

The vertical movements of whale sharks tagged with pop-up archival satellite tags off Quintana Roo, Mexico

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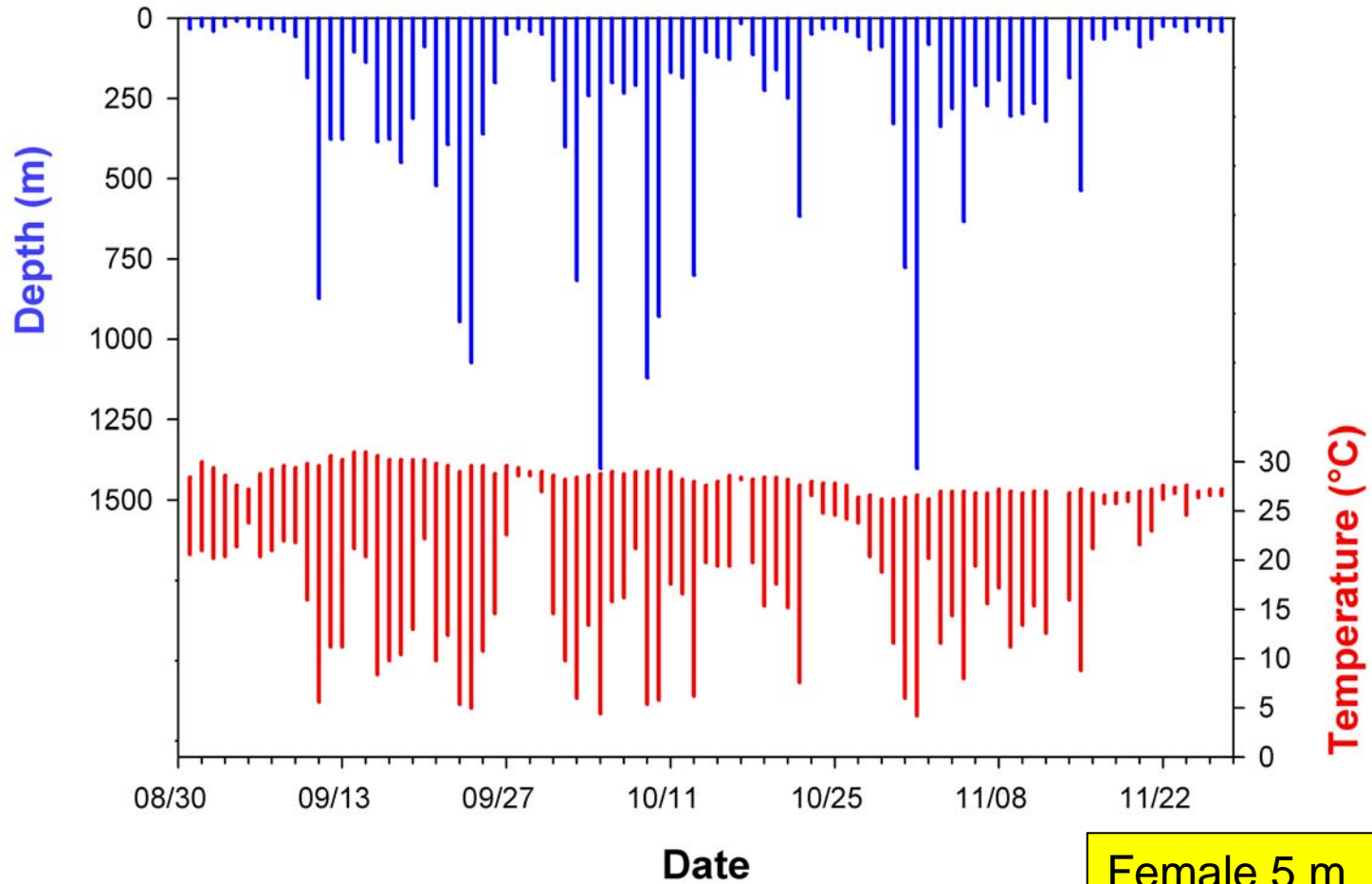
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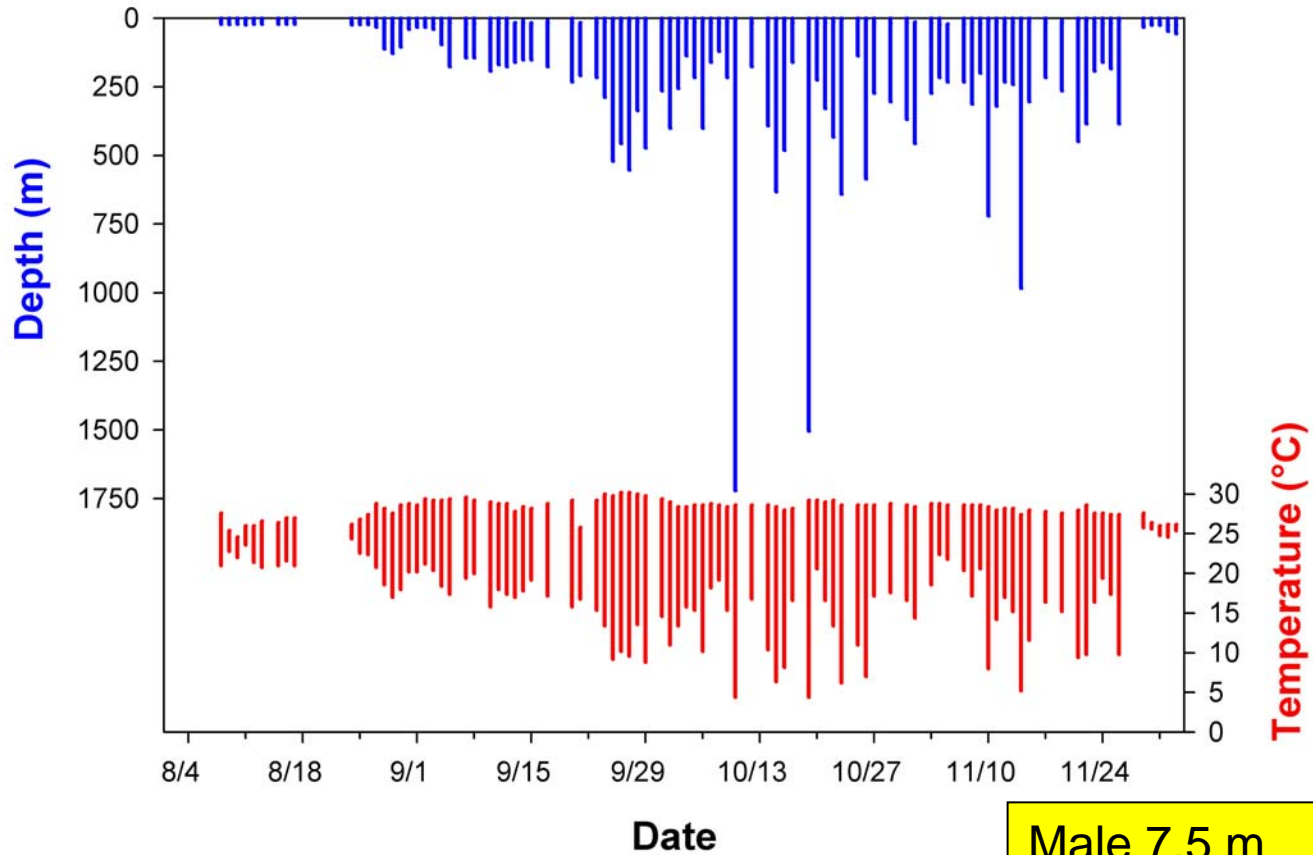


