4ABLE

$ETAILS OF ECHOSOUNDER RESEARCH CRUISES AND OF THE DATA COLLECTED FROM THESE CRUISES FROM n FO
ECHOGRAM MEASUREMENTS AND SPECIES ABUNDANCE #ODES FOR AGENCIES .-&3 .ATIONAL -ARINE &ISHERIES 3ERVIC
.EW :EALAND .ATIONAL)NSTITUTE OF 7ATER AND !TMOSPHERE $&/ #ANADIAN $EPARTMENT OF &ISHERIES AND /CEANS
FROM 14# 1UESTER 4ANGENT #ORPORATION 3IDNEY "RITISH #OLUMBIA #ANADA 2EFERENCE DEPTH IS THE DEPTH F
WERE CORRECTED 3TACKS ARE GROUPS OF IVE ECHOES OR ACOUSTIC RETURNS THAT WERE SUMMED TOGETHER FOR AN
VALUES OUT OF A POSSIBLE THAT CAUSED THE VARIANCE COVARIANCE MATRIX DETERMINANT IN A PRINCIPAL COMPO

6ESSEL	9EAR	,OCATION	%CHO !GENCY	3AMPLING SOUNDER	14# K(Z	14# 6)%7 (Z	2EFERENCE)-0!#4 VERS	$EPTH DEPTH VERS	RANGE M	.UMBER OF FULLY COLLIN M	ECHOG 3TA
&6 *Di^af^qlo*		'ULF OF !LASKA	.-&3	3IMRAD			NONE			n	
&6 *Di^af^qlo*		'ULF OF !LASKA	.-&3	3IMRAD			NONE			n	
26 *Obplirqflk*		'ULF OF !LASKA	!$&'	"IOSONICS						n	
26 *O^kdfqef*		.EW :EALAND	.)7!	3IMRAD %! 0				n			
26 *Mþ /] 6O▲0*		*FK^kaÎų KJCP P◦*									

CALLY INCREASED TO n D" !NOTHER CONVENIENCE OF THE 14# SOFTWARE WAS THAT ABNORMALLY WEAK ECHOES COULD BE ELIMINATED BY SPECIFYING A MINIMAL SIGNAL STRENGTH AND THIS WAS SET TO BE EQUAL TO OF THE MAXIMUM PERMISSIBLE AMOUNT D"

"OTTOM PICKS

!FTER IMPORTING THE RECORDED ECHOES INTO THE SOFTWARE AT AN APPROPRIATE GAIN SETTING ANOTHER METHOD FOR FURTHER IMPROVING THE SIGNAL TO NOISE RATIO WOULD BE TO ASSEMBLE A STACK OF SUCCESSIVE ECHOES PRESUMABLY FROM THE SAME SUBSTRATE AND AVERAGE THE ECHO STACK INTO A SINGLE ECHO 0ACE AND #EEN &OR 14#)-0 A SIM 6@T A@# A 0EE A P 00T@

AND SEAmOOR SLOPES WERE KNOWN 2OOPER AND :IMMER MANN

!SSUMPTION SCALE OF MEASUREMENTS

!LTHOUGH AS A GROUP THE %-S RANGED BETWEEN ZERO AND ONE ,EGENDRE ET AL THIS WAS TESTED FOR EACH OF THE %-S AND %-S FULLY EXTENDING ACROSS THIS RANGE WOULD INDICATE THAT THE DATA HAD BEEN STANDARD IZED FOR PROPER 0#! -ANLY ,EGENDRE AND ,EGEN DRE 0#! WAS ALSO CONDUCTED 3 0LUS VERS)NSIGHTFUL #ORP 3EATTLE 7! INDEPENDENTLY TO ENSURE THAT THE 14# 0#! RESULTS COULD BE REPRODUCED

