	**Satellite**	**SPOT**	Archival	Conventional	
Swordfish	*Xiphias gladius*		6 (0)				6 (0)
Total			6 (0)				6 (0)

References:

6. Poisson, Taquet, 2001.

CAP RUN – Hydrô Réunion

Species: Swordfish

Goal: Behaviour, migratory patterns

Area: Indian Ocean (Reunion Island)

Period: 2015 - ongoing

Funding: EU, Region Reunion

Field operations: Loïc Le Foulgoc, Emilie Richard, Evgeny Romanov

Contacts: Evgeny Romanov (evgeny.romanov@ird.fr)

Table 4. Tagging activities

Species	Latin name	Tagged (recovered / data transmitted) by tag type					Total
		Acoustic	**Satellite**	**SPOT**	Archival	Conventional	
Swordfish	*Xiphias gladius*		1 (1)				1 (1)
Total			1 (1)				1 (1)

References:

6. Romanov et al., 2016

Kenya

African Billfish Foundation

Species: Billfish, Tuna, Sharks, others

Goal: -

Area: Indian Ocean.

Period: 2005-2014-ongoing

Funding: -

Field operations:

Contacts: info@africanbillfish.org

Table. 5 Some of tagging activities (tag-recaptures Indian Ocean) as shown in Harris et al., 2013 and at http://www.africanbillfish.org/index.htm

Species	Latin name	Tagged (recovered) by tag type					Total
		Acoustic	**Satellite**	SPOT	Archival	Conventional	
Blue marlin	*Makaira mazara*					212 (1)	212 (1)
Black marlin	*Makaira indica*					341 (2)	341 (2)
Striped marlin	*Tetrapturus audax*					1641 (3)	1641 (3)
Sailfish	*Istiophorus platypterus*					8536 (5)	8536 (5)
Shortbill spearfish	*Tetrapturus angustirostris*					2 (0)	2 (0)
Swordfish	*Xiphias gladius*					19+? (3)	19+? (3)
Total						43500 (1500)*	43500 (1500)*

* No further details available

References:

Harris et al., 2003; ABF, 2016.

Spain – Tagging Program of the IEO

Species: Pelagic sharks, swordfish.

Goal: -

Area: Worldwide, Indian Ocean.

Period: 1984-2004

Funding:

Field operations:

Contacts: ? Jaime Mejuto (IEO, Spain)

Table 6. Summary of tagging activities (swordfish only)

Species	Latin name	Tagged (recovered) by tag type					Total
		Acoustic	**Satellite**	**SPOT**	Archival	Conventional	
Swordfish	*Xiphias gladius*					? (1)*	? (1)
Total						? (1)	? (1)

* Tagged with The Billfish Foundation 'spaghetti' tag

References:

12. Kasapidis et al., 2008.

South Africa

OCEANOGRAPHIC RESEARCH INSTITUTE (ORI) Tagging Project

Species: Coastal Sharks

Goal: Linefish management and conservation

Area: South Africa

Period: 1983-2014-ongoing

Funding: Initially from the public sector. More recently we have internal funding from SAAMBR (South African Association for Marine Biological Research- ORI's company name) and from the regional government authority DAEA (Department of Agriculture and Environmental Affairs)

Field operations:

Voluntary tagging, Managed by ORI tagging team

Contacts: Stuart Dunlop (oritag@ori.org.za).

Table 7. Summary of tagging activities billfish only

Species	Latin name	Tagged (recovered) by tag type					Total
		Acoustic	**Satellite**	**SPOT**	Archival	Conventional	
Blue marlin	*Makaira mazara*					389 (0)	389 (0)
Black marlin	*Makaira indica*					806 (2)	806 (2)
Striped marlin	*Tetrapturus audax*					542 (2)	542 (2)
Sailfish	*Istiophorus platypterus*					3538 (29)	3538 (29)
Shortbill spearfish	*Tetrapturus angustirostris*					39 (0)	39 (0)
Total						5314 (33)	5314 (33)

References

13. Anonimous, 2015. Dunlop et al., 2013.

UK-Switzerland-Australia-USA

Chagos Archipelago – Bertarelli Foundation

Species: Tuna, Billfish, Sharks,

Goal: Researchers from Stanford University, the University of Western Australia and the Zoological Society of London use electronic tag technology to study the residency and connectivity of pelagic fish, sharks and mantas, within and around the Chagos Archipelago.

Area: Chagos Archipelago

Period: 2013-2015

Funding: Bertarelli Foundation

Field operations: TK Chapple, A Carlisle, JD Dale, R Schallert & BA Block, Hopkins Marine Station of Stanford University; D Tickler, Centre for Marine Futures, Oceans Institute, University of Western Australia

Contacts: Barbara Block (bblock@stanford.edu), Taylor Chapple (tchapple@stanford.edu)

Table 8. Summary of tagging activities (billfish only)

Species	Latin name	Tag type					Total
		Acoustic	**Satellite**	**SPOT**	Archival	Conventional	
Sailfish	*Istiophorus platypterus*		2				2
			2				2

References:

Schallert et al., 2013; Chapple et al., 2015.

UAE

Species: Sailfish

Goal: - Sailfish studies in the Persian Gulf

Area: Persian Gulf.

Period: 1983-2000

Funding: Environmental Research and Wildlife Development Agency (ERWDA)

Field operations: ?

Contacts: John Hoolihan (john.hoolihan@noaa.gov)

Table 9. Summary of Persian Gulf sailfish activities (including tags from TBF, NSW, NMFS, ORI, ABF)

Species	Latin name	Tagged (recovered or transmitted for PSATs) by tag type					Total
		Acoustic	**Satellite**	SPOT	Archival	Conventional	
Sailfish (international agencies)	*Istiophorus platypterus*					1489 (42)	1489 (42)
Sailfish (ERDWA)	*Istiophorus platypterus*		18 (14)			2053 (114)	2071 (128)
Total			18 (14)			3542 (156)	3560 (170)

References:

Hoolihan, 2003, 2005; Hoolihan, Luo, 2007

USA (tags sponsored locally and internationally and deployed locally in South Africa (2012), Australia (2012), Kenya (2013), and Seychelles (2014-2015))

IGFA – Great Marlin Race

Species: Marlins

Goal: -

Area: Indian Ocean: South Africa, Australia, Kenya, Seychelles.

Period: 2012-2014 – ?ongoing?

Funding: ?

Field operations: ?

Contacts: Jason Schratwieser (jschratwieser@igfa.org), Leah Baumwell (lbaumwell@igfa.org)

Table 10. Summary of some IGFA billfish tagging activities

Species	Latin name	Tagged (recovered) by tag type					Total
		Acoustic	**Satellite**	**SPOT**	Archival	Conventional	
Blue marlin	*Makaira mazara*		17 (?)				17 (?)
Black marlin	*Makaira indica*		12 (?)				12 (?)
Striped marlin	*Tetrapturus audax*		0				0
Sailfish	*Istiophorus platypterus*		0				0
Shortbill spearfish	*Tetrapturus angustirostris*		0				0
Swordfish	*Xiphias gladius*		0				0
Total			29 (?)				29 (?)

References:

IGFA, 2016; http://oceanview.pfeg.noaa.gov/ATN/ , Wetjens Dimmlich, pers. comm, 2016.

TBF The Billfish Foundation

Species: Billfish

Goal: -

Area: Indian Ocean

Period: 2012-2014 – ?ongoing?

Funding: ?

Field operations: recreational fishermen

Contacts: Peter Chaibongsai (peter_chaibongsai@billfish.org)

Table 12. Summary of some TBF billfish tagging activities (recoveries only)

Species	Latin name	Tagged (recovered) by tag type					Total
		Acoustic	**Satellite**	**SPOT**	Archival	Conventional	
Blue marlin	*Makaira mazara*					? (2)	? (2)
Black marlin	*Makaira indica*					? (5)	? (5)
Striped marlin	*Tetrapturus audax*					? (3)	? (3)
Sailfish	*Istiophorus platypterus*					? (101)	? (101)
Total						? (111)	? (111)

References:

Peter Chaibongsai, 2016, pers. comm.

SWIOFP (IRD, France; DAFF, South Africa)

Species: Swordfish

Goal: -

Area: Indian Ocean: South Africa, Mozambique Channel, off Reunion and Madagascar

Period: 2011-2013

Funding:

Field operations:

Contacts: see references.

Table 12. Summary of swordfish tagging activities.

Species	Latin name	Tagged (recovered) by tag type	Total

		Acoustic	**Satellite***	**SPOT**	Archival	Conventional
Swordfish	*Xiphias gladius*		14 (5)			
Total			14 (5)			

*For a satellite tag figure in brackets means tags that transmitted data and not associated with immediate post-release mortalities.

References:

West et al., 2012, Marsac, 2013, pers. comm.

Acknowledgements

Thanks due to Stuart Dunlop (ORI/ SAAMBR), Grant Heyer (Avalon Project Management), Wetjens Dimmlich (WWF) and James Clark (MRAG) for summary information on tagging efforts of their respective organizations/research projects.

References

1. ABF, 2014. African Billfish Foundation online resource: www.africanbillfish.org/individual_inernational_recaptures.htm Accessed 01.09.2016.
2. Anonymous, 2009a. Aussie marlin travels to India. 'Blue Water Boats & Sportsfishing magazine' No 74
3. Anonymous, 2009b. Blue marlin recapture rewrites record books. 'Blue Water Boats & Sportsfishing magazine' No 74
4. Anonymous, 2010. Sailfish recaptures explode off the Western Australia coast. 'Tag Times News' No 1 December 2010
5. Anonymous, 2011. Second black marlin heads to India. 'Blue Water Boats & Sportsfishing magazine' No 83
6. Anonymous, 2011. Main fish species tagged up to 31 December 2015. Tagging News. ORI. 7-8. www.oritag.org.za
7. Chapple TK, Carlisle A, Dale JD, Schallert R, Tickler D, Block BA, 2015. BIOT Acoustic and Satellite Tagging Project Final Report, March 2015. Foundation Bertarelli. Gstaad, Switzerland
8. Dunlop S.W., Mann B.Q., van der Elst R.P. 2013. A review of the Oceanographic Research Institute's Cooperative Fish Tagging Project: 27 years down the line. African Journal of Marine Science 35: 209-221.
9. IGFA, 2016.International Gamefish Association. Great Marlin Race https://igmr.igfa.org/Conserve/IGMR.aspx. Consulted on 05.09.2016
10. Harris T, Harris C, Kadagi N, 2013. Developments in the East African Billfish Conservation and Research programme. IOTC-2013-WPB-19, Indian Ocean Tuna Commission, Working Party on Billfish, La Reunion, 18-22 September 2013, 17 p.

11. Hoolihan J (2003) Sailfish movement in the Arabian Gulf: a summary of tagging efforts. Mar Freshw Res 1993:509–513.
12. Hoolihan JP (2005) Biology of Arabian Gulf sailfish. Ph.D. Thesis. University of New South Wales.
13. Hoolihan JP, Luo J (2007) Determining summer residence status and vertical habitat use of sailfish (Istiophorus platypterus) in the Arabian Gulf. ICES J Mar Sci 64:1791–1799.
14. Kasapidis P, Valeiras X, García-Cortés B, Mejuto J (2008) Genetic and growth profiles of several specimens of swordfish (Xiphias gladius) tagged and recaptured in the Atlantic, Indian and Pacific Oceans. ICCAT Col Vol Sci Pap 62:1142-1151.
15. Poisson F, Taquet M, 2001. L'espadon: de la recherche à l'exploitation durable. Programme Palangre Réunionnais Rapport final. IFREMER. 247 p.
16. Romanov E, Sabarros P S, Le Foulgoc L, Bach P, 2016. A preliminary analysis of swordfish (Xiphias gladius) habitat and behaviour on migratory track from Reunion Island to equatorial waters. IOTC Working Party on Billfish (WPB) Victoria, Seychelles, 06-10 September 2016. IOTC-2016-WPB14-16, 20 p.
17. Schallert R, Block B, Tickler, D., 2013. Tagging of pelagics. British Indian Ocean Territory. Foundation Bertarelli. Gstaad, Switzerland. [NP].
18. Stanley CA, 2006. Determining the nature and extent of swordfish movement and migration in the eastern and western AFZ through an industry-based tagging program. AFMA, Hobart (Australia) R99/1541.

Examples of some PSAT tagging data available.
The reports from IGFA Great Marline Race

South African Deep Sea Angling Association
IGFA Great Marlin Race 2013
Summary of Results

Event Summary

The South African Deep Sea Angling Association (SADSAA) launched the 4th Columbia Billfish Classic tournament on February 22, 2012. Through the efforts of SADSAA President Marius Vermaak and the generosity of the SADSAA Council, the captains, crews and all teh anglers who participated, this also marked the beginning of the first IGFA Great Marlin Race to be held in the Indian Ocean - and the first in the southern hemisphere.

The first morning of the tournament saw beautiful weather by South African standards (perhaps what may be called 'rough' to those lacking substantial sea legs, as South African fishermen do). It was at 9:40am that Riann Charmers fought a 150 kg (330 lb) blue marlin for 35 minutes, which was tagged by Darren Grey aboard the Big W.

The second day of the tournament brought brutal winds from the southwest, which forced the tournament to be called off for the day.

Early on the morning of the third day, a 70 kg (160 lb) marlin was fought and tagged by Eric Visser, aboard the Enigme, after a 35 minute bout with the blue. The day proved a bit rougher than it started out, with NE winds picking up later in the day. Saturday was also a sloppy day at sea, from the mix of NE winds and no current. The boat Trinity was the winner, having released 3 marlin during the tournament, more than any other boat.

After the tournament, on March 28th, three more tags were deployed on blues from boats fishing from Maphelane Beach. The Mitsufishi hooked up with a 120 kg (260 lb) blue at about half past six in the morning. After a 40 minute fight by Divan Coetsee, the fish was tagged by Hansie Van Wyk and released unharmed. A 200 kg (440 lb) blue hooked by Malcolm Buchanan was tagged and released from the Ocean Explorer about an hour later. The fifth tag was deployed on a blue marlin by Marius Vermaak, after it was hooked and reeled in by Peet Grobbelaar in a 55 minute fight. The stubborn blue weighed in at 220 kg (485 lb) from the Hlatikulu and tagger

Vermaak stated on the data sheet that it "was an honour to let the fish go with a sat tag," demonstrating the conservation-mindedness of the anglers participating in the IGMR.

On April 28 a sixth tag was placed on a 100 kg (220 lb) black marlin caught by Hardus Rothman on the *Little Joey*. Tag seven went out May 2 on another 100 kg (220 lb) black caught by Lizette Walker on *Proxima*. And the eighth and final tag was placed on "Bob the Marlin," a 95 kg (209 lb) black cdaught by Jan Hofman fishing from *Ocean Commotion*.

Tag Technology

All of the tags used in the SADSAA IGMR event were Wildlife Computers MK10 Pop Up Satellite Archival Tags (PATs), programmed for 120 day deployments. The tags were attached to leadered marlin brought alongside the boat, using a 59 mm titanium dart with an 18-20 cm monofilament leader (136 kg test), protected by a layer of braided Dacron surrounded by shrink-wrap to prevent abrasion, and inserted into the dorsal musculature of the marlin (i.e., the "shoulder") just below and behind the leading edge of the dorsal fin using an aluminum tagging pole.

The tags were deployed in "standby" mode, and were programmed to activate upon reaching a minimum depth of 10 m, at which time they began recording temperature, depth and light at 60 second intervals. These data were recorded on the tag until either the tag reached its programmed 120 day deployment period, or it detected no change in depth greater than +/-2.5 m for a period of 96 hours, indicating that it had either pulled free from the fish or that the fish had ceased all activity. Once one of these conditions was met, the tag would pass an electric current through the corroding pin attaching it to the leader, causing it to be released and float to the surface. Upon surfacing, the tag transmits for a period of 7-10 days, relaying a summary of its stored data through the Argos satellite system back to the laboratory.

Data Processing

When a tag reaches the surface and begins transmitting, its location is determined precisely using the Argos satellite system. This location, combined with the reported deployment location collected when the fish was originally tagged, is used to calculate the total point-to-point distance traveled by the fish, which is used to determine performance in the IGMR.

Once all of the data have been received from a tag, a series of plots are generated to visualize temperature and depth preferences, diving behavior and water column conditions. In addition, tag data are combined with corresponding sea surface temperature (SST) data from orbiting satellites to produce a rough track for the duration of the deployment. The position estimates of these tracks are further refined using a state-space model, used to optimize the track and provide a statistically-robust path for further analysis.

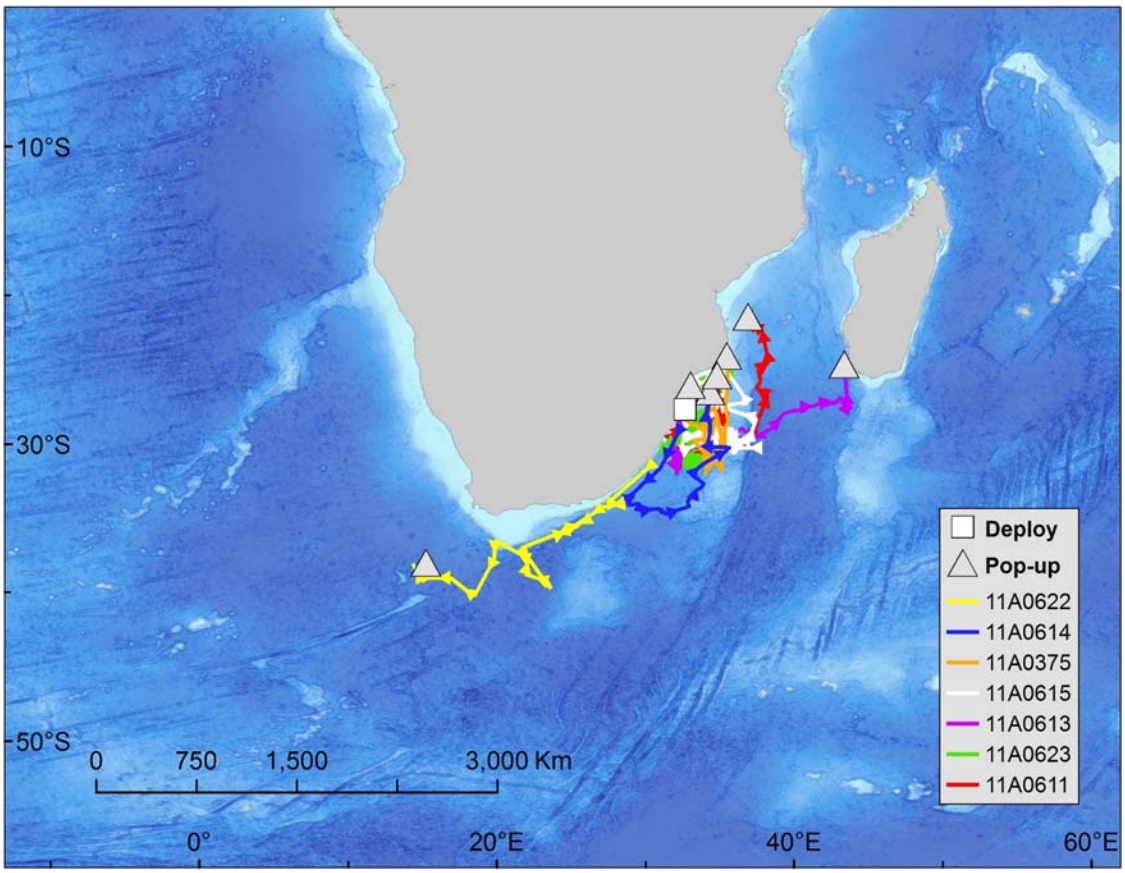
Results

Of the eight tags deployed during the SADSAA event, we had 100% reporting rate – which alone is a remarkable achievement, especially on marlin! This suggests that the tags were deployed skillfully, and that the fish did well in terms of survivorship – with no obvious indication of mortality. There was only one tag that appears to have pulled out immediately after being deployed (tag number 11A0618), with the remaining deployments ranging from 32 to 120 days, with 3 tags going the full deployment period (assuming that the 119 day deployment simply reflects a time zone artifact.) A brief summary of these results is presented in Table 1 below. Note that the fish are numbered in the order they were tagged:

Fish	Tag	Weight (kg)/species	Angler	Tagger	Boat	Deployment Date	Pop Up Date	Days	Distance (nm)
1	11A0622	150 blue	R. Charmers	D. Grey	Big W	2/22/12	4/5/2012	43	1018
2	11A0614	80 blue	Eric Visser	Eric Visser	Enigme	2/22/12	5/4/2012	72	174
3	11A0618	120 blue	Divan Coetlee	Hansle Van Wyk	Mitsufishi	3/28/12	4/1/2012	4	13
4	11A0613	200 blue	Malcolm Buchanan		Ocean Explorer	3/28/12	5/14/2012	47	636
5	11A0375	220 blue	Peet Grobbelaar	Marius Vermaak	Hlatikulu	3/28/12	4/29/2012	32	301
6	11A0611	100 black	Hardus Rothman	Chris Rothman	Little Joey	4/28/2012	8/25/2012	119	441
7	11A0623	100 black	Lizette Walker	Casper Walker	Proxima	5/2/2012	8/30/2012	120	223
8	11A0615	95 black	Jan Hofman	Elize Smith	Ocean Commotion	5/5/2012	9/2/2012	120	92

Reports from the race, including an interactive map with all the animal tracks, can be found on the IGFA website, at http://igmr.igfa.org/Tournaments/SouthAfrica.aspx . Because the controls on the map are not entirely intuitive, we suggest that to see the tracks on this map, locate the slider on the top left hand of the screen. Drag both slider buttons all the way to the right and then drag the left slider all the way back to the left, which should display all of the tag tracks. You can also animate these tracks by then dragging the right slider all the way back to the left and then clicking on the small stopwatch icon at the top of the slider.

The map below shows the tracks from all eight tags, processed through a "state space model" which provides a statistically-robust track that can be combined with other datasets and used in other analyses.



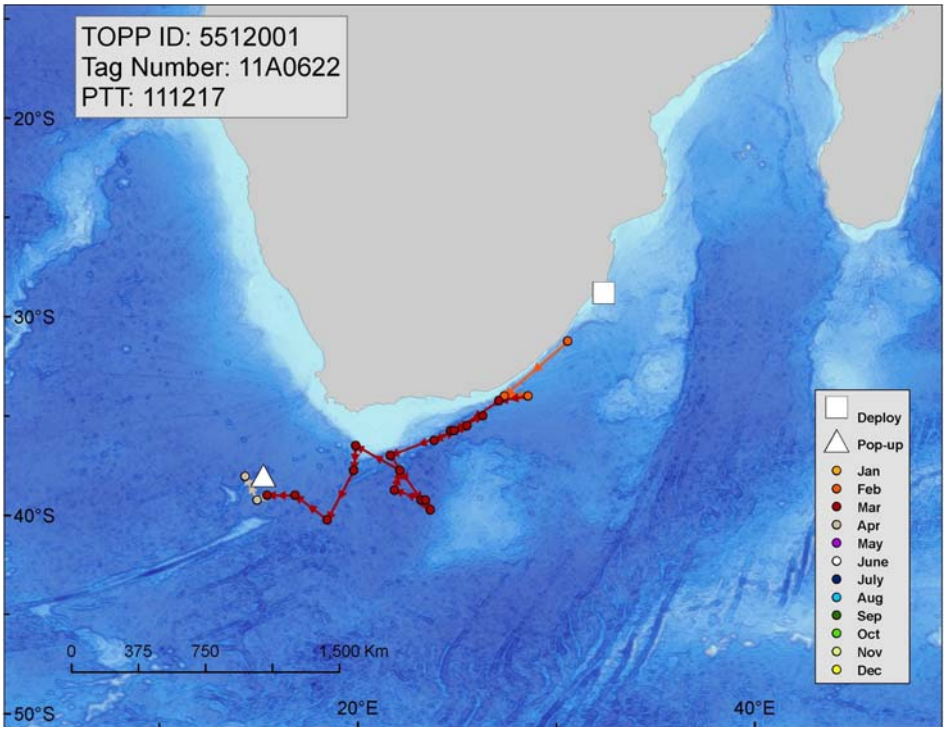
In looking at marlin tracks, perhaps the most striking feature is the diversity of behaviors they represent. Whereas most of the fish traveled generally north along the coast from where they were tagged, Fish 4 (Tag 11A0613) ventured much further offshore, with its tag reporting after 47 days at large just off the southwest coast of Madagascar. And Fish 1 (Tag 11A0622 which, coincidentally, went the furthest), ventured south and west, rounding Cape Agulhas and thus passing from the Indian Ocean into the Atlantic Ocean basin, with its tag reporting 1,018 nautical miles from where it was tagged after just 43 days at liberty.

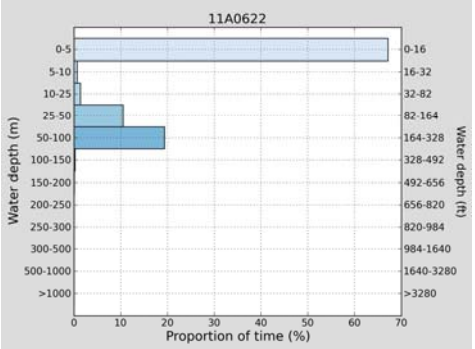
For each individual tag, results are summarized on the pages that follow. The tracks in these maps are less processed than the tracks above – showing the locations where each tag was deployed (white square), where it popped up (white triangle) and all of the light-based geolocations from each tag. In all cases, the marlin spent most of their time in the top 5 m of the water column, and less (though significant) time in depths between 25-100 m. They generally remained above the thermocline, with occasional, brief dives into the cooler waters between 150-250 m. These patterns appeared similar for both blue and black marlin.

