E EFFEC F E E
F DA A D AD E A
HORMONEÆ ON BMAL1, PER2]
AND C-FOÆ] EXPRESÆION IN RAT]
CA A D A DA A

+(,-(..(%/$,-)(

,-./-0102'-3'241'.-51,6578',5-,9':0'-8;18'
2-'<11':3':2':0;6,1<'24187/162:,'1331,2<='

#4181'47>1'?110'0-'<26;:1<'2472'1@7.:01;'
241'1331,2<'-3'<281<<'-0'A18B'1@/81<C
<:-0='(26;:1<'47>1'<4-D0'2472'A18E',70'?1'
87/:;5F':0;6,1;'60;18'<281<<365',-0;:C
2:-0<='G-8'24:<'817<-0H':2':<'/81;:,21;'
2472'A18B'1@/81<<:-0'D:55'?1'<281<<'70;'
10;-I10-6<')J%#'<10<:2:>1':0'17,4'81I:-0'
-3':02181<2='

*!"#$%*K'L.75E'D7<',4-<10'7<'7'I101'-3'
:02181<2'?1,76<1':2':<':0>-5>1;':0'241'
/-<:2:>1'2870<,8:/2:-0'5--/':0'241'.-51,C
6578',5-,9='+@/81<<:-0'/722180<'781'2F/:C
,755F'702:/47<:,'-3'A18BH';61'2-'241'
37,2'2472'241<1'2D-',5-,9'I101<'/782:,C
:/721':0',-./51.10278F'2870<,8:/2:-075M
2870<572:-075'7,2:>:2:1<'NG:I681'OP[EB]='Q1'
/81;:,2'2472'L.75E'1@/81<<:-0'D:55';:</57F'
/722180<'-3'-<,:5572:-0'2472'781':0'
-//-<:21'/47<1'-3'A18B=

_&'()_*K'')CG-<'D7<',4-<10'7<'7'/-<:2:>1'
,-028-5'?1,76<1':2',70'?1'62:5:R1;'7<'
7'?:-.78918'3-8',1556578'7,2:>:2F[BSHOT]='
U121,27?51'51>15<'-3',CG-<'D-65;':0;:,721'
2472'241',155'D7<'I1018755F'817,2:>1'2-'
<281<<[BS]=')CG-<'75<-';:</57F<'7',:8,7;:70'
/722180'-3'7,2:>72:-0H'D:24'51>15<'?1:0I'
4:I41<2';68:0I'241'70:.75V<'D791',F,51='
G-8'24:<'817<-0H',CG-<'1@/81<<:-0':0'241'
4://-,7./6<'70;'7.FI;757'<4-65;';:</57F'
4:I418'51>15<'72'W#EX'2470'W#Y='(281<<'
D:55'75<-'/8-./2'7'87/:;':0;6,2:-0'-3'
,CG-<=

Figure 3: Simplifed model of the mammalian mo'

Z-4',-,&".'*?%ZVM=%O,2*%@($(%4'7'4(4%
(7(-.5%'-2"%!"#$%4'!!($(-2%.'812[4,$A%
rooms as described in supplementary fgure
F=%/""4%,-4%@,2($%@($(%,7,'.,6.(%,4%
.'6'2#3=%D!2($%,$$'7,.%,2%21(%!,)'.'25?%
$,2*%@($(%8'7(-%:%@((A*%2"%,)).'3,2'U(%
2"%21('$%-(@%(-7'$"-3(-2=%%01(%,)).'3,<
2'"-%&($'"4%'*%7'2,.%!"$%(-*#$'-8%21,2%
,-5%4'*&.,5(4%*2$(**%(!!()2*%,$(%4#(%2"%
21(%(9&($'3(-2,.%2$(,23(-2%$,21($%21,-%,%
$(,)2'"-%2"%,%-"7(.%(-7'$"-3(-2=%D-'3,.*%
@($(%(21'),..5%2$(,2(4%,-4%21('$%%#*(%
'-%21'*%(9&($'3(-2%@,*%,&&$"7(4%65%21(%
\-'7($*'25%"!%G"."$,4"]*%Z-*2'2#2'"-,.%
D-'3,.%G,$(%,-4%*(%G"33'22((=

WXY

?60+#0@

D!2($%21(%:<@((A%,)).'3,2'"-%&($'"4?%
$,2*%@($(%8'7(-%('21($%,4$(-,.()2"<
3'(*%KDQRM%"$%)"-2$".%K^PDCM%*#$8($'(*=%
B"21%2$(,23(-2%8$"#&*%$()('7(4%6'.,2($,.%
&($'2"-(#3%'-)'*'"-*%'-%"$4($%2"%(9&"*(%
21(%,4$(-,.%8.,-4*=%Z-%21(%DQR%8$"#&?%
#6_()2]%,4$(-,.%8.,-4*%@($(%."),2(4%,-4%
$(3"7(4%#*'-8%'-2(*2'-,.%2'**#(%!"$)(&*=%
01(%^PDC%8$"#&%!".."@(4%21(%*,3(%&$")(4#$(%

