VARIATION IN GROWTH INCREMENTS OF TAGGED SKIPJACK (Katsuwonus pelamis)

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PREFACE

The Skipjack Survey and Assessment Programme, which commenced in August 1977 and concluded in September 1981, was an externally funded part of the work programme of the South Pacific Commission. The governments of Australia, France, Japan, New Zealand, United Kingdom and the United States of America provided funding for the Programme, which worked in the waters of all of the countries and territories within the area of the South Pacific Commission and in New Zealand and Australia.

This report is one of a series covering various aspects of the biology of skipjack. Many reports resulting from the Skipjack Programme are still in draft form and therefore reference is given to some reports as manuscript (MS). All information so referenced will be released over the duration of the Tuna and Billfish Assessment Programme which succeeded the Skipjack Programme as of 1 October 1981.

The work described here is part of investigations begun by the Skipjack Programme to evaluate growth of skipjack using tag release and recapture data. Whatever measure of success achieved depends to a large extent on previous work (Lawson and Kearney MS; Skipjack Programme 1981). All members of the Tuna and Billfish Assessment Programme provided useful advice and criticism. In particular, we thank M.J. Williams for help with analysis of covariance and P. Kleiber for help with computing joint confidence regions.

The staff of the Tuna Programme at the time of preparation of this report comprised the Programme Co-ordinator, R.E. Kearney; Research Scientists, A.W. Argue, C.P. Ellway, R.S. Farman, R.D. Gillett, P. Kleiber, J.R. Sibert, W.A. Smith and M.J. Williams; Research Assistant, Veronica van Kouwen; and Programme Secretary, Carol Moulin. Most staff were involved to some extent in the fieldwork from which this report resulted and/or in the analysis of the data and preparation of the manuscript.

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1.0 INTRODUCTION

The Skipjack Survey and Assessment Programme of the South Pacific Commission (SPC) tagged over 140,000 skipjack between October 1977 and August 1980. The total area covered by the survey includes all of the countries and territories of the SPC and also areas of New Zealand and Australia (Figure A, inside front cover). All of the countries were visited at least once. Approximately 6,200 tags were recovered by May 1983. The observed increase in length of these fish during the period that they were at liberty may provide valuable information on spatial and temporal variation in skipjack growth, and is the subject of this paper.

Detection of systematic variation in growth is complicated by the self-limiting pattern of skipjack growth (Joseph and Calkins 1969; Skipjack Programme 1981). Small fish grow rapidly and large fish grow slowly. Thus, increase in length of a tagged fish during the time it is at liberty will depend not only on that time-at-liberty but also on its size when released. Simple calculations of growth rate as length increase divided by time-at-liberty are confounded by the decelerating pace of growth. Such calculations are naive at best and may even be misleading.

The primary purpose of the work described in this report was to apply the growth information contained in the tagging data to the following three questions about skipjack growth. Firstly, do fish released and recaptured in one country have different growth rates from fish released and recaptured in other countries? Secondly, do fish recaptured in the country of release have different growth rates from fish recaptured outside the country of release? Thirdly, do fish have different growth rates depending on the season or year in which they were released?

Growth of fish is often summarised by reporting the parameters of the von Bertalanffy growth model fitted to release and recapture data (Fabens 1965). These parameters may be useful for comparing growth of fish in a variety of different circumstances. The secondary purpose of the work described in this report was then to assess the suitability of the von Bertalanffy model for summarising growth of skipjack tagged by the Programme.

2.0 METHODS

2.1 Data Sources and Preparation

The principal data used in this analysis were tag and recapture data collected by the Skipjack Programme according to the methods described by Kearney and Gillett (1982) and compiled according to the methods described by Kleiber and Maynard (1982). Data are coded by "visits" which correspond to surveys, by the Programme's research vessel, of a country or territory. Surveys were normally of several weeks' duration and these codes provide a convenient means of accessing data on fish tagged in a specified area during a discrete period of time. In addition to Programme data, results from fish tagged and released in Papua New Guinea during 1972-1974 (coded as visit PNG0) were obtained from the Department of Primary Industry, Papua

New Guinea (see Lewis 1980) and made compatible with the Programme data base. A third set of growth increment data for skipjack tagged and released in the eastern Pacific was obtained from the Inter-American Tropical Tuna Commission (IATTC). Returns from the IATTC data set were individually matched, by time-at-liberty and size-at-release, to returns from the Programme data base (Skipjack Programme 1981). These matched sets were given visit codes EAST amd WEST respectively.

The first step in the analysis was to screen data for each visit, to exclude records for which release or recapture information was not suitable for growth calculations. Only releases of fish with single tags, for which accurate length measurements were available, were used; only recaptures which were judged to be reliable, i.e. from the Programme's tagging crews, long-range pole-and-line boats, and longliners, or for which lengths were verified by weights, were used.

For tabulation of results, several subdivisions of both size-at-release and time-at-liberty were used. Size-at-release was divided into ranges 30-49 cm and 50-70 cm; or roughly less than and greater than the mean size. Time-at-liberty ranges were 0-9, 10-29, 30-89, 90-179, 180-365, 366-730 and 10-365 days.