<i>Date PSAT attached</i>	<i>Sex</i>	<i>TL (m)</i>	<i>Maturity</i>	<i>Days programmed to pop-up</i>	<i>Days of data</i>	<i>Pop-up / Pull-off location</i>	<i>At-sea min distance from tagging site (km)</i>	<i>Max depth (m)</i>	<i>Tag recovered ?</i>
8/31/2005	M	6	Imm	30	30	Western Gulf	889	980	Yes
9/2/2005	M	5.5	Imm	30	28	NW Caribbean	260	304	No
7/20/2006	M	5.5	Imm	30	2	Yucatan study area	<10	11	Yes
7/21/2006	F	7	Mat?	100	18	Yucatan study area	<15	16	Yes
7/23/2006	M	7	Mat	120	120	Western Gulf	970	1,528	Yes
9/13/2006	M	8	Mat	30	35	Central Gulf	712	464	No
9/13/2006	F	7	Mat?	60	59	Western Gulf	1,027	1,376	No
9/14/2006	F	8	Mat?	100	95	Western Gulf	371	1,072	No
8/6/2007	M	7.5	Mat?	120	118	Western Gulf	770	1,720	No
8/29/2007	F	7-7.5	Imm?	150	146	S Atlantic, off Brazil	7,213	1,600	No
8/30/2007	F	5	Imm	90	89	Southwest Gulf	550	1,400	No

