reliminary performance evaluation of shallow versus normal depth DFADs in the eastern equatorial Pacific type purse-seine fishery

A collaborative effort by NIRSA, ISSF, and IATTC

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- Recent studies have been conducted to evaluate factors contributing to catches of BET by PS vessels in the Pacific, including investigations of spatio-temporal distribution of catch and effort (Sibert et al., 2012, 2015; Harley, 2015; Schaefer, 2015), fishing gear configurations (PS net and DFAD depths) (Lennert-Cody et al. 2007; Satoh et al., 2008; Delgado et al., 2010), as well as fine-scale behavior of BET relative to skipjack (SKJ) and yellowfin (YFT) tunas around DFADs (Schaefer and Fuller, 2005; 2013; Matsumoto et al., 2006); each attempting to reveal practical solutions for reducing BET fishing mortality.

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- Although large dynamic time-area closures in the Pacific may be effective at reducing BET fishing mortality, such measures would significantly reduce SKJ catch due to overlapping high catch areas. Also, it does not appear that reducing PS net depth is a viable solution because of the required minimum PS net depth to catch SKJ and the small differences in depth between SKJ and BET when associated with DFADs. The study by Satoh et al. (2008) reported that DFAD depth in the WCPO was not a significant factor in their general linear models (GLMs) as to BET catch, but area/time was significant. However, Lennert-Cody et al (2007) reported that DFAD depth in the EPO was a significant factor in their random forest model (RFM) as to BET catch, as were area/time effects.

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- The objective of this field experiment is to evaluate the performance of shallow versus normal depth DFADs in the EPO PS fishery, with an emphasis on the tuna species catch composition; seeking a practical solution to reduce purse-seine fishing mortality on BET

• ISSF made arrangements for the field experiment to be undertaken in collaboration with Negocios Industriales Real S.A. (NIRSA), a vertically integrated large diverse seafood company located in Posorja, Ecuador, with a fleet of 11 PS tuna vessels and a large tuna cannery. Shortly before the departure of the fishing trip during which the 100 experimental DFADs were to be deployed, Kurt Schaefer (PI; IATTC senior scientist) spent a few days at the NIRSA facility to examine and confirm the construction specifications of the 100 DFADs and discuss the experimental design with the fleet manager and his assistant, the Captain of the FV Milena A, and the IATTC scientific observer assigned to that trip.







• The rafts for the 50 shallow and 50 normal depth DFADs were all similar dimensions (1.2 x 2 m and 1.5 x 2.3 m) and construction materials, consisting of dried bamboo tied together with nylon twine, covered with Saran black shade cloth, and then wrapped tightly with 30mm sardine netting. 6 PS floats were tied beneath each raft under the shade cloth, and plastic bait containers with either fish or pig parts included were tied underneath all DFADs at the time of deployments.







• The appendages hung beneath the normal depth DFADs were approximately 37 m, and consisted of 2 coils of twisted and tied scrap tuna or sardine netting weighted with chain.





• The appendages hung beneath the shallow depth DFADs were approximately 5 m, and consisted of 4 ropes (1-2" dia) with coconut palm fronds tightly laced, attached to a split bamboo frame weighted with chain.





 Marine Instruments (MI) M3i echo-sounder buoys (50 kHz, 50 depth intervals 3m/ea, 5 min sampling frequency) were attached to each of the 100 DFADs. 50 of the M3i buoys were purchased with ISSF funding from the FAO/GEF program. Arrangements were made with NIRSA and MI so as to receive the M3i buoy data for the 100 DFADs real time, utilizing the MI software installed on an IATTC computer.







• The normal and shallow depth DFADs were deployed from the NIRSA FV Milena A (62m length, 900 t capacity) simultaneously in pairs along 7 transects between 3°S -1°N and 89°-107°W during 25 June through 20 July, 2015. Each deployment was recorded by the navigator on a data form created specifically for this project which included data fields for DFAD type, deployment position and date, M3i buoy number and the NIRSA ID numbers assigned and painted on each buoy. In addition, the IATTC observer aboard (with 8 years of experience) monitored and recorded each of the deployments so as to independently verify the DFAD types with the buoy ID numbers.



Deployment locations for 50 shallow and 50 normal depth DFADs



Observer illustrations of the shallow (top) and normal depth DFADs



50 normal depth (37m) and 50 shallow depth (5m) DFAD deployments with Marine Instruments M3i echo-sounder buoys by the FV Milena A. Drift speeds, durations until set, and status also provided

M3i	Deploy	FAD	Latitude	Longitude	Avg. Speed 1st	Days Until	Still Active
Number	Date	Туре			60d (kn)	Set	(Y/N)
M3I196133	06/25/15	Normal	03°13'S	88°31'W	0.6		Y
M3I195058	06/25/15	Shallow	03°13'S	88°31'W	0.5		Y
M3I196234	06/25/15	Normal	03°13'S	88°41'W	0.7		Y
M3I195087	06/25/15	Shallow	03°13'S	88°41'W	0.6		Ν
M3I196062	06/25/15	Normal	03°15'S	88°50'W	0.4		Y
M3I195152	06/25/15	Shallow	03°15'S	88°50'W	0.6	132	Y
M3I196207	06/25/15	Normal	03°17'S	89°00'W	0.6		Y
M3I194930	06/25/15	Shallow	03°17'S	89°00'W	0.6		Ν
M3I196142	06/25/15	Normal	03°20'S	89°13'W	0.6	136	Y
M3I194981	06/25/15	Shallow	03°20'S	89°13'W	0.6		Y
M3I196229	06/25/15	Normal	03°23'S	89°29'W	0.5		Y
M3I195084	06/25/15	Shallow	03°23'S	89°29'W	0.5	126	Y
M3I196241	06/25/15	Normal	03°24'S	89°41'W	0.4	110	Y
M3I195144	06/25/15	Shallow	03°24'S	89°41'W	0.5	132	Y
M3I196060	06/25/15	Normal	03°26'S	89°59'W	0.5		Y
M3I192970	06/25/15	Shallow	03°26'S	89°59'W	0.6		Y
M3I196079	06/25/15	Normal	03°27'S	90°09'W	0.5		Y
M3I194794	06/25/15	Shallow	03°27'S	90°09'W	0.5	138	Y
M3I196224	06/25/15	Normal	03°25'S	90°17'W	0.4		Y
M3I195072	06/25/15	Shallow	03°25'S	90°17'W	0.6		Y
M3I195146	06/29/15	Shallow	00°05'S	100°36'W	0.9		N
M3I196242	06/29/15	Normal	00°05'S	100°36'W	0.8		Y
M3I194152	06/29/15	Shallow	00°02'S	100°45'W	0.8		Ŷ
M3I196247	06/29/15	Normal	00°02'S	100°45'W	0.7	89	Ŷ
M3I195158	06/29/15	Shallow	00°00'N	100°55'W	0.8	•7	N
M3I196283	06/29/15	Normal	00°00'S	100°55'W	0.8		Y
M3I195171	06/29/15	Shallow	00°06'N	101°03'W	0.8		N
M3I196298	06/29/15	Normal	00°06'N	101°03'W	0.8		Y
M3I195638	06/29/15	Shallow	00°08'N	101°12'W	1.1		N
M3I196403	06/29/15	Normal	00°08'N	101°12'W	1.1		Y
M3I195151	06/29/15	Shallow	00°13'N	101°22'W	1.0		N
M3I196243	06/29/15	Normal	00°13'N	101°22'W	0.8		Y
M3I195154	06/29/15	Shallow	00°14'N	101°32'W	0.0		Y Y
M3I196257	06/29/15	Normal	00°14'N	101°32'W	1.2		I V
M3I195168	06/29/15	Shallow	00°17'N	101°42'W	1.2	81 10	I N
M3I106287	06/20/15	Normal	00°17'N	101°42 W	1.1	111	V
M3I190287 M3I105704	06/29/15	Shallow	00°19'N	101 42 W	1.1	111	I V
M3I195794 M3I106404	06/29/15	Normal	00°10'N	101 51 W	1.0		I V
M211059404	06/29/15	Shallow	00 19 N 00°22'N	102002'W	1.0		I N
M31193649	06/29/13	Normal	00 23 IN 00°22'N	102 02 W	1.0	79	N V
M31190444	06/29/13	Shallow	00 23 IN 00%20'N	102 02 W	1.0	78	I N
M31193843	06/29/13	Marmal	00 30 N	102 10 W	1.0	0 2	IN N
M31190431	06/29/13	Normai	00 30 N	102 10 W	0.9	82	IN N
M2110C420	06/29/15	Shallow Norre-1	00 30 IN	102°18 W	1.0	/0	ľ V
M31190429	06/29/15	INORMAI	00°30 N	102°18'W	0.9		ľ V
M31193840	06/29/15	Snallow	00°43 N	102°25°W	0.9	100	ľ
M3119641/	06/29/15	Normal	00°43′N	102°25'W	1.0	109	IN N
M31195839	06/29/15	Shallow	00°50'N	102°30'W	0.9		N
M31196414	06/29/15	Normal	00°50'N	102°30'W	1.0	107	N
M31195838	06/29/15	Shallow	00°52'N	102°40′W	0.8	136	Ŷ
M31196412	06/29/15	Normal	00°52'N	102°40'W	0.9		N