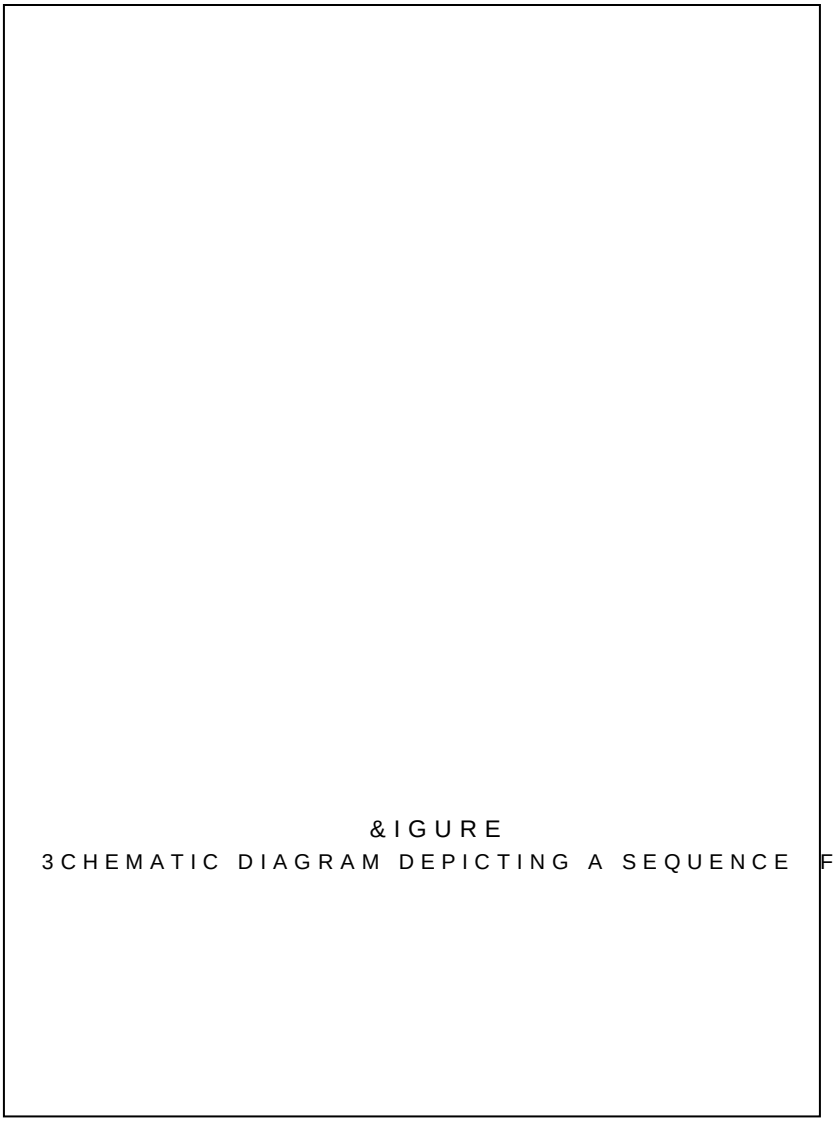
!SSUMPTION TWO FIRST ECHO

!LTHOUGH IT IS WIDELY REPORTED OR IMPLIED IN THE LIT ERATURE THAT 14#)-0!#4 SOFTWARE ANALYZES ONLY THE IRST ECHO THAT CONCLUSION IS NOT STRICTLY CORRECT 14#)-0!#4 ANALYZES THE IRST SOUND SAMPLES BENEATH THE BOTTOM PICK AND IT IS UP TO THE USER TO ENSURE THAT THIS IS A MEANINGFUL WINDOW 4HE RELATIONSHIP BETWEEN THE SAMPLES AND THE ANALYSIS DEPTH RANGE IS DIRECTLY RELATED TO HALF OF THE SAMPLE INTERVAL PRESET IN THE ECHOSOUNDER