Daily Max/Min Depth and Temperature

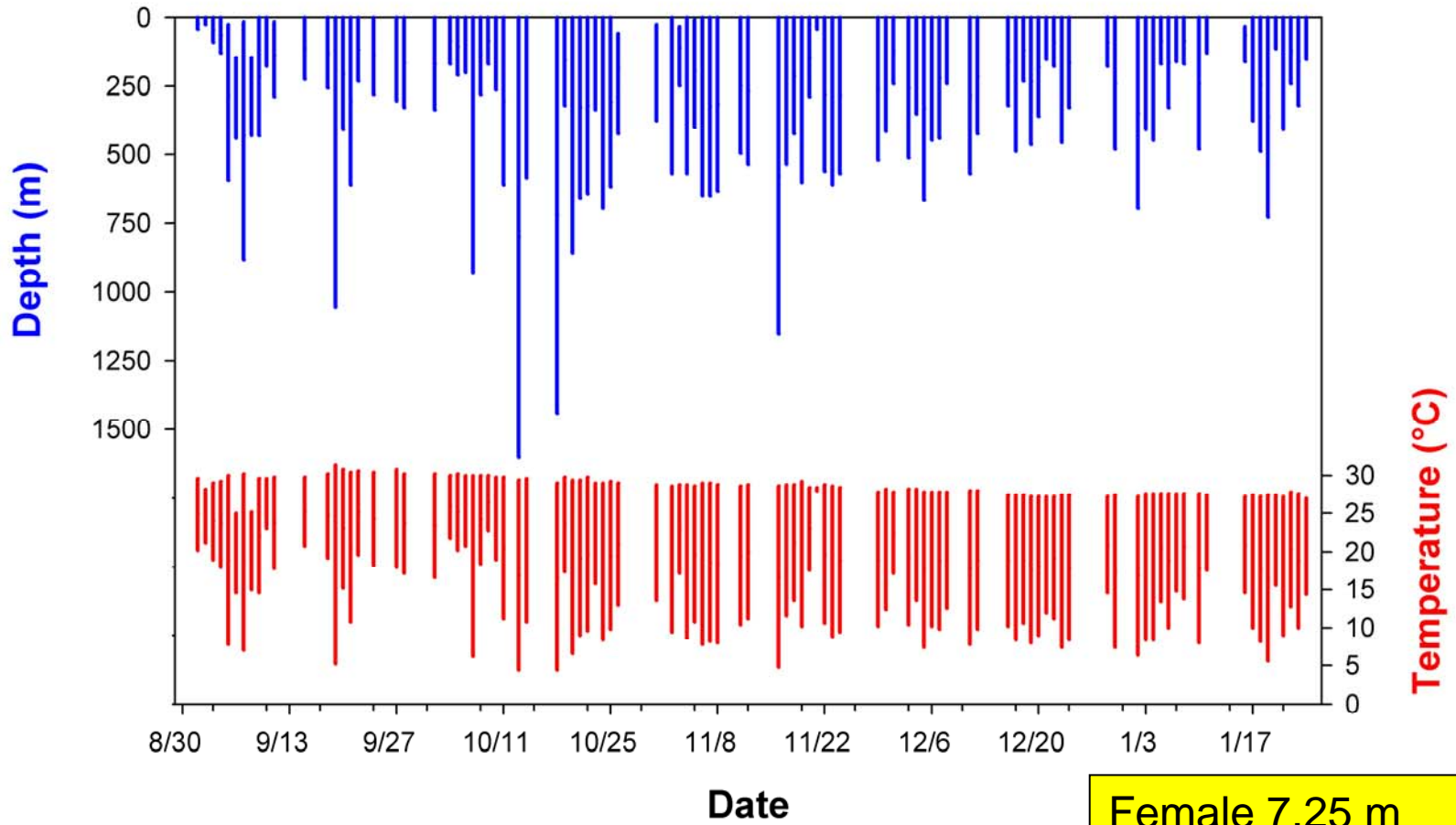


Daily Max/Min Depth and Temperature

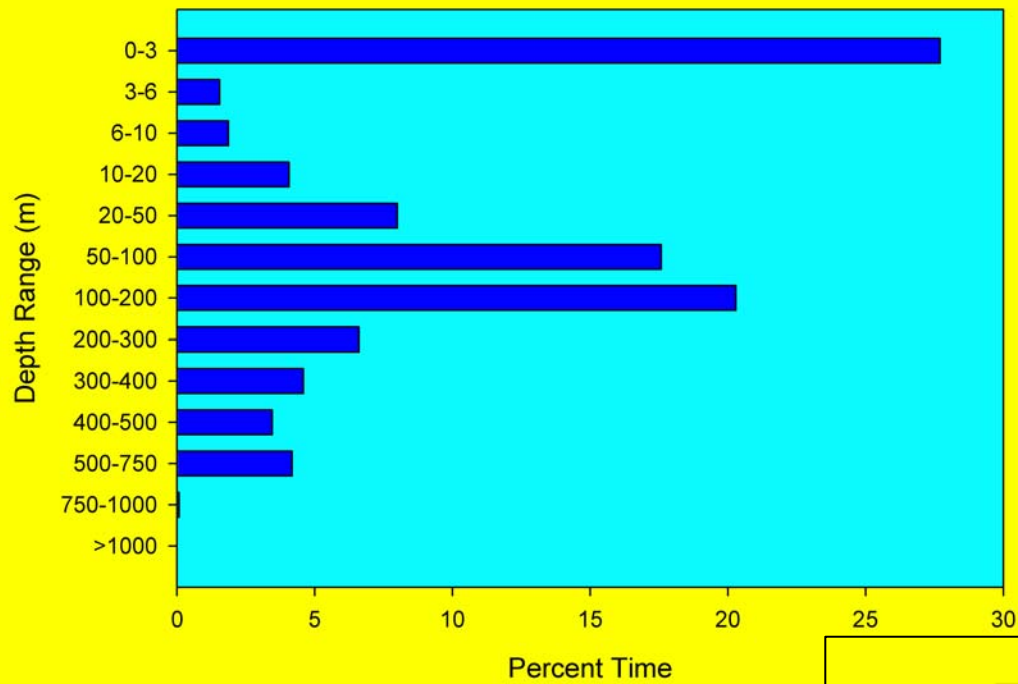


Daily Max/Min Depth and Temperature

“Rio Lady”

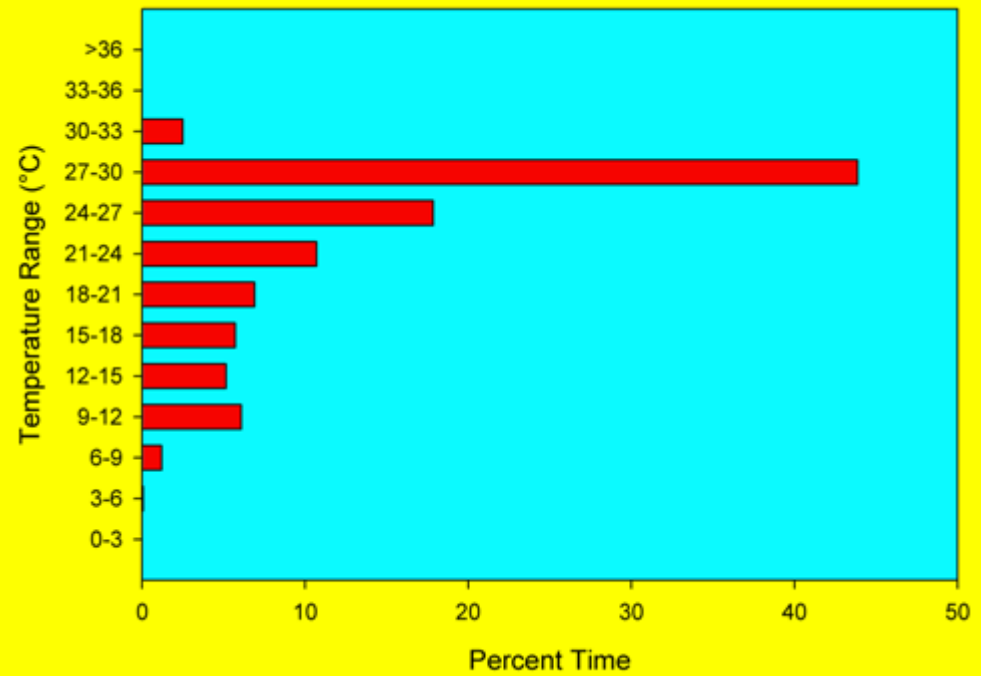


“Rio Lady” (Female 7.25 m)