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NumberDateType60d (kn)Set (Y/N) M3119584106/29/15Shallow00752N102'40'V0.8136YM3119584106/29/15Shallow00733N105'05W0.9YM3119584506/30/15Shallow00753N105'05W0.9YM3119584006/30/15Shallow00753N105'20W0.9YM3119584006/30/15Shallow00752N105'30W0.9NM3119584006/30/15Shallow00752N105'30W0.9NM3119584006/30/15Shallow0074N105'35W0.9NM3119584506/30/15Shallow0074N105'35W0.9NM3119585506/30/15Shallow0074N105'35W0.9YM3119585606/30/15Shallow0072N105'55W0.9YM3119585906/30/15Shallow0072N105'55W0.9YM3119589306/30/15Shallow0072N106'11W1.0YM3119589306/30/15Shallow0072N106'11W1.0YM3119589306/30/15Shallow0072N106'11W1.0YM3119589306/30/15Shallow0072N106'11W1.0YM3119647906/30/15Shallow0072N106'21W1.1YM3119647906/30/15Shallow0072N106'21W1.1YM3196470 <th>M3i</th> <th>Deploy</th> <th>FAD</th> <th>Latitude</th> <th>Longitude</th> <th>Avg. Speed 1st</th> <th>Days Until</th> <th>Still Active</th>	M3i	Deploy	FAD	Latitude	Longitude	Avg. Speed 1st	Days Until	Still Active
M3195838 06/29/15 Shallow 09/22N 102'40'W 0.8 1.36 Y M319541 06/20/15 Shallow 00'33N 105'08'W 0.9 Y M319542 06/20/15 Shallow 00'33N 105'20'W 0.9 101 Y M319542 06/20/15 Shallow 00'33N 105'20'W 0.9 N M3194640 06/20/15 Normal 00'32N 105'30'W 0.9 N M3194810 06/20/15 Nallow 00'40'N 105'30'W 0.9 N M3194810 06/20/15 Nallow 00'40'N 105'36'W 0.8 Y M3194846 06/20/15 Nallow 00'40'N 105'36'W 0.8 Y M3194846 06/20/15 Shallow 00'22N 105'55'W 0.0 Y M3194846 06/20/15 Shallow 00'22N 105'55'W 1.0 Y M3194847 06/20/15 Normal 00'23N 106'02'W <t< th=""><th>Number</th><th>Date</th><th>Туре</th><th></th><th></th><th>60d (kn)</th><th>Set</th><th>(Y/N)</th></t<>	Number	Date	Туре			60d (kn)	Set	(Y/N)
M31196112 0.06/2015 Normal 00%2N 1.05%0W 0.9 N M31195814 0.670015 Normal 0.0733N 1.05%0W 0.0 1.01 Y M31196405 0.670015 Normal 0.0733N 1.05%0W 0.9 Y M31196408 0.670015 Natlaw 0.0733N 1.05%20W 0.9 N M31196410 0.630115 Natlaw 0.0752N 1.05%30W 0.9 N M31196410 0.630115 Natlaw 0.0752N 1.05%30W 0.9 N M31196450 0.630115 Natlaw 0.0752N 1.05%30W 0.9 N M31196450 0.630115 Natlaw 0.0742N 0.08%W 0.9 Y M31196450 0.630115 Natlaw 0.0722N 1.05%5W 0.9 Y M31196450 0.630115 Narmal 0.0725N 1.06%1W 0.9 Y M31196450 0.630115 Narmal 0.0725N 1.06%1W 0.9	M3I195838	06/29/15	Shallow	00°52'N	102°40'W	0.8	136	Y
N310 58140.6/3015Shallow0.0733N0.0508W0.9YM310 564050.6/3015Shallow0.0733N1.05707W0.9YM310 564050.6/3015Shallow0.0733N1.05707W0.9NM31194040.6/3015Normal0.0752N1.05707W0.9NM31194040.6/3015Normal0.0752N1.05730W0.9NM31194010.6/3015Normal0.0746N1.05738W0.9NM31194010.6/3015Normal0.0746N1.05738W0.9NM31194040.6/3015Normal0.0740N1.05746W0.8NM31194840.6/3015Nallow0.0740N1.05755W0.9YM311948400.6/3015Nallow0.0722N1.05755W1.0YM311946400.6/3015Nallow0.0725N1.06704W0.8YM311946400.6/3015Nallow0.0727N1.06704W0.8YM311946400.6/3015Nallow0.0721N1.06704W0.8YM311946400.6/3015Nallow0.0731N1.06724W1.1YM311946400.6/3015Nallow0.0731N1.06724W1.1YM311946470.6/3015Nallow0.0731N1.06724W1.1YM311946470.6/3015Namal0.0731N1.06735W1.1YM311946470.6/3015Namal0.0731N1.06735W1.1N	M3I196412	06/29/15	Normal	00°52'N	102°40'W	0.9		Ν
M3119405 06/3015 Normal 00753N 105720W 0.9 Y M31194808 06/3015 Normal 00753N 105720W 0.9 Y M3119408 06/3015 Shallow 00753N 105720W 0.9 N M3119430 06/3015 Shallow 00752N 105730W 0.9 N M3119430 06/3015 Shallow 00746N 105738W 0.9 N M3119436 06/3015 Normal 00747N 105757W 0.9 N M3119436 06/3015 Normal 00722N 105757W 0.9 Y M31194585 06/3015 Normal 00722N 106757W 0.9 Y M31194649 06/3015 Normal 00725N 106701W 1.0 Y M3119489 06/3015 Normal 00725N 106711W 1.1 Y M31194647 06/3015 Normal 00725N 106711W 1.1 N M31	M3I195814	06/30/15	Shallow	00°53'N	105°08'W	0.9		Y
M3195829 06/30/15 Shallow 00753N 105207W 0.9 Y M3196408 06/30/15 Shallow 00752N 105707W 0.9 N M3196408 06/30/15 Shallow 00752N 105730W 0.9 N M3196410 06/30/15 Shallow 00752N 105730W 0.9 N M3196411 06/30/15 Normal 00746N 105738W 0.9 N M3196406 06/30/15 Normal 00740N 105746W 0.8 N M3196406 06/30/15 Normal 00725N 106704W 0.8 Y M3196406 06/30/15 Normal 00725N 106704W 0.8 Y M3196406 06/30/15 Normal 00725N 106711W 1.0 Y M3196469 06/30/15 Normal 00727N 106711W 1.1 Y M3196470 06/30/15 Normal 00727N 106724W 0.8 N	M3I196405	06/30/15	Normal	00°53'N	105°08'W	1.0	101	Y
M311940806/3015Normal00°53'N10°20'W0.9YM3119583006/3015Normal00°52'N10°53'D'W0.9NM3119583606/3015Shallow00°46'N105'38'W0.9NM3119684106/3015Shallow00'46'N105'38'W0.9NM3119585506/3015Shallow00'40'N105'36'W0.8NM319584506/3015Shallow00'32'N105'55'W0.9YM319585606/3015Shallow00'32'N105'55'W0.9YM319585006/3015Shallow00'25'N100'04'W0.9YM319645006/3015Shallow00'25'N100'01'W1.0YM319645006/3015Shallow00'25'N100'01'W1.0YM319645906/3015Shallow00'25'N100'1'W1.0YM319645906/3015Shallow00'25'N1.1NNM319645906/3015Normal00'32'N100'23'W1.1NM319645906/3015Normal00'32'N100'35'N1.1NM319645906/3015Normal00'33'N100'45'N1.1YM319645007/8015Normal00'33'N100'45'N1.1YM319645707/8015Normal00'33'N100'45'N1.1YM319657607/8015Normal00'33'N100'25'N1.0NM3196575	M3I195829	06/30/15	Shallow	00°53'N	105°20'W	0.9		Y
M311988006/30/15Shallow00752N10/570W0.9NM3119641006/30/15Shallow00762N10/5738W0.9NM3119641106/30/15Normal00/46N10/5738W0.9NM31196414106/30/15Normal00/40N10/5746W0.8NM3119644606/30/15Normal00/40N10/5746W0.8NM3119644606/30/15Normal00/32N10/5755W0.9YM3119645006/30/15Normal00/32N10/5755W1.0YM3119646906/30/15Normal00/25N10/6705W0.8YM3119646906/30/15Normal00/25N10/6705W0.8YM3119646906/30/15Normal00/25N10/671W1.1YM3119647006/30/15Normal00/22N10/671W1.1NM3119647006/30/15Normal00/32N10/6735W1.1NM3119647006/30/15Normal00/32N10/6735W1.1NM3119647106/30/15Normal00/32N10/6735W1.1YM3119647306/30/15Normal00/32N10/6745W0.8YM3119647306/30/15Normal00/32N10/6745W0.8NM3119647306/30/15Normal00/32N10/6745W0.8NM3119648307/08/15Shallow01/10S10/022W0.6127N <td>M3I196408</td> <td>06/30/15</td> <td>Normal</td> <td>00°53'N</td> <td>105°20'W</td> <td>0.9</td> <td></td> <td>Y</td>	M3I196408	06/30/15	Normal	00°53'N	105°20'W	0.9		Y
