

(VWLPDWLRQ RI \*URXS 6LJH \$JH DQG 6H[ &RPS WKH 6HJXU 3ODWHDX 1LOJLUL %LRVSKHUH 5H

0DQRM %RRQ \$ODZGQ6WDOLQ 9HGDPDQLFNDP

)RUH&RVOOHJHSHDQDUFK ,QVWLWXWH 71\$8 0HWWXSDOD\DP 7DPLO 1DGX ,QGLD

0DGUDV 9HWHULQDU\ &ROOHJH 7\$189\$6 &KHQQDL 7DPLO 1DGX ,QGLD

&RUUHVSRRGLQ%RQVWROZLQ 0DGUDV 9HWHULQDU\ &ROOHJH 7\$189\$6 &KHQQDL 7DPLO 1DGX #Q6DD 07H

5HFHLYHG GDWH \$XØHSWHG GDWH 6HS 3XEOLVKHG GDWH 6HS

&RSULJKW 0DQRM . HW DO 7KLV LV DQ RSHQ DFFHV DUWLFOH GLVWULEXWHG XQGHU WKH WHUPV RI XVH GLVWULEXWLRQ DQG UHSURGXFWRQ LQ DQ\ PHGLXP SURYLGHG WKH RULJLQDO DXWKRU DQG VRXU

\$EVWUDFW  
6HJXU3ODWHDX LV SDUW RI 0XGXP0DOL 7LJHU 5HVHUYH WKH 6HJXU 3ODWHDX LV SDUW RI WKH 1LOJLUL %LRVSKHUH 5HVHUYH 7KH VDQFWXDU\ LV ORFDWHG LQ WKH :HVW KRWVSRWV RI WKH ZRUOG 7KLV VWXG\ ZDV FRQGXFWHG WR GHWHUPLQH WKH SRS GHQVLW\ RI GLIIHUHQW SRWHQWLDO SUH\ VSHFLHV LQ WKH VHJXU 3ODWHDX ,Q RU WKH OLQH WUDQVHFV VDPSOLQJ PHWKRG ZHUH XVHG ZKHU FKHWDQD LQGLYLGXDO JDXU EODFN QDSSHG KDUH HOHSDQW DQG ZLOG SLJ 7KH WR RWKHU KHUELYRUHV 7KH PHDQ JURXS VLJH RI EODFN QDSSHG KDUH HOHS ZLOG SLJ ZHUH FDOFXODWHG UHVSHFWLYHO\ \$JH FRPSRVLWLRQ ZDV DOVR UDQJH EHWZHHQ WR ZHUH UHFRUGHG DQG HOHSDQW WR JDXU WR VD SLJ WR 7KH VH\ UDWLR IRU HOHSDQW JDXU VDPEU FKLW LQGHWHUPLQDWH IRU ZLOG SLJV DQG EODFN QDSSHG KDUHV GXH WR IDVW PRY EHKDYLRXU

.HIZRUGVH3VSHFLHV \*URXS VLJH &RPSRVLWLRQDOV UDQJH R0HWKRGV

,QWURGXFWRQ 6WXG\ DUHD

\$QLPDOV LQ JURXS DUH WKRXJKW WR KHJHU 3ODWHDX LV SDUW RI WKH 6HJXU 3ODWHDX LV SDUW RI WKH 1LOJLUL %LRVSKHUH 5HVHUYH 7KH VDQFWXDU\ LV ORFDWHG LQ WKH :HVW KRWVSRWV RI WKH ZRUOG 7KLV VWXG\ ZDV FRQGXFWHG WR GHWHUPLQH WKH SRS GHQVLW\ RI GLIIHUHQW SRWHQWLDO SUH\ VSHFLHV LQ WKH VHJXU 3ODWHDX ,Q RU WKH OLQH WUDQVHFV VDPSOLQJ PHWKRG ZHUH XVHG ZKHU FKHWDQD LQGLYLGXDO JDXU EODFN QDSSHG KDUH HOHSDQW DQG ZLOG SLJ 7KH WR RWKHU KHUELYRUHV 7KH PHDQ JURXS VLJH RI EODFN QDSSHG KDUH HOHS ZLOG SLJ ZHUH FDOFXODWHG UHVSHFWLYHO\ \$JH FRPSRVLWLRQ ZDV DOVR UDQJH EHWZHHQ WR ZHUH UHFRUGHG DQG HOHSDQW WR JDXU WR VD SLJ WR 7KH VH\ UDWLR IRU HOHSDQW JDXU VDPEU FKLW LQGHWHUPLQDWH IRU ZLOG SLJV DQG EODFN QDSSHG KDUHV GXH WR IDVW PRY EHKDYLRXU