E %

01(%$(*#.2*%!$"3%21(%DVHfD%,-,.5*'*%"!%
(,)1%8(-(%@'21'-%(,)1%OHZ%,$(%*#33,$'U(4%

DQR[L`]k%1"@(7($?%21,2%2$(-4%@,*%-"2%4'$()2.5%
"6*($7(4=%01($(%@,*%,%3,'-%(!!()2%"!%
2'3(%'-%GDF?%GDL%,-4%BED=%01(*(%$15213*%
,$(%)"-*'*2(4%@'21%&$(7'"#*.5%&#6.'*1(4%
$(*(,$)1%@'21%,4$(-,.%'-2,)2%,-'3,.*[LT]=

Although insignifcant, there was a
8(-($,.%2$(-4%"!%S0;%1,7'-8%1'81($%(9&$(*<
'"-%21,-%S0FTk%1"@(7($?%21'*%2$(-4%@,%
$(7($*(4%'-%*1,3%,-'3,.*%'-%GND=%01'*%
$(*#.2%'*%)"-*'*2(-2%@'21%"21($%(9&($'<
3(-2*%21,2%*1"@%>($:%3OVD%,-4%>NO:%&$"2('-%
.(7(.*%4'*&.,5%"&&"*'2(%$15213*%21,-%
BED%,-4%1'&&"),3&#*[L`?LT]=%Z-2($(*2'-8.5?%
@(%!"#-4%21,2%21'*%2'3(%"!%4,5%4'!!($<
(-)(%1,4%21(%"&&"*'2(%&,22($-%'-%DQR%$,2*?%
resulting in a signifcant time by adrenal
2,2#%'-2($,)2'"-=

/#2#$(%*2#4'(*%*1"#.4%(9,3'-(%21(%$".(%
4'!!($(-2%25&(*%"!%*2$(**"$*%&.,5%'-%>($:%
(9&$(**'"-=%O(*2$,'-2%*2$(**%,)2'7,2(*%
21(%P>D%,9'*?%3,A'-8%'2%,%8""4%),-4'<
4,2(%2"%*2#45%3'.4%*2$(**=%h1'.(%3'.4%
*2$(**%4'4%-"2%,.2($%>($:%(9&$(**'"-?%
4'!!($(-2%*2$(**%3"4(.*%3,5%5'(.4%4'**'3<
'.,$%$(*#.2*=%D%8""4%*2,$2'-8%&"'-2%@"#.4%
6(%-,.5U'-8%&$"."-8(4%,-4%$(&(,2(4%*2$(**%
6(),#*(%21(*(%)"-4'2'"-*%1,7(%6((-%*1"@-%
2"%3"4#.,2(%3,-5%&$")(**(*%21,2%,$(%#-4($%
)'$),4',-%)"-2$".[Li]=%

BCDEF

%

%%^2$(**%1,4%-"%(!!N)2%"-%BCDEF%(9&$(**'"-%
'-%1'&&"),3&#*%"$%,3584,.,=%01(%$(*#.2*%
show a signifcant time of day effect in
GDF%,-4%GDL%!"$%>($:%@'21%(9&$(**'"-%6('-8%
1'81($%,2%S0FT=%B3,.F%4'*&.,5(4%1'81($%
(9&$(**'"-%,2%S0;%'-%6"21%"!%21(*(%6$,'-%
$(8'"-*%,*%@(..%,*%BED=%01(%3".()#.,$%
).")A%3"4(.%*#88(*2*%21,2%>($:%(9&$(*<

VD0\ODE%^

EFFEC F C A B EAC AB DA CE FEED BE A A D AB A E F EE A C B E F F

C,4'*"-%^,-A"7'2U

!"#$%&''&()*+$),$-*$#./#012$%0&3$-$'&+#0$1)#/#4$5&0$%6''$2#.27$1'#-,#$8),)2$(((4"&*&0,9&60*-'4/&3*