M3119641006/30/15Normal00752N105°30°W0.9NM3119583606/30/15Normal00746'N105°38°W0.9NM3119584506/30/15Normal00746'N105°46'W0.8YM3119585506/30/15Shallow00740'N105°46'W0.8YM3119585606/30/15Normal00732'N105°55'W0.9YM3119685006/30/15Normal00732'N105°55'W0.9YM3119685906/30/15Normal00725'N106°05'W0.8YM3119685906/30/15Normal00725'N106°1'W1.0YM3119646906/30/15Normal0072'N106°1'W1.1YM3119647906/30/15Normal0072'N106°1'W1.1YM3119647906/30/15Normal0073'N106°2'W1.1YM3119647906/30/15Normal0073'N106°3'S'W1.1YM3119647906/30/15Normal0073'N106°4'S'W1.1YM3119647906/30/15Normal0073'N106°4'S'W1.1YM3119647906/30/15Normal0073'N106°4'S'W1.1YM3119647906/30/15Normal0073'N106°4'S'W1.1YM3119647006/30/15Normal01°10'S100°2'S'W0.6127NM3119657807/30/15Normal01°10'S100°2'S'W0.	M3I195830	06/30/15	Shallow	00°52'N	105°30'W	0.9		Ν
M3119836006/30/15Shallow00/46/N105°38'W0.9YM3119641506/30/15Normal00/46/N105°36'W0.8NM3119644606/30/15Normal00/40/N105°46'W0.8NM3119644606/30/15Normal00/32'N105°55'W0.9YM3119645006/30/15Normal00/32'N105°55'W1.0YM3119646906/30/15Normal00/32'N106°05'W0.8YM3119646906/30/15Normal00/25'N106°05'W0.8YM3119646906/30/15Normal00/22'N106°11'W1.1YM3119647906/30/15Normal00/22'N106°11'W1.1YM3119647906/30/15Normal00/32'N106°35'W1.1YM3119590306/30/15Normal00/33'N106°45'W1.1YM3119647406/30/15Normal00/33'N106°45'W1.1YM3119657607/08/15Shallow01°10'S100°2'S'W1.0YM3119657607/08/15Normal01°13'S100°2'S'W1.0YM3119657607/08/15Normal01°13'S100°2'S'W1.0YM3119657607/08/15Normal01°13'S100°2'S'W1.0YM3119657607/08/15Normal01°2'S'S100°3'W0.6YM3119657607/08/15Normal01°2'S'S100°3'W0.6	M3I196410	06/30/15	Normal	00°52'N	105°30'W	0.9		Ν
M3119641106/30/15Normal00/40/N105°38/W0.9NM319585506/30/15Shallow00/40/N105°46/W0.8NM319585606/30/15Shallow00/32/N105°55/W0.9YM319585606/30/15Shallow00/32/N105°55/W0.9YM319585906/30/15Shallow00/25/N106°04/W0.9YM319646006/30/15Shallow00/25/N106°04/W0.9YM319646006/30/15Shallow00/25/N106°11/W1.0YM319647006/30/15Normal00/25/N106°11/W1.0YM319647006/30/15Namal00/31/N106°24/W1.1YM319647906/30/15Normal00/32/N106°35/W1.1YM319647906/30/15Normal00/32/N106°35/W1.1YM319647906/30/15Normal00/32/N106°35/W1.1YM319647906/30/15Normal00/32/N100°28/W0.6127NM319647006/30/15Normal01°10/S100°28/W0.6127NM319647006/30/15Normal01°12/S100°28/W0.6127NM319647007/30/15Normal01°12/S100°28/W0.6127NM319657807/30/15Normal01°28/S100°28/W0.6127NM319657507/30/15Normal <td>M3I195836</td> <td>06/30/15</td> <td>Shallow</td> <td>00°46'N</td> <td>105°38'W</td> <td>0.9</td> <td></td> <td>Y</td>	M3I195836	06/30/15	Shallow	00°46'N	105°38'W	0.9		Y
M31198855 06/30/15 Shallow 00'40'N 105'46'W 0.8 Y M31196460 06/30/15 Shallow 00'40'N 105'46'W 0.8 N M31196850 06/30/15 Shallow 00'22'N 105'55'W 0.9 Y M31196850 06/30/15 Shallow 00'22'N 106'0'4'W 0.9 Y M31196460 06/30/15 Normal 00'22'N 106'0'1'W 1.0 Y M31196470 06/30/15 Normal 00'22'N 106'1'W 1.1 Y M31196470 06/30/15 Normal 00'32'N 106'35'W 1.1 Y M31196470 06/30/15 Normal 00'32'N 106'35'W 1.1 Y M31196487 06/30/15 Normal 00'33'N 106'45'W 0.8 N M31196487 06/30/15 Normal 00'33'N 106'45'W 0.8 N M31196487 06/30/15 Normal 01'10'S 100'2'W 0.6 12'Z N M31196575 07/08/15 Shallow 01'18'S	M3I196411	06/30/15	Normal	00°46'N	105°38'W	0.9		Ν
M31196446 06/30/15 Normal 00°40'N 105°46'W 0.8 N M31195856 06/30/15 Shallow 00°32'N 105°55'W 1.0 Y M31196450 06/30/15 Shallow 00°22'N 106°55'S'W 1.0 Y M31196460 06/30/15 Shallow 00°25'N 106°0'W 0.8 Y M31196470 06/30/15 Normal 00°29'N 106°11'W 1.0 Y M31196470 06/30/15 Normal 00°21'N 106°11'W 1.1 Y M31196470 06/30/15 Normal 00°32'N 106°35'W 1.1 Y M31196444 06/30/15 Normal 00°32'N 106°45'W 0.8 Y M31196475 06/30/15 Normal 01°32'N 106°45'W 1.1 Y M31196470 06/30/15 Normal 01°10'S 100°28'W 0.8 N M31196170 06/30/15 Normal 01°10'S 100°28'W 0.6	M3I195855	06/30/15	Shallow	00°40'N	105°46'W	0.8		Y
M31195856 06/30/15 Shallow 00°32'N 105°55'W 0.9 Y M31196450 06/30/15 Normal 00°32'N 105°55'W 1.0 Y M31196850 06/30/15 Normal 00°22'N 106°0'4'W 0.9 Y M31196860 06/30/15 Normal 00°22'N 106°1'W 1.0 Y M31196467 06/30/15 Shallow 00°29'N 106°1'W 1.0 Y M3119647 06/30/15 Normal 00°3'N 106°24'W 1.1 Y M31195903 06/30/15 Normal 00°32'N 1.1 Y M3119647 06/30/15 Normal 00°33'N 106°45'W 0.8 Y M3119647 06/30/15 Normal 01°10'S 100°28'W 0.6 127 N M3119647 06/30/15 Normal 01°10'S 100°28'W 0.6 127 N M31196517 07/08/15 Normal 01°18'S 100°28'W 0.6	M3I196446	06/30/15	Normal	00°40'N	105°46'W	0.8		Ν
M31196450 06/30/15 Normal 00725N 106°04W 0.9 Y M31196460 06/30/15 Shallow 00°25N 106°05W 0.8 Y M31195893 06/30/15 Shallow 00°25N 106°05W 0.8 Y M31195893 06/30/15 Shallow 00°21N 106°05W 0.8 Y M31196470 06/30/15 Normal 00°21N 106°24W 0.8 N M31196479 06/30/15 Shallow 00°31N 106°24W 1.1 N M31196470 06/30/15 Normal 00°32N 106°35W 1.1 N M31196470 06/30/15 Normal 00°33N 106°45W 0.8 N M31196471 06/30/15 Normal 01°10S 100°28W 0.6 127 N M31196578 0708/15 Normal 01°10S 100°28W 0.6 127 N M31196183 0708/15 Normal 01°18S 100°23W 0.6 127 N M31196184 0708/15 Normal 01°27	M3I195856	06/30/15	Shallow	00°32'N	105°55'W	0.9		Y
M31195859 06/30/15 Shallow 00?25N 106?04W 0.9 Y M31196469 06/30/15 Normal 00?25N 106?01W 0.0 Y M3119589 06/30/15 Shallow 00?29N 106?11W 1.0 Y M31195899 06/30/15 Normal 00?31N 106?24W 0.8 Y M31195903 06/30/15 Normal 00?31N 106?24W 1.1 Y M31195903 06/30/15 Normal 00?31N 106?35W 1.1 Y M31196487 06/30/15 Normal 00?33N 106?45W 0.8 N M31196487 06/30/15 Normal 00?33N 106?28W 0.6 127 N M31196487 07/08/15 Normal 01°10S 100?28W 0.6 127 N M3119647 07/08/15 Normal 01°12S 100?28W 0.6 127 N M3196576 07/08/15 Shallow 01°13S 100?28W 0.6 127 N M3196182 07/08/15 Normal <td>M3I196450</td> <td>06/30/15</td> <td>Normal</td> <td>00°32'N</td> <td>105°55'W</td> <td>1.0</td> <td></td> <td>Y</td>	M3I196450	06/30/15	Normal	00°32'N	105°55'W	1.0		Y