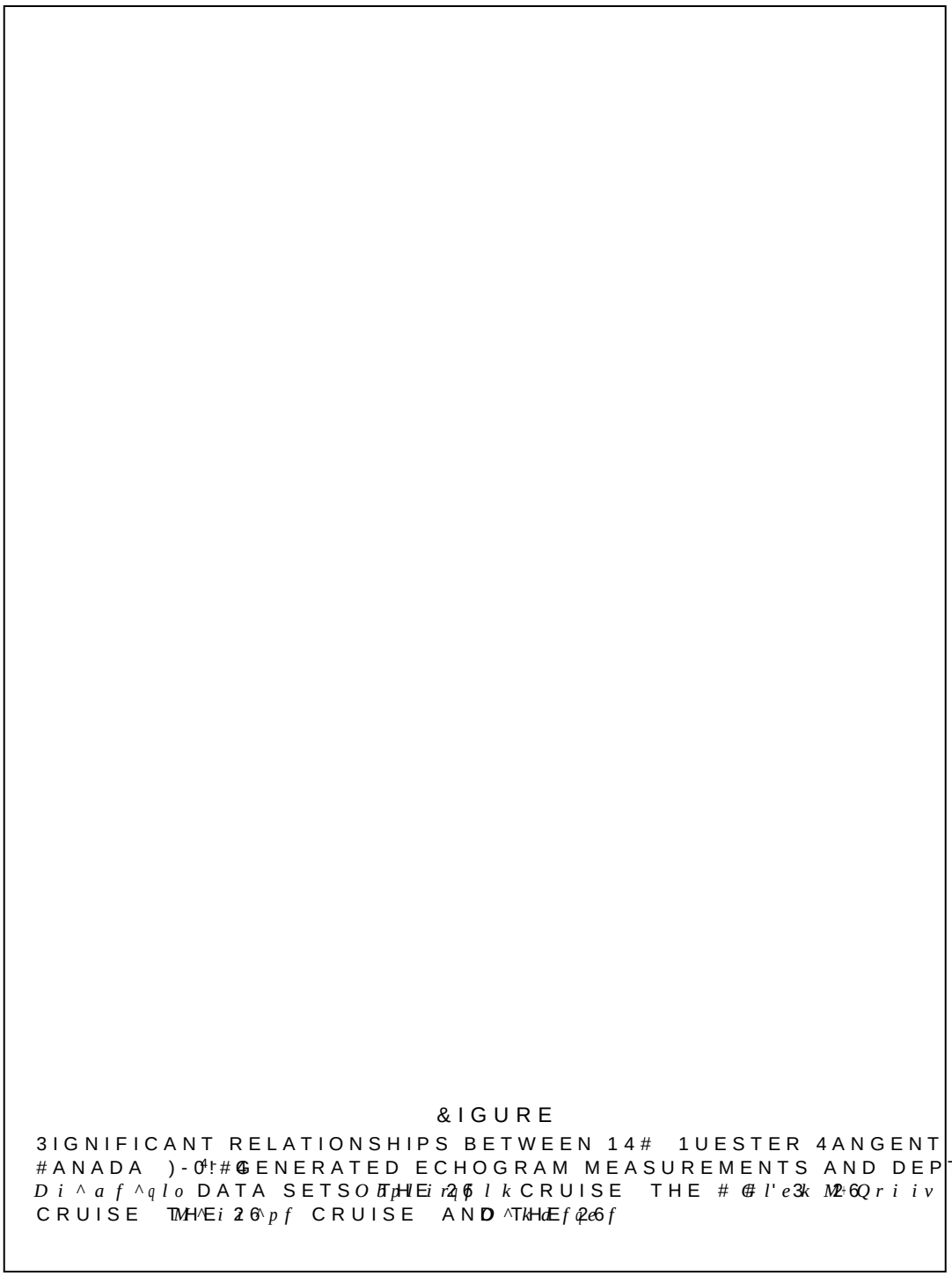
%-S IN EACH OF THE THIRD %-S n %AND #HERE %-S AND ˆNEVER VARI
n GROUPS THERE WERE ORIGINALLY %-S GROUPED AND IT IS PR
INTO SUCCEEDING SUMS WITH THE THESE %-S THE SAME THREE THAT ,EGEN
THE THIRD GROUP AND %- IN THE FOURTH GROUP WERE OBTAINED FROM ONE !DDITIO
THE SUM OF THE WHOLE GROUP &IG FROM THE THIRD GROUPISE DATA WERE AL
%- WHICH WAS ALWAYS WAS CREATED BY THE SUM
OF %- AND %- WHICH ARE COMPLEMENTS TO EACH
OTHER AND THEREFORE ARE ENTIRELY DEPENDENT

6ARIABILITY AND COVARIANCE OF ECHOGRAM MEASUREMENTS

4HERE WERE SEVERAL UNUSUAL OBSERVATIONS OF VARIANCE
OR COVARIANCE AMONG THE 14#)-0!#4 GENERATED



&IGURE
3CHEMATIC DIAGRAM DEPICTING A SEQUENCE FROM LEFT TO RIGHT OF



&IGURE
3IGNIFICANT RELATIONSHIPS BETWEEN 14# 1UESTER 4ANGENT #ORPORATION 3
#ANADA)-0!#4 GENERATED ECHOGRAM MEASUREMENTS AND DEPTH FOR THE SHAL
Di^af^qlo DATA SETS OF THE *ir26lk* CRUISE THE *#@l'e3k M26Qriiv*
CRUISE THE *Ei26^pf* CRUISE AND *D^THE f2e6f*