AB AC

01(%j$(,2%B,$$'($%O((!%'*%,-%(92$(3(.5%)"3&.(9%()"*5*2(3?%1"3(%2"%3"$(%21,-%F?`aa% fsh species and countless other verte< 6$,2(*%,-4%'-7($2(6$,2(*=%G#$$(-2.5?%,% 3,**'7(%)"$,.%6.(,)1'-8%(7(-2%'*%"))#$$'-8% K21(%!"#$21%"!%21(*(%(7(-2*%*'-)(%FiidM?% @1')1%'*%A'..'-8%.'7(%)"$,.%,..%"7($%21(% $((!=%G"$,.%6.(,)1'-8%"))#$*%6(),#*(%"!% 8."6,.%).'3,2(%)1,-8(%,-4%*#6*(g#(-2% $'*'-8%")(,-%2(3&($,2#$(=%01(%&#$&"*(% "!%21'*%*2#45%@,*%2"%'-7(*2'8,2(%21(% g#(*2'"-%"!%1"@%)"$,.%6.(,)1'-8%,!!()2*% three sympatric butterfyfsh species, *Chaetodon auriga, Chaetodon ocellicaudus*?% ,-4%*Chaetodon plebeius*?%,2%P"$*(*1"(%O((!% ,-4%>,.!$(5%Z*.,-4%O((!?%6"21%."),2(4%"!!% 21(%)",*2%"!%E'U,$4%Z*.,-4?%D#*2$,.',=% 01(%&$'3,$5%15&"21(*'*%*2,2(*%21,2%)"$,.% bleaching has a negative effect on fsh ,6#-4,-)(%6(),#*(%'2%4()$(,*(*%21(%,3"#-2% of live coral for fsh to feed on and use ,*%*1(.2($=%01(%*()"-4%15&"21(*'*%*2,2(*% that omnivorous fsh, or generalists, will 6(%,6.(%2"%*#$7'7(%6(22($%'-%,%6.(,)1(4% environment than coralivorous fsh, or *&()',.'*2*=%/'*1%,6#-4,-)(%,-4%6(1,7'"$% 4,2,%@($(%)"..()2(4%#*'-8%,%7'*#,.%6(.2% 2$,-*()2%3(21"4%,-4%*#6*2$,2(%)"3&"*'2'"-% 4,2,%@($(%)"..()2(4%#*'-8%,%.'-(%2$,-*()2=% O(*#.2*%4'4%-"2%).(,$.5%*#&&"$2%('21($% 15&"21(*'*=%/"),.%*&()'(*%@($(%"7($,..% 3"$(%,6#-4,-2%,2%>,.!$(5%Z*.,-4%O((!?% @1')1%*1"@(4%21(%3"*2%)"$,.%6.(,)1'-8?%6#2% !"),.%*&()'(*%*&(-2%3"$(%2'3(%!((4'-8%,2% P"$*(*1"(%O((!%)"3&,$(4%2"%>,.!$(5%Z*.,-4% O((!=%Z-%,44'2'"-?%*L4$-60)*+-%K"3-'7"< $"#*%*&()'(*M%@,*%"6*($7(4%#2'.'U'-8%,% @'4($%7,$'(25%"!%3')$"1,6'2,2*%21,-%*L4$ ocellicaudus*%,-4%*L4$1'#H#)6,*%K)"$,.'7"< $"#*%*&()'(*M?%6#2%*L4$-60)*+-%@,*%-"2%3"$(% ,6#-4,-2%21,-%21(%"21($%$%!"),.%*&()'(*%,2% P"$*(*1"(%O((!%K21(%3"*2%6.(,)1(4%*'2(M%,*% &$(4')2(4=%D.21"#81%-"%*2$"-8%)"-).#*'"-*% were drawn from the fndings of this study, 21(%4,2,%,.."@%1#3,-*%2"%6(22($%#-4($*2,-4% 21(%6(1,7'"$%"!%"3-'7"$"#*(*%,-4%)"$,.'< 7"$(*%'-1,6'2,2*%6('-8%"7($)"3(%65%)"$,.% 6.(,)1'-8=%

D C

01(%j$(,2%B,$$'($%O((!%'*%"-(%"!%21(% .,$8(*2%,-4%3"*2%)"3&.(9%()"*5*2(3*%"-% the earth, housing more than 1,500 fsh *&()'(*?%!"*2($'-8%,%)"3&.(9%6'"4'7($<

B,$$'($%O((!?%'-%@1')1%21(%6'"4'7($*'25%
"!%21(%$((!%'*%#&1(.4%65%21(%'-2($)"-<
nected systems of fora and fauna working
'-%)"3&.(9%8'7(<,-4<2,A(%$(.,2'"-*1'&*=%
C,-5%"!%21(%$((!*%*#$$"#-4'-8%21(%'*.,-4%
,.*"%1,7(%6((-%,!!()2(4%65%21(%)#$$(-2%
)"$,.%6.(,)1'-8%(7(-2=%D%&$(7'"#*%*2#45%"-%
21(%(!!()2*%"!%)"$,.%6.(,)1'-8%"-%)"$,.%
habitats and associated fshes examined the
6$(,421%"!%*&()'(*%21,2%,$(%-(8,2'7(.5%
,!!()2(4%65%)"$,.%6.(,)1'-8%K>$,2)1(22%(2%
al., 2012). The research revealed that fsh
&()'(%21,2%4'$()2.5%!((4%"-%)"$,.%,$(%
3"*2%*2$"-8.5%,!!()2(4%65%)"$,.%6.(,)1'-8%
,-4%4'(%"!!%'-%21(%8$(,2(*2%-#36($*?%6#2%
even non-coralivorous fshes still depend
"-%21(%)"$,.%*2$#)2#$(%!"$%21('$%1,6'2,2%
,-4%21#*%21('$%&"&#.,2'"-%4()$(,*(*%!$"3%
)"$,.%6.(,)1'-8=%O((!%()"*5*2(3*%,$(%
so tightly interconnected that all fsh
&()'(%,$(%,!!()2(4%65%).'3,2(%)1,-8(?%
$'*'-8%")(,-%2(3&($,2#$(?%,-4%*#6*(g#(-2%
)"$,.%6.(,)1'-8%(7(-2*%K>$,2)1(22%(2%,.=?%
:aF:M=%