,Q WKL V VWXG\ WKH DJH RI IHPDOH VSRWWHG GHU ZDV FDWHJRULJHG DV  
IROORZV IXOO JURZQ ! NJ DV DGXOWV ZKLOH NJ DV VXE DGXOWV  
PDOH VSRWWHG DGXOWV ! IHHW DQWOHUV DQG VXE  
DGXOW VSLNH DQG IHHW DQWOHUV )DZQV ZHUH FRQVLGHUHG LI WKH VLJH ZD  
HTXDO WR WKH KHLJKW RI WKH FDVWUJWGEHO\ %DUNLQJ GHU ZHUH  
LQWR PDOHV DGXOWV ZLWK DQWOHUV KDYLQJ D VKRUW EURZ OLQH SURWUXGH  
XSSHU FDQLQHV ZKHQHYHU SRVVLEOH ! NJ DQG VXE DGXOWV RI  
DSSUR[LPDWHO\ NJ IHPDOHV DGXOWV ZKLFK ZHUH DQWOHUOHVV ! NJ  
DQG VXE DGXOW ZKLFK ZHUH DQWOHUOHVV RI DSSUR[LPDWHO\ NJ DQG  
IDZQV VRPHWLPHV ZLWK VSRWWHG FRDW DQG DSSUR[LPDWHO\ NJ \*DXUV  
ZHUH FDVWLQW DGXOW PDOHV VKLQ\ EODFN FRDW ZLWK KHDY\ KRUQV  
VZHSLQJ VLGHZD\V DQG XSZDUGV VXE DGXOW PDOHV GDUN EURZQ FRDW  
ZLWK D FRQVSLFXRXV GRUVDU ULGJH DQG VPDOO GHZODS KDQLQJ EHZ WKH  
FKLQ ODUJH GUDSHV EHWZHHQ WKH IRUH OHJV \HDUOLQJV PRQWKV ROG  
DGXOW IHPDOHV VPDOOHU WKDQ DGXOW PDOHV SHODJH LV GDUN EURZQ ZLWK  
PRUH XSULJKW KRUQV FRUUXJDWHG LQZDUGV WKDQ LQ DGXOW PDOHV VXE DGXOW  
IHPDOHV VLJH RI DGXOW IHPDOH ODFNLQJ D FRQVSLFXRXV ZKLWH  
VWRFNLQJ IHPDOH \HDUOLQJV OLJKW EURZQ FRDW ZKLFK ZHUH WR  
SHUFHQW VLJH RI VXE DGXOW IHPDOHV VPDOO FDOYHV OLJKW EURZQ FRORXUH  
FRDW DSSUR[LPDWHO\ PRQWKV ROG RI NJ PHGLXP FDOYHV OLJKW