M3196469 06/30/15 Normal 00°25N 10°07W 0.8 Y M3195893 06/30/15 Shallow 00°29N 10°11W 1.0 Y M3195897 06/30/15 Shallow 00°29N 10°11W 1.1 Y M3195897 06/30/15 Shallow 00°31N 10°24W 0.8 N M3196479 06/30/15 Normal 00°32N 10°35W 1.1 Y M3196484 06/30/15 Shallow 00°32N 10°35W 1.1 Y M3196487 06/30/15 Normal 00°33N 10°45W 1.1 Y M3196676 07/08/15 Normal 01°10S 10°28W 0.6 127 N M3196576 07/08/15 Normal 01°18S 10°28W 0.6 127 N M3196576 07/08/15 Normal 01°28S 10°23W 0.6 127 N M3196182 07/08/15 Normal 01°28S 10°31W 0.6 75 Y M3196183 07/08/15 Normal 01°28S<	M3I195859	06/30/15	Shallow	00°25'N	106°04'W	0.9		Y
M3119589306/30/15Shallow00°29N106°11W1.0YM3119589306/30/15Normal00°29N106°11W1.1YM3119590306/30/15Shallow00°31N106°24W1.1YM3119590306/30/15Normal00°32N106°35W1.1YM3119647906/30/15Normal00°32N106°35W1.1YM311954106/30/15Normal00°33N106°45W0.8YM3119647706/30/15Normal00°33N106°45W0.8YM3119657807/08/15Normal01°10S100°28W0.0YM3119657907/08/15Normal01°10S100°28W0.6127NM3119657507/08/15Normal01°128S100°28W0.6127NM3119657507/08/15Normal01°128S100°28W0.6127NM3119657507/08/15Shallow01°18S100°28W0.6127NM3119657507/08/15Shallow01°28S100°31W0.67YM3119656507/08/15Shallow01°37S100°33W0.613,69NM3119656507/08/15Shallow01°46S100°36W0.811NM3119656507/08/15Normal02°21S102°30W0.613,69NM3119656507/09/15Normal02°21S102°30W0.613,69NM311965	M3I196469	06/30/15	Normal	00°25'N	106°05'W	0.8		Y
M3119647606/30/15Normal00°29N106°11W1.1YM3119589906/30/15Shallow00°31N106°24W0.8NM3119648406/30/15Normal00°32N106°35W1.1NM3119648406/30/15Normal00°37N106°35W1.1YM3119648706/30/15Normal00°33N106°45W0.8YM3119648706/30/15Normal00°33N106°45W1.1YM3119657807/08/15Normal01°10S100°28W0.8NM3119657807/08/15Normal01°10S100°28W0.6127NM3119657607/08/15Shallow01°18S100°28W0.6127NM3119618307/08/15Normal01°18S100°28W0.67YM3119618407/08/15Normal01°28S100°31W0.67YM3119618207/08/15Normal01°28S100°33W0.6YYM3119616407/08/15Normal01°28S100°33W0.6YYM311965307/08/15Normal02°21S10°30W0.6YYM311965407/08/15Normal02°21S10°30W0.6YYM311965307/09/15Normal02°21S10°30W0.6YYM3119653607/09/15Normal02°21S10°30W0.6YYM3119656307/09/15	M3I195893	06/30/15	Shallow	00°29'N	106°11'W	1.0		Y
M31195899 $06'30'15$ Shallow $00''31'N$ $106''24'W$ 0.8 NM311950479 $06'30'15$ Shallow $00''31'N$ $106''32'W$ 1.1 YM31195051 $06'30'15$ Shallow $00''32'N$ $106''35'W$ 1.1 YM311951911 $06'30'15$ Normal $00''33'N$ $106''35'W$ 1.1 YM3119547 $06'30'15$ Normal $00''33'N$ $106''45'W$ 0.8 YM3119578 $0708'15$ Normal $00''33'N$ $106''45'W$ 0.8 NM31196191 $0708'15$ Normal $01''10'S$ $100''28W$ 0.6 127 NM31196576 $0708'15$ Normal $01''18'S$ $100''28W$ 0.6 127 NM31196575 $0708'15$ Normal $01''28'S$ $100''31'W$ 0.6 75 YM31196575 $0708'15$ Shallow $01''28'S$ $100''31'W$ 0.6 75 YM31196575 $0708'15$ Normal $01''37'S$ $100''33'W$ 0.6 $13, 69$ NM31196563 $0708'15$ Shallow $01''37'S$ $100''33'W$ 0.6 $13, 69$ NM3119655 $0708'15$ Shallow $01''37'S$ $100''33'W$ 0.6 $13, 69$ NM31196563 $0708'15$ Shallow $01''37'S$ $100''33'W$ 0.6 $13, 69$ NM31196563 $0709'15$ Shallow $02''21'S$ $102''30'W$ 0.6 YMM31196563 $0709'15$ Shallo	M3I196476	06/30/15	Normal	00°29'N	106°11'W	1.1		Y
M3119647906/30/15Normal00°31'N106°32'W1.1NM3119548406/30/15Normal00°32'N100°35'W1.1NM3119648706/30/15Shallow00°33'N106°45'W0.8YM3119648706/30/15Normal00°33'N106°45'W0.8YM3119648706/30/15Normal01°10'S100°28'W0.8NM3119657607/08/15Shallow01°10'S100°28'W0.6127NM3119657607/08/15Shallow01°18'S100°28'W0.675YM3119657507/08/15Shallow01°18'S100°28'W0.675YM3119618207/08/15Shallow01°28'S100°31'W0.675YM3119618607/08/15Normal01°27'S100°33'W0.613,69NM3119648807/08/15Shallow01°37'S100°33'W0.613,69NM3119648807/08/15Shallow01°46'S100°36'W0.7YYM311965507/09/15Shallow01°47'S100°33'W0.613,69NM3119656307/09/15Shallow02°21'S102°30'W0.6YNM311965507/09/15Normal02°21'S102°30'W0.6YNM311965507/09/15Normal02°21'S102°30'W0.9NNM311965507/09/15Normal02°21'S102°30'	M3I195899	06/30/15	Shallow	00°31'N	106°24'W	0.8		Ν
M3119590306/30/15Shallow00°32'N106°35'W1.1NM3119648406/30/15Normal00°32'N10°45'W0.8YM3119648706/30/15Normal00°33'N10°45'W0.8YM3119648706/30/15Normal00°33'N10°45'W1.1YM3119657807/08/15Normal01°10'S100°2'S'W0.8NM3119657607/08/15Shallow01°10'S100°2'S'W0.6127NM3119618307/08/15Shallow01°18'S100°2'S'W0.67YM3119657607/08/15Shallow01°2'S'S100°3'S'W0.67YM3119657507/08/15Shallow01°2'S'S100°3'S'W0.67YM311965807/08/15Normal01°3'S'S100°3'S'W0.613,6'9NM3119648407/08/15Normal01°4'S'S100°3'S'W0.613,6'9NM311965507/08/15Shallow01°3'S'S100°3'S'W0.6YMM3119656507/09/15Normal02°2'S'S102°3'O'W0.6YNM3119656307/09/15Normal02°2'S'S102°3'O'W0.6YNM3119656307/09/15Normal02°2'S'S102°3'O'W0.9NNM3119656507/09/15Normal02°2'S'S102°2'S'W0.9NNM3119656307/09/15Normal02°5'S'S <td>M3I196479</td> <td>06/30/15</td> <td>Normal</td> <td>00°31'N</td> <td>106°24'W</td> <td>1.1</td> <td></td> <td>Y</td>	M3I196479	06/30/15	Normal	00°31'N	106°24'W	1.1		Y
M31196484 $06/30/15$ Normal $00''32'N$ $106''35'W$ 1.1 YM31195911 $06/30/15$ Normal $00''33'N$ $106''45'W$ 0.8 YM31196487 $06/30/15$ Normal $00''33'N$ $106''45'W$ 0.8 NM31196578 $07/08/15$ Normal $01''10'S$ $100''28'W$ 0.8 NM31196576 $07/08/15$ Shallow $01''10'S$ $100''28'W$ 0.6 127 NM31196576 $07/08/15$ Shallow $01''18'S$ $100''28'W$ 0.6 127 NM31196575 $07/08/15$ Normal $01''28'S$ $100''28'W$ 0.6 75 YM31196182 $07/08/15$ Shallow $01''28'S$ $100''31'W$ 0.6 YM3119616807/08/15Normal $01''23'S$ $100''33'W$ 0.6 $13, 69$ NM31196168 $07/08/15$ Shallow $01''37'S$ $100''33'W$ 0.6 $13, 69$ NM3119515 $07/08/15$ Normal $01''37'S$ $100''33'W$ 0.6 YNM3119515 $07/08/15$ Normal $01''37'S$ $100''33'W$ 0.6 YNM31196164 $07/09/15$ Normal $02''21'S$ $102''30'W$ 0.6 YM31196535 $07/09/15$ Normal $02''21'S$ $102''30'W$ 0.6 YM31196540 $07/09/15$ Normal $02''21'S$ $102''30'W$ 0.9 8YM31196550 $07/09/15$ Normal $02''21'S$ </td <td>M3I195903</td> <td>06/30/15</td> <td>Shallow</td> <td>00°32'N</td> <td>106°35'W</td> <td>1.1</td> <td></td> <td>Ν</td>	M3I195903	06/30/15	Shallow	00°32'N	106°35'W	1.1		Ν