There were two identifed hypotheses
*#$$"#-4'-8%21(%g#(*2'"-%"!%1"@%)"$,.%
bleaching affects fsh abundance and
6(1,7'"$=%>"**'6.(%(9&.,-,2'"-*%$(7".7(%
,$"#-4%)"$,.%,*%,%1,6'2,2%,-4%3,_"$%!""4%
*"#$)(%'-,%$((!%()"*5*2(3=%01(%&$'3,$5%
15&"21(*'*%*2,2(*%21,2%)"$,.%6.(,)1'-8%1,*%
a negative effect on fsh abundance because
'2%4()$(,*(*%21(%,3"#-2%"!%.'7(%)"$,.%!"$%
fsh to feed on and use as shelter. Three
species of butterfyfsh were examined in
21'*%*2#45J%*Chaetodon auriga*?%*Chaetodon ocellicaudus*?%,-4%*Chaetodon plebeius*=%Z2%
'*%&$(4')2(4%21,2%,.%21$((%*&()'(*%"!%
butterfyfsh will be more abundant in reef
1,6'2,2*%21,2%,$(%.(**%6.(,)1(4%21,-%'-%
$((!%1,6'2,2*%21,2%,$(%*2$"-8.5%6.(,)1(4=%
In addition, it is predicted that fsh
!"#-4%'-%1'81.5%6.(,)1(4%,$(,*%@'..%6(%
"6*($7(4%*@'33'-8%3"$(%!$(g#(-2.5%21,-%
,)2'7(.5%(,2'-8?%,-4%7')(%7($*,%!"$%.(**%
6.(,)1(4%*'2(*=%D%&$(7'"#*%*2#45%(9,3'-'-8%
resource partitioning among butterfyfsh
&()'(%$(7(,.(4%21,2%6'2(%$,2(%'*%,%8""4%
'-4'),2"$%"!%!((4'-8%1,6'2%,-4%*@'33'-8%
'*%,%8""4%'-4'),2"$%"!%!"$,8'-8%KS(A($',%
(2%,.=?%:aa:M=%Z2%'*%,.*"%&$(4')2(4%21,2%

/'8#$(%F%4'*&.,5*%,%1'81($%"7($,..%,6#-<
dance of the three species on the reef fat
)"3&,$(4%2"%21(%$((!%)$(*2%,2%6"21%*'2(*=%

WXY%

%

B#"-8)&0

H6*($7,2'"-*%@($(%$()"$4(4%!"$%L:%*L4$ -60)*+-?%T%*L4$1'#H#)6,*?%,-4%:L%*L4$&/#'')D caudus*=%/'8#$(%:,%4'*&.,5*%21(%&($)(-2,8(% of time each fsh was observed swimming 4#$'-8%21(%21$((<%3'-#2(%"6*($7,2'"-% period. It shows that fsh spent 6.7% 8$(,2($%2'3(%*@'33'-8%,2%>,.!$(5%Z*.,-4% O((!%21,-%,2%P"$*(*1"(%O((!?%,-4%*L4$-60)*+-% *&(-2%21(%3"*2%2'3(%*@'33'-8%"#2%"!%,..% 21(%!"),.%*&()'(*=%/'8#$(%:6%4'*&.,5*%21(% percentage of time each fsh was observed #2'.'U'-8%*1(.2($%4#$'-8%21(%"6*($7,< tion period. It illustrates that fsh *&(-2%Fi=:r%3"$(%2'3(%#2'.'U'-8%*1(.2($% ,2%P"$*(*1"(%O((!%21,-%,2%>,.!$(5%Z*.,-4% O((4?%,-4%*L4$1'#H#)6,*%#2'.'U(4%*1(.2($%21(% 3"*2%"#2%"!%,..%21(%!"),.%*&()'(*=%/'8#$(% 2c shows the percentage of time each fsh @,*%"6*($7(4%!((4'-8%4#$'-8%21(%"6*($< vation period. It illustrates that fsh *&(-2%T=:r%3"$(%2'3(%!((4'-8%,2%P"$*(*1"(% O((!%21,-%,2%>,.!$(5%Z*.,-4%O((!?%,-4%*L4$ ocellicaudus*%*&(-2%21(%3"*2%2'3(%!((4'-8% "#2%"!%,..%21(%!"),.%*&()'(*=%/'8#$(%:4% displays the percentage of time each fsh was observed interacting with other fsh 4#$'-8%21(%"6*($7,2'"-%&($'"4=%Z2%*1"@*% that fsh spent 27.3% more time interacting with other fsh at Palfrey Island Reef 21,-%,2%P"$*(*1"(%O((!?%,-4%*L4$1'#H#)6,*% '-2($,)2(4%21(%3"*2%"#2%"!%,..%21(%!"),.% *&()'(*=%