DGXOW a DQG MXYHQLOH XQFODVVE DQG HV DQG  
WKH ODUJH JURXS VLJH ZDV REVHUYHG LQ FRQJUHVV PDWWDP DUHD 7DEOH

5DWLR	%ODFN QDSSH KDUH	GOHSDQW XU6DPEDU &KLW	LOG SLJ
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\$GXOW ODOH

\$GXOW )HPDOH

6XE \$GXOW  
ODOH

6XE \$GXOW  
)HPDOH

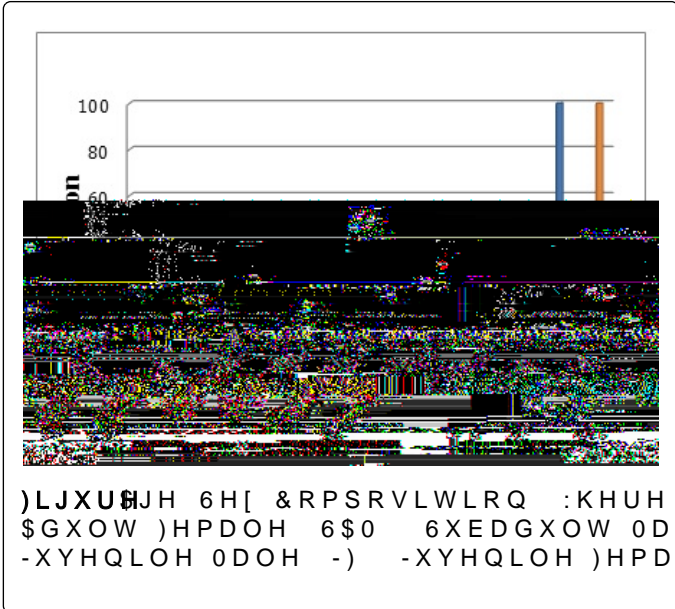
-XYHQLOH PDOH

-XYHQLOH  
IHPDOH

&DOI )DZQ

8QFODVVLILHG

RYHUDOO IHPDOH FDOYH UDWLR IRU HOHSDQW LQ VHJXU SODWHX ZDV ZKLFK  
LV VLPLODU WR LQ 5DMDML ORZHU WKDQ 8WWDU 3UDGHVK a  
\*DLRID > @ /DKXJDOD <DOD > @



)LJXU\$JH 6H[ &RPSRVLWLRQ :KHUH \$0 \$GXOW ODOH \$)  
\$GXOW )HPDOH 6\$0 6XEDGXOW ODOH 6\$) 6XEDGXOW )HPDOH -0  
-XYHQLOH ODOH -) -XYHQLOH )HPDOH

H W\SLFDO JURXS LQ JDXU FRQVLVWV RI FRZV DQG IHZ FDOYHV RQH WR WZR  
DGXOW EXOOV DQGURXS DGHOWDQJHG IURP WR LQ  
0XGXPDDL WR LQ 3HQFKH UMRXOWLQDQD > @  
OLNHO\ WR EHHKHJWLLPDWHG PHDQ JURXS VLJH RI JDXU LQ  
VHJXU SODWHDX ZDV ZKLFK LV VLPLODU WR .DQD s > @  
1DJDUDKROH H WDUJHVW JURXS RI JDXU FRPSULVLQJ  
LQGLYLGXDOV ZDV UHFRUGHG LQ VHJXU SODWHDX 0RUH WKDQ JDXU  
LQGLYLGXODV ZHUH REVHUYHG SULQWLRQDQJULRQV @

2 @10

G C O E O T V E O S Y O X ' N S H B H D Y O L R U D Q G H F R O R J \ R I W K H \$ V L D W L F P H O H S K D Q W Q L Q € B N C D ' b . D @  
V R X W K H D V W H U Q & H \ O R Q 6 P L W K V R Q & R Q W U L E = R R O  
' D Q L H O H D & \$ 6 L Y D J D Q H D D Q V K N K P D U H 6 W X G \  
R I 6 R P H ( Q G D Q J H U H G 6 S H L L H D V E R W H L V G L O L H D Q G  
( O H S K D Q W 1 D W + L V W 6 R F  
9 D Q 2 U V G R O . \* / L R Q S U H G D W L R Q L Q 5 Z H Q J R U L 1 D W L R Q D O 3 D U N  
8 J D Q G D  
6 X N X B D U \$ D L H V @ A € ` 2 D A ` 2 D W Q ) 0 @ P ` 2 D L O r \$ V L G R I Q I ` 5 D ` R P R G D V 5 D @ ` A