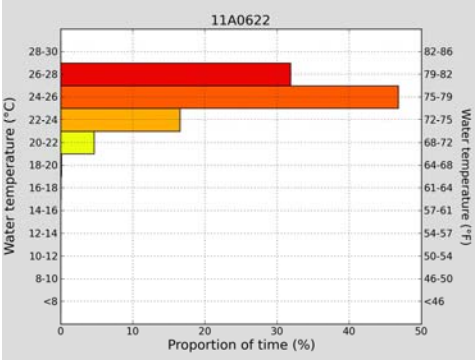
The IGFA and Stanford University would like to thank SADSAA and the individuals that sponsored tags for participating in the Great Marlin Race. Your leadership and benevolence facilitated research that is providing information on marlin migration patterns and open ocean habitat use on scale that has never been seen before. And the data from the IGMR has already been used enact better conservation measures for these fish. Data yielded from the IGMR was featured last year in IGFA's testimony to the United States Congress which ultimately led to the passage of the *Billfish Conservation Act* which now bans the importation of marlin, sailfish and spearfish into the United States. It is our hope that continuing this project in the years to come will lead to similar conservation measures for billfish internationally.

Tag 11A0622

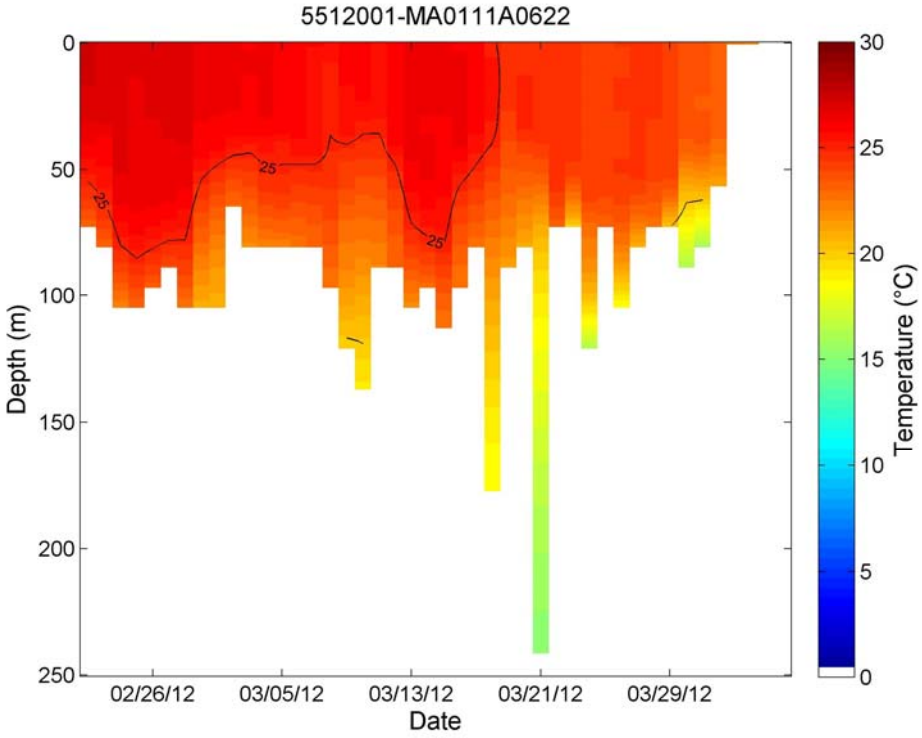
Fish 1





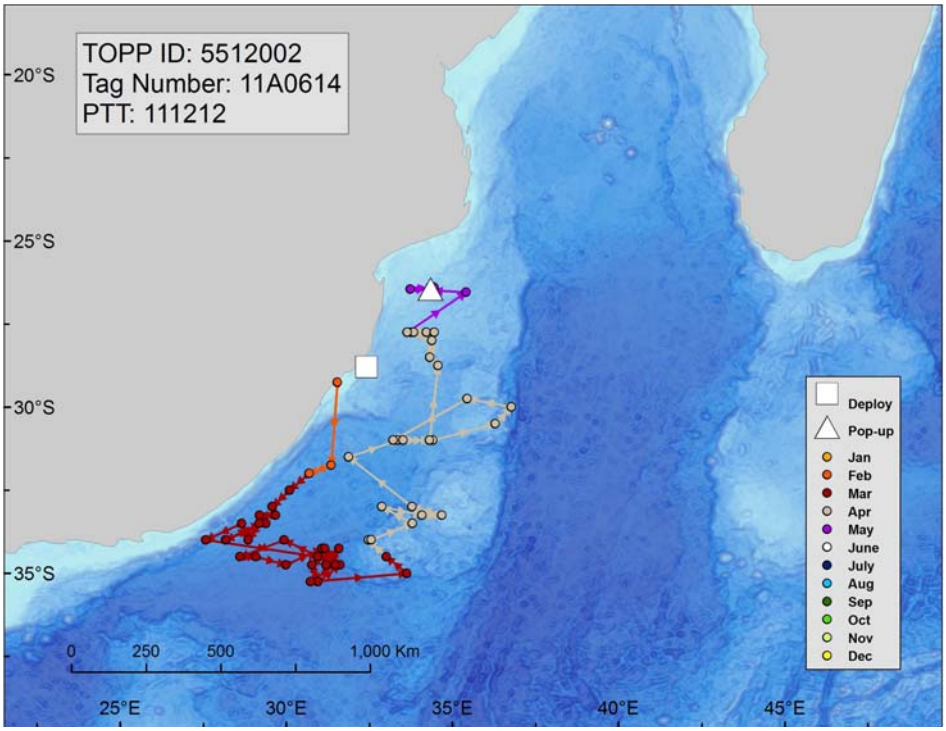


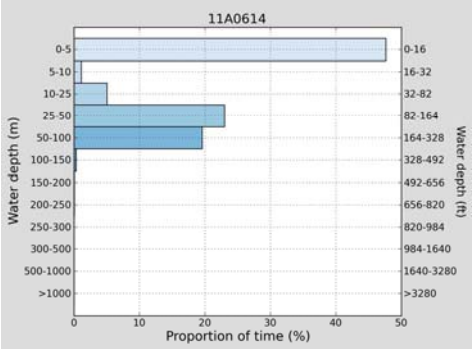
Tag number: 11A0622
Sponsors: Wayne Ritchie, Ivan Hartley (Ritchie Auto, A Ford Motor Dealer)
Angler: Riann Charmers
Tagger: Darren Grey
Boat: *Big W*
Species: Blue Marlin
Size: 150 kg (330 lbs)
Deployed: 2/22/2012
Reported: 4/5/2012
Days at large: 43
Distance traveled: 1018
Ranking: 1
Maximum depth: 240 m
Minimum temp: 15.2 C
Maximum temp: 27.8 C

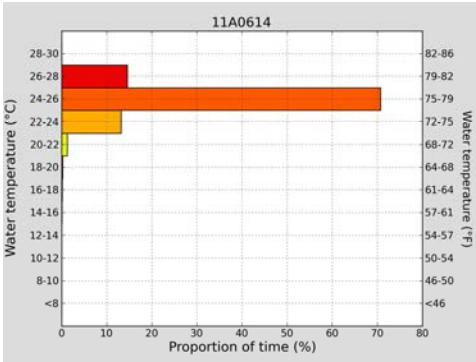


Tag 11A0614

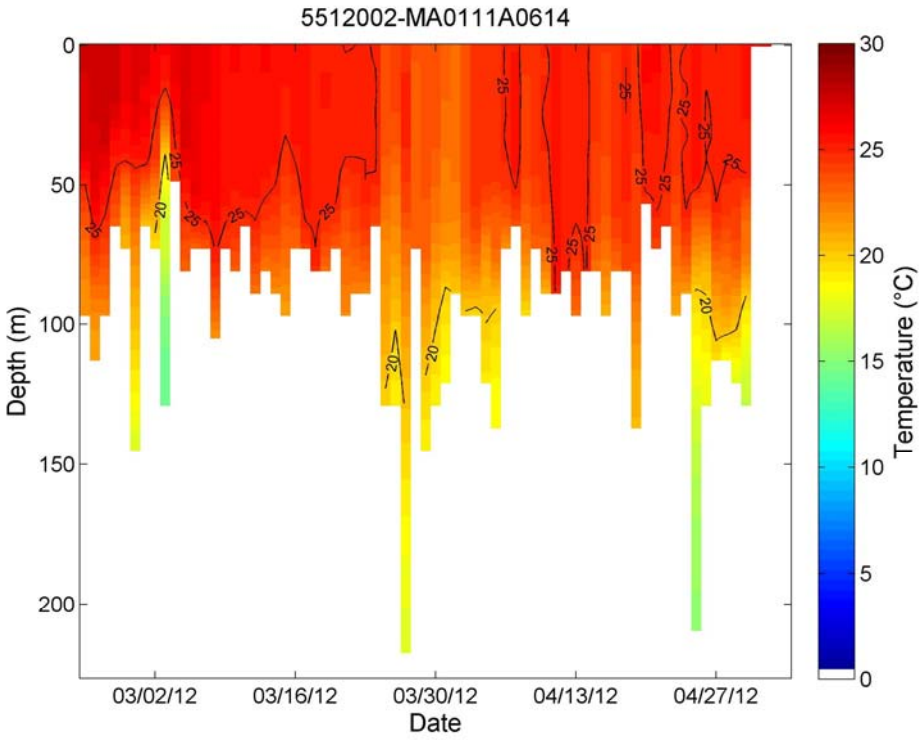
Fish 2





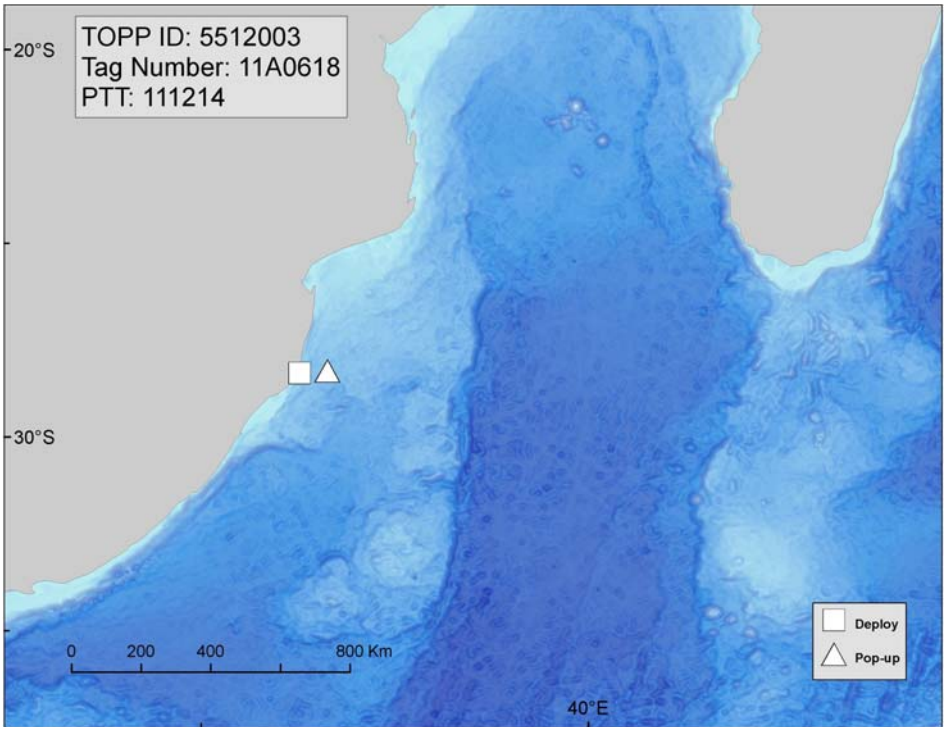


Tag number: 11A0614
Sponsor: Eric Visser
Angler: Eric Visser
Tagger: Eric Visser
Boat: *Enigme*
Species: Blue Marlin
Size: 75 kg (165 lbs)
Deployed: 2/22/2012
Reported: 5/4/2012
Days at large: 72
Distance traveled: 174 nm
Ranking: 6
Maximum depth: 216 m
Minimum temp: 14 C
Maximum temp: 27.6 C



Tag 11A0618

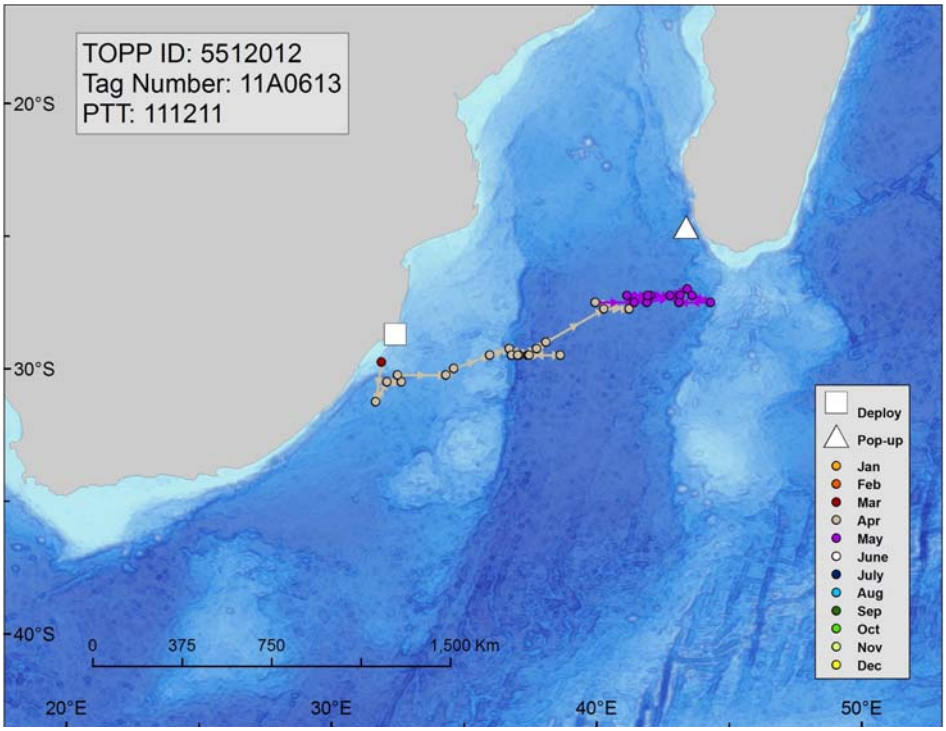
Fish 3

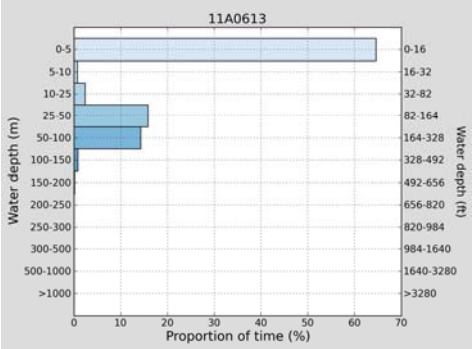


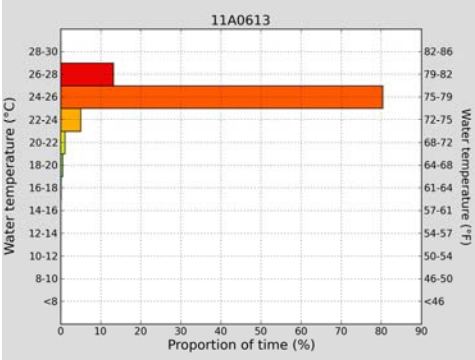
Tag number: 11A0618
Sponsor: Herman Olivier (Ultra Gear)
Angler: Divan Coetsee
Tagger: Hansie van Wyk
Boat: *Mitsufishi*
Species: Blue Marlin
Size: 120 kg (265 lbs)
Deployed: 3/28/2012
Reported: 4/1/2012
Days at large: 4
Distance traveled: 13 nm
Ranking: 8
Maximum depth: 184 m
Minimum temp: 14.8 C
Maximum temp: 26.4 C

Tag 11A0613

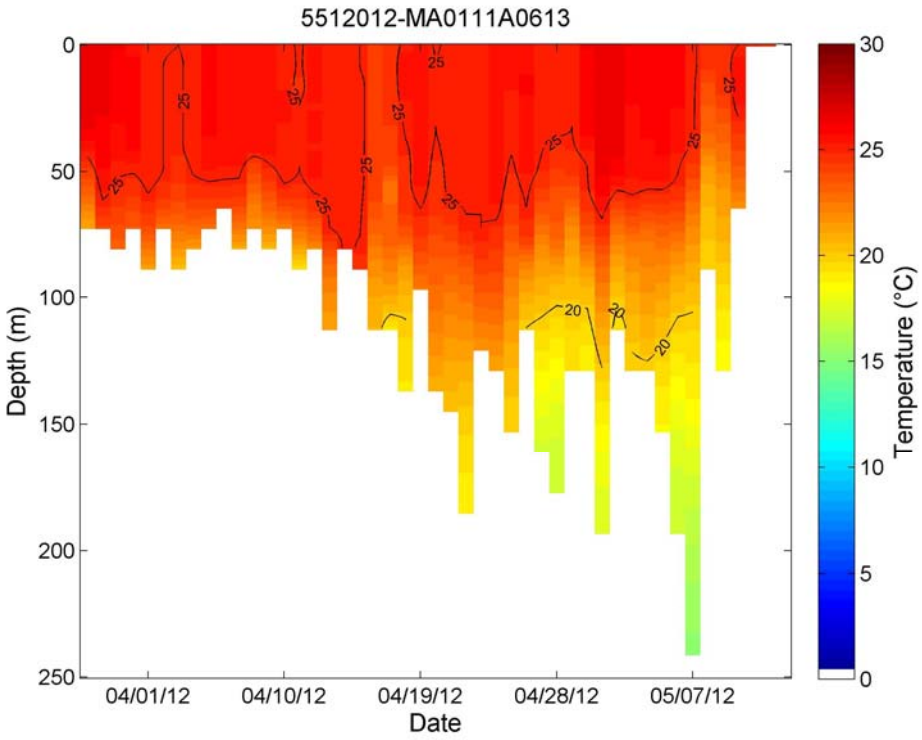
Fish 4





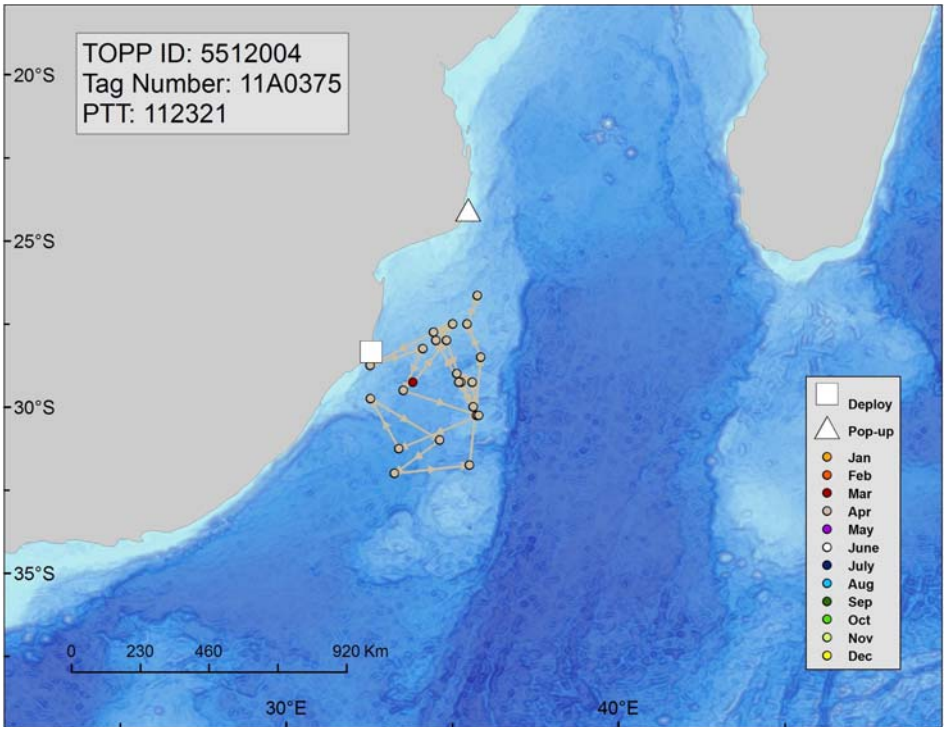


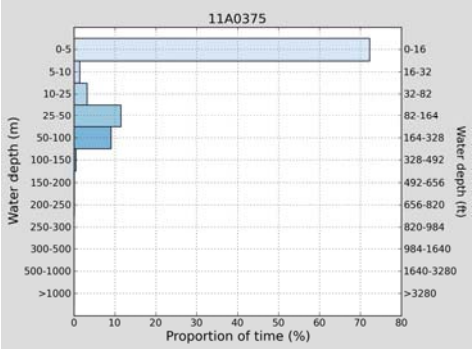
Tag number: 11A0613
Sponsor: Ryan Williamson (SADSAA Initiative)
Angler: Malcolm Buchanan
Tagger: Ryan Williamson
Boat: *Ocean Explorer*
Species: Blue Marlin
Size: 200 kg (440 lbs)
Deployed: 3/28/2012
Reported: 5/14/2012
Days at large: 47
Distance traveled: 636 nm
Ranking: 2
Maximum depth: 240 m
Minimum temp: 15.2 C
Maximum temp: 27.2 C

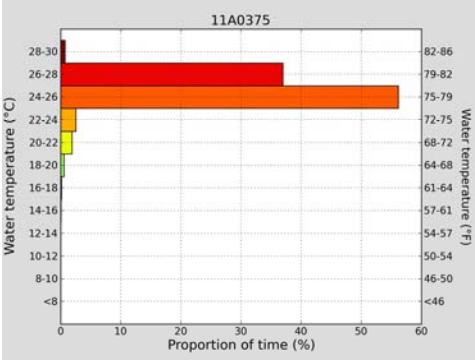


Tag 11A0375

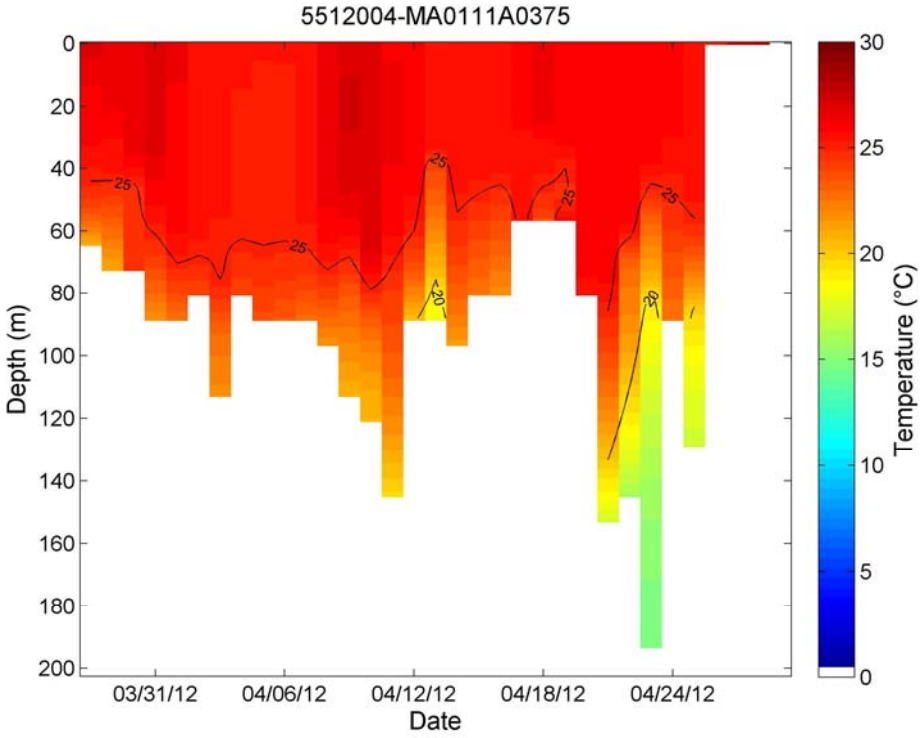
Fish 5





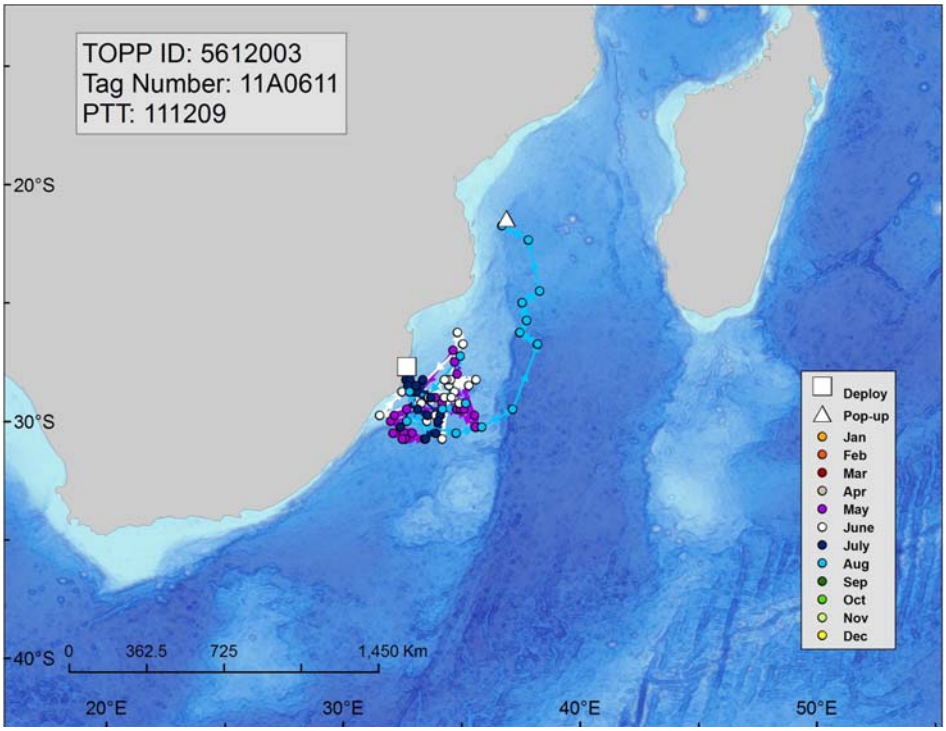


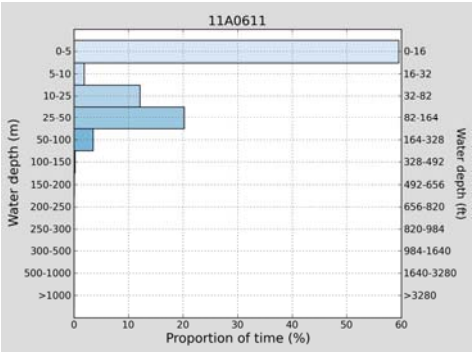
Tag number: 11A0375
Sponsor: Marius Vermaak, Erwin Bursik (SADSAA Initiative)
Angler: Peet Grobbelaar
Tagger: Marius Vermaak
Boat: *Hlatikulu*
Species: Blue Marlin
Size: 220 kg (485 lbs)
Deployed: 3/28/2012
Reported: 4/29/2012
Days at large: 32
Distance traveled: 301 nm
Ranking: 4
Maximum depth: 192 m
Minimum temp: 14.8 C
Maximum temp: 36.2 C