*5)+60#$=4$<#0/#*2-+#$&%$2)3#$L4$-60)+-7$L4$1'#D beius, and C. ocellicaudus were observed (a) swimming, (b) utilizing shelter, (c) feeding, and (d) interacting with other fsh during the three-minute observation period at Horseshoe Reef and Palfrey Island Reef.*

0,6.(*%F%,-4%:%4'*&.,5%21(%3')$"1,6'<

?6H,20-2#

/'8#$(%L%4'*&.,5*%21(%,7($,8(%&($)(-2%
)"7($%"!%6(-21')%)"$,.%,-4%*#6*2$,2(%
"6*($7(4%,."-8%.'-(%2$,-*()2*%,2%P"$*(*1"(%
O((!%,-4%>,.!$(5%Z*.,-4%O((!=%^"!2%)"$,.%
@,*%3"*2%,6#-4,-2%,2%P"$*(*1"(%O((!?%
@1($(,*%$#66.(%@,*%21(%&$"3'-(-2%8$"#-4<
)"7($%,2%>,.!$(5%Z*.,-4%O((!=%D.21"#81%
*"!2%)"$,.%@,*%4"3'-,-2%"7($,..%,2%
P"$*(*1"(%O((!?%21($(%@,*%,%*.'812.5%
8$(,2($%,3"#-2%"!%1,$4%4(,4%)"$,.%21,-%
*"!2%)"$,.%"-%21(%$((!%)$(*2%,2%21'*%*'2(=%

WXY

D%2"2,.%"!%;`L%1,$4%)"$,.*%K::d%,2%
P"$*(*1"(%O((!%,-4%::`%,2%>,.!$(5%Z*.,-4%
O((!M%,-4%TL:%*"!2%)"$,.*%KLi`%,2%
P"$*(*1"(%O((!%,-4%:Lb%,2%>,.!$(5%Z*.,-4%
O((!M%@($(%"6*($7(4%,."-8%21(%.'-(%2$,-<
()2=%ib=ar%"!%1,$4%)"$,.%K/'8#$(%;,M%,-4%

CA A E D
A D E E CE

A D FFA E D
ED E F A A

D.(_,-4$,%>(4$,U,

!"#$%&''&()*+$),$-*$#./#012$%0&3$-$'&+#0$1)#/#4$5&0$%6''$2#.27$1'#-,#$8),)2$(((4"&*&0,9&60*-'4/&3*

EXECUTIVE SUMMARY

D-21$"&"8(-')%).'3,2(%)1,-8(%'*%2$,-*<
!"$3'-8%21(%-,2#$,.%(-7'$"-3(-2?%4'$()2.5%
#-4($3'-'-8%21(%@(..6('-8%"!%8."6,.%&"&#<
.,2'"-*%,-4%&.,)'-8%)"-*'4($,6.(%*2$(**%"-%
.'7(.'1""4%*5*2(3*=%Z-%4(7(."&'-8%)"#-<
2$'(*?%21(%&$"3'-(-)(%"!%).'3,2(<*(-*'2'7(%
()2"$*?%&$'3,$'.5%#6*'*2(-)(%!,$3'-8?%
&$"3"2(*%21(%)"-4'2'"-,.%$(.,2'"-*1'&%
6(2@((-%'-4'7'4#,.%.'7(.'1""4*%,-4%).'3,2(%
7,$',6'.'25=%

FPF<!Q?0)$R-*S*-%),$$'(4%"#2%,%#$7(5%
K^NDQ^M%(-)"3&,**'-8%$(*&"-*(*%!$"3%:`%
4'!!($(-2%)"33#-'2'(*%,-4%FF;d%1"#*(1".4*%
'-%21(%4$5%U"-(%"!%^$'%E,-A,=%01(%8",.%@,*%
2"%#-4($*2,-4%1"@%!,$3($*%,4_#*2%21('$%
!,$3'-8%&$,)2')(*%@1(-%21(5%(-)"#-2($%
)1,..(-8(*%,22$'6#2(4%2"%).'3,2(%)1,-8(=%%%%%
\2'.'U'-8%4,2,%)"..()2(4%!$"3%^NDQ^?%Z%
,-,.5U(4%,-4%'-2($&$(2(4%21(%$(.,2'"-<
ship between the fve types of capital,

C#.2'7,$',2(%O(8$(**'"-%C"4(.%F=%%

Adaptive Effcacy

The frst outcome variable I looked at
was Adaptive Effcacy. Adaptive Effcacy
$(!($*%2"%,%!,$3($]*%&($)('7(4%,6'.'25%2"%
"7($)"3(%&$"6.(3*%'-%)#.2'7,2'"-=%H7($,..?%
21(%4,2,%*1"@%21,2%,-%'-)$(,*(%'-%-,2#$,.?%
fnancial/physical, and social capital
increases a farmer’s adaptive effcacy. On
21(%"21($%1,-4?%1#3,-%),&'2,.%4"(*%-"2%
seem to have an infuence.