Time at Depth

Time at Temperature





**Found
1/08**



Gulf of Mexico

**Tagged
7/23/06
(7 m Male)**



**Transmit
12/25/06**



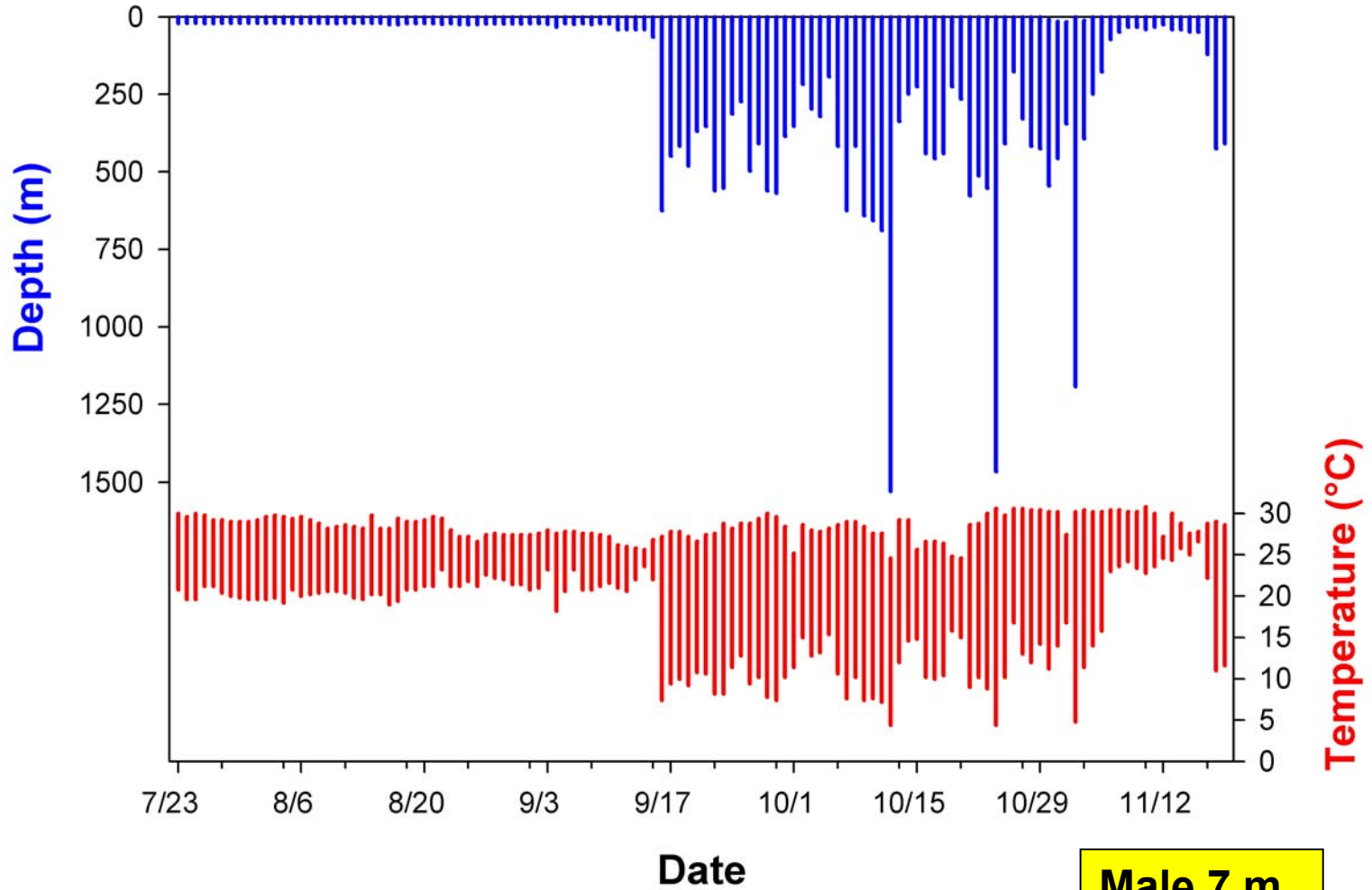
Still had battery power for download