M31195911 $0630/15$ Shallow $00''33'N$ $106''45'W$ 0.8 YM31196487 $06'30/15$ Normal $00''33'N$ $106''45'W$ 1.1 YM31196578 $07/08/15$ Normal $01''10'S$ $100''28'W$ 1.0 YM31196576 $07/08/15$ Shallow $01''10'S$ $100''28'W$ 1.0 YM31196576 $07/08/15$ Normal $01''18'S$ $100''28'W$ 0.6 127 NM31196575 $07/08/15$ Normal $01''18'S$ $100''28'W$ 0.6 127 NM31196575 $07/08/15$ Normal $01''28'S$ $100''28'W$ 0.6 75 YM31196575 $07/08/15$ Normal $01''28'S$ $100''31'W$ 0.6 75 YM31196576 $07/08/15$ Normal $01''28'S$ $100''33'W$ 0.6 $13, 69$ NM31196182 $07/08/15$ Normal $01''37'S$ $100''33'W$ 0.6 $13, 69$ NM311961848 $07/08/15$ Normal $01''46'S$ $100''36'W$ 0.8 11 NM31196565 $07/09/15$ Normal $02''21'S$ $102''30'W$ 0.6 YM31196563 $07/09/15$ Normal $02''21'S$ $102''30'W$ 0.6 YM31196563 $07/09/15$ Normal $02''21'S$ $102''30'W$ 0.6 YM31196516 $07/09/15$ Normal $02''21'S$ $102''30'W$ 0.6 YM31196515 $07/09/15$ Normal $02''25'S$ <td>M3I196484</td> <td>06/30/15</td> <td>Normal</td> <td>00°32'N</td> <td>106°35'W</td> <td>1.1</td> <td></td> <td>Y</td>	M3I196484	06/30/15	Normal	00°32'N	106°35'W	1.1		Y
M31196487 06/30/15 Normal 00°33N 106°45'W 1.1 Y M31196578 07/08/15 Normal 01°10'S 100°28'W 0.8 N M31196578 07/08/15 Shallow 01°10'S 100°28'W 0.6 127 N M31196575 07/08/15 Shallow 01°18'S 100°28'W 0.6 127 N M31196575 07/08/15 Shallow 01°18'S 100°28'W 0.6 7 Y M31196575 07/08/15 Normal 01°28'S 100°31'W 0.6 7 Y M31196586 07/08/15 Normal 01°37'S 100°33'W 0.6 13, 69 N M31196488 07/08/15 Shallow 01°37'S 100°36'W 0.8 11 N M31196488 07/08/15 Normal 02°21'S 102°30'W 0.6 Y M31196565 07/09/15 Normal 02°21'S 102°30'W 0.6 Y M31196169 <td< td=""><td>M3I195911</td><td>06/30/15</td><td>Shallow</td><td>00°33'N</td><td>106°45'W</td><td>0.8</td><td></td><td>Ŷ</td></td<>	M3I195911	06/30/15	Shallow	00°33'N	106°45'W	0.8		Ŷ
M31196578 M3119657807/08/15 V07/08/15Normal Normal01°10'S 100°28'W0.8NM31196191 M3119657607/08/15 V7/08/15Shallow 01°10'S100°28'W0.6127 NNM31196575 M3119618207/08/15 V7/08/15Shallow 01°18'S100°28'W0.730 30YM31196575 M3119657507/08/15 V7/08/15Normal Normal01°28'S100°31'W0.675YM31196388 M3119638807/08/15 V7/08/15Normal Normal01°37'S100°33'W0.613, 69NM31196388 M3119648807/08/15 V7/08/15Normal Normal01°46'S100°36'W0.7YM31195565 M3119656307/09/15 V7/09/15Normal Normal02°21'S102°30'W0.6YM31196563 M3119656307/09/15 V7/09/15Normal Normal02°21'S102°30'W0.6YM31196563 M3119656307/09/15 V7/09/15Normal Normal02°28'S102°30'W0.9NM31196563 M3119656307/09/15 V7/09/15Normal Normal02°28'S102°30'W0.9NM31196575 M3119657007/09/15 V7/09/15Normal Normal02°28'S102°30'W0.9NM31196575 M3119657007/09/15 V7/09/15Normal Normal02°56'S102°29'W0.8YM31196570 M3119657107/09/15 V10/15Normal Normal02°56'S102°27'W0.8YM31196571 M311965715	M3I196487	06/30/15	Normal	00°33'N	106°45'W	1.1		Ŷ
M3119619107/08/15Shallow01°10'S100°28'W1.0YM3119657607/08/15Normal01°18'S100°28'W0.6127NM3119618307/08/15Shallow01°18'S100°28'W0.730YM3119675507/08/15Shallow01°28'S100°31'W0.675YM3119636807/08/15Normal01°28'S100°31'W0.6YYM3119636807/08/15Normal01°37'S100°33'W0.613,69NM3119517607/08/15Shallow01°46'S100°36'W0.811NM3119654807/08/15Normal01°46'S100°36'W0.6YM3119655607/09/15Normal02°21'S102°30'W0.6YM3119656307/09/15Normal02°21'S102°30'W0.6YM3119656307/09/15Normal02°28'S102°30'W0.9NM3119653607/09/15Normal02°28'S102°30'W0.9NM3119652907/09/15Normal02°26'S102°29'W0.8YM3119651507/09/15Normal02°56'S102°29'W0.8YM3119651507/09/15Normal02°56'S102°29'W0.8NM3119651507/09/15Normal02°56'S102°21'W0.8YM3119650407/09/15Normal02°56'S102°14'W0.8YM31195547	M3I196578	07/08/15	Normal	01°10'S	100°28'W	0.8		N
M3119576 07/08/15 Normal 01°18'S 100°28'W 0.6 127 N M31196183 07/08/15 Shallow 01°18'S 100°28'W 0.7 30 Y M31196575 07/08/15 Shallow 01°28'S 100°31'W 0.6 75 Y M31196182 07/08/15 Shallow 01°28'S 100°31'W 0.6 Y M31196368 07/08/15 Shallow 01°37'S 100°33'W 0.6 13, 69 N M31195488 07/08/15 Shallow 01°37'S 100°33'W 0.6 13, 69 N M31195488 07/08/15 Normal 01°46'S 100°36'W 0.7 Y Y M31195655 07/08/15 Shallow 01°46'S 100°30'W 0.6 Y Y M31196563 07/09/15 Shallow 02°21'S 102°30'W 0.6 Y Y M31196563 07/09/15 Normal 02°28'S 102°30'W 0.9 N N M31196564 07/09/15 Shallow 02°28'S 102°20'W	M3I196191	07/08/15	Shallow	01°10'S	100°28'W	1.0		Y
M31196183 M3119618307/08/15Shallow Normal01°18'S 01°28'S100°28'W 0.070.730YM31196575 M3119636807/08/15Normal Normal01°28'S100°31'W 0.60.675YM31196368 M3119636807/08/15Shallow 01°37'S100°33'W 0.60.6YYM31195176 M3119517607/08/15Shallow 01°37'S100°33'W 0.60.613, 69NM3119516 M3119565507/08/15Shallow 01°46'S100°36'W 0.70.7YM3119555 M3119656307/08/15Shallow 01°46'S100°36'W 0.60.811NM31196563 M3119656307/09/15Normal M3119656302°21'S102°30'W 0.60.6YM31196563 M3119656307/09/15Normal M3119656302°28'S102°30'W 0.90.9NM31196564 M3119656407/09/15Shallow M2°242'S102°30'W 0.90.9NM31196575 M31196575Normal 02°42'S02°29'W 0.80.8YM31196575 M3119657007/09/15Shallow 02°56'S02°29'W 0.80.8YM31196570 M3119657007/09/15Shallow 02°56'S02°29'W 0.80.8YM31196570 M3119657407/09/15Shallow 02°56'S02°27'W 1.082YM31196574 M3119657407/09/15Shallow 02°56'S02°27'W 1.082YM31196574 M3119657407/09/15Shallow <br< td=""><td>M3I196576</td><td>07/08/15</td><td>Normal</td><td>01°18'S</td><td>100°28'W</td><td>0.6</td><td>127</td><td>N</td></br<>	M3I196576	07/08/15	Normal	01°18'S	100°28'W	0.6	127	N
M3I196575 07/08/15 Normal 01°28'S 100°31'W 0.6 75 Y M3I196182 07/08/15 Shallow 01°28'S 100°31'W 0.6 Y M3I196368 07/08/15 Normal 01°37'S 100°33'W 0.6 Y M3I196488 07/08/15 Shallow 01°37'S 100°33'W 0.6 13, 69 N M3I196488 07/08/15 Shallow 01°46'S 100°36'W 0.7 Y M3I196488 07/08/15 Shallow 01°46'S 100°36'W 0.8 11 N M3I196565 07/09/15 Normal 02°21'S 102°30'W 0.6 Y M3I196169 07/09/15 Normal 02°28'S 102°30'W 0.9 N M3I196169 07/09/15 Normal 02°28'S 102°30'W 0.9 N M3I196536 07/09/15 Normal 02°26'S 102°29'W 0.8 Y M3I196515 07/09/15 Normal 02°56'S<	M3I196183	07/08/15	Shallow	01°18'S	100°28'W	0.7	30	Y