01(%&$(4')2"$%7,$',6.(%#*(4%2"%$(&$(*(-2%
-,2#$,.%),&'2,.%'*%*Perceived Environmental*
T6'#0-H)')2@*=%>($)('7(4%N-7'$"-3(-2,.%
f#.-($,6'.'25%$(!($*%2"%,%!,$3($]*%&($)(&<
2'"-%"!%21('$%5'(.4]*%7#.-($,6'.'25%2"%
(-7'$"-3(-2,.%21$(,2*=%01'*%7,$',6.(%@,*%
),2(8"$'U(4%,*%&,$2%"!%-,2#$,.%),&'2,.%
6(),#*(%,%!,$3($]*%(-7'$"-3(-2,.%7#.-($<
,6'.'25%'*%)."*(.5%2'(4%2"%21(%,7,'.<
,6'.'25%"!%-,2#$,.%$(*"#$)(*=%/"$%(9,3&.(?%
as actual rainfall conficts with expected
$,'-!,..?%,%!,$3($%3,5%!((.%21,2%1'*%5'(.4%
'*%21$(,2(-(4%65%,%.,)A%"!%@,2($%,-4%@'..%
*((A%,-%,.2($-,2'7(%@,5%2"%*()#$(%(-"#81%
@,2($%!"$%1'*%)#.2'7,2'"-=%D*%,%!,$3($%
6()"3(*%3"$(%,@,$(%"!%)1,-8'-8%(-7'$"-<
3(-2,.%)"-4'2'"-*?%1'*%-,2#$,.%),&'2,.%
'-)$(,*(*=%Q,2,%!$"3%35%,-,.5*'*%*1"@%21,2%
,*%,%!,$3($%!((.*%3"$(%7#.-($,6.(?%21('$%
adaptive effcacy increases. An explana<
2'"-%!"$%21'*%$(.,2'"-*1'&%),-%6(%21,2%,%
!,$3($%@1"%!((.*%(*&()',..5%7#.-($,6.(%'*%
3"$(%.'A(.5%2"%*((A%1(.&%"$%'-!"$3,2'"-%
2"%4()$(,*(%1'*%"$%1($%7#.-($,6'.'25=%B5%
6()"3'-8%3"$(%'-!"$3(4?%,-4%21($(!"$(%3"$(%
&$(&,$(4?%,%!,$3($%),-%"$(*((%)1,..(-8(*%
,-4%,44$(**%21(3%(,$.5%"-?%21#*%6#'.4'-8%
his adaptive effcacy.

A#')-/#$&*$O-/")*#0@*%'*%'-4'),2'7(%"!%
fnancial/physical capital and refers to
21(%4'7($*'25%"!%(g#'&3(-2%,%!,$3($%1(.4=%
>"2(-2',.%(9,3&.(*%'-).#4(%,%2$,)2"$?%
*&$,5($?%@,2($%&#3&?%)"36'-(%1,$7(*2($?%
,-4%@,2($%6#!!,."=%Z-%^$'%E,-A,?%1,7'-8%
,))(**%2"%*#)1%(g#'&3(-2%'*%,%*536".%"!%
()"-"3')%@(,.21=%%/,$3($*%21,2%1,7(%,))(**%
2"%,%4'7($*(%$,-8(%"!%3,)1'-($5%,-4%'-!$,<
*2$#)2#$(%,$(%6(22($%,6.(%2"%,4,&2%2"%
).'3,2(%)1,..(-8(*=%/"$%(9,3&.(?%,%@,2($%
&#3&%),-%6(%*&()',..5%1(.&!#.%@1(-%21($(%
'*%.'22.(%$,'-!,..%,-4%@,2($%3#*2%6(%
'$$'8,2(4%!$"3%,%!,$%4'*2,-)(=%Z-%21'*%
)(-,$'"?%!,$3($%@'21%,))(**%2"%(*2,6<
.'*1(4%'$$'8,2'"-%'-!$,*2$#)2#$(%@"#.4%6(%
6(22($%,6.(%2"%,4,&2%2"%4$"#812%21,-%21"*(%
who do n

")',.%),&'2,.%((3%2"%6(%21(%.,$8(*2%
)"-2$'6#2"$*%2"%&$"3"2'-8%,4,&2'7(%
6(1,7'"$%,3"-8%^$'%E,-A,-%!,$3($*=%B"21%
fnancial and social capital create buffers
21,2%&$(7(-2%,%!,$3($%!$"3%(9&($'(-)'-8%
21(%*1"$2)"3'-8*%,**")',2(4%@'21%2$5'-8%
*"3(21'-8%-(@%"$%4'!!($(-2%!$"3%21(%(*2,6<
.'*1(4%-"$3=%01#*?%,%!,$3($%@1"%1,*%.,$8(%
quantities of fnancial/physical and social
),&'2,.%@'..%6(%6(22($%,6.(%2"%4(7(."&%
).'3,2(%$(*'.'(-)(%,-4%,44$(**%21(%)1,.<
.(-8(*%,**")',2(4%@'21%).'3,2(%)1,-8(=%%