Image © 2008 TerraMetrics
Image NASA

© 2005 Google

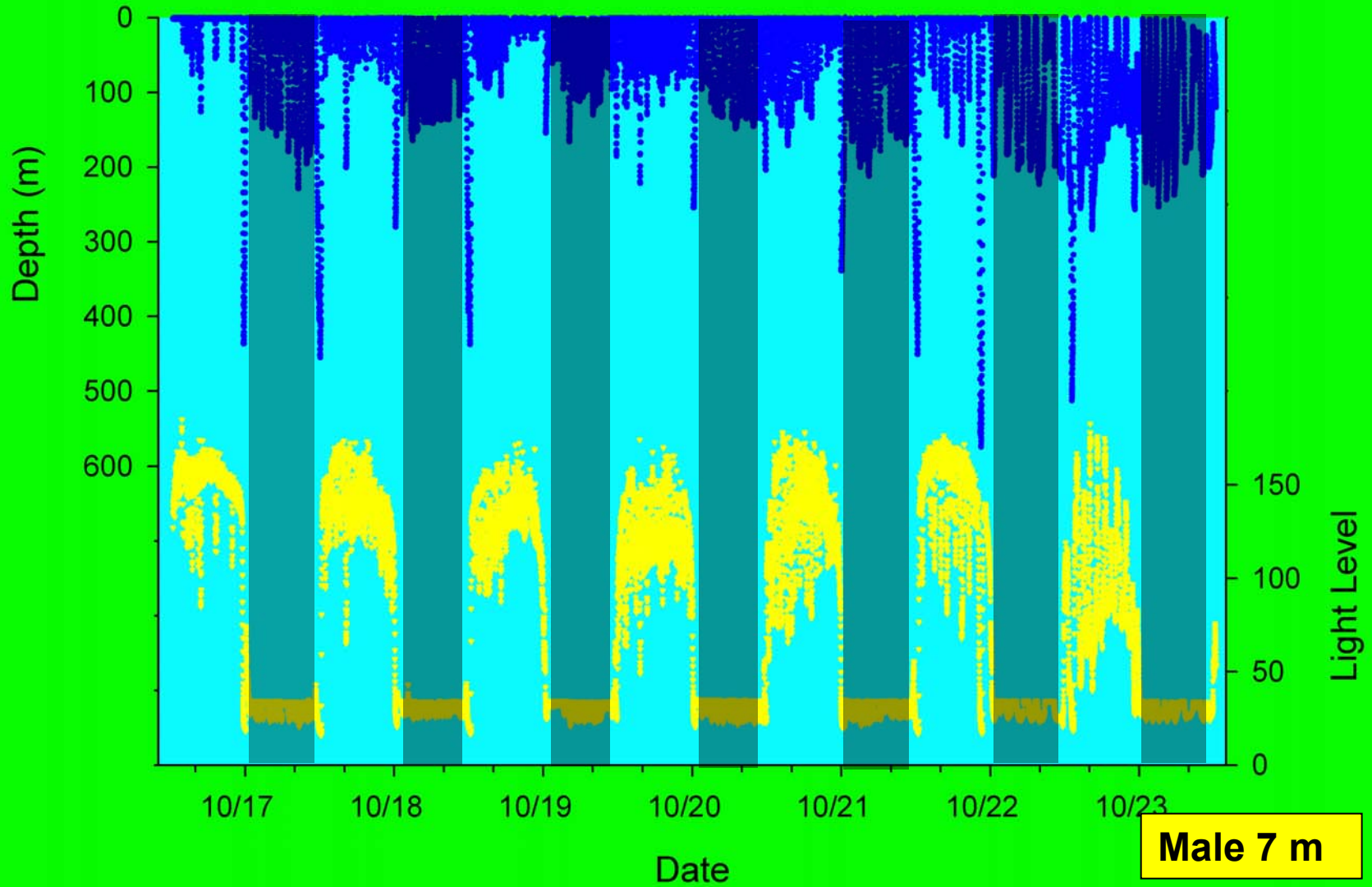


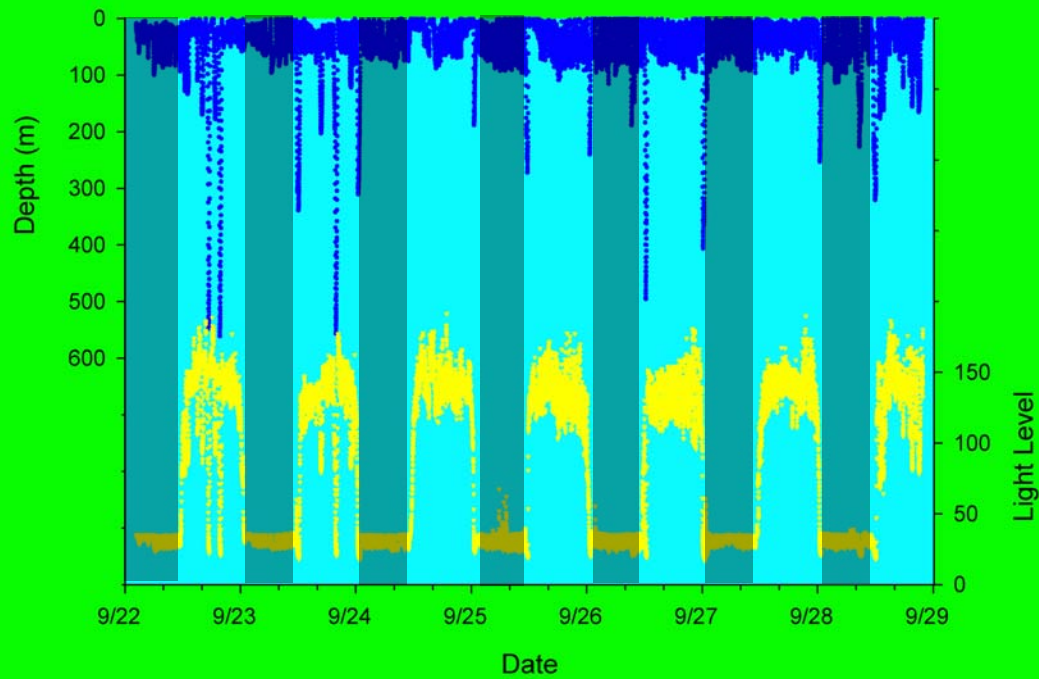
Daily Max/Min Depth and Temperature



Dive Profile for a 1 week Period (Oct 17-24, 2006)