M31196182 07/08/15 Shallow 01°28'S 100°31'W 0.6 Y M31196368 07/08/15 Normal 01°37'S 100°33'W 0.6 13, 69 N M31196368 07/08/15 Shallow 01°37'S 100°33'W 0.6 13, 69 N M31196488 07/08/15 Normal 01°46'S 100°36'W 0.7 Y M31196555 07/09/15 Normal 02°21'S 102°30'W 0.6 Y M31196565 07/09/15 Normal 02°21'S 102°30'W 0.6 Y M31196563 07/09/15 Normal 02°21'S 102°30'W 0.6 Y M31196563 07/09/15 Normal 02°21'S 102°30'W 0.9 N M31196563 07/09/15 Normal 02°28'S 102°30'W 0.9 N M31196563 07/09/15 Normal 02°27S'S 102°30'W 0.9 N M31196529 07/09/15 Shallow 02°27S'S 102°29'W 0.8 Y M31196515 07/09/15 Normal	M3I196575	07/08/15	Normal	01°28'S	100°31'W	0.6	75	Y
M31196368 07/08/15 Normal 01°37'S 100°33'W 0.6 Y M31195176 07/08/15 Shallow 01°37'S 100°33'W 0.6 13, 69 N M31195176 07/08/15 Shallow 01°46'S 100°36'W 0.7 Y M31195915 07/08/15 Shallow 01°46'S 100°36'W 0.8 11 N M31196565 07/09/15 Shallow 02°21'S 102°30'W 0.6 Y M31196563 07/09/15 Shallow 02°21'S 102°30'W 0.6 Y M31196563 07/09/15 Shallow 02°21'S 102°30'W 0.9 8 Y M31196563 07/09/15 Shallow 02°28'S 102°30'W 0.9 N N M31196564 07/09/15 Normal 02°28'S 102°29'W 0.8 Y N M31196510 07/09/15 Shallow 02°56'S 102°29'W 0.8 89 N M31196515 <	M3I196182	07/08/15	Shallow	01°28'S	100°31'W	0.6		Y
M31195176 07/08/15 Shallow 01°37'S 100°33'W 0.6 13, 69 N M31196488 07/08/15 Normal 01°46'S 100°36'W 0.7 Y M3119515 07/08/15 Shallow 01°46'S 100°36'W 0.8 11 N M31196565 07/09/15 Normal 02°21'S 102°30'W 0.6 Y M31196563 07/09/15 Shallow 02°21'S 102°30'W 0.6 Y M31196563 07/09/15 Normal 02°28'S 102°30'W 0.9 8 Y M31196536 07/09/15 Normal 02°28'S 102°30'W 0.9 102 N M31196536 07/09/15 Normal 02°28'S 102°29'W 0.8 Y M3119653 M31196516 07/09/15 Normal 02°56'S 102°29'W 0.8 89 N M31196507 07/09/15 Normal 02°56'S 102°22'W 1.0 Y M3119595 07/09/15N	M3I196368	07/08/15	Normal	01°37'S	100°33'W	0.6		Y
M31196488 07/08/15 Normal 01°46'S 100°36'W 0.7 Y M31195915 07/08/15 Shallow 01°46'S 100°36'W 0.8 11 N M31196565 07/09/15 Normal 02°21'S 102°30'W 0.6 Y M31196174 07/09/15 Shallow 02°21'S 102°30'W 0.6 Y M31196563 07/09/15 Normal 02°28'S 102°30'W 0.9 8 Y M31196563 07/09/15 Normal 02°28'S 102°30'W 0.9 N N M31196563 07/09/15 Normal 02°28'S 102°30'W 0.9 N N M31196563 07/09/15 Normal 02°28'S 102°30'W 0.9 N N M31196516 07/09/15 Normal 02°42'S 102°29'W 0.8 Y N M31196515 07/09/15 Normal 02°56'S 102°29'W 0.8 89 N M31196507 07/09/15 Shallow 02°56'S 102°21'W 0.9 Y M	M3I195176	07/08/15	Shallow	01°37'S	100°33'W	0.6	13.69	N
M31195915 07/08/15 Shallow 01°46'S 100°36'W 0.8 11 N M31196565 07/09/15 Normal 02°21'S 102°30'W 0.6 Y M31196174 07/09/15 Shallow 02°21'S 102°30'W 0.6 Y M31196563 07/09/15 Normal 02°28'S 102°30'W 0.9 8 Y M31196169 07/09/15 Shallow 02°28'S 102°30'W 0.9 N N M31196536 07/09/15 Normal 02°28'S 102°30'W 0.9 N N M31196161 07/09/15 Normal 02°42'S 102°29'W 0.9 102 N M31196529 07/09/15 Shallow 02°42'S 102°29'W 0.8 Y N M31196515 07/09/15 Normal 02°56'S 102°29'W 0.8 89 N M31196507 07/09/15 Shallow 02°59'S 102°22'W 1.0 Y M M31195504 07/09/15 Shallow 02°56'S 102°14'W 0.9 N<	M3I196488	07/08/15	Normal	01°46'S	100°36'W	0.7	- ,	Y
M31196565 07/09/15 Normal 02°21'S 102°30'W 0.6 Y M31196174 07/09/15 Shallow 02°21'S 102°30'W 0.6 Y M31196563 07/09/15 Normal 02°28'S 102°30'W 0.9 8 Y M31196169 07/09/15 Shallow 02°28'S 102°30'W 0.9 N N M31196161 07/09/15 Shallow 02°28'S 102°29'W 0.9 102 N M31196536 07/09/15 Normal 02°42'S 102°29'W 0.8 Y M31196529 07/09/15 Normal 02°56'S 102°29'W 0.8 89 N M3119607 07/09/15 Shallow 02°56'S 102°29'W 0.8 89 N M31196515 07/09/15 Normal 02°57'S 102°22'W 1.0 82 Y M31195507 07/09/15 Shallow 02°56'S 102°14'W 0.9 Y M3119504 N M31195044 07/10/15 Normal 02°56'S 102°14'W 0.8	M3I195915	07/08/15	Shallow	01°46'S	100°36'W	0.8	11	N
M31196174 07/09/15 Shallow 02°21'S 102°30'W 0.6 Y M31196563 07/09/15 Normal 02°28'S 102°30'W 0.9 8 Y M31196169 07/09/15 Shallow 02°28'S 102°30'W 0.9 N N M31196169 07/09/15 Shallow 02°28'S 102°30'W 0.9 N N M31196161 07/09/15 Normal 02°42'S 102°29'W 0.8 Y N M31196161 07/09/15 Shallow 02°56'S 102°29'W 0.8 Y N M31196007 07/09/15 Normal 02°56'S 102°29'W 0.8 89 N M31196515 07/09/15 Normal 02°56'S 102°22'W 1.0 82 Y M3119555 07/09/15 Shallow 02°56'S 102°21'W 0.9 Y Y M31195040 07/09/15 Shallow 02°56'S 102°14'W 0.9 Y Y M31195044 07/09/15 Shallow 02°57'S 102°51'W 0.8 <td>M3I196565</td> <td>07/09/15</td> <td>Normal</td> <td>02°21'S</td> <td>102°30'W</td> <td>0.6</td> <td></td> <td>Y</td>	M3I196565	07/09/15	Normal	02°21'S	102°30'W	0.6		Y
M31196563 07/09/15 Normal 02°28'S 102°30'W 0.9 8 Y M31196169 07/09/15 Shallow 02°28'S 102°30'W 0.9 N M31196536 07/09/15 Normal 02°42'S 102°29'W 0.9 102 N M31196536 07/09/15 Shallow 02°42'S 102°29'W 0.8 Y M31196529 07/09/15 Shallow 02°56'S 102°29'W 0.8 Y M31196515 07/09/15 Shallow 02°56'S 102°29'W 0.8 89 N M31196515 07/09/15 Shallow 02°56'S 102°22'W 0.8 89 N M31196515 07/09/15 Normal 02°59'S 102°22'W 1.0 82 Y M3119555 07/09/15 Shallow 02°56'S 102°14'W 0.9 Y Y M3119504 07/09/15 Normal 02°57'S 102°14'W 0.8 N N M3119504 07/10/15 Normal 02°57'S 102°51'W 0.8 N N <td>M3I196174</td> <td>07/09/15</td> <td>Shallow</td> <td>02°21'S</td> <td>102°30'W</td> <td>0.6</td> <td></td> <td>Ŷ</td>	M3I196174	07/09/15	Shallow	02°21'S	102°30'W	0.6		Ŷ
M31196169 07/09/15 Shallow 02°28'S 102°30'W 0.9 N M31196536 07/09/15 Normal 02°42'S 102°29'W 0.9 102 N M31196536 07/09/15 Shallow 02°42'S 102°29'W 0.8 Y M31196529 07/09/15 Normal 02°56'S 102°29'W 0.8 Y M31196515 07/09/15 Normal 02°56'S 102°29'W 0.8 89 N M31196515 07/09/15 Shallow 02°56'S 102°29'W 0.8 89 N M31196515 07/09/15 Shallow 02°56'S 102°22'W 1.0 82 Y M3119555 07/09/15 Normal 02°56'S 102°14'W 0.9 Y M31195948 07/09/15 Normal 02°57'S 102°14'W 0.8 Y M31195947 07/10/15 Normal 02°57'S 102°51'W 0.8 N M31195947 07/10/15 Shallow 02°57'S 103°43'W 0.6 60,90 Y M31195897	M3I196563	07/09/15	Normal	02°28'S	102°30'W	0.9	8	Ŷ