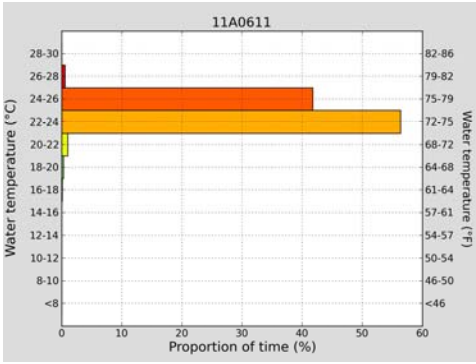


Tag 11A0611

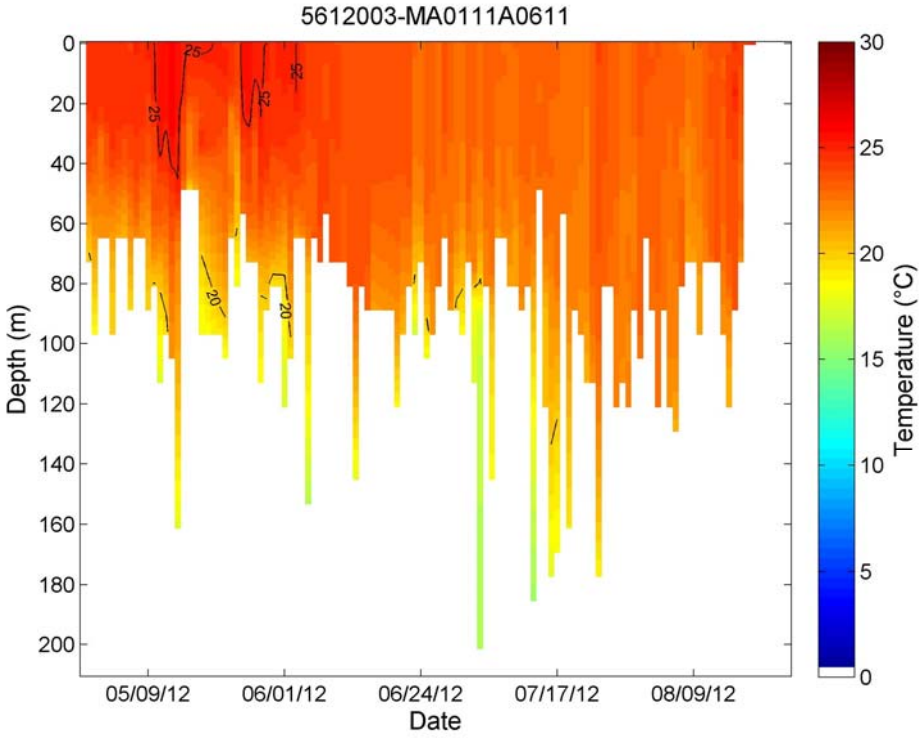
Fish 6





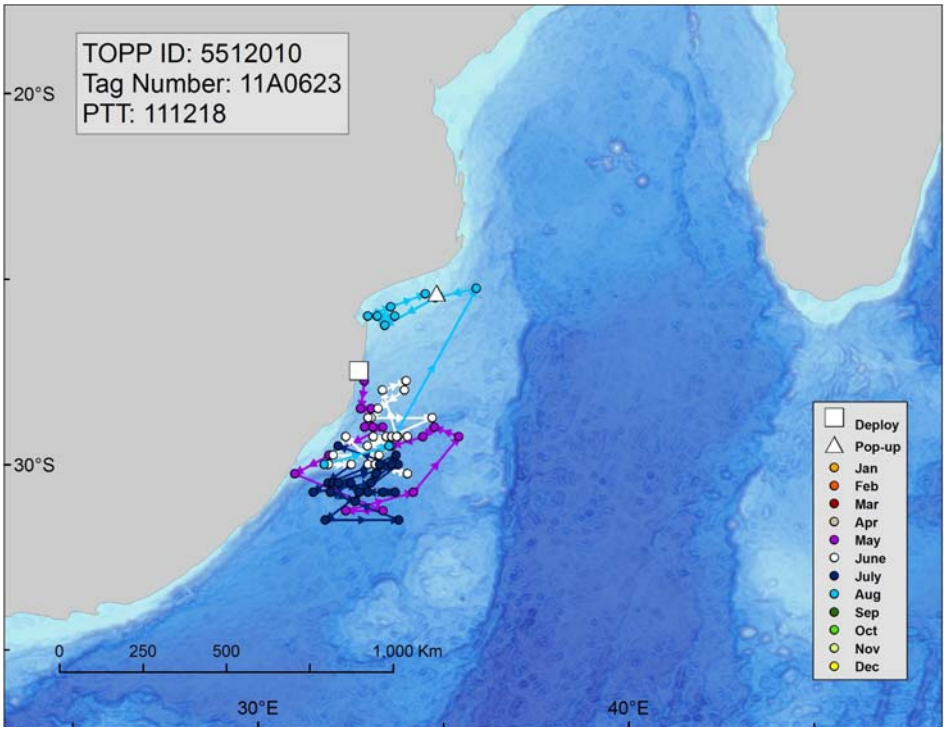


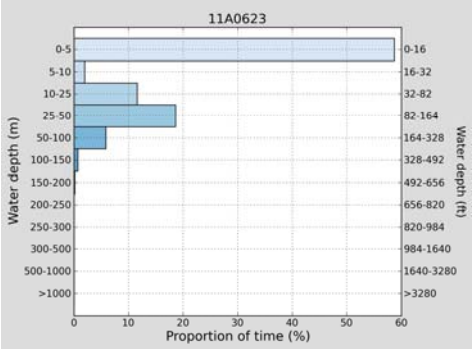
Tag number: 11A0611
Sponsor: Chris Rothmann
Angler: Hardus Rothmann
Tagger: Chris Rothmann
Boat: *Little Joey*
Species: Black Marlin
Size: 100 kg (220 lbs)
Deployed: 4/28/2012
Reported: 8/25/2012
Days at large: 119
Distance traveled: 441 nm
Ranking: 3
Maximum depth: 200 m
Minimum temp: 15.2 C
Maximum temp: 26.6 C

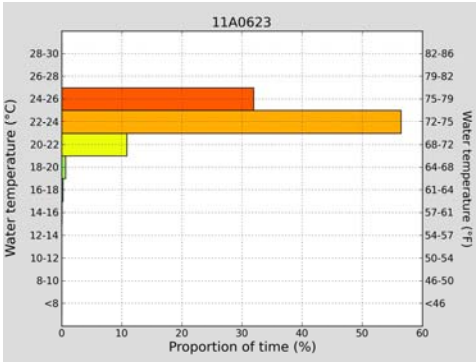


Tag 11A0623

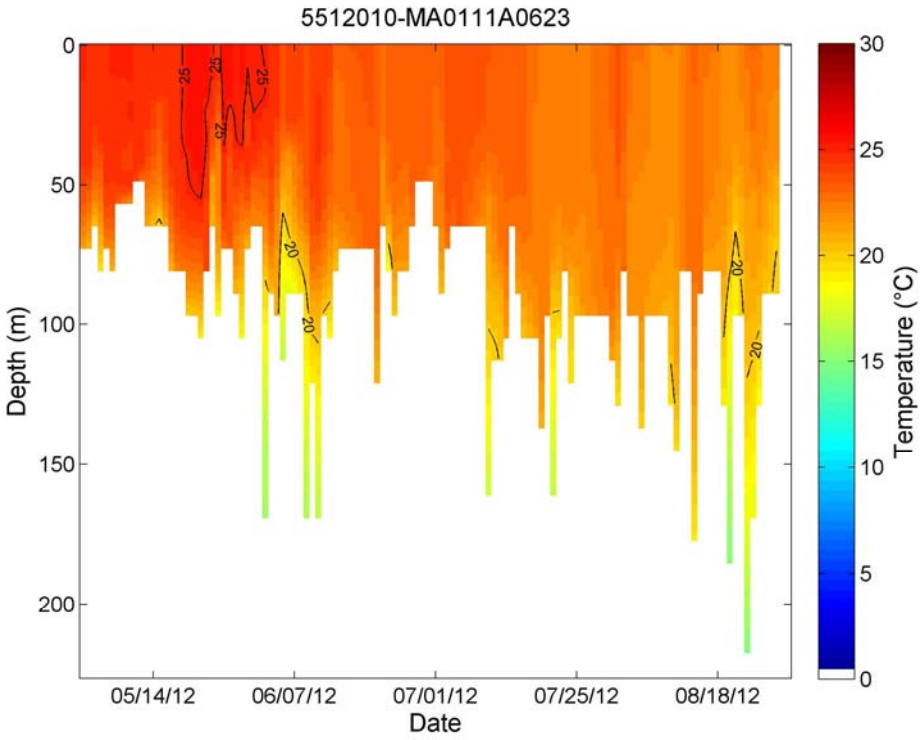
Fish 7





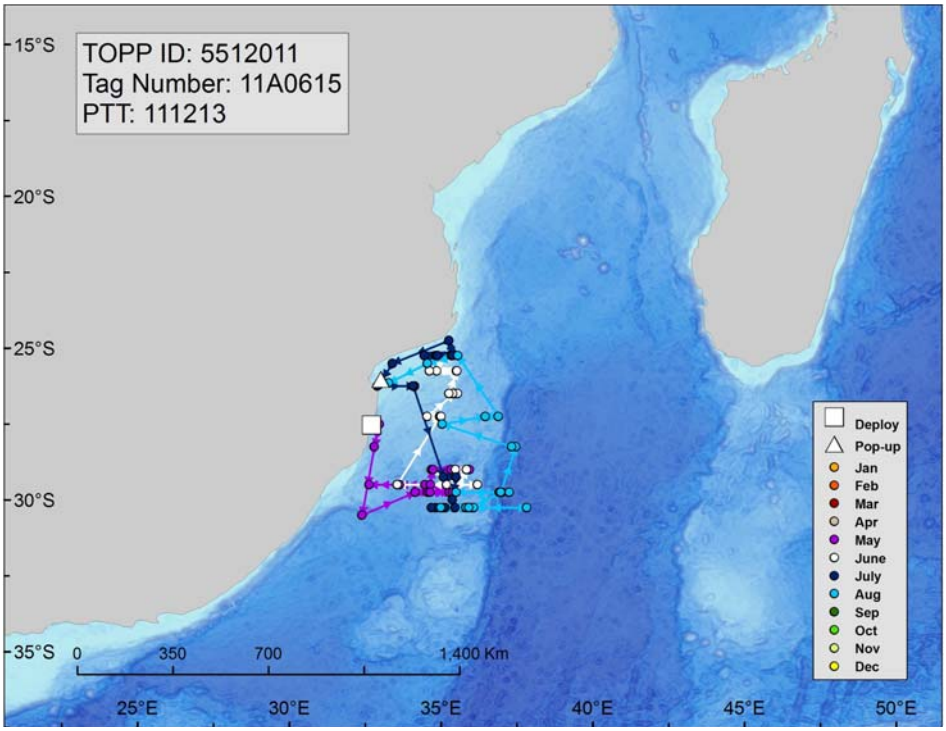


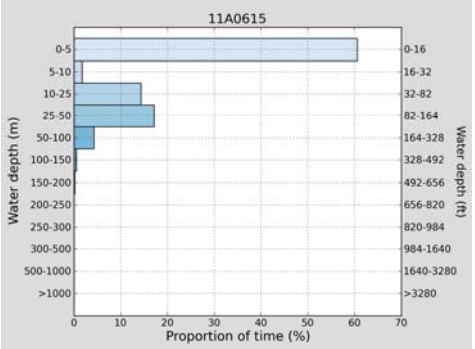
Tag number: 11A0623
Sponsor: Casper Walker, Jan Hofman, Bradley Kuhn & Padoa Brothers, Garch McGee, Danny Fisher
Angler: Lizette Walker
Tagger: Casper Walker
Boat: *Proxima*
Species: Black Marlin
Size: 100 kg (220 lbs)
Deployed: 5/2/2102
Reported: 8/30/2012
Days at large: 120
Distance traveled: 223 nm
Ranking: 5
Maximum depth: 216 m
Minimum temp: 14.8 C
Maximum temp: 28 C

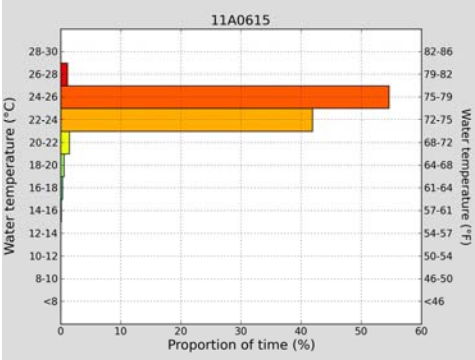


Tag 11A0615

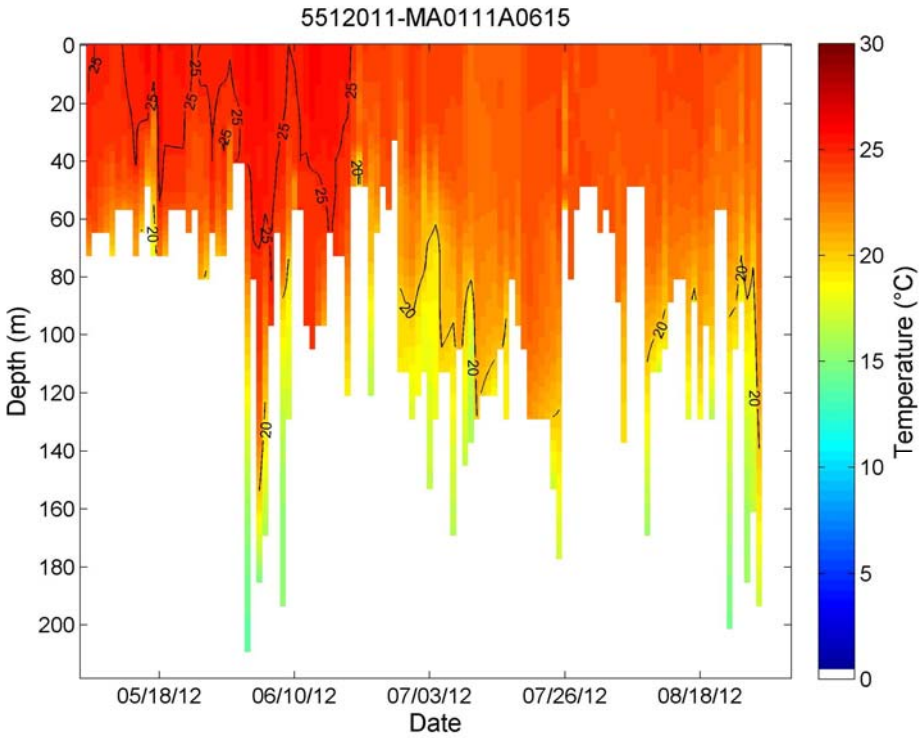
Fish 8 - Bob the Marlin







Tag number: 11A0615
Sponsor: Jan Hofman
Angler: Jan Hofman
Tagger: Elize Smith
Boat: *Ocean Commotion*
Species: Black Marlin
Size: 95 kg (209 lbs)
Deployed: 5/5/2012
Reported: 9/2/2012
Days at large: 120
Distance traveled: 92 nm
Ranking: 7
Maximum depth: 208 m
Minimum temp: 13.8 C
Maximum temp: 26.4 C



GAMEX/Australian International Billfish Tournament
IGFA Great Marlin Race 2012
Summary of Results

Race Summary

The Exmouth Game Fishing Club (EGFC) hosted the GAMEX 2012 tournament from March 9-17, 2012. Through the efforts and generosity of the EGFC and the generosity of the captains, crews, and anglers who participated, this event marked the beginning of the first IGFA Great Marlin Race (IGMR) held in Australia!

On the morning of the 6th day of the tournament (March 14th 2012), Dave Thomson fought a lively, 150 kg (332 lb) blue marlin for 20 minutes, which was tagged by Gary Miles aboard the *Azura* before being released with the first tag. The next day (March 15th 2012), IGFA Conservation Director, Jason Schratweiser, tagged an enormous 136 kg (300 lb) black marlin after a 25 minute bout with angler Greg Anderson aboard *Inner Visions* in the afternoon. The following morning (March 16th 2012), A. Zuvela tagged a second black marlin after a 15 minute by Phil Agate, who subdued the 80 kg (176 lb) fish aboard the *Paradise*. The GAMEX 2012 tournament was a wonderful event with great camaraderie.

On March 19th 2012, two days after the conclusion of the GAMEX 2012, the IGMR participated in the Australian International Billfish Tournament (AIBT). The four day tournament was hosted by the EGFC, the Western Australian Gamefishing Association and the Game Fishing Association of Australia.

In the morning of March 22nd 2012, during the final day of the tournament, Rusty Ellis quickly hooked up with a 150 kg (330 lb) blue marlin aboard the *A Lure*. The tagger, Steve Riley, demonstrated the conservation-mindedness of the anglers participating in the IGMR as he stated on the data sheet that his fish “swam away freely” and was in “great condition”. The fish was the only marlin tagged in the AIBT.

In the weeks following the end of the two tournaments, three more tags were deployed on marlin from boats fishing out of Exmouth, Australia.

On the morning of March 24th 2012, two days after the AIBT ended, John Prince reeled in and tagged the largest marlin of the race, a 181 kg (400 lb) blue marlin after a 40 minute fight aboard *The Bear*. In the afternoon of March 25th 2012, Ross newton caught a 150 kg (330 lb) blue marlin that was tagged by his wife, Tracey Rushford, aboard the *Reel Teaser*.

At noon on On March 29th 2012, Bjorn Farley placed the seventh tag on a 100 kg (200 lb) blue marlin that he reeled in after a 10 minute fight aboard *Jaime*.

About three months later, on June 18th 2012, Jim Ireland placed the eighth tag on a 45 kg (100 lb) black marlin that he reeled in after a 20 minute aboard *Our Time*.

One month after, on July 20th 2012, the ninth tag was placed on another black marlin by Matt Gates on *In Deep* after angler, Daniel McKintyre, reeled in the 145 kg (320 lb) fish.

On November 16th 2012, Matt Gates deployed the tenth and final tag on a 172 kg (200 lb) blue marlin by caught by Aaron Lewis fishing from *In Deep*.

The effort put forth by the GAMEX and AIBT tournament organizers, fishing clubs, captains, crews, and anglers made IGMR's first trip to Australia memorable and extremely successful. It is clear that every person involved has a strong passion for billfishing as well as an appreciation for the fish they target. Their dedication to the project is admirable and proves that they are both ethical anglers and passionate conservationists.

Tag Technology

All of the tags used by the IGMR during the first official Australia race were Wildlife Computers MK10 Pop Up Satellite Archival Tags (PATs), programmed for 120 day deployments. The tags were attached to leadered marlin brought alongside the boat, using a 59 mm titanium dart with an 18-20 cm monofilament leader (136 kg test), protected by a layer of braided Dacron surrounded by shrink-wrap to prevent abrasion, and inserted into the dorsal musculature of the marlin (i.e., the "shoulder") just below and behind the leading edge of the dorsal fin using an aluminum tagging pole.

The tags were deployed in "standby" mode, and were programmed to activate upon reaching a minimum depth of 10 m, at which time they began recording temperature, depth and light at 60 second intervals. Data was recorded on the tag until either the tag reached its programmed 120 day deployment period, or it detected no change in depth greater than +/-2.5 m for a period of 96 hours, indicating that it had either pulled free from the fish or that the fish had ceased all activity. Once one of these conditions was met, the tag passed an electric current through the corroding pin attaching it to the leader, causing it to be released and brought to the surface. Upon surfacing, the tag transmitted for a period of 7-10 days, relaying a summary of its stored data through the Argos satellite system, back to the laboratory.

Data Processing

When a tag reaches the surface and begins transmitting, its location is determined precisely using the Argos satellite system. This location, combined with the re reported deployment location (collected when the fish was originally tagged), is used to calculate the total point-to-point distance traveled by the fish, which is used to determine performance in the IGMR. Once all of the data are received from a tag, a series of plots are generated to visualize temperature and depth preferences, diving behavior, and water column conditions. In addition, tag data are combined with corresponding sea surface temperature (SST) data from orbiting satellites to produce a rough track for the duration of the deployment. The position estimates of these tracks

are further refined using a state-space model, used to optimize the track and provide a statistically-robust path for further analysis.

The Importance of Conservation

The IGFA and Stanford University would like to thank the organizers of the GAMEX, and AIBT, the EGFC, GFAA, and WAGFA, as well as all the individuals that sponsored tags and everyone who participated in the Great Marlin Race. Your leadership and benevolence facilitated research that is providing information on marlin migration patterns and open ocean habitat use on scale that has never been seen before. The data from the IGMR has already been used to enact better conservation measures for these fish. Data yielded from the IGMR was featured last year in IGFA's testimony to the United States Congress which ultimately led to the passage of the *Billfish Conservation Act* that now bans the importation of marlin, sailfish, and spearfish into the United States. It is our hope that continuing this project in the years to come will lead to similar conservation measures for billfish internationally, so they may be enjoyed by future generations of anglers.

Race Results

Of the ten tags deployed, three were during the GAMEX 2012, one was during the ABT, and six were deployed independently at times later in the year. The tags are programmed to know if their depth has remained constant, +/- 5 m, for 96 hours. If so, they undergo a release routine of floating to the surface and reporting. Therefore, if we see that a tag sunk to the bottom for 4 days prior to release, we assume that there was mortality. If we see that a tag spent 4 days at the surface prior to reporting, we assume that the tag pulled out or the leader (attaching the tag to the fish) failed. In this race, eight of the ten tags successfully recorded data for 29+ days and two of those eight recorded data for the full expected time of 120 days. The remaining two tags offered data for only 5 and 14 days respectively, which is likely a result of premature dislodging from the marlin and not a post-release mortality. A brief summary of these results is presented in the Table below. Note that the fish are numbered in the order they were tagged:

Fish	Tag	Weight (kg)/species	Angler	Tagger	Boat	Deployment Date	Pop Up Date	Days	Distance (nm)
1	11A0756	150 blue	Dave Thomson	Gary Miles	Azura	3/14/2012	5/24/2012	71	286
2	11A0675	136 black	Greg Anderson	Jason Schratweiser	Inner Visions	3/15/2012	5/8/2012	54	399
3	11A0624	80 black	Phil Agate	A. Zuvela	Paradise	3/16/2012	7/14/2012	120	466
4	11A0743	150 blue	Rusty Ellis	Steve Riley	A Lure	3/22/2012	3/27/2012	5	8
5	11A0625	182 blue	John Prince	John Prince	The Bear	3/24/2012	4/23/2012	30	26

6	11A0745	150 blue	Ross Newton	Tracey Rushford	Reel Teaser	3/25/2012	4/23/2012	29	44
7	11A0740	100 blue	Bjorn Farley	Bjorn Farley	Jaime	3/29/2012	7/27/2012	120	1035
8	11A0626	45 black	Jim Ierland	Jim Ierland	Our Time	6/18/2012	7/2/2012	14	57
9	11A0630	145 black	Daniel McKintyre	Matt Gates	In Deep	7/20/2012	10/22/2012	94	87
10	11A0730	91 blue	Aaron Lewis	Matt Gates	In Deep	11/16/2012	1/6/2013	51	172

Reports from the race, including an interactive map with all the animal tracks, can be found on the IGFA website, at http://igmr.igfa.org/Tournaments/Exmouth.aspx

Race Results

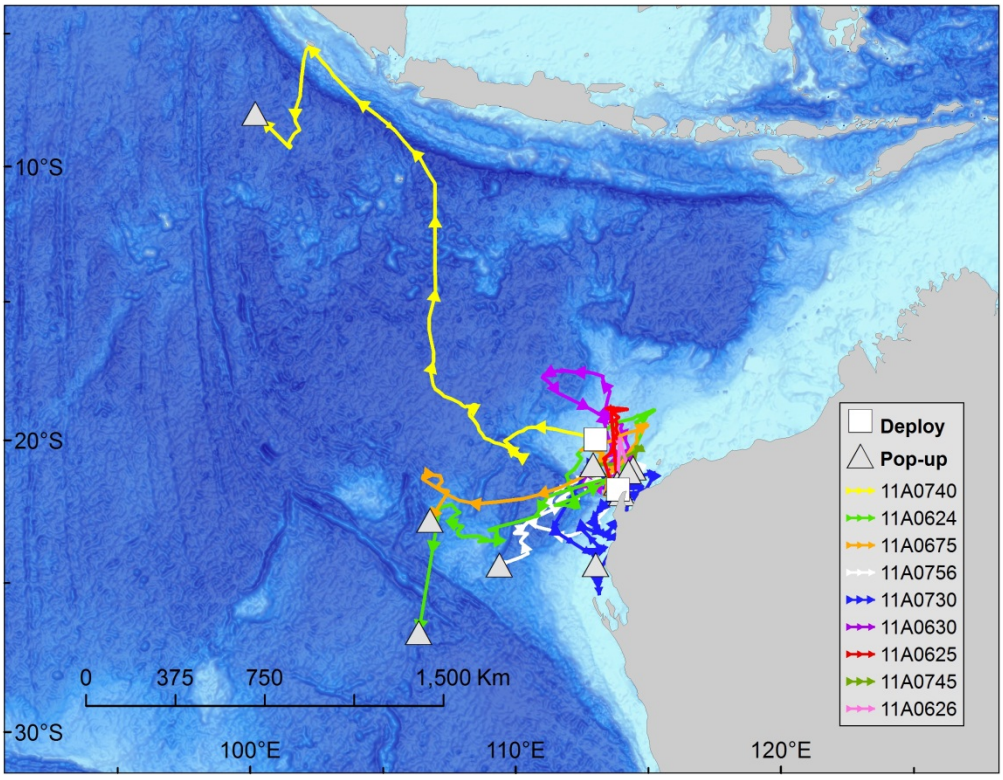


Figure 1. The tracks above describe all marlin tagged during the Exmouth, Australia IGMR. The winner of the race was a 100 kg fish that traveled a remarkable 1035 nm!