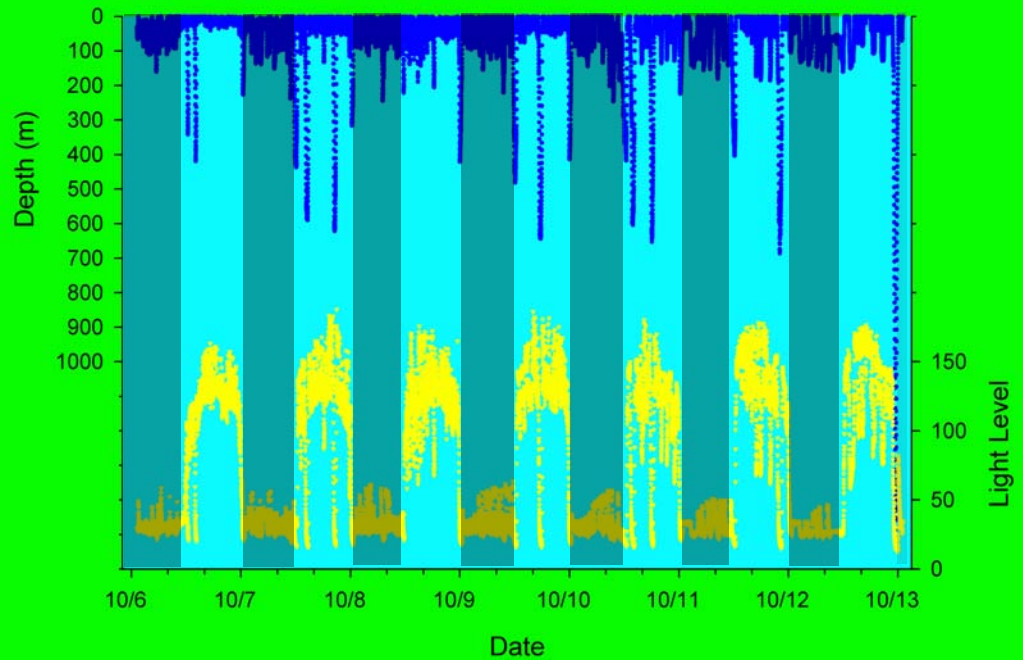
Data archived every 30 seconds





Sept 22-29, 2006

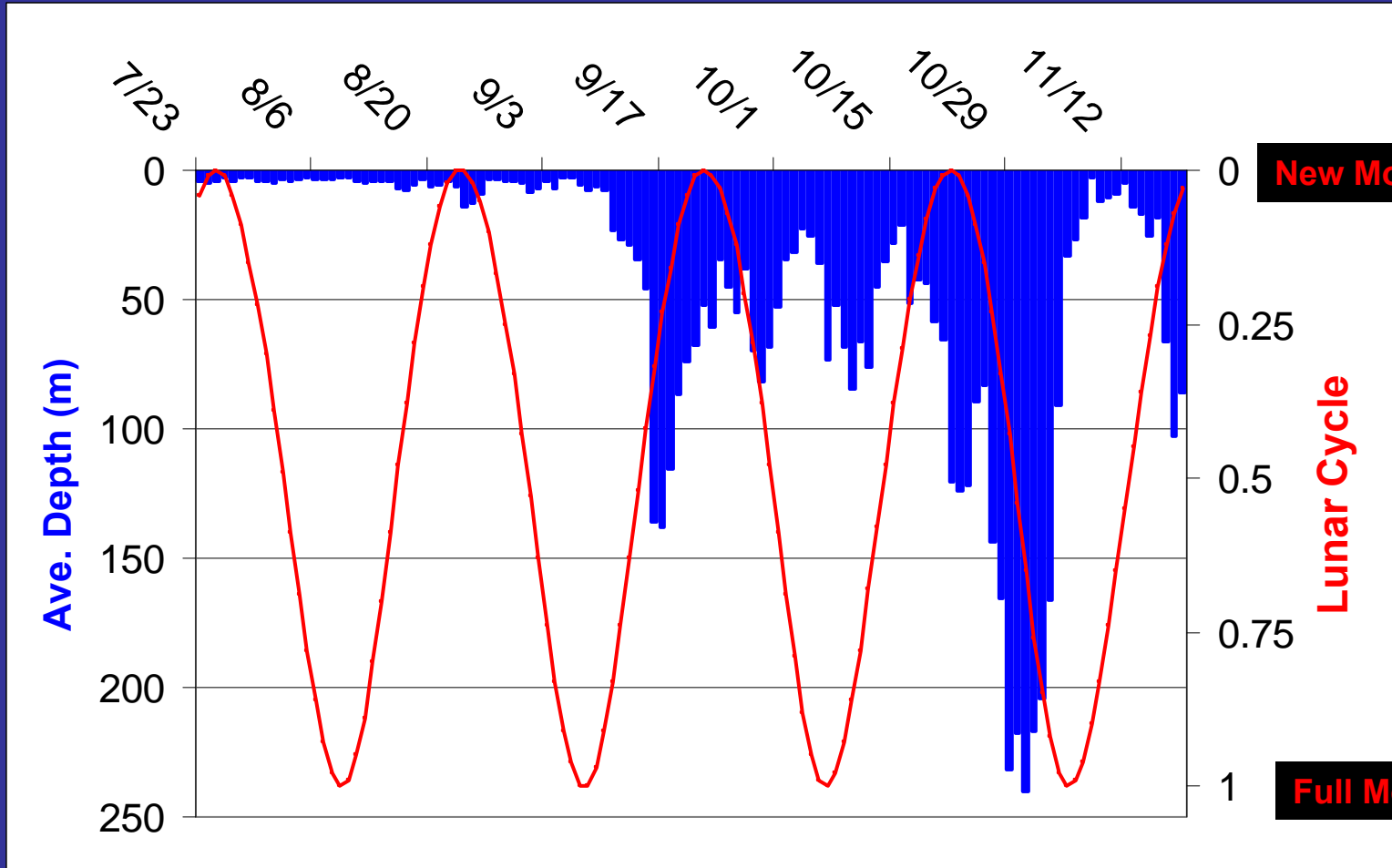
Oct 6-13, 2006



Average Daily Depth with Lunar Phase (120 days)

From data archived every 30 sec

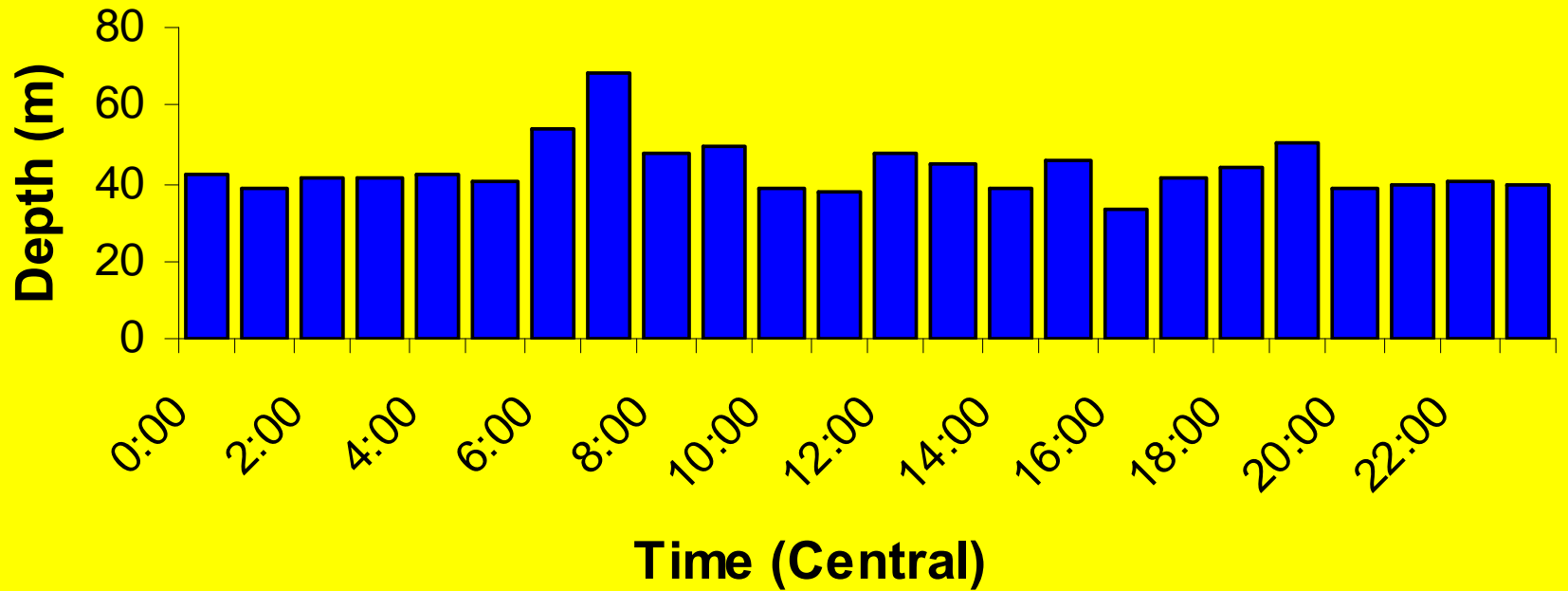
Male 7 m



- No relationship between vertical movements and lunar phase detected (so far)