DIVISION BY STANDARD DEVIATION -ANY LARGER RANGES AND WERE MORE VARIABL
DRE AND ,EGENDRE REVEALED THAT TWO OF THE %-S WERE %- WAS ALWAYS
REQUIRED TO EXPLAIN THE SAME TOTAL VARIANCE AS WAS ONLY SOMETIMES
AS THE 14#)-0!#4 0#! METHOD &IG • %4HUS WHILE THE WAS ALWAYS
LACK OF STANDARDIZATION WITHIN THE 14# METHOD VARIABLES HAVE CONSTRICTE
METHOD CAN HAVE A STRONG EFFECT ON THE RESULTS IN ADDITION ONLY THE STRONG CO
ALL SIX DATA SETS SOME %-S SUCH AS %- WERE HIGHLY CORRELATED WITH MANY
LARGE SOME SUCH AS %- WERE ALWAYS SMALL GROUPS INDICATE THAT
AND SOME SUCH AS %-S AND ARE RELATIVELY HEAVILY WEIGHTED DURING NEARLY THE SAME

OR THAT %-S ARE BASED ON NEIGHBORING %-S RESULTS AND ONE OF THESE C
STANDARDIZATION OF THESE CORRELATED VARIABLES THE AMOUNT OF THE THREE INVAR
VARIANCE EXPLAINED BY THE IRST THREE 0#S IS ARTIICIALLY
INmATED 4HE INCLUSION OF SUMS OF VARIABLES IN A 0#!
SUCH AS THE SUMS OF VARIABLES IN THE THIRD %-S
n AND FOURTH %-S n GROUPS 4HESE ARTIICIALLY
INmATES THE AMOUNT OF VARIANCE EXPLAINED BY A 0#!
)NCLUSION OF A VARIABLE THAT IS A CROSS PRODUCT OF TWO
VARIABLE %- OR %- IN A 0#! DOES NOT

!SSUMPTION TWO IRST ECHO
ENVELOPE USED WITH TH
A MISMATCH FOR THE A
SHALLOW AND DEE
M THE SAMPLIN

(Z OR S TRANSLATED IN
EXCESSIVE AND UNNECESSARY
DEPTH RANGE BELOW THE START O
mOOR REmECTION A FACT NOT REA
COLLECTION OF THE ECHOSOUNDER
THE RECORDING OF MOST OF THE
TRUNCATED BEFORE THE FULL
BEFORE ANY SECOND ECHO AND A
FULL SAMPLES THEREFORE MOST
NEEDED PADDING EXTENDED REPE
LAST SOUND SAMPLE IN THE ECHO
ECHO WAS RECORDED IN THE RAW
WITHIN THE SAMPLE REQUIREME
THE €P Añ•T@C

DIFFERENT GAIN SETTINGS AND DIFFERENCES IN TEMPERATURE COMPENSATION HAVE BEEN REP
5SERS HAVE ALSO BEEN UNAWARE OF THE SAMPLING INTERVAL #4 GENERATED 0#
MENT OR THE EFFECTS OF REPEATING WITH DIFFERENT SOUNDER AND THAT 1
PADDING IN ORDER TO FULFILL THIS REQUIREMENT SUBSTRATE CLASSES ARE SO
ET AL MENTIONED THAT TRUNCATION OF THE !S WIT
TIONS RESULTED IN A LOSS OF SOME OF THE BIAS WERE ALSO REPORTED FOR
RESULTS FROM THEIR FIELD WORK RESULTED IN ERRONEOUS MEASUREMENTS MADE
TO THE 14#)-0!#4 SOFTWARE SO THAT THE 3COTLAND 5 +
SAMPLE WAS REPEATED A PROCESS KNOWN AS DETERMINED BY A MORE TH
CAREFUL SEAMOOR GROUNDTRUTHING +LO