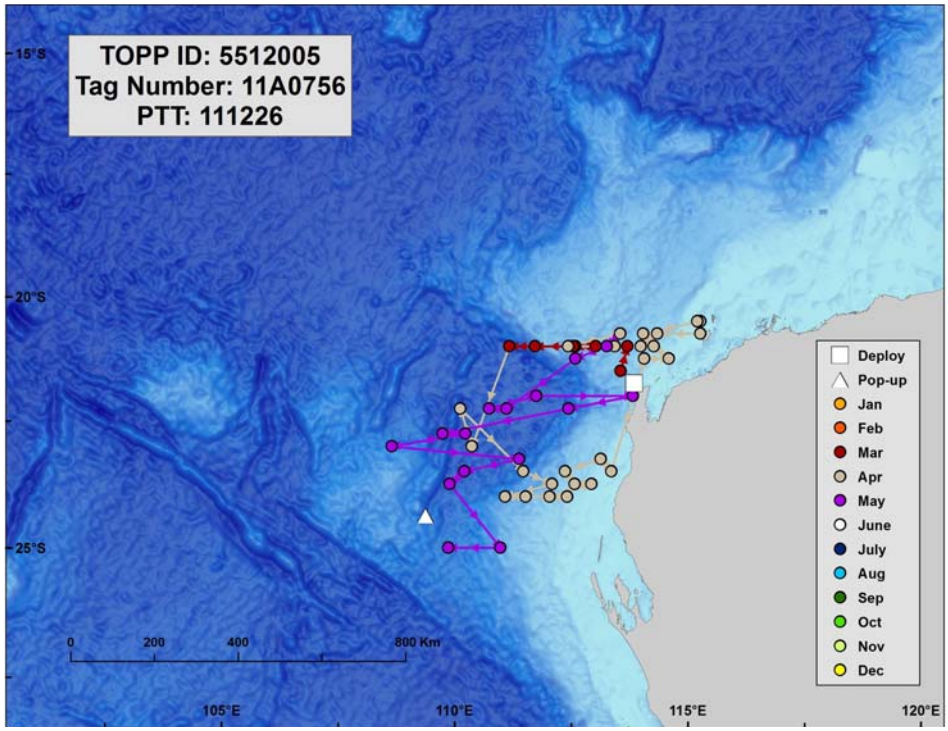
The map above shows the tracks from all ten tags, processed through a "state space model" which provides a statistically-robust track that can be combined with other datasets and used in other analyses. In looking at the marlin tracks, perhaps the most striking feature is the diversity of behaviors they represent. Several marlin stayed relatively close, within 100 nautical miles of

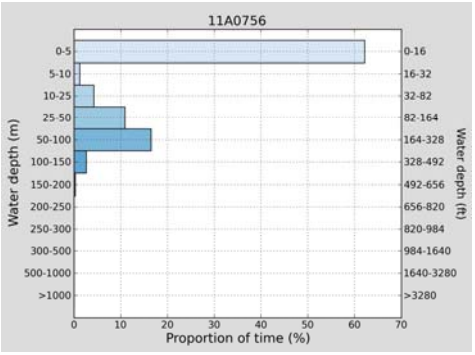
where the tags were deployed. This includes some very short tracks as well as a 94-day track, which suggests that some marlin chose to stay nearby for long periods of time. Four other marlin (Fish 1, 2, 3 and 10), ventured further afield and moved generally west to southwest from where they were tagged. Specifically Fish 3 (Tag 11A0624), who took second place in the race, swam 466 nautical miles (nm) southwest of Exmouth after a full 120 days. However, the marlin track that stands out from the rest is that of Fish 7 (Tag 11A0740), which covered 1035 nm over a 120 day period. This blue marlin swam west off the Australian coast before heading north towards Java, and ultimately shifted its course northwest towards Sumatra.

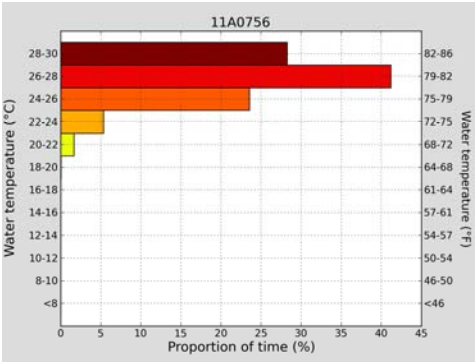
For each individual tag, results are summarized on the pages that follow. The tracks in these maps are less processed than the tracks above – showing the locations where each tag was deployed (white square), where it popped up (white triangle) and all of the light-based geolocations from each tag. In all cases, the marlin spent most of their time in the top 5 m of the water column, and less (though significant) time in depths between 10-250 m. They generally remained above the thermocline, with occasional, brief dives into the cooler waters below 200 m. These patterns appeared similar for both blue and black marlin.

Tag 11A0756

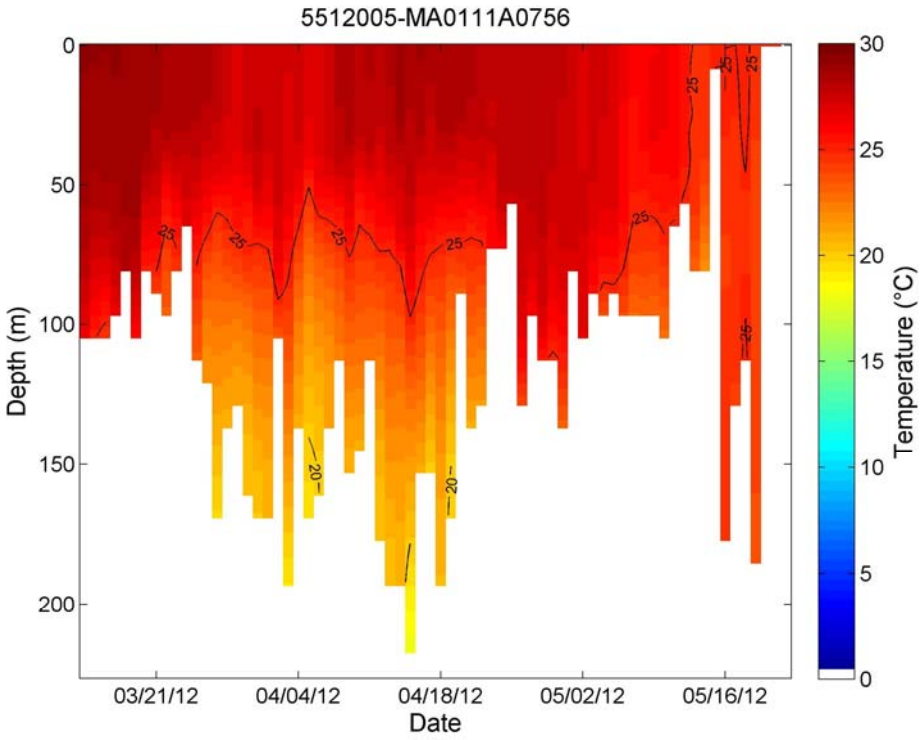
Fish 1





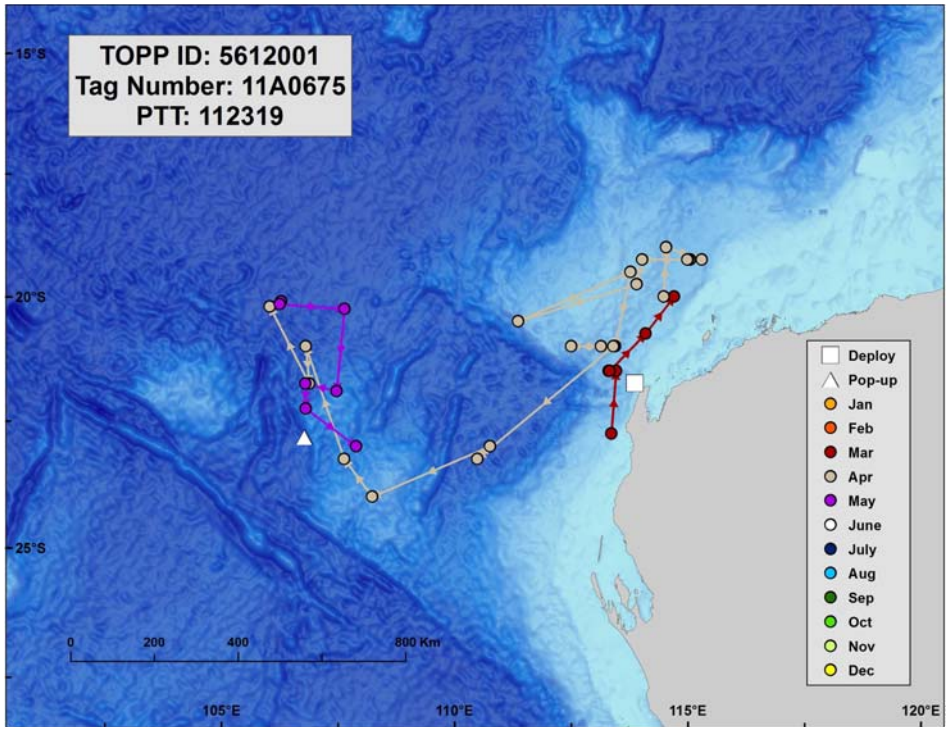


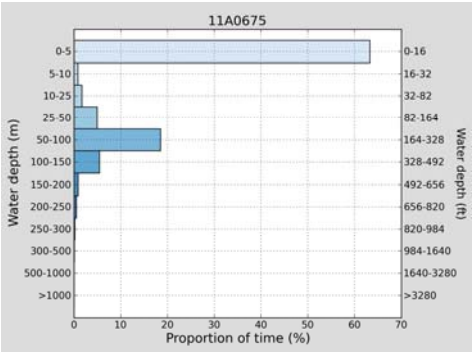
Tag number: 11A0756
Sponsor: Dave Thomson
Angler: Dave Thomson
Tagger: Gary Miles
Boat: *Azura*
Species: Blue marlin
Estimated weight: 150 kg
Deployed: 3/14/2012
Reported: 5/24/2012
Days at large: 71
Distance traveled: 286 nm
Ranking: 4
Maximum depth: 216 m
Minimum temp: 17.8 C
Maximum temp: 30 C

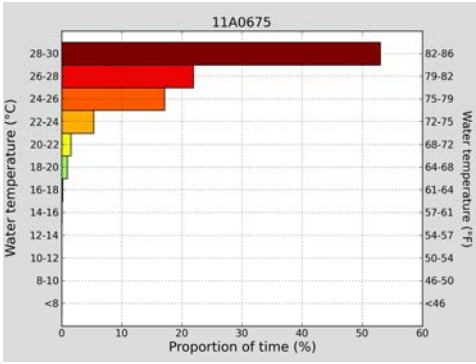


Tag 11A0675

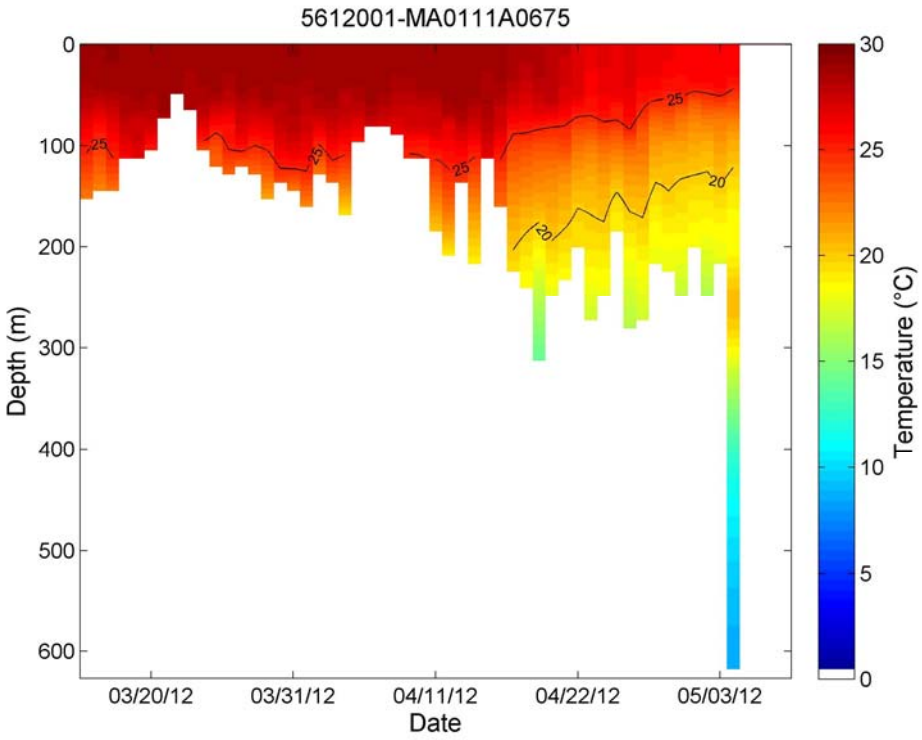
Fish 2





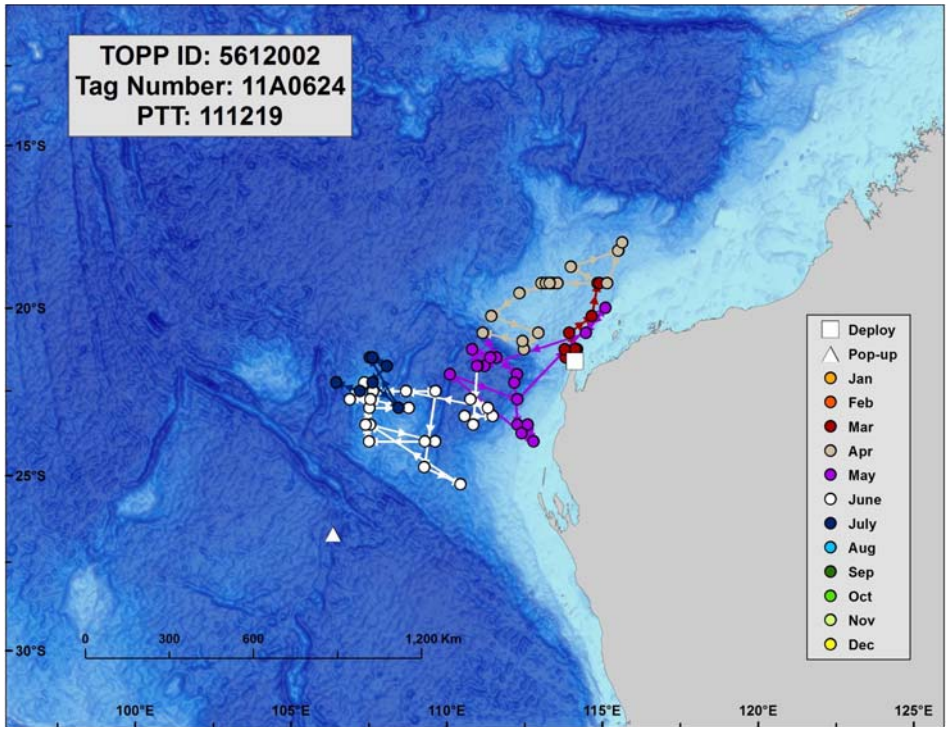


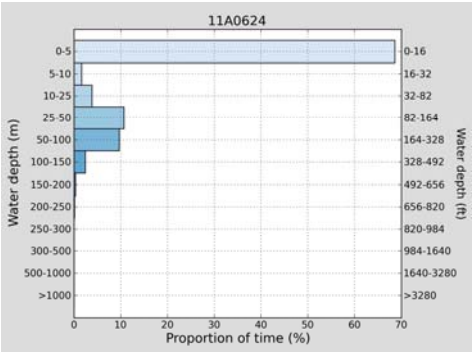
Tag number: 11A0675
Sponsor: Murray Olden
Angler: Greg Anderson
Tagger: Jason Schratwieser
Boat: *Inner Visions*
Species: Black marlin
Estimated weight: 136 kg
Deployed: 3/15/2012
Reported: 5/8/2012
Days at large: 54
Distance traveled: 399 nm
Ranking: 3
Maximum depth: 616 m
Minimum temp: 8.6 C
Maximum temp: 29.6 C

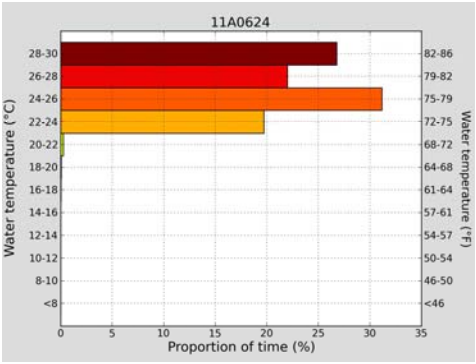


Tag 11A0624

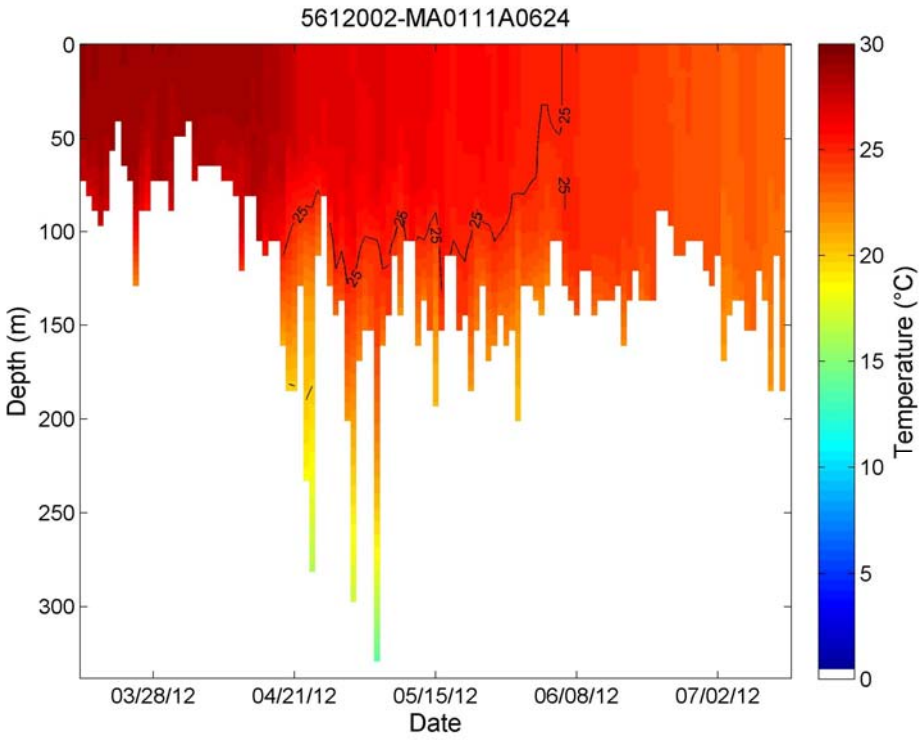
Fish 3





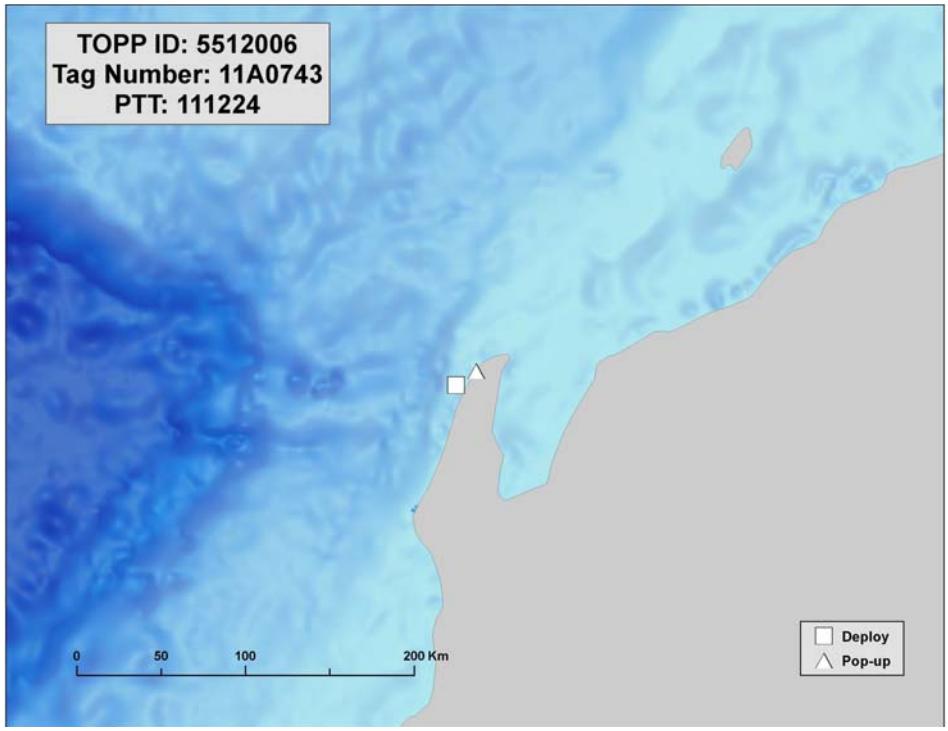


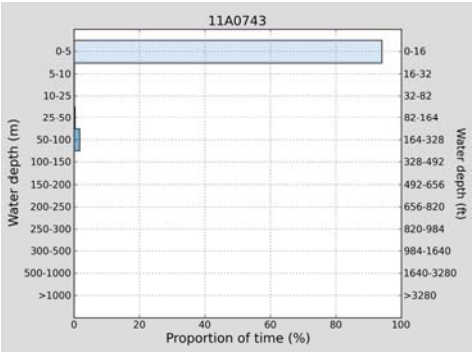
Tag number: 11A0624
Sponsor: John Jones
Angler: Phil Agate
Tagger: A. Zuvela
Boat: *Paradise*
Species: Black marlin
Estimated weight: 80 kg
Deployed: 3/16/2012
Reported: 7/14/2012
Days at large: 120
Distance traveled: 466 nm
Ranking: 2
Maximum depth: 328 m
Minimum temp: 13.6 C
Maximum temp: 30 C

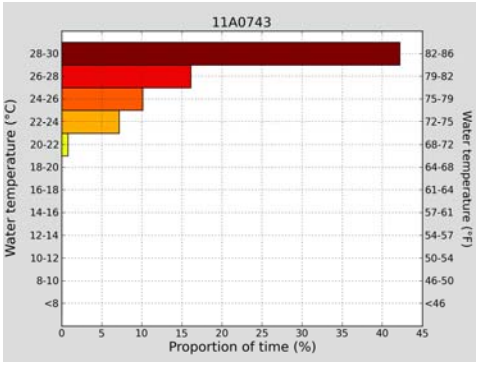


Tag 11A0743

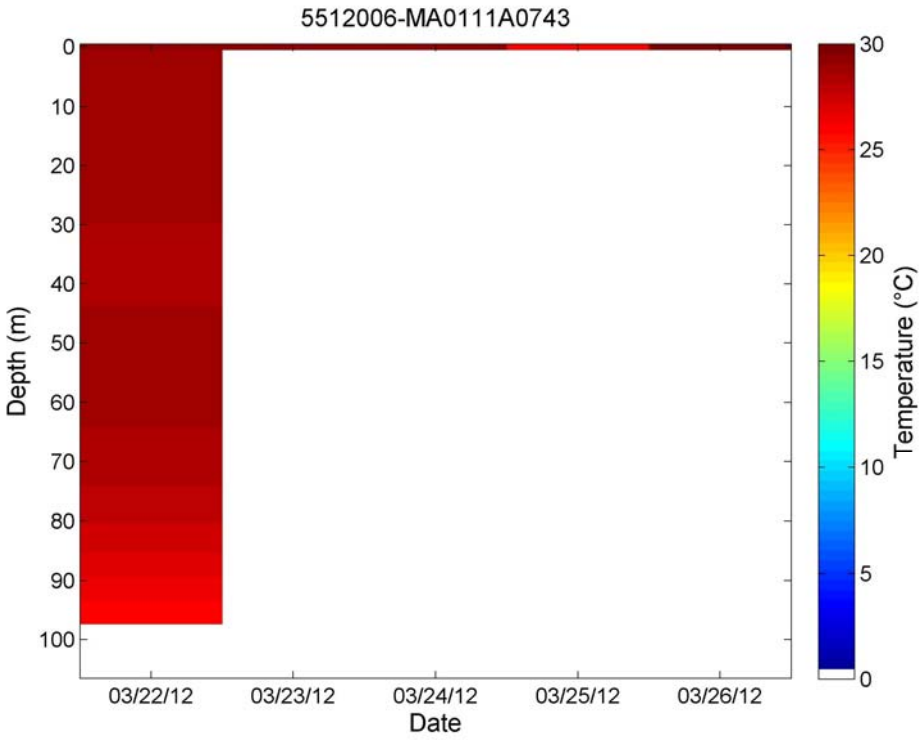
Fish 4





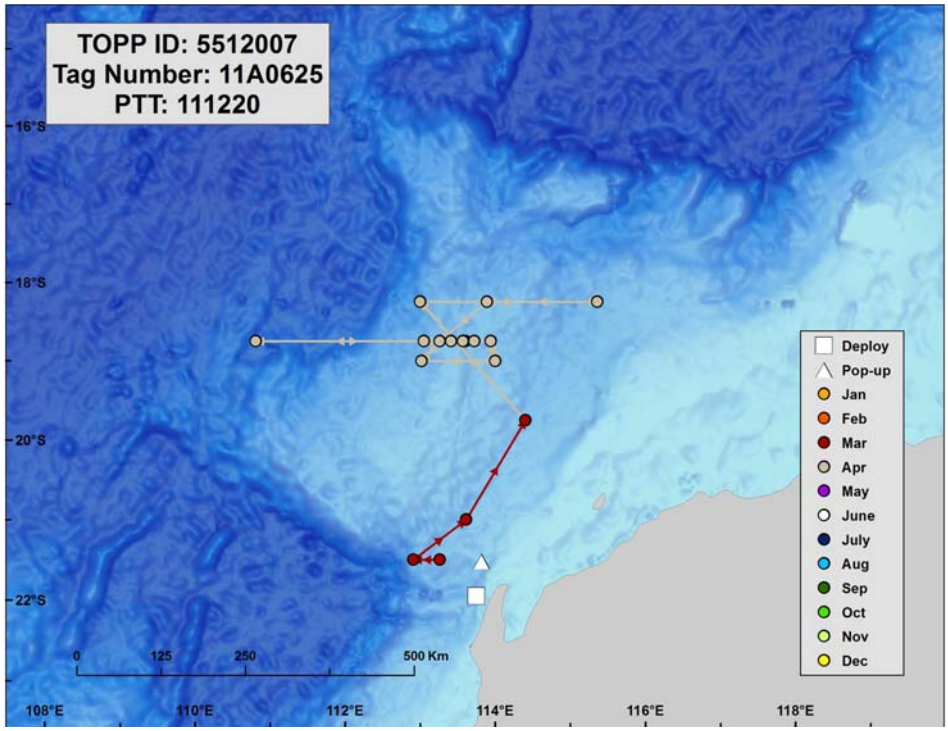


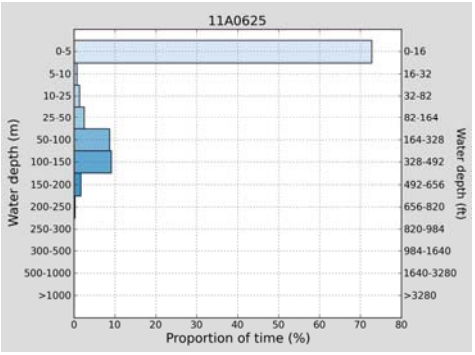
Tag number: 11A0743
Sponsor: Steve Riley
Angler: Rusty Ellis
Tagger: Steve Riley
Boat: *A Lure*
Species: Blue marlin
Estimated weight: 150 kg
Deployed: 3/22/2012
Reported: 3/27/2012
Days at large: 5
Distance traveled: 8 nm
Ranking: 10
Maximum depth: 96 m
Minimum temp: 21.2 C
Maximum temp: 48 C