Average Depth by Hour of the Day

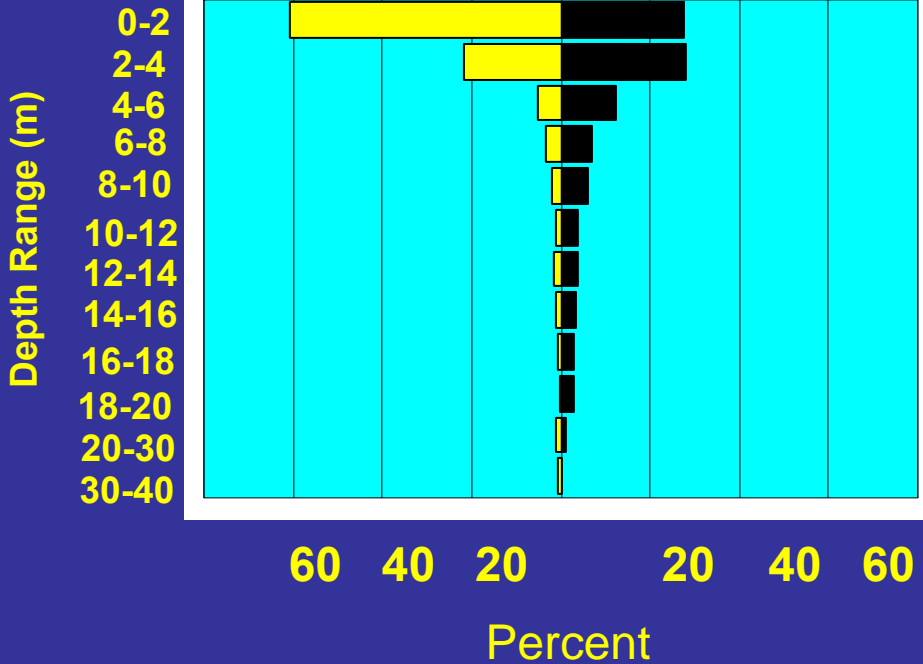
Male 7 m



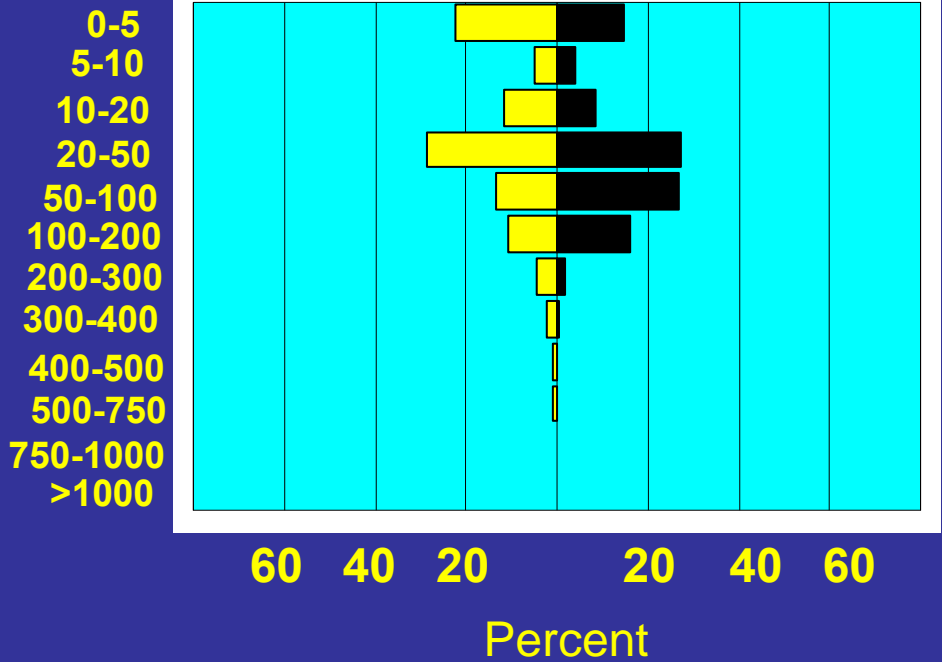
Percent Time at Depth from Recovered Tag