#ORRELATION OF ECHOGRAM MEASUREMENTS WITH DEPTH

!NGLE OF INCIDENCE

4HE INFLUENCE OF DEPTH ON THE %-S AND ON THE RESULTING
0#S MAY BE DUE TO IMPROPER ECHOSOUNDER CALIBRATION OR
IMPROPER DEPTH CORRECTION IN 14#)-0!#4 RATHER THAN
TO TRUE VARIATION IN SUBSTRATE TYPES)T IS NOT POSSIBLE
FOR USERS TO DETERMINE THE ORIGIN OF THE DEPTH INFLUENCE
!LTHOUGH THE REFERENCE DEPTH IS SUPPOSED TO COMPENSATE
FOR THE SIGNAL PROTRACTION OF PINGS OF DIFFERENT DEPTHS
WITHIN A DATA SET NONE OF THE 14#)-0!#4 STUDIES IN
THE LITERATURE HAVE ACTUALLY CHECKED TO DETERMINE IF SUCH

SEAFLOOR SLOPES EXCEEDING TO CAUSED SIGNIFICANT SUBSTRATE MISCLASSIFICATION)N %LLINGSEN ET AL EFFECTS FROM VESSEL MOTION MAY HAVE BEEN REDUCED OR ELIMINATED BY WORKING IN CALM SEAS /UR ANALYSIS OF INDIVIDUAL %-S REVEALED THE MECHANISM WHEREBY SUBSTRATES MAY BE MISCLASSIFIED IN AREAS WITH SLOPE AND WE WOULD SUGGEST THAT THERE IS GREATER SENSITIVITY WITH 14# 6)%7 THAN PREVIOUSLY NOTED BY VON 3ZALAY AND VON 3ZALAY AND -C#ONNAUGHEY 4HE 14#)-0!#4 METHOD OF STACKING MULTIPLE PINGS COULD POTENTIALLY AMELIORATE THE INFLUENCE OF SLOPE AFFECTED PINGS BUT IT COULD ALSO CREATE NEW SUBSTRATE CLASSES BY COMBINING NORMAL AND NON NORMAL REFLECTIONS !LTHOUGH IT IS PRESUMED THAT 14#)-0!#4 SOFTWARE COULD DISTINGUISH AMONG SUBSTRATES AT A CONSTANT DEPTH IN A FLAT SEAFLOOR AREA WITH NO VESSEL PITCH AND ROLL THIS TYPE OF SITUATION IS NOT REALISTIC FOR THE .-&3 BOTTOM TRAWL SURVEYS IN THE 'ULF OF !LASKA AND !LEUTIANS)SLANDS)F STEEP SEAFLOOR AREAS CAN BE DIS TINGUISHED FROM VESSEL MOTION THROUGH CAREFUL INCOR PORATION OF VESSEL MOTION MEASUREMENTS SLOPE MAY BE CONSIDERED AS A SUBSTRATE MODIFIER OR AS A SIGNIFICANTLY DIFFERENT SUBSTR ' FI BˆG S0PBTH AFw)S &NDŒ•p0

'RANDIN FOR THE
DATA AND * (EWITT
4HE DATA CONTRIBUTORS ALSO PROVIDED HELPFUL MANU
SCRIPT REVIEWS ALONG WITH $ 3OMERTON 2 -C#ON
NAUGHEY 3 3YRJALA , "ONACCI AND THREE ANONYMOUS
REVIEWERS 3 3YRJALA 0 3PENCER AND OTHERS PROVIDED
HELPFUL STATISTICAL ADVICE 4HE VIDEO AND MULTIBEAM
GROUNDTRUTH DATA FROM THE !LEUTIAN)SLANDS WERE COL
LECTED WITH SUPPORT FROM THE .ORTH 0ACIFIC 2ESEARCH
"OARD

,ITERATURE CITED

!NDERSON * 4
#LASSIFICATION OF MARINE HABITATS USING SUBMERSIBLE
AND ACOUSTIC SEABED
AND MANAGEMENT OF FISH POPULATIONS ' (+RUSE .
"EZ ! "OOTH - 7 $ORN 3 (ILLS 2 . ,IPCIUS $
0ELLETIER # 2OY 3 * 3MITH AND $ 7ITHERELLS EDS
P n !LASKA 3EA 'RANT 2EP !LASKA 3EA 'RANT
0ROGRAM 5NIV !LASKA &AIRBANKS !+ 3'

!NDERSON * 4 2 3 'REGORY AND 7 4 #OLLINS
!COUSTIC CLASSIFICATION OF MARINE HABITATS IN COASTAL
.EWFOUNDLAND)#%3 * -AR 3CI n

%LLINGSEN + % * 3 'RAY AND % "J'RNBOM
!COUSTIC CLASSIFICATION OF SEABED HABITATS USING
THE 14# 6)%7 SYSTEM)#%3 * -AR 3CSM