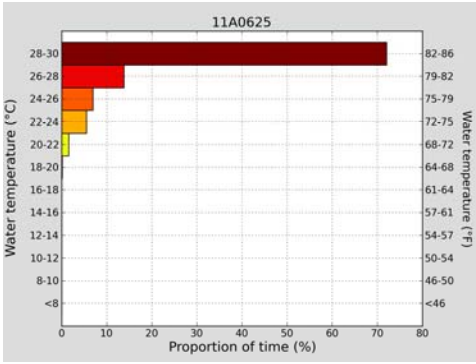


Tag 11A0625

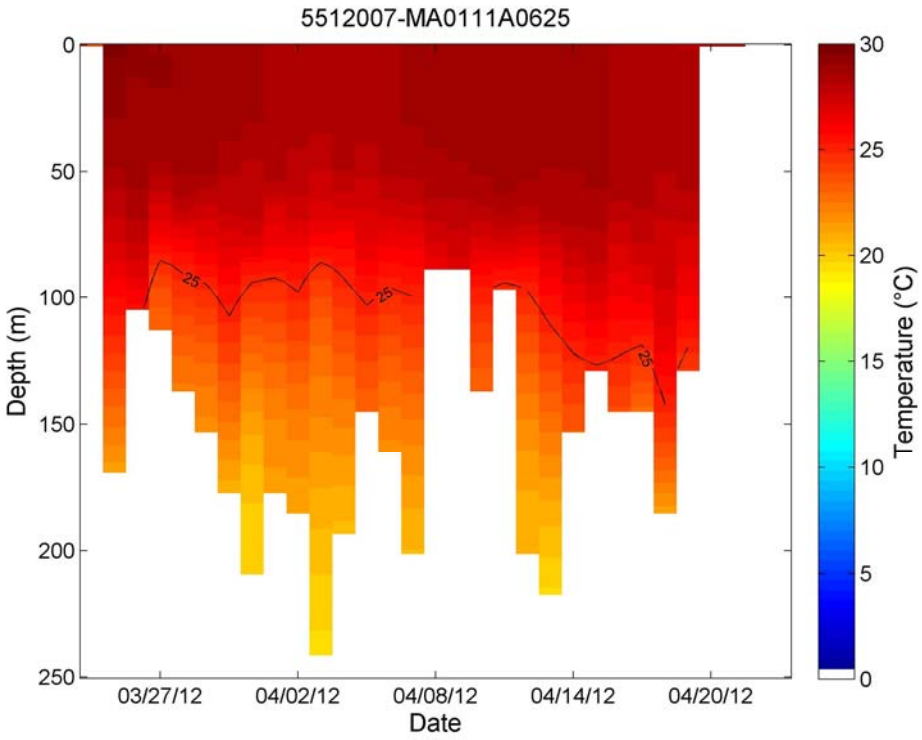
Fish 5





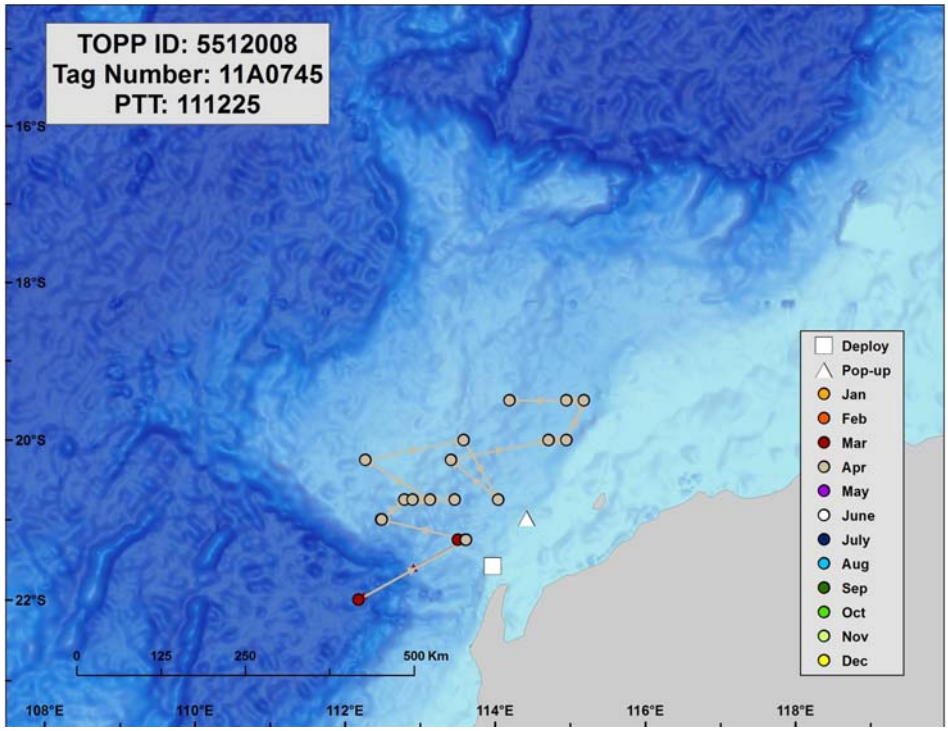


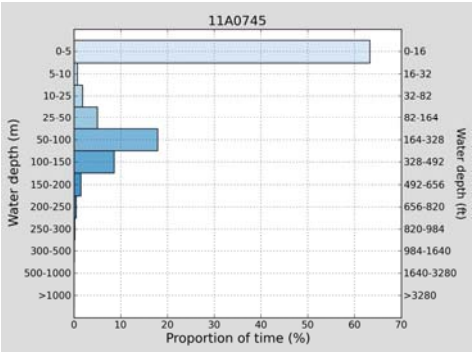
Tag number: 11A0625
Sponsor: John Prince
Angler: John Prince
Tagger: John Prince
Boat: *The Bear*
Species: Blue marlin
Estimated weight: 180 kg
Deployed: 3/24/2012
Reported: 4/23/2012
Days at large: 30
Distance traveled: 26 nm
Ranking: 9
Maximum depth: 240 m
Minimum temp: 19.4 C
Maximum temp: 37 C

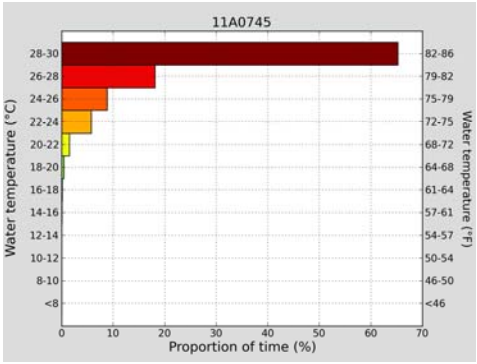


Tag 11A0745

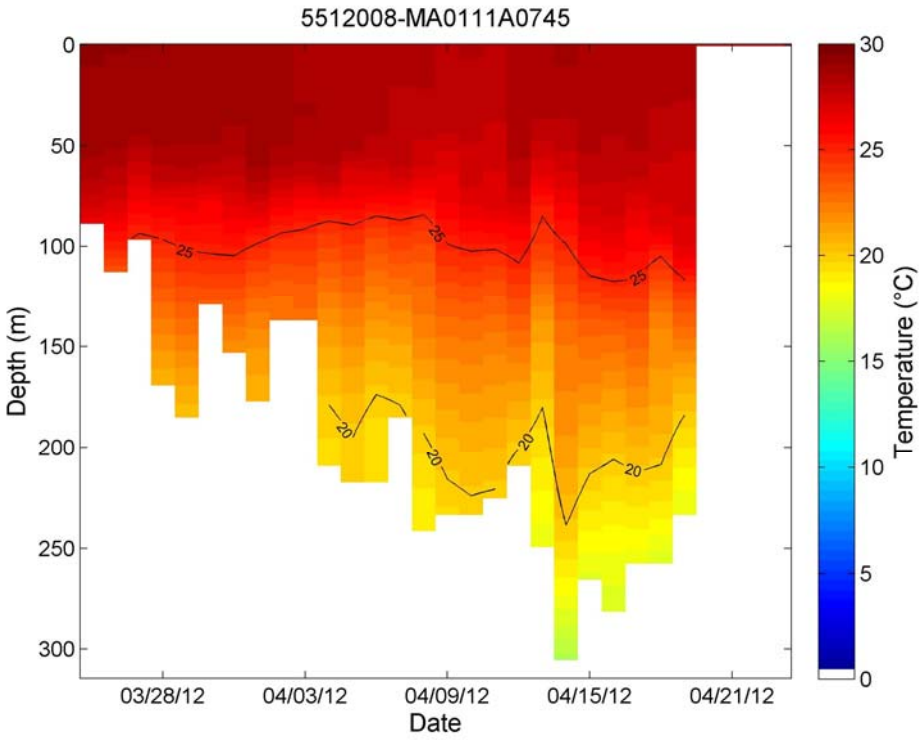
Fish 6





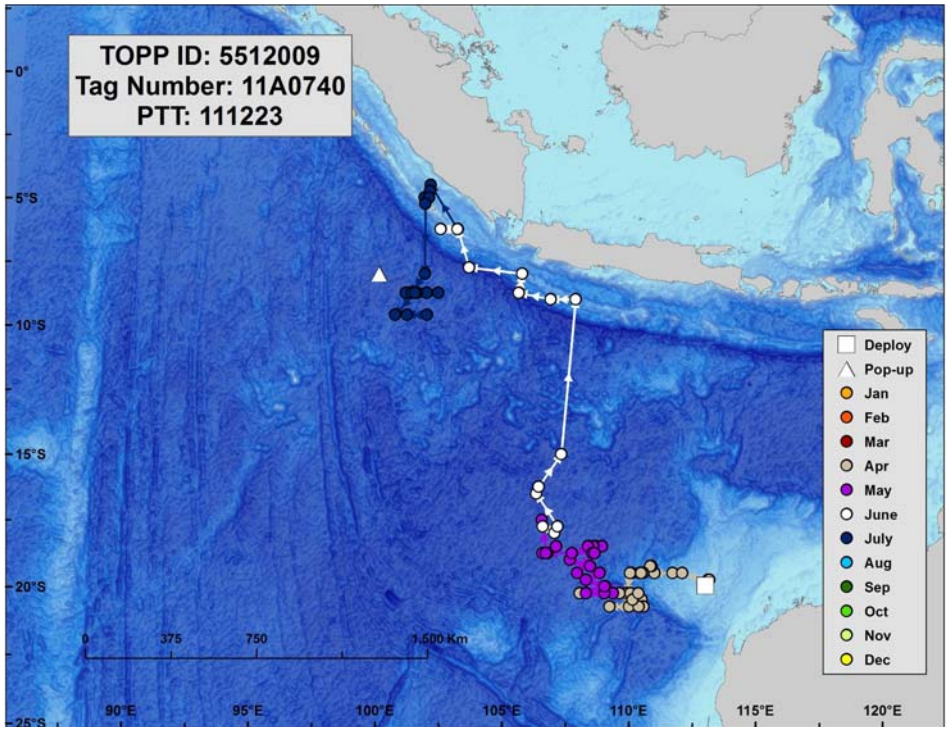


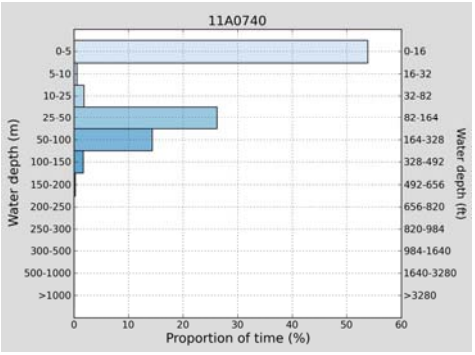
Tag number: 11A0745
Sponsor: Tracey Rushford
Angler: Ross Newton
Tagger: Tracey Rushford
Boat: *Reel Teaser*
Species: Black marlin
Estimated weight: 150 kg
Deployed: 3/25/2012
Reported: 4/23/2012
Days at large: 29
Distance traveled: 44 nm
Ranking: 7
Maximum depth: 304 m
Minimum temp: 16.2 C
Maximum temp: 30 C

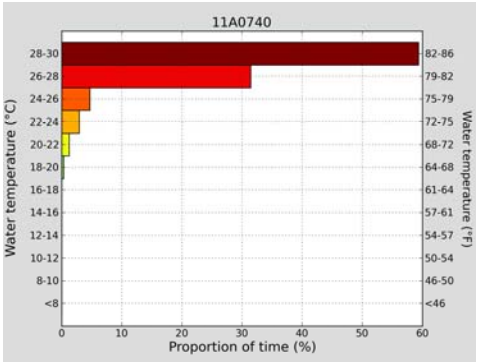


Tag 11A0740

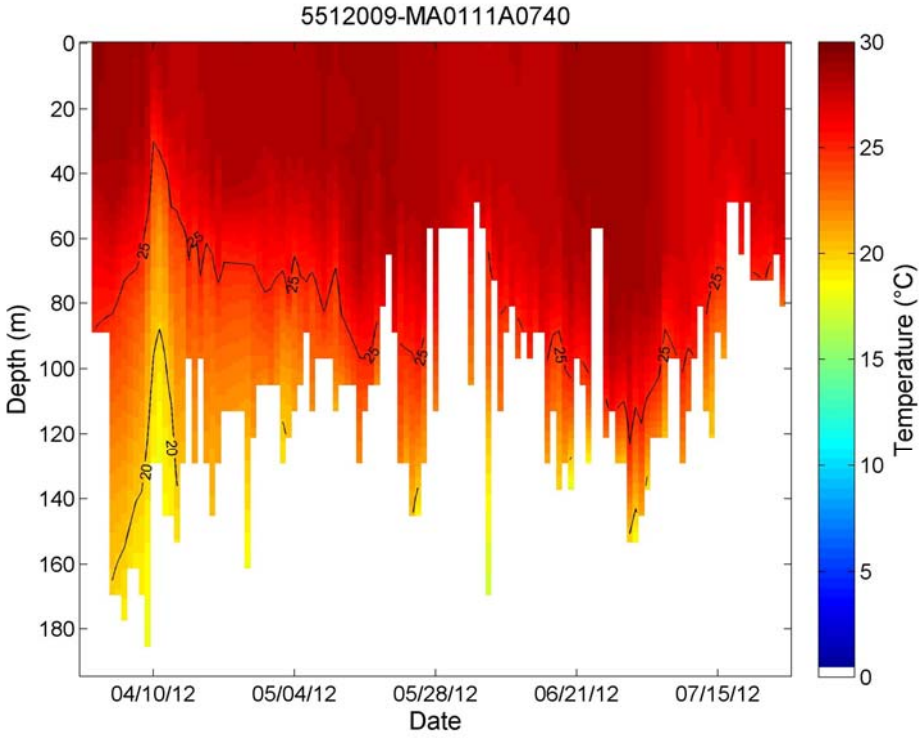
Fish 7





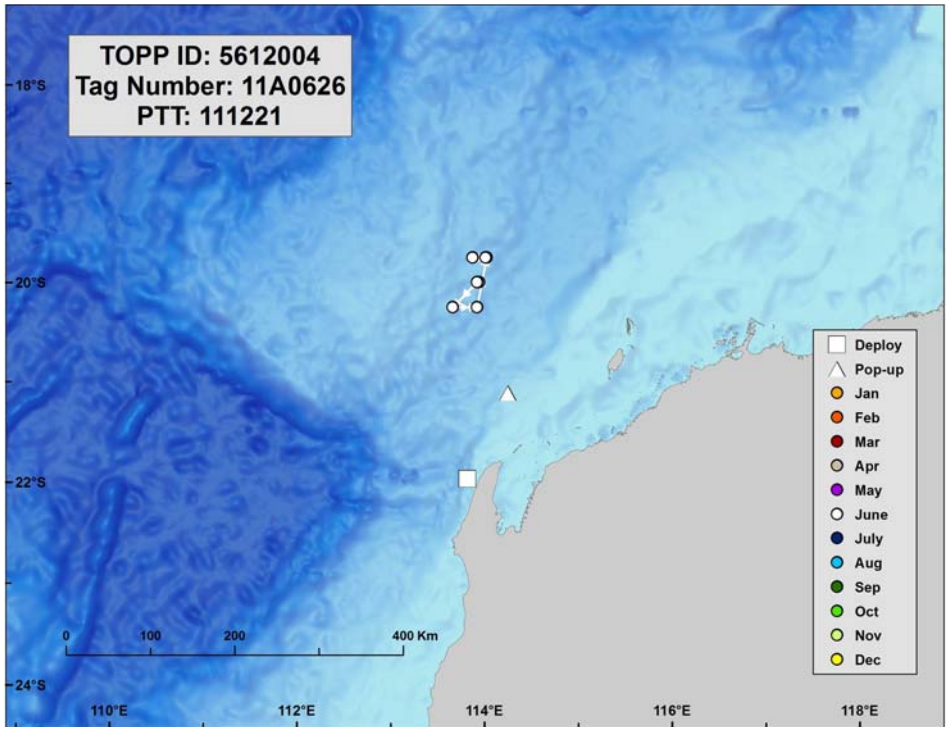


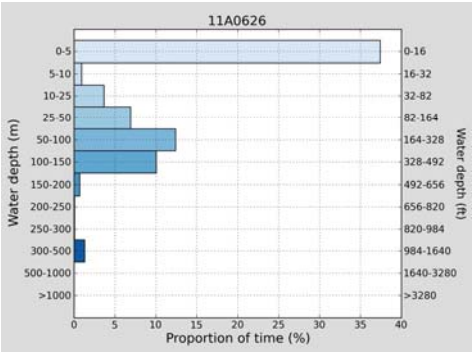
Tag number: 11A0740
Sponsor: Bjorn Farley
Angler: Bjorn Farley
Tagger: Bjorn Farley
Boat: *Jaime*
Species: Blue marlin
Estimated weight: 100 kg
Deployed: 3/29/2012
Reported: 7/27/2012
Days at large: 120
Distance traveled: 1,035 nm
Ranking: 1
Maximum depth: 184 m
Minimum temp: 18 C
Maximum temp: 29.6 C

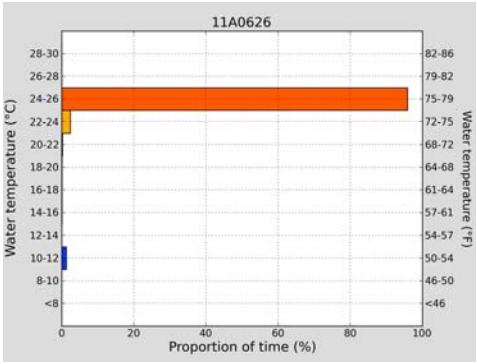


Tag 11A0626

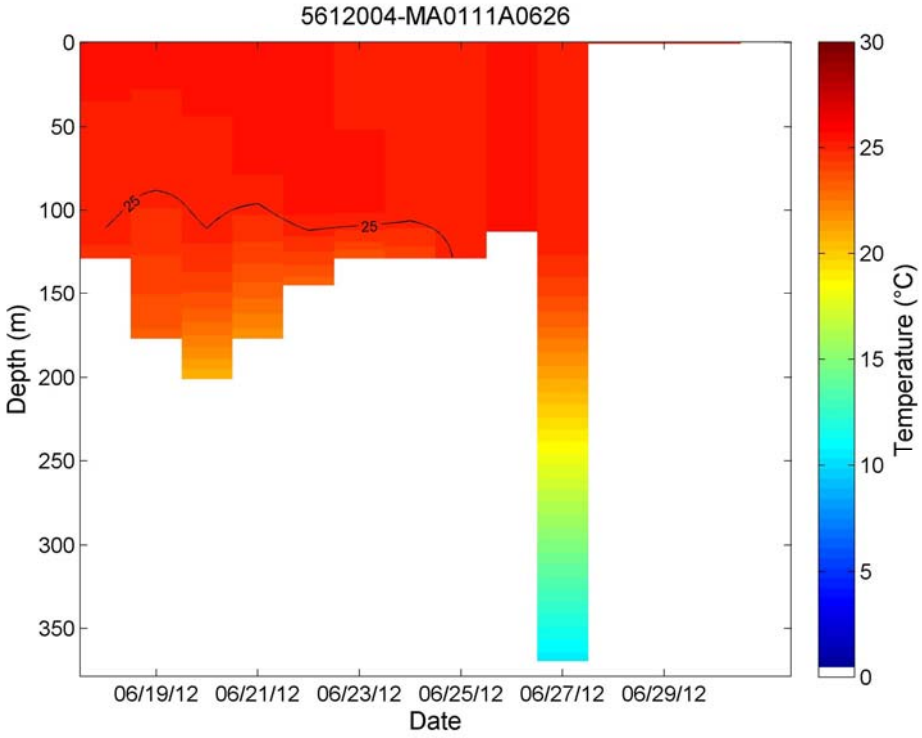
Fish 8





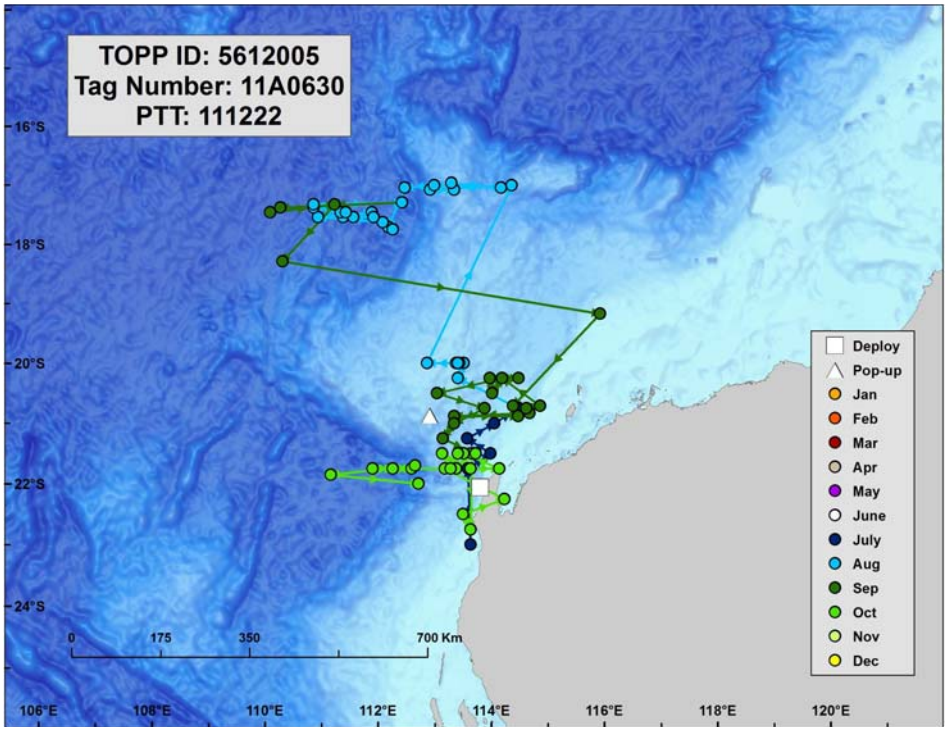


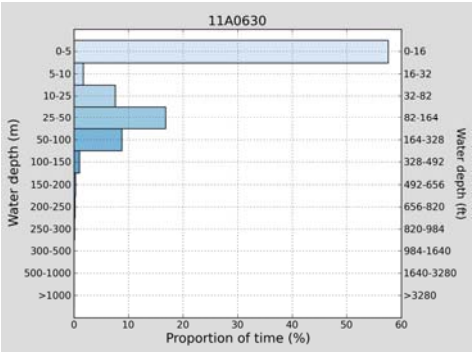
Tag number: 11A0626
Sponsor: Jim Lerland
Angler: Jim Lerland
Tagger: Jim Lerland
Boat: *Our Time*
Species: Black marlin
Estimated weight: 45 kg
Deployed: 6/18/2012
Reported: 7/2/2012
Days at large: 14
Distance traveled: 57 nm
Ranking: 7
Maximum depth: 368 m
Minimum temp: 10.4 C
Maximum temp: 25.8 C