M31196536 07/09/15 Normal 02°42'S 102°29'W 0.9 102 N M31196161 07/09/15 Shallow 02°42'S 102°29'W 0.8 Y M31196529 07/09/15 Normal 02°56'S 102°29'W 0.8 Y M31196007 07/09/15 Shallow 02°56'S 102°29'W 0.8 89 N M31196007 07/09/15 Shallow 02°56'S 102°29'W 0.8 89 N M31196515 07/09/15 Shallow 02°56'S 102°22'W 1.0 82 Y M3119555 07/09/15 Normal 02°56'S 102°22'W 1.0 Y Y M3119555 07/09/15 Shallow 02°56'S 102°14'W 0.9 Y Y M31195548 07/09/15 Shallow 02°56'S 102°14'W 0.8 Y N M31195544 07/10/15 Normal 02°57'S 102°51'W 0.8 N N M31196477 07/18/15 Normal 02°57'S 103°43'W 0.6 60,	M3I196169	07/09/15	Shallow	02°28'S	102°30'W	0.9	-	N
M31196161 07/09/15 Shallow 02°42'S 102°29'W 0.8 Y M31196529 07/09/15 Normal 02°56'S 102°29'W 0.8 Y M31196007 07/09/15 Shallow 02°56'S 102°29'W 0.8 Y M31196007 07/09/15 Shallow 02°56'S 102°29'W 0.8 89 N M31196515 07/09/15 Normal 02°59'S 102°22'W 1.0 82 Y M31196507 07/09/15 Shallow 02°56'S 102°21'W 0.9 Y M31195955 07/09/15 Normal 02°56'S 102°14'W 0.9 Y M31195948 07/09/15 Shallow 02°57'S 102°14'W 0.8 Y M31195947 07/10/15 Normal 02°57'S 102°51'W 0.8 N M31196477 07/18/15 Normal 02°27'S 103°43'W 0.7 Y M31196492 07/20/15 Normal 02°27'S 103°43'W 0.6 60, 90 Y M31196492 07/20/15	M3I196536	07/09/15	Normal	02°42'S	102°29'W	0.9	102	N
M31196529 07/09/15 Normal 02°56'S 102°29'W 0.8 Y M31196007 07/09/15 Shallow 02°56'S 102°29'W 0.8 89 N M31196515 07/09/15 Shallow 02°56'S 102°22'W 1.0 82 Y M31195515 07/09/15 Shallow 02°59'S 102°22'W 1.0 82 Y M31195955 07/09/15 Shallow 02°59'S 102°22'W 1.0 Y M31196507 07/09/15 Shallow 02°56'S 102°14'W 0.9 Y M31195948 07/09/15 Shallow 02°57'S 102°14'W 0.8 Y M31196504 07/10/15 Normal 02°57'S 102°51'W 0.8 N M31195947 07/10/15 Shallow 02°57'S 102°51'W 0.9 100 Y M31196477 07/18/15 Normal 02°27'S 103°43'W 0.7 Y M31195897 07/18/15 Shallow 02°27'S 103°43'W 0.6 60, 90 Y M31196492	M3I196161	07/09/15	Shallow	02°42'S	102°29'W	0.8	102	Y
M31196007 07/09/15 Shallow 02°56'S 102°29'W 0.8 89 N M31196515 07/09/15 Shallow 02°56'S 102°22'W 1.0 82 Y M31195515 07/09/15 Shallow 02°59'S 102°22'W 1.0 82 Y M31195955 07/09/15 Shallow 02°56'S 102°22'W 1.0 Y M31196507 07/09/15 Shallow 02°56'S 102°14'W 0.9 Y M31195948 07/09/15 Shallow 02°56'S 102°14'W 0.8 Y M31196504 07/10/15 Normal 02°57'S 102°51'W 0.8 N M31195947 07/10/15 Shallow 02°57'S 102°51'W 0.8 N M31196477 07/18/15 Normal 02°27'S 103°43'W 0.7 Y M31195897 07/18/15 Shallow 02°27'S 103°43'W 0.6 60, 90 Y M31196492 07/20/15 Normal 00°52'S 103°06'W 0.7 63 Y M31196492<	M3I196529	07/09/15	Normal	02°56'S	102°29'W	0.8		Ŷ
M31196515 07/09/15 Normal 02°59'S 102°22'W 1.0 82 Y M31195555 07/09/15 Shallow 02°59'S 102°22'W 1.0 Y M31195955 07/09/15 Shallow 02°56'S 102°21'W 0.0 Y M31196507 07/09/15 Normal 02°56'S 102°14'W 0.9 Y M31195948 07/09/15 Shallow 02°56'S 102°14'W 0.8 Y M31195947 07/10/15 Normal 02°57'S 102°51'W 0.8 N M31195947 07/10/15 Shallow 02°57'S 102°51'W 0.9 100 Y M31196477 07/18/15 Normal 02°27'S 103°43'W 0.7 Y M31195897 07/18/15 Shallow 02°27'S 103°43'W 0.6 60, 90 Y M31196492 07/20/15 Normal 00°52'S 103°06'W 0.7 63 Y	M3I196007	07/09/15	Shallow	02°56'S	102°29'W	0.8	89	N
M31195955 07/09/15 Shallow 02°59'S 102°22'W 1.0 Y M31195955 07/09/15 Shallow 02°59'S 102°14'W 0.9 Y M31195948 07/09/15 Shallow 02°56'S 102°14'W 0.8 Y M31195948 07/09/15 Shallow 02°56'S 102°14'W 0.8 Y M31195947 07/10/15 Normal 02°57'S 102°51'W 0.8 N M31195947 07/10/15 Shallow 02°57'S 102°51'W 0.9 100 Y M31196477 07/18/15 Normal 02°27'S 103°43'W 0.7 Y M31196492 07/20/15 Normal 00°52'S 103°043'W 0.6 60, 90 Y M31196492 07/20/15 Normal 00°52'S 103°06'W 0.7 63 Y M31195928 07/20/15 Shallow 00°53'S 103°05'W 0.7 63 Y	M3I196515	07/09/15	Normal	02°59'S	102°22'W	1.0	82	Y
M31196507 07/09/15 Normal 02°56'S 102°14'W 0.9 Y M31195948 07/09/15 Shallow 02°56'S 102°14'W 0.8 Y M31196504 07/10/15 Normal 02°57'S 102°51'W 0.8 N M31195947 07/10/15 Shallow 02°57'S 102°51'W 0.8 N M31195947 07/10/15 Shallow 02°57'S 102°51'W 0.9 100 Y M31196477 07/18/15 Normal 02°27'S 103°43'W 0.7 Y M31196492 07/20/15 Normal 00°52'S 103°06'W 0.7 63 Y M31195928 07/20/15 Shallow 00°53'S 103°05'W 0.7 63 Y	M3I195955	07/09/15	Shallow	02°59'S	102°22'W	1.0	-	Ŷ
M31195948 07/09/15 Shallow 02°56'S 102°14'W 0.8 Y M31195948 07/10/15 Shallow 02°57'S 102°51'W 0.8 N M31195947 07/10/15 Shallow 02°57'S 102°51'W 0.8 N M31195947 07/10/15 Shallow 02°57'S 102°51'W 0.9 100 Y M31196477 07/18/15 Normal 02°28'S 103°43'W 0.7 Y M31195897 07/18/15 Shallow 02°27'S 103°43'W 0.6 60, 90 Y M31196492 07/20/15 Normal 00°52'S 103°06'W 0.7 63 Y M31195928 07/20/15 Shallow 00°53'S 103°05'W 0.7 63 Y	M3I196507	07/09/15	Normal	02°56'S	102°14'W	0.9		Ŷ
M31196504 07/10/15 Normal 02°57'S 102°51'W 0.8 N M31195947 07/10/15 Shallow 02°57'S 102°51'W 0.9 100 Y M31196477 07/18/15 Normal 02°28'S 103°43'W 0.7 Y M31195897 07/18/15 Shallow 02°27'S 103°43'W 0.6 60, 90 Y M31196492 07/20/15 Normal 00°52'S 103°06'W 0.7 63 Y	M3I195948	07/09/15	Shallow	02°56'S	102°14'W	0.8		Ŷ
M31195947 07/10/15 Shallow 02°57'S 102°51'W 0.9 100 Y M31195947 07/10/15 Shallow 02°57'S 102°51'W 0.9 100 Y M31196477 07/18/15 Normal 02°28'S 103°43'W 0.7 Y M31195897 07/18/15 Shallow 02°27'S 103°43'W 0.6 60, 90 Y M31196492 07/20/15 Normal 00°52'S 103°06'W 0.7 63 Y M31195928 07/20/15 Shallow 00°53'S 103°05'W 0.7 V	M3I196504	07/10/15	Normal	02°57'S	102°51'W	0.8		N
M31196477 07/18/15 Normal 02°28'S 103°43'W 0.7 Y M31195897 07/18/15 Shallow 02°27'S 103°43'W 0.6 60, 90 Y M31196492 07/20/15 Normal 00°52'S 103°06'W 0.7 63 Y M31195928 07/20/15 Shallow 00°53'S 103°05'W 0.7 63 Y	M3I195947	07/10/15	Shallow	02°57'S	102°51'W	0.9	100	Y
M3I195897 07/18/15 Shallow 02°27'S 103°43'W 0.6 60, 90 Y M3I196492 07/20/15 Normal 00°52'S 103°06'W 0.7 63 Y M3I195928 07/20/15 Shallow 00°53'S 103°05'W 0.7 5 Y	M3I196477	07/18/15	Normal	02°28'S	102°43'W	0.7	100	Ŷ
M3I196492 07/20/15 Normal 00°52'S 103°06'W 0.7 63 Y M3I195928 07/20/15 Shallow 00°53'S 103°05'W 0.7 V V	M3I195897	07/18/15	Shallow	02°27'S	103°43'W	0.6	60.90	Ŷ
M3I195928 07/20/15 Shallow 00°53'S 103°05'W 0.7 V	M3I196492	07/20/15	Normal	00°52'S	103°06'W	0.7	63	Ŷ
11313320 012013 01000 00330 103030 0.1	M3I195928	07/20/15	Shallow	00°53'S	103°05'W	0.7		Ŷ