Research Question 2: Capital and Sustainable Livelihood Outcomes$

01(%*()"-4%8",.%"!%35%*2,2'*2'),.%
,-,.5*'*%@,*%2"%*1(4%.'812%"-%21(%$(.,<
2'"-*1'&%6(2@((-%),&'2,.%,-4%*#*2,'-,6.(%
.'7(.'1""4%"#2)"3(*=%01$"#81%35%,-,.5*'*?%
Z%@,-2(4%2"%#-4($*2,-4%1"@%),&'2,.%
)"-2$'6#2(4%2"%,%!,$3($%*()#$'-8%"#2)"3(*%
21,2%&$"3"2(4%,%*#*2,'-,6.(%.'7(.'<
1""4=%C5%,-,.5*'*%4$,@*%!$"3%C#.2'7,$',2(%
O(8$(**'"-%C"4(.%:?%4'*&.,5(4%'-%21(%
O(*#.2*%*()2'"-%"!%21'*%4")#3(-2=%01(%!"#$%
*#*2,'-,6.(%.'7(.'1""4%"#2)"3(*%Z%*2#4'(4%
,$(%()"-"3')%@(.!,$(?%-#2$'2'"-?%1(,.21?%
,-4%1,&&'-(**=%%

K/&&3)/$N#'%-0#%*

D-%'3&"$2,-2%"#2)"3(%"!%,%*#*2,'-,6.(%
.'7(.'1""4%'*%()"-"3')%@(.!,$(=%0"%,-,.5U(%
()"-"3')%@(.!,$(?%Z%.""A(4%,2%2@"%"#2)"3(%
7,$',6.(*J%C,1,%n'(.4*%,-4%Q(62=%P'81($%
C,1,%5'(.4*%*#&&"$2*%()"-"3')%@(.!,$(?%6#2%
4(62%)"3&.(2(.5%4(2($'"$,2(*%'2=
%

WXY%

H7($,..?%C,1,%5'(.4*%@($(%4(&(-4(-2%"-%
fnancial and social capital. R*#')-*/#$*
on Machinery, Hired Help, Wealth 2 ₴ ₭ À

,-4%2$#*2%"!%)"33#-'25<6,*(4%"$8,-'U,<
2'"-*%KC'-,3"2"?%:aFaM=%C"*2%-,2'"-,.%,-4%
'-2($-,2'"-,.%,'4%8$"#&*%!")#*%"-%)$(,2'-8%
fnancial capital by trying to increase
5'(.4*%,-4%*,7'-8*?%6#2%21(%)$(,2'"-%"!%
*")',.%),&'2,.%3,5%$(g#'$(%(7(-%!(@($%
$(*"#$)(*%,-4%6(%_#*2%,*%7,.#,6.(=%%
^$'%E,-A,%'*%*2'..%$()"7($'-8%!$"3%21(%
'3&,)2*%"!%'2*%$()(-2%)'7'.%@,$?%*"%*")',.%
),&'2,.%3,5%-"2%6(%,2%'2*%&(,A%*'3&.5%
6(),#*(%21(%.(8,)5%@,$%.(,7(*%6(1'-4%2(-4*%
2"%6(%(92(-*'7(=%D.*"?%21"*(%'3&,)2(4%21(%
3"*2%65%21(%@,$%@($(%&("&.(%'-%21(%4$5%
U"-(?%35%*2#45%8$"#&=%D*%*#)1?%,%4'!!($(-2%
,&&$",)1%2"%*")',.%),&'2,.%3,5%6(%-()(*<
,$5=%O(*(,$)1%'-4'),2(%21,2%$,21($%21,-%
!")#*'-8%"-%(-8'-(($'-8%*")',.%),&'2,.?%
(92($-,.%,8(-)'(*%-((4%2"%!")#*%"-%6(22($%
#-4($*2,-4'-8%21(%&$()"-4'2'"-*%!"$%

E AC
E E A
C

A BEA F A A

0"$$'%j.,4(3

!"#$%&''&()*+$),$-*$#./#012$%0&3$-$'&+#0$1)#/#4$5&0$%6''$2#.27$1'#-,#$8),)2$(((4"&*&0,9&60*-'4/&3*