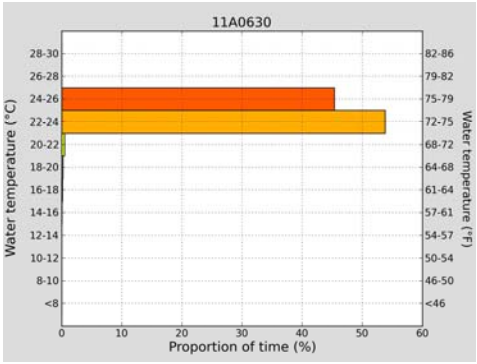


Tag 11A0630

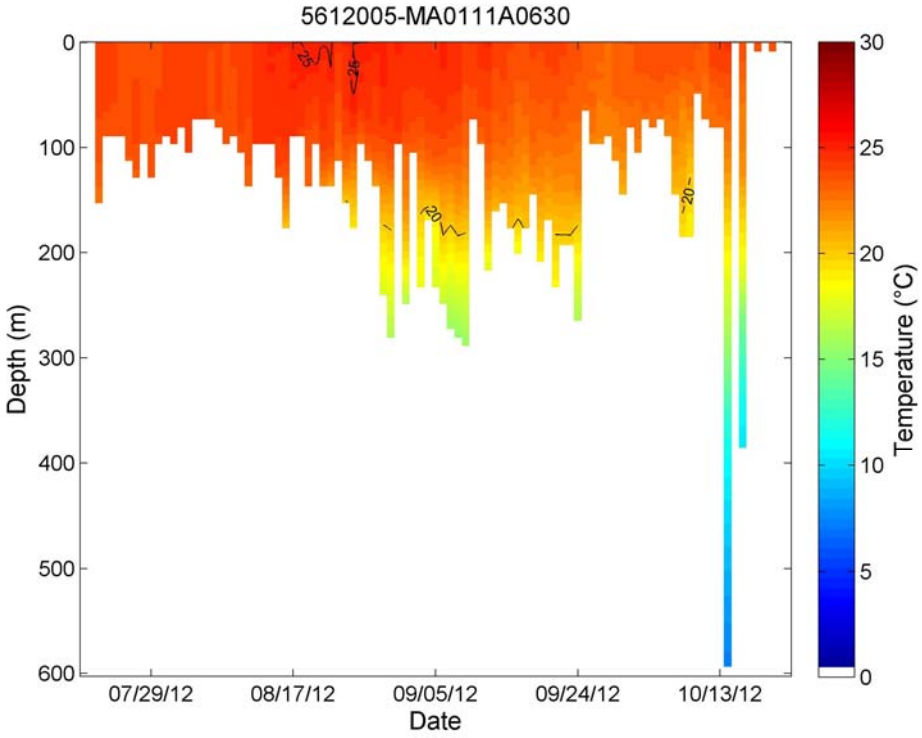
Fish 9





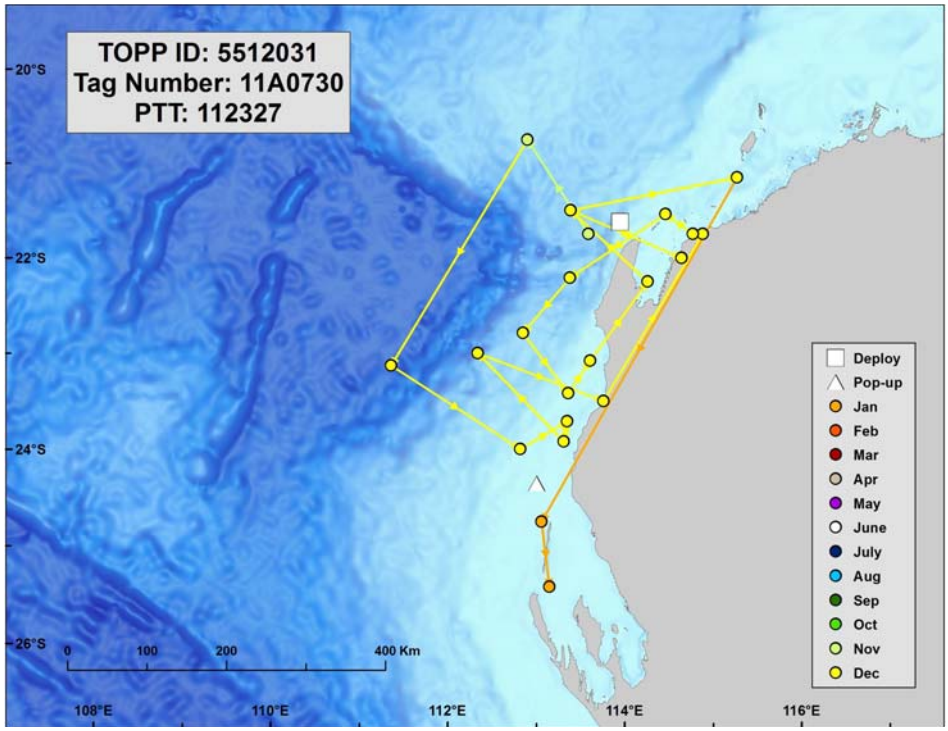


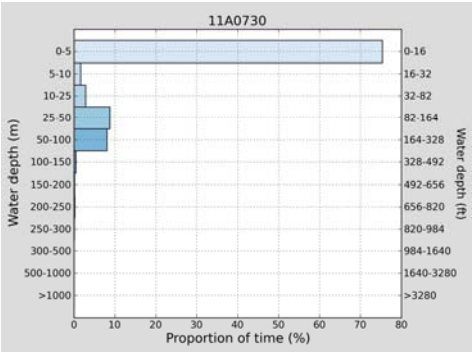
Tag number: 11A0630
Sponsor: Tackle World
Angler: Daniel M
Tagger: Matt Gates
Boat: *In Deep*
Species: Black marlin
Estimated weight: 145 kg
Deployed: 7/20/2012
Reported: 10/22/2012
Days at large: 94
Distance traveled: 87 nm
Ranking: 6
Maximum depth: 592 m
Minimum temp: 7 C
Maximum temp: 25.4 C

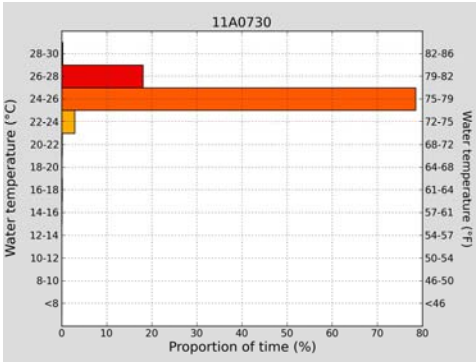


Tag 11A0730

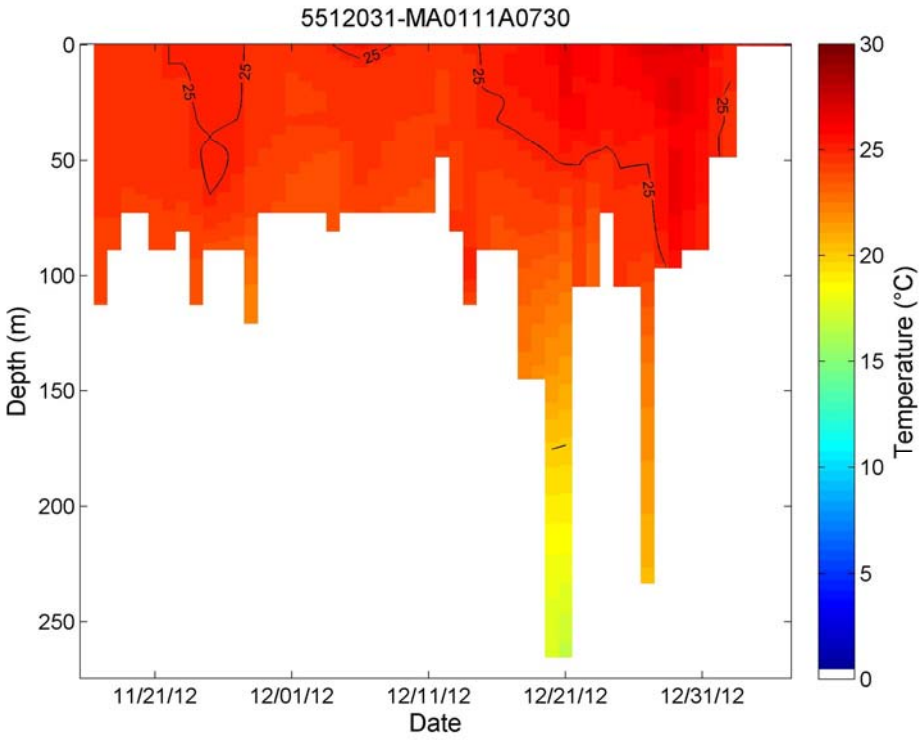
Fish 10







Tag number: 11A0730
Sponsor: Team Reel Obsession
Angler: Aaron Lewis
Tagger: Matt Gates
Boat: *In Deep*
Species: Blue Marlin
Estimated weight: 90 kg
Deployed: 11/16/2012
Reported: 1/6/2013
Days at large: 51
Distance traveled: 172 nm
Ranking: 5
Maximum depth: 264 m
Minimum temp: 15.6 C
Maximum temp: 28.4 C



A total of five Wildlife Computers MK-10 pop-up satellite archival tags (PATs) were deployed on marlin off the coast of Watamu, Kenya as part of the 2013 Watamu, Kenya IGFA Great Marlin Race (IGMR).

On August 19, 2013 the first tag was placed on a lively, 80 kg (176 lb) black marlin by Sammy Tuva after it was caught by Sam Horner aboard *Ol Jogi II*. The tag popped up in the Gulf of Aden on October 4, 2013 and showed that the fish swam a point to point distance of 1,108 nautical miles (nm) and a total estimated distance of 1,697* nm in a mere 46 days! Congratulations to Team 1: *Ol Jogi II* – winners of the Watamu, Kenya 2013 IGMR! Not only was this tag the first to be deployed in the race, but it was the first satellite tag deployed on a marlin in East Africa. Congratulations to angler Sam Horner, tagger Sammy Tuva, and Captain Stuart Simpson of Team *Ol Jogi II*!

On December 13, 2013, *Unreel* Captain Rob Hellier placed the second tag on an estimated 90 kg (198 lb) blue marlin. The angler, Sam Coate, stated on the data sheet that the fish was "in good condition and swam away well". On February 19, 2014, after 67 days at large, the tag popped up 104 nm away from where it was deployed. However, as evidence by the track, the blue actually swam much farther- a distance that we estimate to be about 1,405 nm*!

On January 30, 2014, Mark Smith hooked up to an estimated 60 kg (132 lb) blue marlin while fishing from *Simba* and after a 20 minute bout, Mtwalia Zia placed the third tag on the fish. According to the data sheet, the fish named "Roger the Marlin" was "healthy and swam away well". After 27 days, on February 26, 2014, the tag surfaced 37 nm away from its point of deployment.

On February 24, 2014, *Unreel* Captain Rob Hellier placed another tag, the fourth of the Kenya IGMR, on the largest fish in the race- an estimated 159 kg (350 lb) blue marlin - after a 40 minute fight with angler Sean Durham. As noted on the data sheet, the fish "swam for a bit, turned upside down for 15 seconds then righted and swam" away. Only five days later on March 1, 2014, the tag surfaced 44 nm away from where it was deployed.

*The total estimated distance is a based on the length of a "best-guess" track calculated using light and sea surface temperature measurements from the tag and a complex mathematical algorithm. Since each location along the track potentially has significant error associated with it, the IGMR instead uses the reliable and more precise linear distance (the point of tag deployment determined by GPS to the point of tag pop-up determined by Argos satellites) to establish IGMR results and winners.

On the morning of September 6, 2014, the fifth and final tag was deployed on an estimated 75 kg (165 lb) black marlin. The fish was tagged and released by African Billfish Foundation's Roy Bealey after a 12 minute fight with angler Cindy Gagnepain aboard *Tarka*. 110 days later on Christmas day, the tag revealed that rather than going north like Fish 1, the black marlin swam a linear distance of 935 nm to the south (and a total estimated distance of 1,997 nm*), almost reaching the Zambezi River delta.

Watamu, Kenya 2013 Deployments											
Tag	**Boat**	**Fish**	**Species**	**Tagged**	**Reported**	**Days at Large**	**Distance (nm)**	**Est. Wt. (lbs)**	**Est. Wt. (kg)**	**Angler**	**Tagger**
07A0985	*Ol Jogi II*	1	Black marlin	8/19/2013	10/4/2013	46	1,108	176	80	Sam Horner	Sammy Tuva
11A0782	*Unreel*	2	Blue marlin	12/14/2013	2/19/2014	67	104	198	90	Sam Coate	Rob Hellier
11A0834	*Simba*	3	Blue marlin	1/30/2014	2/26/2014	27	37	132	60	Mark Smith	Mtawali Zia
11A0832	*Unreel*	4	Blue marlin	2/24/2014	3/1/2014	5	44	350	159	Sean Durham	Rob Hellier
11A0784	*Tarka*	5	Black marlin	9/6/2014	12/25/2014	110	935	165	75	Cindy Gagnepain	Roy Bealey

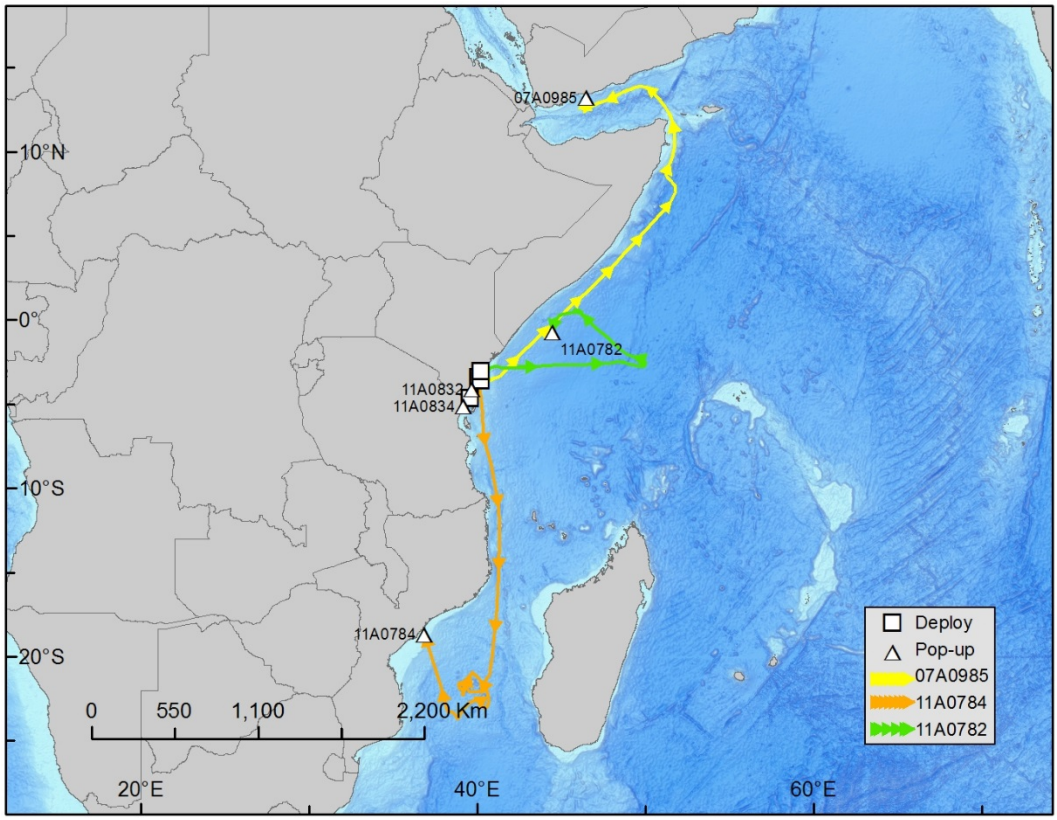


Figure 1: Map of the Watamu, Kenya 2013 tracks with Fish 1 in yellow, Fish 2 in green, and Fish 5 in orange.

*The total estimated distance is a based on the length of a "best-guess" track calculated using light and sea surface temperature measurements from the tag and a complex mathematical algorithm. Since each location along the track potentially has significant error associated with it, the IGMR instead uses the reliable and more precise linear distance (the point of tag deployment determined by GPS to the point of tag pop-up determined by Argos satellites) to establish IGMR results and winners.

The journey of Fish 1 (Tag 11A0782) is remarkable because not only did the black marlin swim rapidly, but it also established connectivity between the waters off the coast of Kenya to the Gulf of Aden, a location where sailfish and striped marlin are known to occur and black marlin sightings are rare. This marlin exhibited typical bi-modal depth distribution patterns, almost certainly associated with diurnal (day/night) diving behavior. It also encountered incredibly warm waters during its journey, spending 10% of its time in water from 28-30°C, and reaching a maximum temperature of 33.6°C – among the highest we've ever recorded.

Fish 2 (Tag 11A0782) appears to have headed east offshore for the first couple of weeks after it was tagged in mid-December. In mid-January, the blue marlin turned northwest to the nearshore waters off the coast of Mogadishu, Somalia. In early February, it appears that the tag may have detached from the marlin and then floated at the surface where it was occasionally pulled down to great depths – one time reaching 976 meters (m)! We have seen this phenomenon before in the IGFA Great Marlin Race and believe that the floating tag was grabbed by a squid, which carries it into deep water before letting it go. That being said, we have now started programming the tags to wait less time to start transmitting once they reach a constant depth in order to reduce the chances of this occurring.

Fish 3 (Tag 11A0834) appears to have been an immediate mortality after it was tagged on January 30, 2014 as evidenced by the immediate decline to over 400 m depth (the depth of the basin where the tag was deployed) into temperatures far below the marlin's thermal preference. The tag was subsequently ingested by an animal with a warm, constant body temperature which we believe was most likely that of a lamnid shark. This putative shark carried the tag for about three weeks, swimming at depths ranging throughout the top 500 m of the water column! The tag was then regurgitated around Feb. 22, 2014 and it reported after four days of floating at the surface, (as it is programmed to do) just 37 nm from where it was deployed. It is impossible to know where the tag was during the time it was ingested because there is no light available from which to derive geographic location. However, the short distance between point of tag deployment and point of tag pop-up suggests that the shark stayed relatively local for the entire three week deployment period, markedly different from the behavior of a marlin.

Given the significant depth (>300 m) the tag reached on the first day followed by time the tag floated at the surface, we believe that Fish 4 (Tag 11A0832) may also have been an immediate mortality following tag deployment. However, we can only speculate in this case since there are very few data available because the tag was attached to the blue marlin for such a short time.

Fish 5 (Tag 11A0784) perhaps yielded the oddest dataset of the five tags. The data we received suggests that the marlin consistently dove to a depth around 110 m and stayed

*The total estimated distance is a based on the length of a "best-guess" track calculated using light and sea surface temperature measurements from the tag and a complex mathematical algorithm. Since each location along the track potentially has significant error associated with it, the IGMR instead uses the reliable and more precise linear distance (the point of tag deployment determined by GPS to the point of tag pop-up determined by Argos satellites) to establish IGMR results and winners.

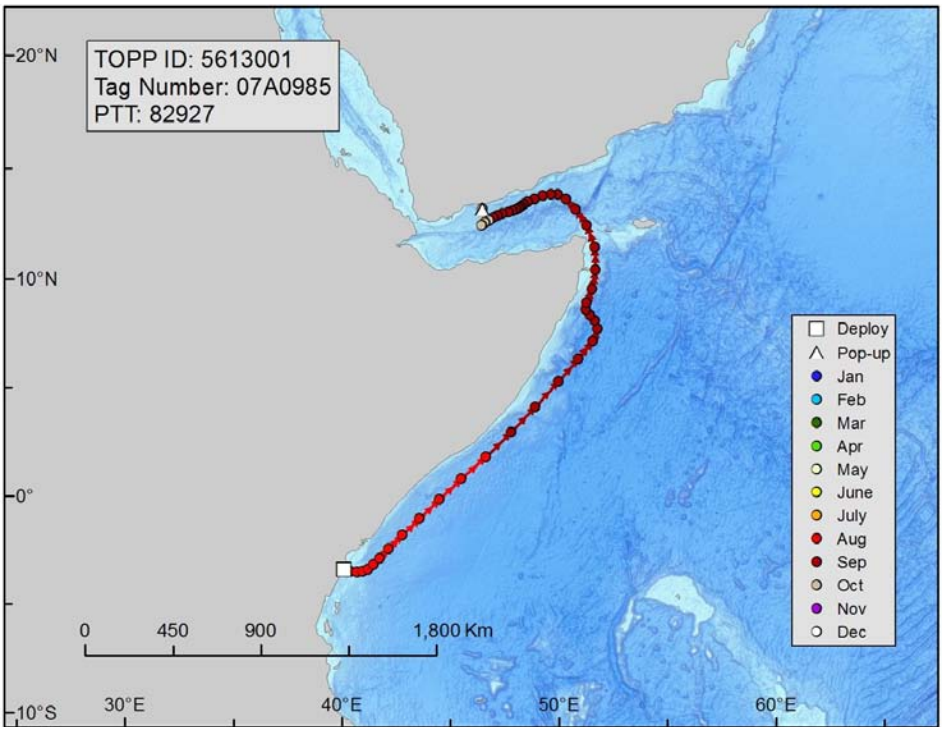
strictly within the very warm surface waters above 20°C. Although it isn't unusual to see a marlin preferring warm water, most datasets show that they dive down to the thermocline (to whatever depth the thermocline happens to be). We have witnessed that as the depth of the thermocline changes, marlin diving behavior changes accordingly. However, this particular black marlin seemed content to stay well above the thermocline, as he only made one single foray into slightly deeper, cooler water around October 10, 2014. However, it is unclear whether this was driven by physical factors or prey distribution. Most interestingly, Fish 5 (Tag 11A0784) spent the latter portion of its journey in the vicinity of Bassas da India and Europa Island, between Madagascar and Mozambique and in 2012, another black marlin (tagged during the South African Deep Sea Angling Association Classic) also reported from this area. This suggests that black marlin could range along the eastern African coastline from South Africa to the Gulf of Aden.

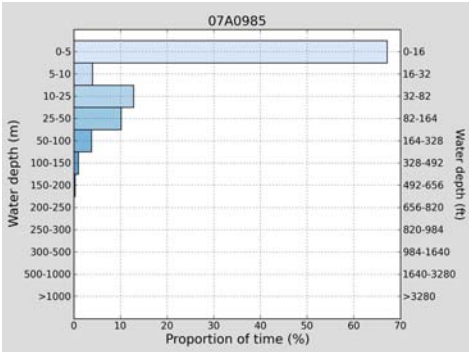
The findings from the 2013 Watamu, Kenya IGMR illustrate how useful it can be to carry out tagging studies in multiple locations and over long time periods. Documentation of a contiguous black marlin population along the entire East African coast carries significant ramifications for management of these species, as the activities at one end of the African continent could have impacts at the other. The entire IGMR team at Stanford University and the IGFA are deeply grateful for the generous support of the African Billfish Foundation, as well as the captains, crews, anglers, taggers and participants in the Watamu, Kenya IGMR. Without everyone's hard work and perseverance, the information we are gaining to ensure a better future for these miraculous sportfish would not exist.

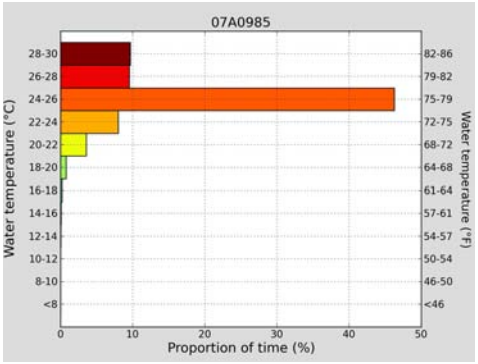
*The total estimated distance is a based on the length of a "best-guess" track calculated using light and sea surface temperature measurements from the tag and a complex mathematical algorithm. Since each location along the track potentially has significant error associated with it, the IGMR instead uses the reliable and more precise linear distance (the point of tag deployment determined by GPS to the point of tag pop-up determined by Argos satellites) to establish IGMR results and winners.