• The deployment and fishing activity forms, also created at IATTC for this project, were provided to all 11 NIRSA PS vessels and the captains were instructed to complete when conducting any activities around the 100 experimental DFADs, including setting, checking, recovering and/or relocating DFADs.

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- The echo-sounder data from the M3i buoys, which is being saved on a computer hard drive at IATTC, is both graphical and numerical. A relative value (U) is provided as an estimation of total tuna abundance for each detection and for the highest value per day. In the raw data export format, there is a 0 to 7 value for each of the 50 layers (of 3 meter each), which we are planning to utilize in evaluating whether it is useful for estimation of tuna species catch composition.

Individual M3i echo-sounder buoy (50 KHz) display for a shallow depth DFAD with an associated aggregation



Cerrar

• We expect to continue this experiment for several more months, in order to attempt to obtain catch data from about 50 sets on each DFAD type. The catch information collected thus far from this experiment is inadequate for conducting valid statistical analyses, utilizing a general linear model (GLM) or another appropriate model, to evaluate whether DFAD depth is a significant variable with respect to BET catch composition.

Deployment locations and drift trajectories during the first 60d for 50 normal and 50 shallow depth DFADs



Current Locations and drift trajectories during the previous 60d for 39 normal and 32 shallow depth DFADs



Set locations on 16 normal and 14 shallow depth DFADs



Tuna catch and M3i echo-sounder data for sets on 16 normal and 14 shallow depth DFADs by seven NIRSA vessels

										M3i Eo	cho-soun	der buoy data
			Set Information				Catch Information				Numer	ical Data in 3m bins (0 – 150 m)
M3i Number	FAD depth	Vessel	Date Time	Lat	Lon	SKJ	BET	YFT	Proportion BET	U value	Total	Proportion >30m
196563	Normal	Milena A.	7/16/15 6:15	3.03 S	104.53 W	6	5	0	0.45	19	69	0.42
196488	Normal	Milena A.	7/20/15 6:00	1.22 S	102.85 W	5	2	1	0.25	11	61	0.13
196444	Normal	Rafa	9/14/15 6:05	5.18 S	92.08 W	3	0	1	0.00	23	97	0.36
196488	Normal	Milena A.	9/14/15 13:49	4.12 S	114.35 W	3	5	0	0.63	13	76	0.28
196431	Normal	Rafa	9/18/15 10:25	5.22 N	92.93 W	2	0	1	0.00	20	84	0.35
196575	Normal	Milena A.	9/20/15 7:31	3.90 S	113.97 W	11	21	0	0.66	41	99	0.65
196492	Normal	Milena A.	9/20/15 13:31	3.68 S	114.43 W	0	0	0	0.00	47	104	0.63
196247	Normal	Milena A.	9/25/15 12:22	5.08 S	124.06 W	4	5	1	0.50	45	115	0.45
196515	Normal	Milena A.	9/28/15 6:17	0.80 N	118.08 W	14	13	3	0.43	31	53	0.36
196405	Normal	Milagros A	10/8/15 5:50	2.80 S	127.82 W	10	38	0	0.79	34	80	0.64
196241	Normal	Rosa F	10/13/15 5:21	6.17 S	101.6 W	5	0	0	0.00	1	32	0.00
196417	Normal	Roberto A	10/15/15 5:16	3.00 N	90.82 W	20	0	7	0.00	32	100	0.43
196287	Normal	Roberto A	10/17/15 10:17	3.35 N	90.77 W	1	0	0	0.00	7	25	0.59
196536	Normal	Milagros A	10/18/15 15:20	7.35 S	129.35 W	0	0	0	0.00	33	88	0.40
196142	Normal	Milena A.	11/8/15 5:25	4.17 S	107.92 W	16	2	0	0.11	28	98	0.35
196576	Normal	Drennec	11/11/15 6:15	7.54 S	124.10 W	1	4	0	0.80	12	57	0.42
195915	Shallow	Milena A.	7/19/15 5:55	0.98 S	102.80 W	20	8	3	0.26	11	68	0.21
196183	Shallow	Milena A.	8/6/15 6:37	4.03 S	106.67 W	0	0	0	0.00	6	50	0.12
195844	Shallow	Rafa	9/12/15 10:05	5.37 N	91.65 W	6	0	3	0.00	11	70	0.16
195897	Shallow	Milena A.	9/15/15 7:20	2.90 S	116.68 W	15	9	0	0.38	13	79	0.29
195168	Shallow	Rafa	9/17/15 7:55	4.50 N	92.18 W	3	0	2	0.00	4	26	0.31
195168	Shallow	Rafa	9/27/15	2.62 N	81.08 W	2	0	3	0.00	14	60	0.22
196007	Shallow	Milagros A	10/5/15 5:30	1.08 S	122.22 W	19	35	2	0.63	30	106	0.42
195897	Shallow	Drennec	10/16/15 6:16	3.08 S	117.57 W	3	2	1	0.33	12	61	0.15
195947	Shallow	Milagros A	10/18/15 5:47	6.47 S	130.18 W	13	0	2	0.00	4	56	0.08
195084	Shallow	Rosa F	10/29/15 6:01	9.55 S	104.28 W	1	5	0	0.83	6	28	0.07
195152	Shallow	Rosa F	11/3/15 11:53	8.02 S	101.10 W	0	0	1	0.00	12	75	0.00
195144	Shallow	Elizabeth F	11/4/15 6:11	7.10 S	103.35 W	3	7	0	0.70	13	44	0.25
194794	Shallow	Milena A.	11/9/15 10:05	3.20 S	103.95 W	8	4	0	0.33	15	35	0.14
195838	Shallow	Drennec	11/12/15 6:24	4.92 S	124.40 W	2	0	13	0.00	18	45	0.00

Summary of set and catch metrics for 30 sets by seven NIRSA vessels on normal and shallow depth DFADs

	Normal	Shallow		
Number of sets	16	14		
Range in set dates	7/16/2015 - 11/11/2015	7/19/2015 - 11/12/2015		
Range in set locations	7.54 S - 5.22 N	9.55 S - 5.37 N		
	90.77 - 129.35 W	81.08 - 130.18 W		
Average (range) number of days until set	90.7 (7.5 - 136.5)	80.8 (10.0 - 137.6)		
Average (range) SKJ catch (t)	7.2 (1 - 20)	7.3(0 - 20)		
Average (range) BET catch (t)	6.8 (0 - 38)	5.4 (0 - 35)		
Average (range) YFT catch (t)	1.0 (0 - 7)	2.3 (0 - 13)		
Average (range) total tuna catch (t)	15.0 (1 - 48)	15.0 (1 - 56)		
Average (range) proportion of BET	0.33 (0 - 0.80)	0.27 (0 - 0.83)		
Number DFADs active	39	32		

• ANOVA indicated there was no significant difference in the average daily drift speeds between the normal depth (0.80 kn; 0.41-1.18) and shallow depth (0.81 kn; 0.45-1.10) DFADs, for the first 60 days following deployments (F = 0.45, P = 0.50)

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- ANOVA indicated there was no significant difference in the estimated total tuna catch in successful sets on the normal depth (15.0 t; 1 48) and shallow depth (15.0 t; 1 56) DFADs (F = 0.00, P = 1.00)
- ANOVA on the proportions transformed to arcsine values indicated there was no significant difference in the proportion of BET caught in successful sets on the normal depth (0.33; 0 - 0.80) and shallow depth (0.27; 0 - 0.83) DFADs (F = 0.29, P = 0.60)

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- Also, the timing of this experiment is not optimal since it is occurring during anomalous oceanographic conditions, one of the strongest El Nino-Southern Oscillation (ENSO) events in history. This has caused some substantial changes in the physical oceanography of the equatorial EPO, including elevated surface and subsurface water temperatures, substantially deeper mixed layer and thermocline depths, and shifts in current patterns; which can influence BET behavior and habitat utilization.

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- A transition to ENSO-neutral is anticipated by summer 2016. It seems sensible to repeat this experiment, starting in January 2017, if NIRSA is willing to continue this collaboration under a similar agreement as the ongoing experiment. That should substantially increase the number of sets on shallow and normal depth DFADs and enable an appropriate statistical test of the null hypothesis under normal and abnormal oceanographic conditions in the equatorial EPO.