AB AC

Z-%:aF;?%G"."$,4"%>,$A*%l%h'.4.'!(% (-,)2(4%,%3#.2'<&$"-8(4%*2$,2(85%@'21% 21(%'-2(-2'"-%"!%3'2'8,2'-8%21$(,2*%2"% 21(%3#.(%4(($%&"&#.,2'"-=%01'*%*&()'(*% 1,*%4().'-(4%'-%$()(-2%4(),4(*%,)$"**% 21(%*2,2(%"!%G"."$,4"=%f,$'"#*%&#6.')% 3((2'-8*%&$"7'4(4%'-&#2%21,2%&$(4,2'"-%,-4% 4(8$,4(4%1,6'2,2%@($(%*"3(%"!%21(%3"*2% '3&"$2,-2%!,)2"$*%2"%3'2'8,2(=%Z-%:aFT?% G>h%,22(3&2(4%2"%4"%_#*2%21,2%@'21%21(% >')(,-)(%B,*'-%&$(4,2"$%)"-2$".%*2#45=% Z-%21'*%*2#45?%6.,)A%6(,$*%,$(%'-).#4(4% ,*%,%&$(4,2"$%*&()'(*%2"%6(%$(3"7(4%!$"3% 21(%4(*'8-,2(4%,$(,%2"%4(2($3'-(%'!%3#.(% 4(($%&"&#.,2'"-*%$(*&"-4%&"*'2'7(.5=%01'*%),*(]*%'**#(*?%1"@(7($?%,$(%21,2%21(%&$'"$% &#6.')%3((2'-8*%@($(%"7($@1(.3'-8.5%1(.4% '-%$#$,.%&.,)(*?%,-4%8,$-($(4%.'22.(%'-&#2% !$"3%#$6,-%$(*'4(-2*=%G"#&.'-8%21'*%'**#(% @'21%G>h]*%*()"-4%*2$,2(85%8",.%"!%3'2'< 8,2'-8%4(7(."&3(-2,.%'3&,)2*%1,*%.(!2%'2% "-%21(%4(!(-*(=%01'*%'*%6(),#*(%3,-5%$(*'< 4(-2*?%,*%(9&$(**(4%'-%3((2'-8*%,*%@(..% ,*%35%*2#45?%!(.2%21,2%(-($85%4(7(."&< 3(-2%4(*2$"5(4%7,.#,6.(%3#.(%4(($%1,6'2,2=% ^'-)(%21(%,8(-)5]*%$(*(,$)1%1,*%*#88(*2(4% "21($@'*(?%35%8",.%'*%-"2%2"%4'*&#2(%21'*% 6#2%$,21($%?%g#(*2'"-%21(%.,)A%"!%1"."'*2')% $(*(,$)1%'-%21(%1(,7'.5%4(7(."&(4%&%$(4,2"$%)"-2$".%,$(,=%C"*2%$(*'4(-2*%.'A(%6.,)A% 6(,$*?%,-4%21(%(!!()2*%"!%(-($85%4(7(.< "&3(-2%"-%21'*%*&()'(*%1,*%-"2%6((-% (9&."$(4=%C5%&,&($%1,*%&$"7'4(4%,%*".#2'"-% 21,2%3(4',2(*%*"3(%"!%21(%3"*2%)"-2(-< 2'"#*%'**#(*=%Z2%'-7".7(*%,-(@.5%&$"&"*(4% !#-4%!"$%&$(4,2"$%*(,$)1=%B5%)"-4#)2'-8% ,%*#$7(5?%Z%4(2($3'-(4%21,2%&#6.')%$()(&< 2'7'25%2"%,44'2'"-,.%@'.4.'!(%!#-4'-8%

(9'*2*%,-4%21($(%,$(%"&2'"-*%2"%&#$*#(%'2= %

WXY%

E

C5%*#$7(5%8(-($,2(4%iT%$(*&"-*(*% 2"2,.=%^'-)(%Z%@,*%&$'3,$'.5%)"-)($-(4% @'21%G"."$,4,-%*2,A(1".4($*?%1"@(7($?%Z% fltered out responses from non-residents. 01'*%.(!2%3(%@'21%b`%$(*&"-*(*%2"%!#..5% ,-,.5U(=%H7($,..?%Z%$()('7(4%$(*&"-*(*% !$"3%:b%2"@-*%"$%)'2'(*?%*#33,$'U(4%'-% /'8#$(%`%6(."@=

Figure 5. When participants' information was categorized by place of residence, it was clear that respondents to this survey typically residD ed in urban areas along the Front Range. BoulD der, Denver, and Lakewood accounted for 48% of 2"#$0#,1&*,#,4$F3&+,2$2"#$0#3-)*)*+$0#,1&*,#,7$ a divernp oMɖҐᵁMҰ˙ ĂҐᴱM*

21(5%)"#.4%-"2%6(%#*(4%2"%(*2'3,2(%,%2$#(%
$(&$(*(-2,2'"-%"!%21(%$#$,.%&"&#.,2'"-%"!%
G"."$,4"]*%"&'-'"-*%6(),#*(%35%*,3&.(%*'U(%
was too small to create valuable confdence
'-2($7,.*=%D."-8%@'21%21'*?%,%&"$2'"-%"!%

"21($%,*&()2*%"!%!#-4'-8?%6(),#*(%21($(%
3,5%6(%,7,'.,6.(%*".#2'"-*%#-'g#(%!$"3%
35%&$"&"*,.?%6#2%21,2%,))"3&.'*1%*'3'.,$%
8",.*=%

C5%*".#2'"-%@,*%,-%,22(3&2%2"%&$"7'4(%,%
3"$(%&,.,2,6.(%,-*@($%2"%21(%7,*2%-#36($%