Tag 07A0985

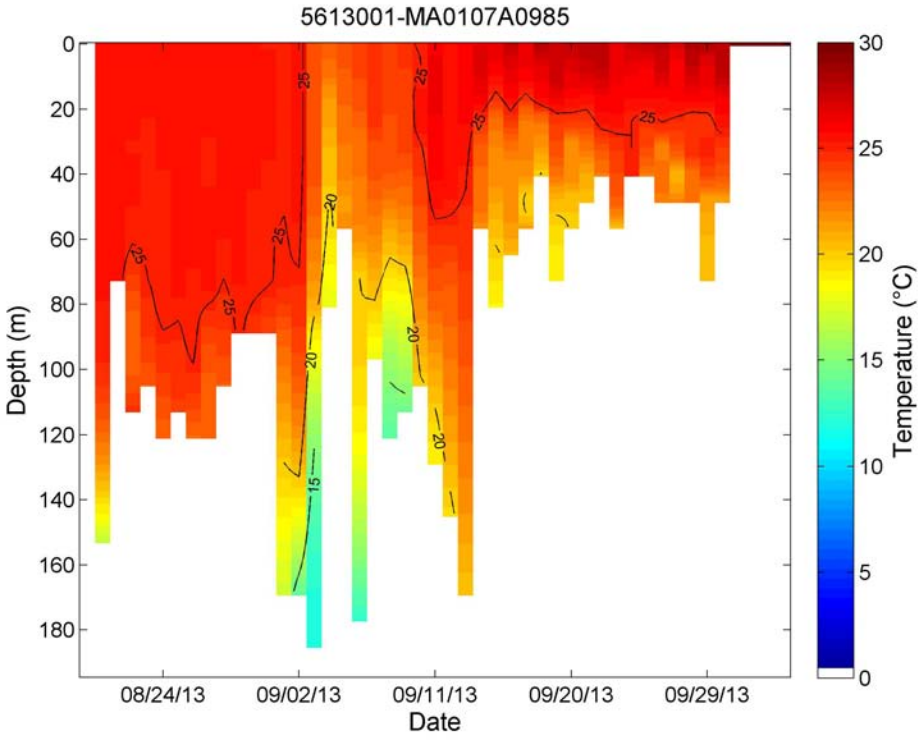
Fish 1





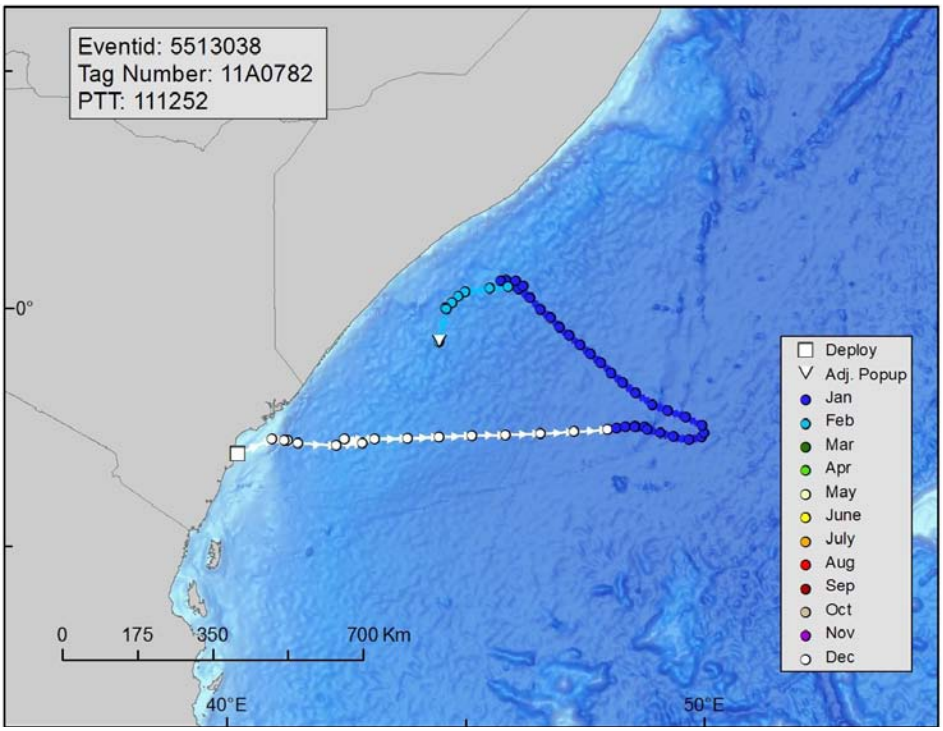


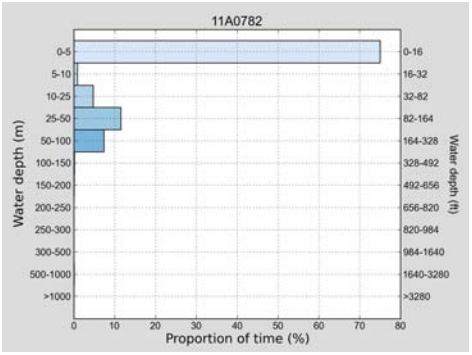
Tag number: 07A0985
Sponsor: African Billfish Foundation
Angler: Sam Horner
Tagger: Sammy Tuva
Boat: *Ol Jogi II*
Species: Black marlin
Estimated weight: 80 kg
Deployed: 8/19/2013
Reported: 10/4/2013
Days at large: 46
Distance traveled: 1,108 nm
Maximum depth: 184 m
Minimum temp: 11.8 C
Maximum temp: 33.6 C

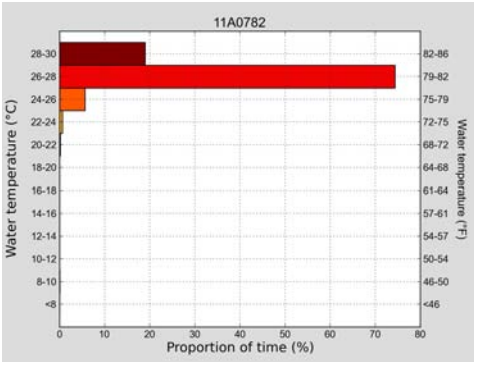


Tag 11A0782

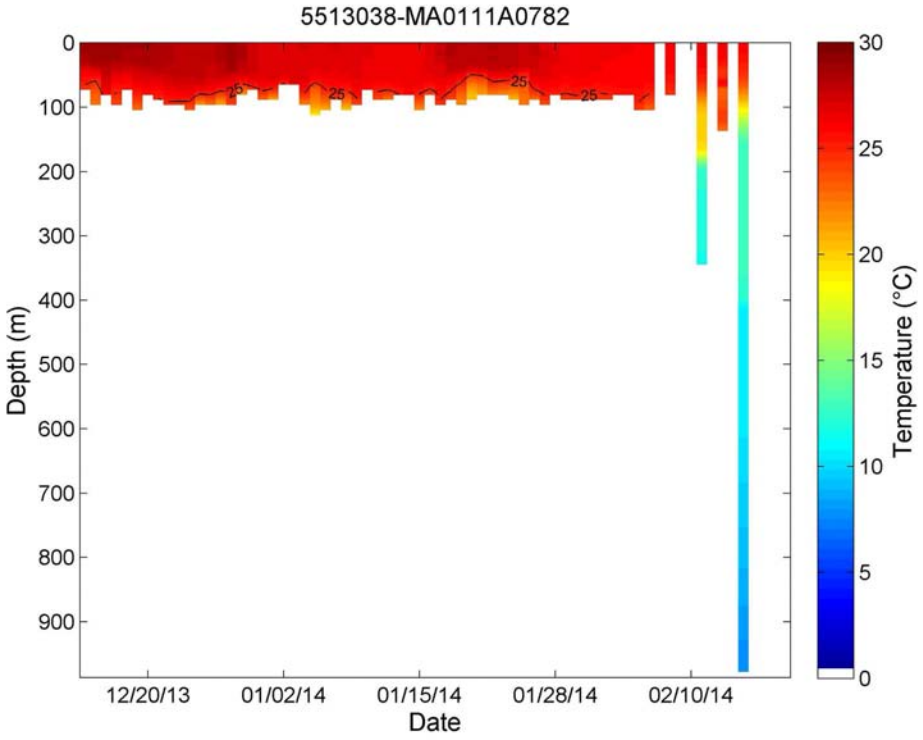
Fish 2





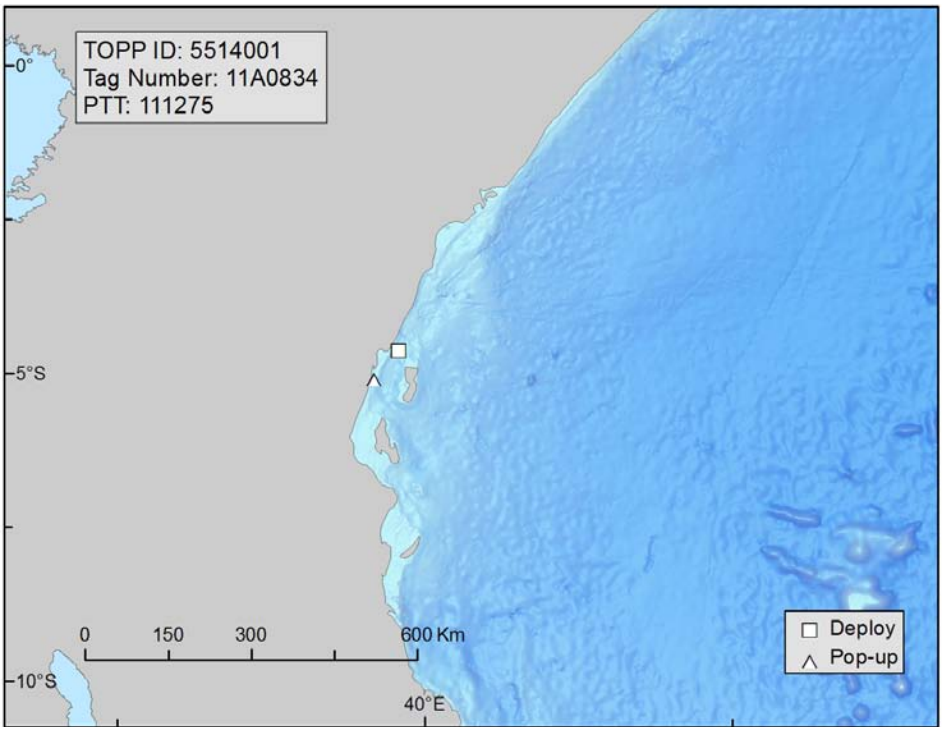


Tag number: 11A0782
Sponsor: African Billfish Foundation
Angler: Sam Coate
Tagger: Rob Hellier
Boat: *Unreel*
Species: Blue marlin
Estimated weight: 90 kg
Deployed: 12/14/2013
Reported: 2/19/2014
Days at large: 67
Distance traveled: 104 nm
Maximum depth: 976 m
Minimum temp: 7.4 C
Maximum temp: 29.2 C

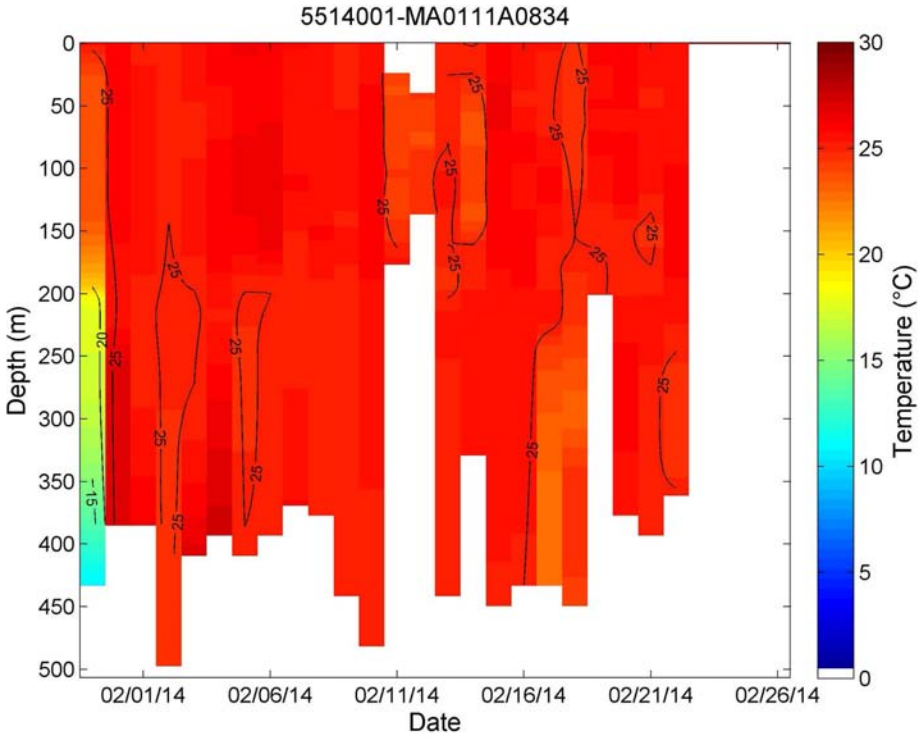


Tag 11A0834

Fish 3

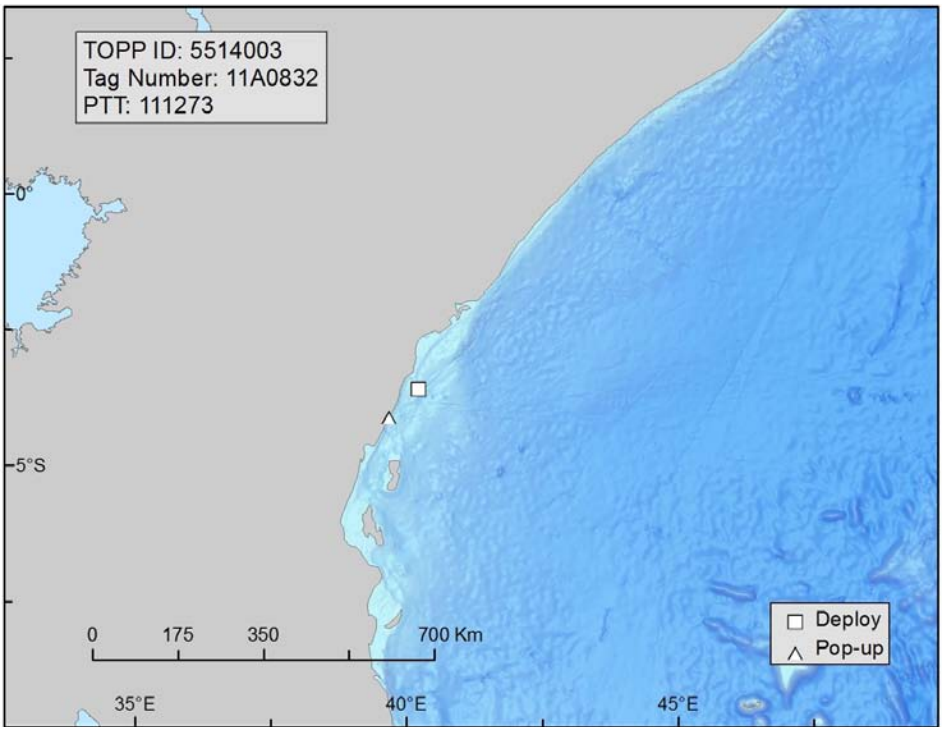


Tag number: 11A0834
Sponsor: African Billfish Foundation
Angler: Mark Smith
Tagger: Mtawali Zia
Boat: *Simba*
Species: Blue marlin
Estimated weight: 60 kg
Deployed: 1/30/2014
Reported: 2/26/2014
Days at large: 27
Distance traveled: 37 nm
Maximum depth: 496 m
Minimum temp: 9.8 C
Maximum temp: 31.4 C

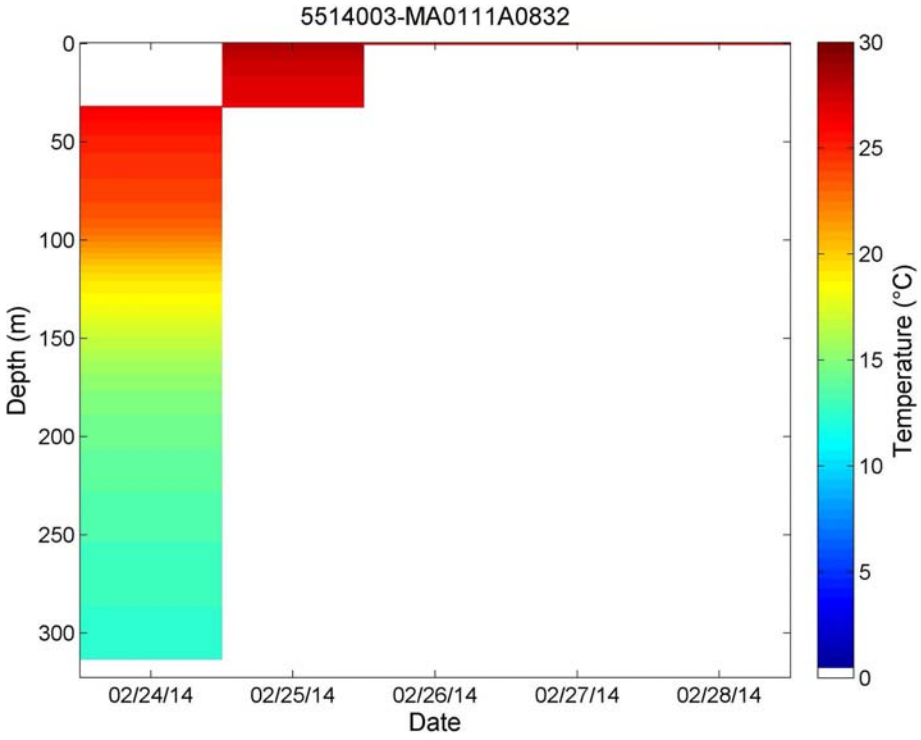


Tag 11A0832

Fish 4

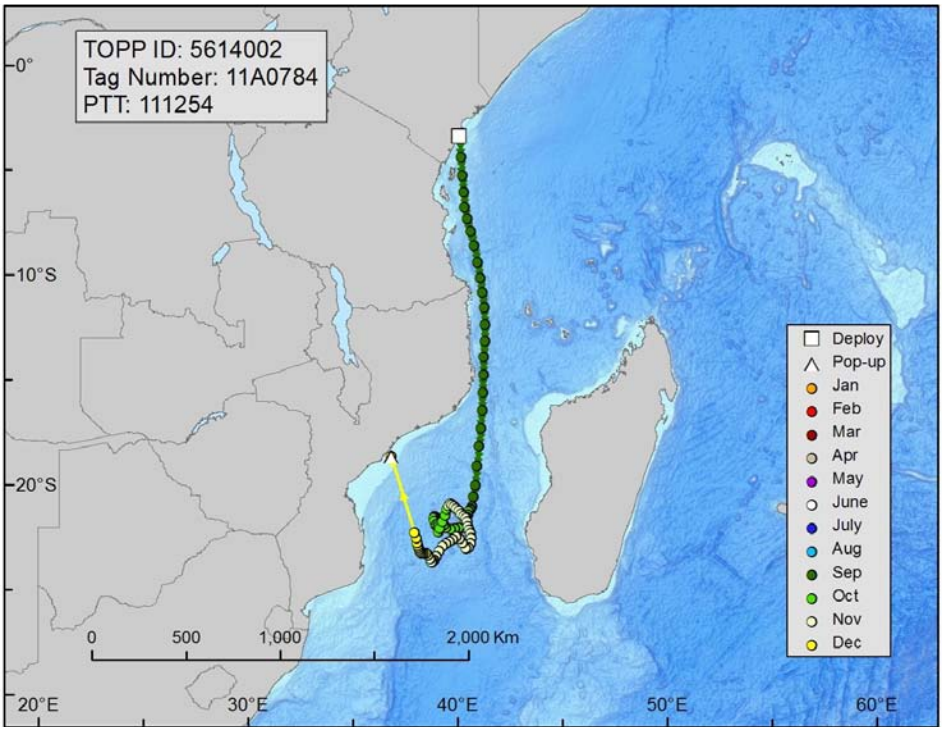


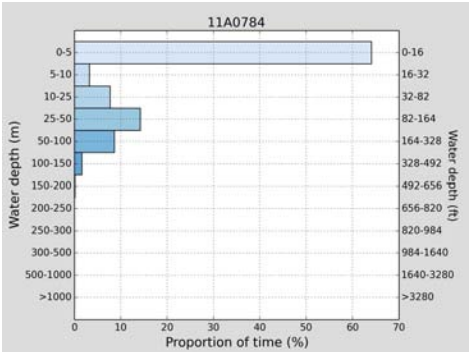
Tag number: 11A0832
Sponsor: African Billfish Foundation
Angler: Sean Durham
Tagger: Rob Hellier
Boat: *Unreel*
Species: Blue marlin
Estimated weight: 159 kg
Deployed: 2/24/2014
Reported: 3/1/2014
Days at large: 5
Distance traveled: 44 nm
Maximum depth: 312 m
Minimum temp: 10.8 C
Maximum temp: 29.8 C

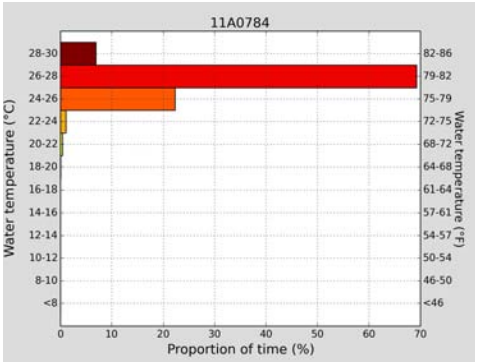


Tag 11A0784

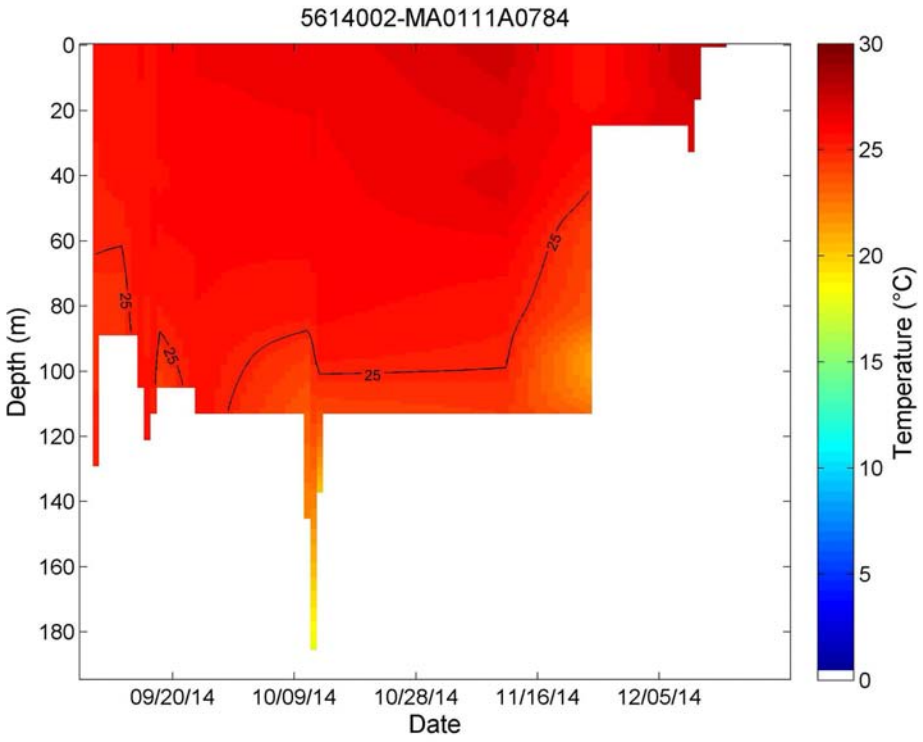
Fish 5







Tag number: 11A0784
Sponsor: African Billfish Foundation
Angler: Cindy Gagnepain
Tagger: Roy Bealey
Boat: *Tarka*
Species: Black marlin
Estimated weight: 75 kg
Deployed: 9/6/2014
Reported: 12/25/2014
Days at large: 110
Distance traveled: 935 nm
Maximum depth: 184 m
Minimum temp: 17.4 C
Maximum temp: 28 .6 C



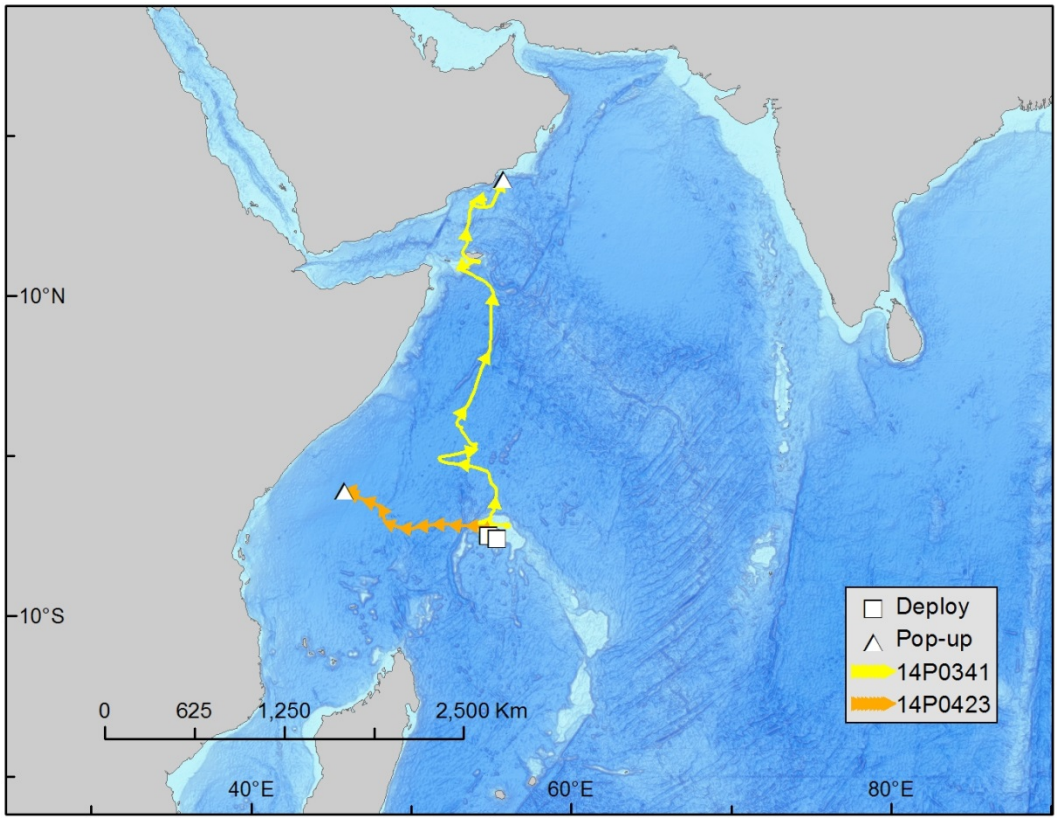
Famous for its granite and coral islands and stunning beaches, Seychelles is also known for its fantastic marlin fishing. On Saturday, November 29, 2014, The Seychelles Sports Fishing Club (SSFC) and Bisbee's Fish & Wildlife Conservation Fund teamed up to host a first ever IGFA Great Marlin Race (IGMR) in beautiful Seychelles which became the 15th country in the world added to the IGMR!

At 11:15 am on the opening day, SSFC Secretary Grant Heyer received a call from *Island Star* Captain Marc Houareau, who told him they had just successfully deployed their satellite tag on a "beauty of a black marlin estimated at around 240 kg (529 lbs)". Marc's uncle, Davis Houareau, fought the fish for 20 minutes before Anthony Payet deployed the first tag of the race on the fish. This tag was the first of five tags generously sponsored by Bisbee's Fish & Wildlife Conservation Fund. Not long after Tag 1 (Tag 14P0341) was deployed, Capt. Danny Lowlam of *Blue Lady* reported that tagger Ronny placed the second tag of the race on an estimated 70 kg (154 lb) blue marlin after a 20 minute fight with angler Mervyn. Tag 2 (Tag 14P0423) was the first of two tags graciously sponsored by Oceana Fisheries. A few hours later, the third tag of the race was deployed on an estimated 45 kg (99 lb) marlin by Henry Riggs-Miller after a quick fight with angler Daniel Hoenings while fishing aboard *Albemarlin* with Captain Roslen Panasovsky. Tag 3 (Tag 14P0403) was the first of two satellite tags sponsored by World Wide Fund for Nature (WWF) in an effort to promote conservation of the Seychelles marine environment.