Male 7 m

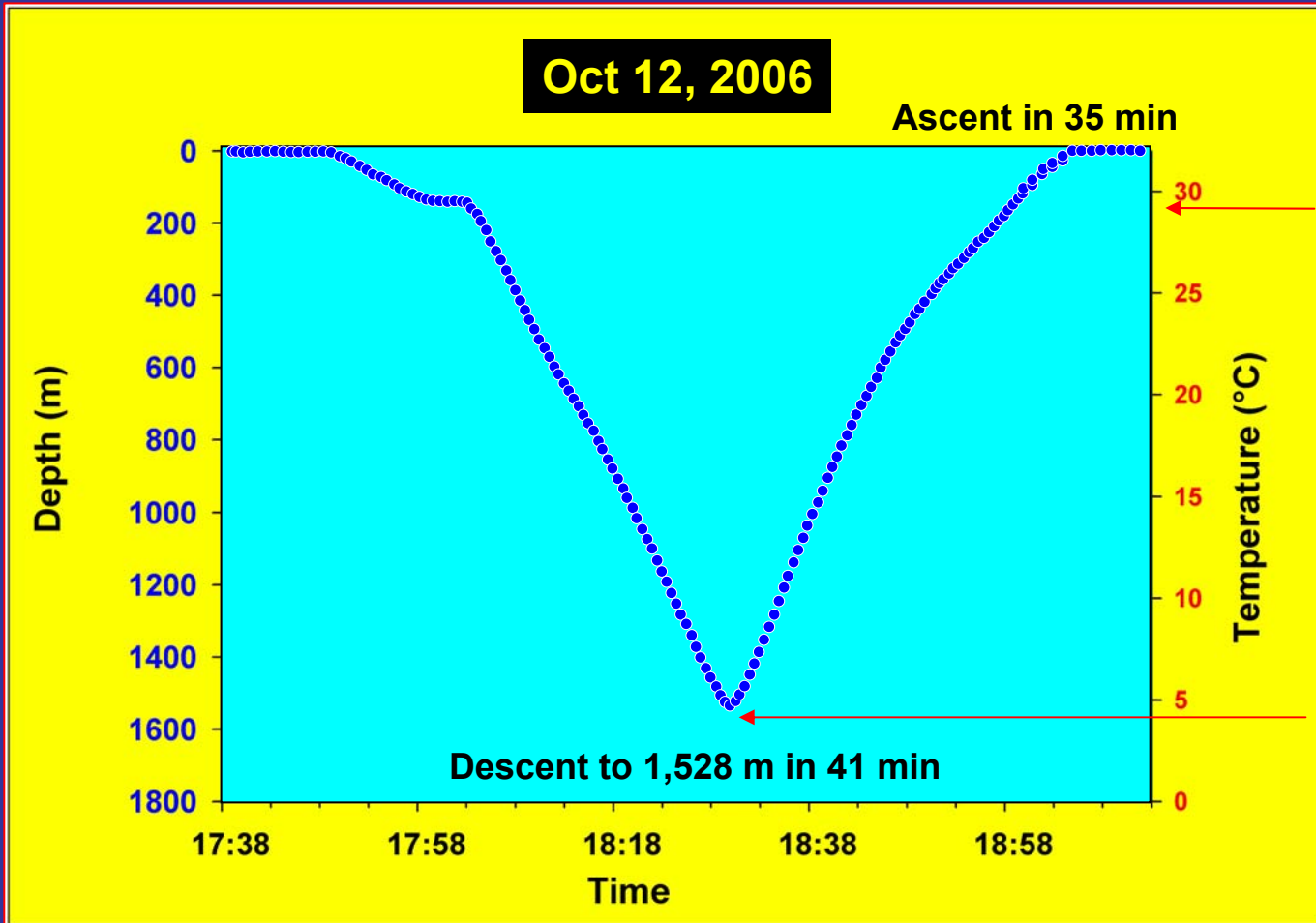
Inshore



Offshore



Time/Depth Profile of an Extreme Dive



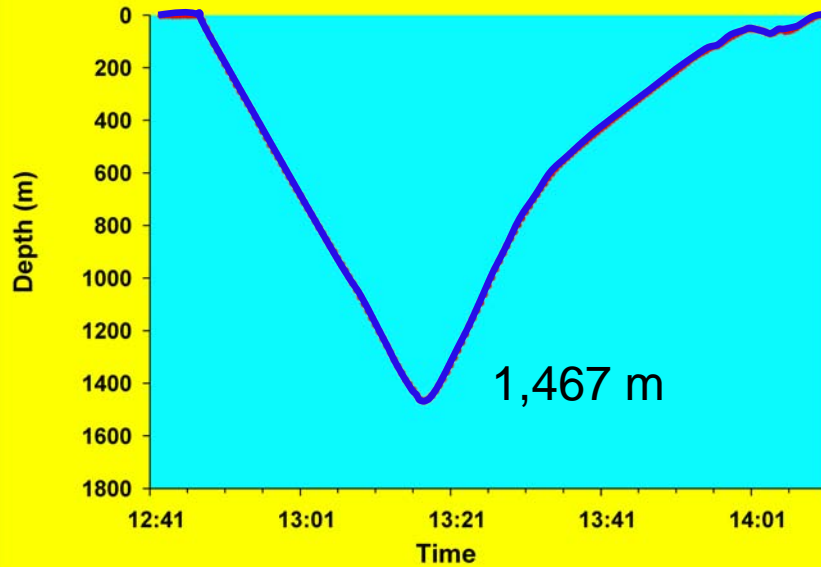
29.2 $^\circ\text{C}$

$\Delta T = 24.8^\circ\text{C}$

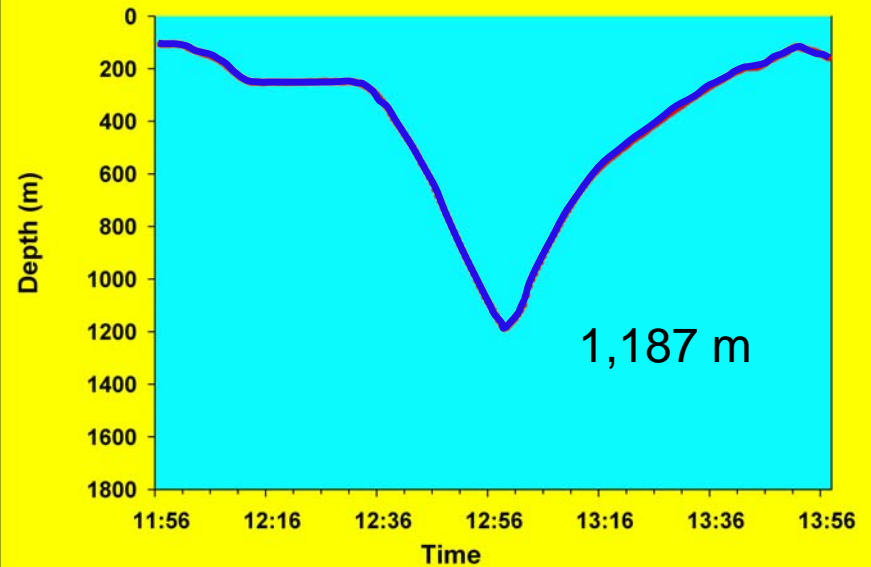
4.4 $^\circ\text{C}$

Examples of Other Extreme Dives from the Same Shark

Oct 24, 2006



Nov 2, 2006



Possible explanations for the deep diving behavior include:

- **Feeding at deep depths**
 - Parasite removal
 - Thermoregulation
 - Predation avoidance
- **Metabolic resting (gliding)**

Summary

- Whale sharks spend significant time each day in surface waters but also dive daily to some depths
- They take regular deep dives to at least 1,720 m and experience temperatures to 4 degrees C
- When off the shelf, the extreme dives (>750 m) seem fairly regular but do not appear to be related to foraging behavior
- Data from recovered tags have revealed a crepuscular pattern to some of the extreme dives
- We have not detected a relationship between vertical movements and lunar phase (so far)
- There is evidence of differences in the time spent at depth between day/night and inshore/offshore

Acknowledgments

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