Although there were nine other satellite tags sponsored for the event, rough and rainy weather prevented their deployment. Therefore, the remaining tags sponsored by Bisbee Fish & Wildlife Conservation Fund, A1 Sportfishing, WWF, Oceana Fisheries, Eden Island, and Seychelles Fishing Authority are scheduled to be deployed during the 2015 Victoria, Seychelles IGMR.

*The total estimated distance is based on the length of a "best-guess" track calculated using light and sea surface temperature measurements from the tag and a complex mathematical algorithm. Since each location along the track potentially has significant error associated with it, the IGMR instead uses the reliable and more precise linear distance (the point of tag deployment determined by GPS to the point of tag pop-up determined by Argos satellites) to establish IGMR results and winners

2014 Victoria, Seychelles Deployments											
Tag	**Boat**	**Fish**	**Species**	**Tagged**	**Reported**	**Days at Large**	**Distance (nm)**	**Est. Wt. (lbs)**	**Est. Wt. (kg)**	**Angler**	**Tagger**
14P0341	Island Star	1	Black marlin	11/29/2014	5/28/2015	180	1335	529	240	Davis Houareau	Anthony Payet
14P0423	Blue Lady	2	Blue marlin	11/29/2014	1/25/2015	57	600	154	70	Mervyn	Ronny
14P0403	Albemarlin	3	Blue marlin	11/29/2014	12/5/2014	6	152	99	45	Daniel Hoenings	Henry Riggs-Miller



*The total estimated distance is based on the length of a “best-guess” track calculated using light and sea surface temperature measurements from the tag and a complex mathematical algorithm. Since each location along the track potentially has significant error associated with it, the IGMR instead uses the reliable and more precise linear distance (the point of tag deployment determined by GPS to the point of tag pop-up determined by Argos satellites) to establish IGMR results and winners

Unfortunately, Tag 3- Team *Albemarlin* (Tag 14P0403) popped off the marlin after six days at large, 152 nautical miles away from where it was tagged. After close examination of the data, we concluded that the tag was most likely consumed by a yellowfin tuna. When Team *Albemarlin*'s blue was first released, tag data showed that the marlin exhibited typical marlin diving behavior with the expected associated temperatures (ie colder temperatures as the marlin swam deeper in the water column). However, several hours after deployment (around 17:00-18:00), the diving behavior recorded by the tag changed, and the temperature remained relatively consistent (around 25-26°C) with changes in depth (50-100 meters). Also, the tag stopped detecting light which reaffirmed that the tag was definitely inside something's stomach. The tag stayed inside the stomach of the animal for several days before it was egested, floated to the surface, and began transmitting the data to Argos.

We have experienced data like this before in the IGMR, and in the past, we have concluded that these occurrences were likely predation events which we have often attributed to lamnid sharks such as mako or white sharks. However, in those circumstances, the temperatures that the tag recorded were much more consistent and indicative of being inside of an endothermic (warm-bodied) lamnid shark, where in this instance, the recorded temperatures varied by several degrees which is more similar to the internal temperature of an ectothermic (cold blooded) species. While it is possible that this event reflects consumption of the marlin by an ectothermic species of shark, a local Seychelles expert reviewed the data and suggested that this was unlikely a shark predation event since sharks often stay at deep depths for long periods of time and Tag 3 (Tag 14P0403) data shows that the depth change occurrence was a quick dive (within a 30 minute period). The expert also stated that he had witnessed similar diving behavior from Yellowfin tuna that, in order to remove parasites from themselves, will make dives to 1,200 meters (m) for around 20 minutes and then return to shallower depths. Indeed, the animal with Tag 3 (Tag 14P0403) inside its stomach undertook such a dive to an incredible depth of almost 1,100 m, a depth that is much deeper than the maximum depths recorded for any marlin tagged during any IGMR event.

Since recent scientific publications reveal that Yellowfin tuna exhibit similar diving behaviors as the behavior recorded by Tag 3 (Tag 14P0403), and the evidence of scrape marks and teeth marks on other recovered satellite tags reveal that it is possible that other animals may be attracted to the tags and bite them, we believe that Tag 3 (Tag 14P0403) was most likely ingested by a Yellowfin Tuna. It is possible that the tuna bit the tag off of the marlin or perhaps, a shark preyed upon the marlin and the yellowfin ingested the scraps which contained the tag. Although we know it is disappointing that tag sponsor WWF cannot see a track of their marlin, their

*The total estimated distance is based on the length of a "best-guess" track calculated using light and sea surface temperature measurements from the tag and a complex mathematical algorithm. Since each location along the track potentially has significant error associated with it, the IGMR instead uses the reliable and more precise linear distance (the point of tag deployment determined by GPS to the point of tag pop-up determined by Argos satellites) to establish IGMR results and winners

support has allowed for this amazing discovery – something we've never witnessed before in the IGFA Great Marlin Race.

Tag 2- Team *Blue Lady* (Tag 14P0423) was the second tag to report on January 25, 2015 after recording data for 57 days on the estimated 70 kg (154 lb) blue marlin. After release, the marlin swam due west for a point to point distance of 600 nm and a total estimated distance of 711 nm* before popping up approximately 240 nm off the coast of Somalia. Data received from this tag indicated that the short deployment period was due to the tag being ingested by another animal. Tag 2 (Tag 14P0423) data showed that on January 20th, light levels dropped, temperature rose from 26°C (79°F) to 29°C (84°F) and became more consistent, and the diving behavior changed significantly with fewer, longer dives to deeper depths. The temperature data indicated the tag was ingested by an endothermic predator such as a mako or white shark. Although we've observed events such as these in the past during other IGMR events, they typically occur shortly after the animal is tagged. So, it was especially interesting to record a predation event on a marlin that had first been thriving for months in the wild.

Tag 1- Team *Island Star* (Tag 14P0341) was the third and final tag to surface to win the 2014 Victoria, Seychelles IGMR! On May 28, 2015 after reaching the full deployment period of 180 days, Tag 1- Team *Island Star* (Tag 14P0341) popped up north of the Seychelles near the Gulf of Aden after traveling a linear distance of 1,335 nm and a total estimated distance of 2,484 nm*! Observed diving behavior was consistent with other billfish, diving during the day and swimming near the surface at night with diving depths near or above the 20°C (68°F) thermocline. The majority of the deployment period was spent in temperatures ranging from 24°C (75°F) to 30°C (86°F). Congratulations to sponsor Bisbee's Fish and Wildlife Conservation Fund and Team *Island Star* for tagging the winning fish.

Although only three fish were tagged in the 2014 Victoria, Seychelles IGMR, it is noteworthy that the two tags that recorded tracks were different species: one black and one blue marlin. Data from multiple species in the same area can provide significant insight into how these species coexist and utilize the available habitat. In this event, the black marlin consistently dove deeper than the blue marlin, but depths for both fish appear to have been limited by the 20°C (68°F) thermocline with limited diving below this thermocline. This data provides an excellent baseline against which to study marlin tagged during the 2015 Victoria, Seychelles IGMR as well as other marlin tagged in this region in future years. For future races, miniPAT tags will be programmed with a 240 day deployment duration, instead of the 180 day deployment period used in previous events. We hope that the additional 60 days of data will provide even more insight into where these animals go as they spend more time in the open ocean.

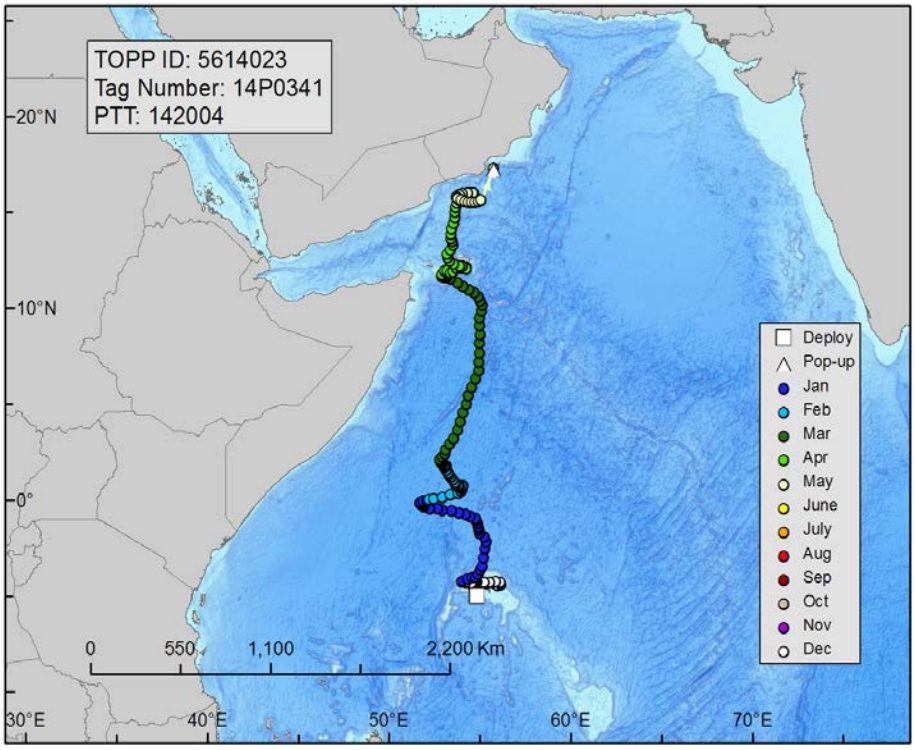
*The total estimated distance is based on the length of a "best-guess" track calculated using light and sea surface temperature measurements from the tag and a complex mathematical algorithm. Since each location along the track potentially has significant error associated with it, the IGMR instead uses the reliable and more precise linear distance (the point of tag deployment determined by GPS to the point of tag pop-up determined by Argos satellites) to establish IGMR results and winners

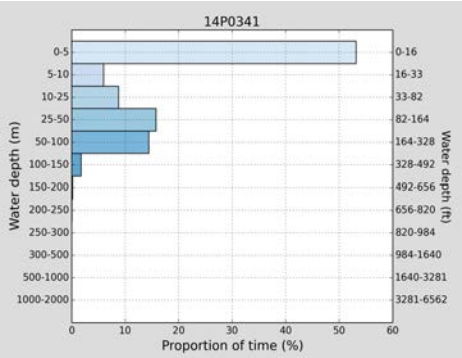
Many thanks to all the sponsors, captains, anglers, crew, and participants in the 2014 Seychelles IGMR and for contributing to the initial data sets for this region collected through the IGMR. We continue to learn about billfish behavior which enables their conservation and protection of the sport we love for future generations of fishing!

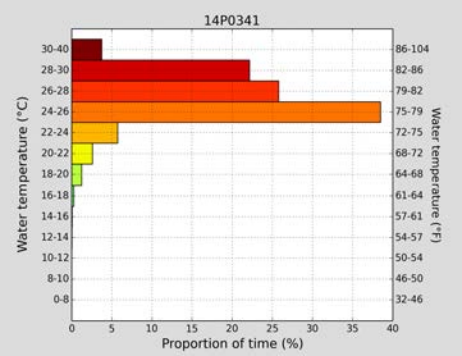
*The total estimated distance is based on the length of a “best-guess” track calculated using light and sea surface temperature measurements from the tag and a complex mathematical algorithm. Since each location along the track potentially has significant error associated with it, the IGMR instead uses the reliable and more precise linear distance (the point of tag deployment determined by GPS to the point of tag pop-up determined by Argos satellites) to establish IGMR results and winners

Tag 14P0341

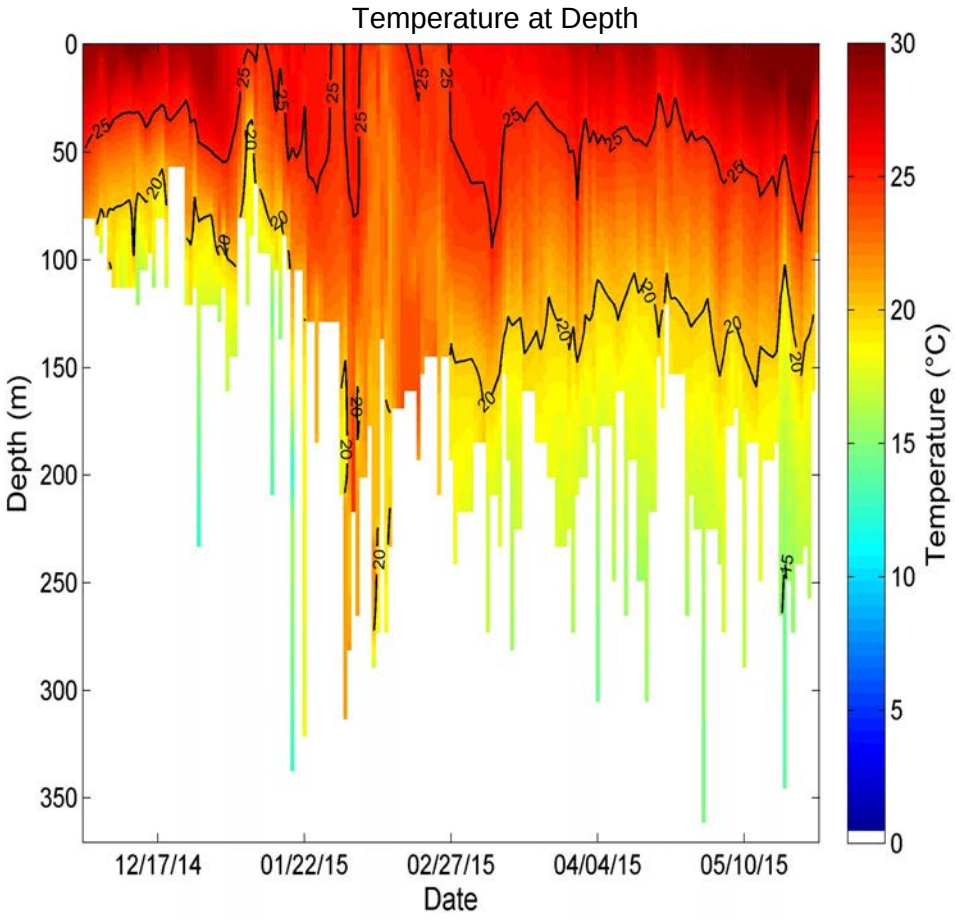
Fish 1





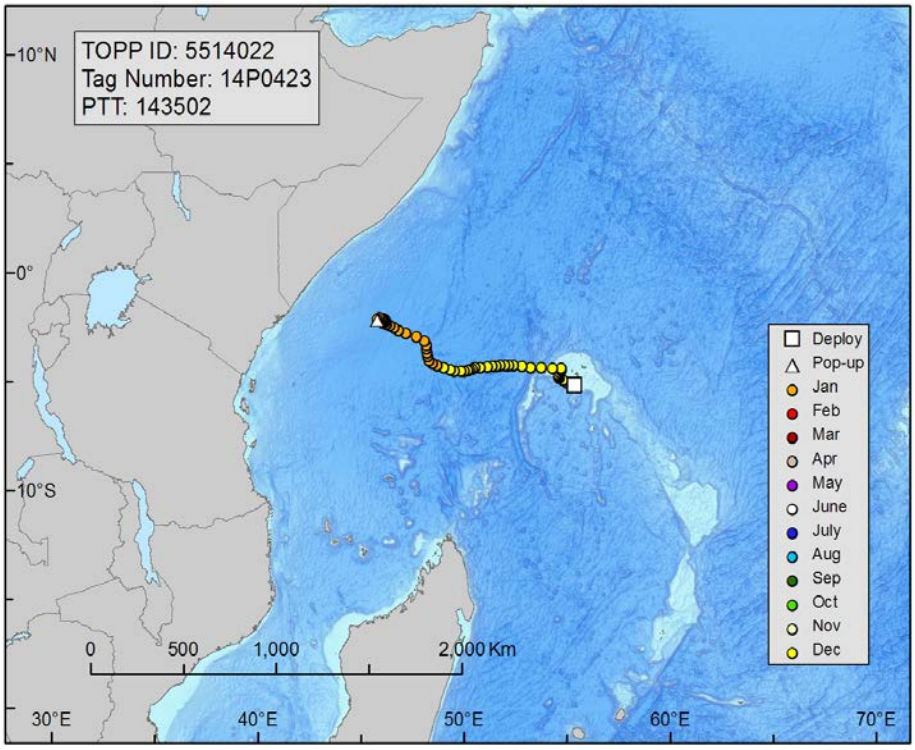


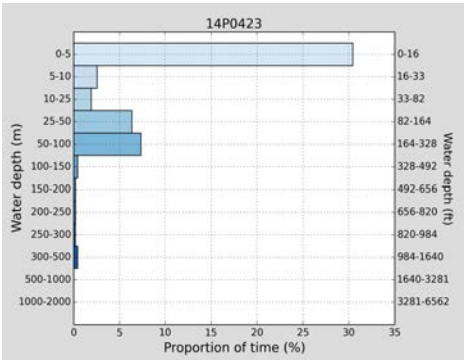
Tag number: 14P0341
Sponsor: Bisbee's Fish and Wildlife Conservation Fund
Angler: Davis Houareau
Tagger: Anthony Payet
Boat: *Island Star*
Species: Black Marlin
Estimated weight: 240 kg
Deployed: 11/29/2014
Reported: 05/28/2015
Days at large: 180
Distance traveled: 1,335 nm
Maximum depth: 360 m
Minimum temp: 12.2°C
Maximum temp: 32.6°C

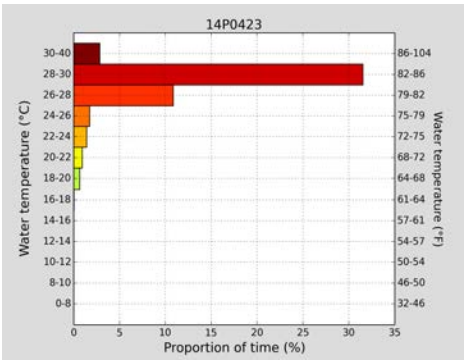


Tag 14P0423

Fish 2

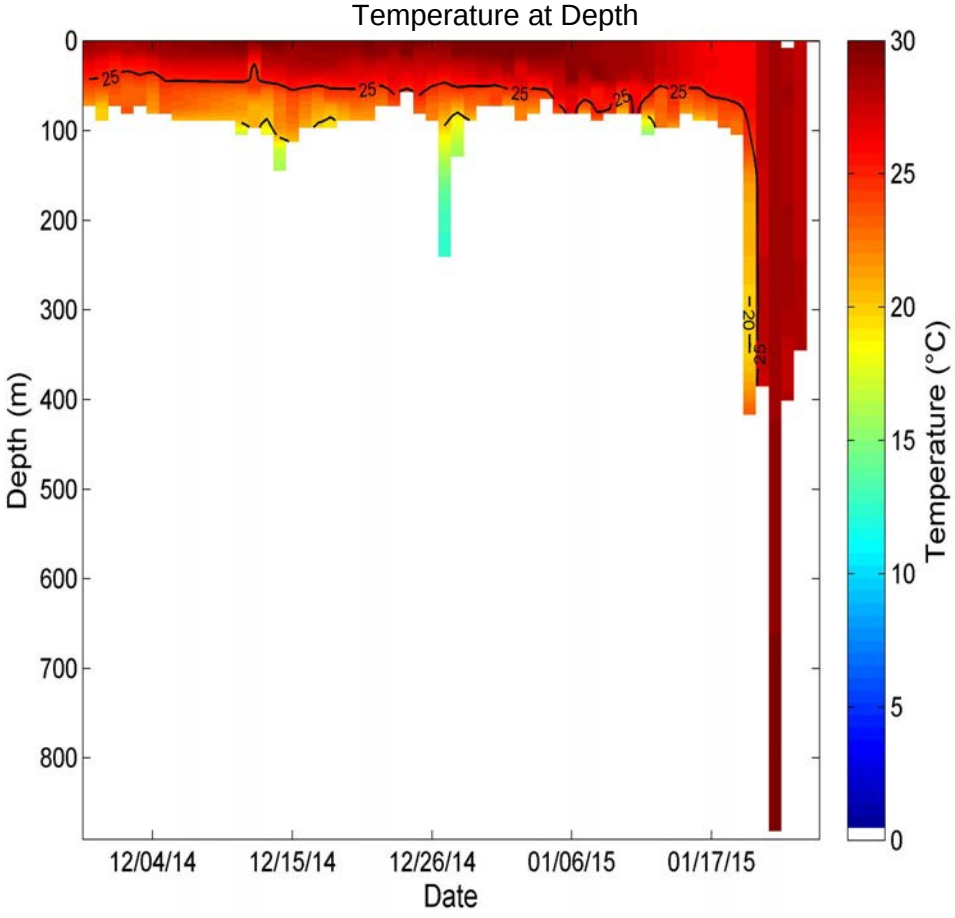






Tag number: 14P0423
Sponsor: Oceana Fisheries
Angler: Mervyn
Tagger: Ronny
Boat: *Blue Lady*
Species: Blue Marlin
Estimated weight: 70 kg
Deployed: 11/29/2014
Reported: 01/25/2015
Days at large: 57
Distance traveled: 600 nm
Maximum depth: 880 m
Minimum temp: 11.4°C
Maximum temp: 31.4°C

Temperature at Depth

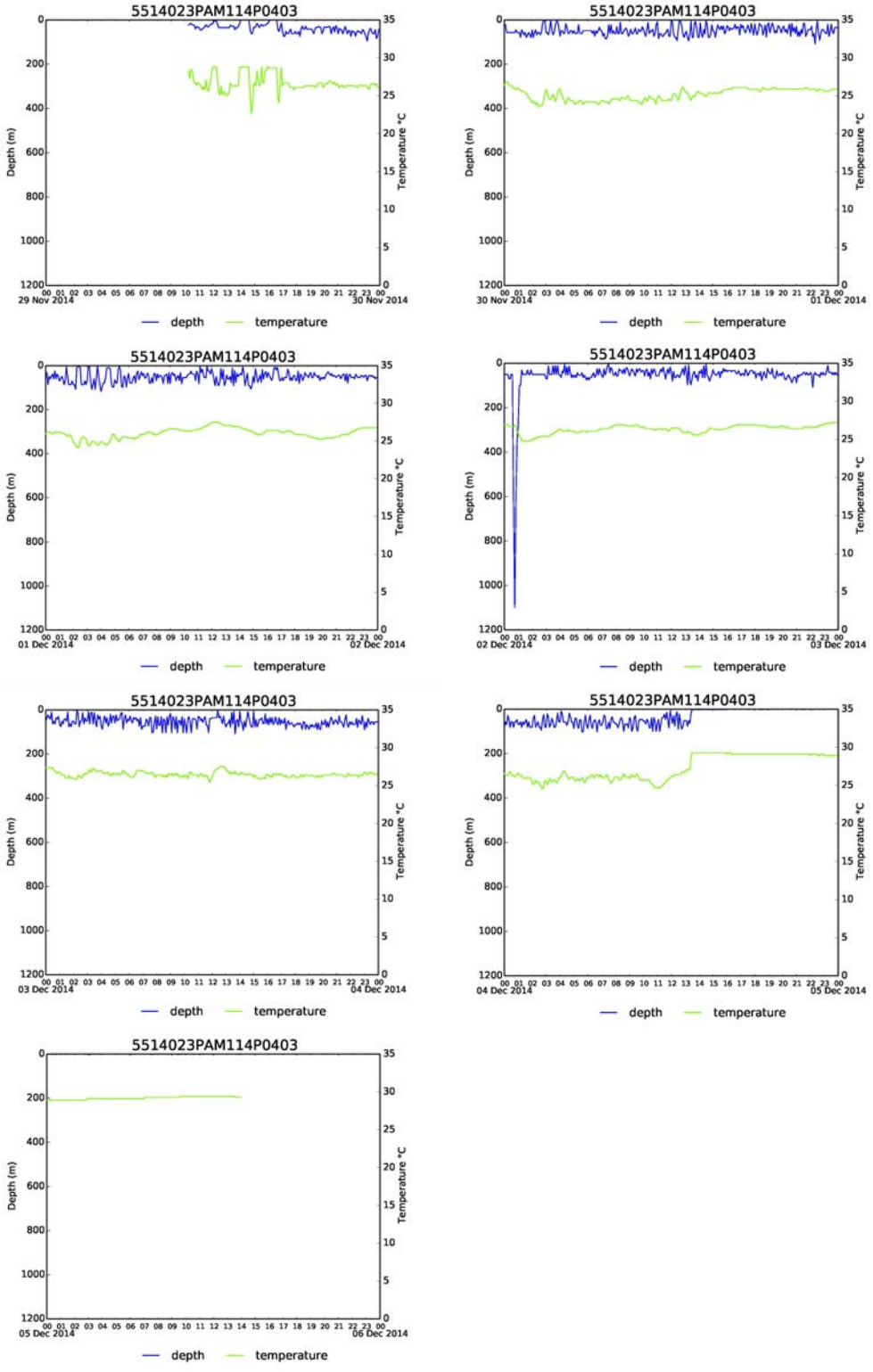


Tag 14P0403

Fish 3

Tag number: 14P0403
Sponsor: WWF
Angler: Daniel Hoenings
Tagger: Henry Riggs-Miller
Boat: *Albemarlin*
Species: Blue Marlin
Estimated weight: 45 kg
Deployed: 11/29/2014
Reported: 12/5/2014
Days at large: 6
Distance traveled:152 nm

Daily Plot of Temperature and Depth Data for the Duration of Fish 3 Deployment



The tag was consumed around 17:00-18:00, several hours after tagging. Note that after this time, temperature became consistent (around 25°C-26°C) despite the depth changing 50-100 meters. Also note the beginning of the time series when the marlin was alive to see how temperature changes with depth.