For the statistical analysis of growth increments described below, times-at-liberty less that 10 days were excluded to reduce the number of observations showing negative or zero growth. Times-at-liberty greater than 365 days were also excluded to reduce the probability of extensive migration and hence exposure to different geographical conditions prior to recapture. Lawson, Kearney and Sibert (MS) discuss corrections for release length bias and treatment of outliers. These corrections are small and were neglected in the present analysis.

There were large differences between visits in the number of observations per visit, leading to an extremely unbalanced analysis of covariance design, that is, unequal numbers of observations per cell. Therefore it was necessary to subsample data sets with large numbers of returns. Random samples of 50, 75, or 100 returns were taken. For visits with few observations, all were used. Generally 200 to 400 data points were used in each analysis with between 15 and 100 observations per cell. The subsampling process was repeated five times yielding five independent analyses of covariance. Sums of squares and standardised increments (defined below) from each analysis were averaged for the final summary analyses.

2.2 Linear Correction for Size-at-Release and Time-at-Liberty

Comparisons of increments between countries are confounded by the effects of time-at-liberty and size-at-release mentioned above. It is necessary to compare differences among countries after the increments have been adjusted for time-at-liberty and size-at-release. One method is to employ analysis of covariance to analyse differences in growth increment using size-at-release and time-at-liberty as covariates. This method is widely used to compare curves and exploits the power and well-developed theory of general linear models (Nelder and Wedderburn 1972). The resulting analysis of covariance model can also be used to calculate standardised increments for arbitrary sizes-at-release and times-at-liberty. The difficulty with this method is that it requires the mathematical description of growth increment to be a sum of some, preferably simple, functions of time-at-liberty and size-at-release.

Unfortunately, the usual mathematical descriptions of fish growth are not amenable to such simple expressions. It was possible, however, to employ a linear growth model in an analysis of covariance. In its derivative form, the von Bertalanffy growth model is

$$\frac{dx}{dt} = a - bx = b\left(\frac{a}{b} - x\right) \tag{1}$$

where x is the size of the fish, t is time, and a and b are (unknown) parameters. This expression merely says that the rate of growth, dx/dt, is proportional to the difference between the size of the fish and the constant a/b. As x gets close to a/b, the rate of growth decreases becoming zero when $x=a/b$. This equation can be solved for size at any known time yielding

$$x = \frac{a}{b}\left[1 - e^{-b(t-t_0)}\right] + x_0 e^{-b(t-t_0)} \tag{2}$$

where x_0 and t_0 are constants of integration, x_0 being the size at time $t=t_0$. Generally it is assumed that at $t=t_0$, $x_0=0$ which yields

$$x = L_\infty\left[1 - e^{-b(t-t_0)}\right] \tag{3}$$

which is the familiar von Bertalanffy equation where $L_\infty=a/b$ and $k=b$.

In a tagging experiment, the age of the fish is usually unknown. Only size-at-release, time-at-liberty (Δt) and size-at-recovery are known. The Taylor series may be used to express the increment in size as a sum of the derivatives of the growth model.

$$f(t+\Delta t) = f(t) + \Delta t\frac{dx}{dt} + \frac{\Delta t^2}{2!}\cdot\frac{d^2x}{dt^2} + \frac{\Delta t^3}{3!}\cdot\frac{d^3x}{dt^3} + \cdots \tag{4}$$

Letting $x=f(t)$, the size-at-release, and $y=f(t+\Delta t)$, size-at-recapture, and substituting the derivatives of Equation (1), the Taylor series becomes

$$y-x = \Delta t(a - bx) + \frac{\Delta t^2}{2!}\cdot(-ab+b^2y) + \frac{\Delta t^3}{3!}\cdot(ab^2-b^3y) + \cdots \tag{5}$$

Here, the difference, $y-x$, is the growth increment which, after rearrangement, becomes

$$y-x = \left(\frac{a}{b} - x\right)\cdot\left(b\Delta t - \frac{b^2\Delta t^2}{2!} + \frac{b^3\Delta t^3}{3!} - \cdots\right) \tag{6}$$

a linear approximation to the growth increment of arbitrary accuracy. In theory, terms can be added until any desired level of accuracy is reached. Note that the increment in size, $y-x$, depends only on a, b, x and higher powers of Δt.

This series has a known sum

$$y = \frac{a}{b}\left(1 - e^{-b\Delta t}\right) + xe^{-b\Delta t} \tag{7}$$

which is identical to Equation (2) with $x=x_0$ and $\Delta t=t-t_0$. It would appear that under the conditions of a tagging experiment, parameters derived from the constants of integration (x_0 and t_0) are lost and a second independent variable is gained (x). Unless the assumptions that $x=x_0$ and

$t_0=0$ are acceptable, it may be impossible to determine the absolute age of a fish from the results of a tagging and recovery experiment (Fabens 1965).

2.3 Analysis of Covariance and Standardised Growth Increments

Since the growth increment depends on x and higher powers of Δt, these terms were used in an empirical model of growth in analysis of covariance:

$$y-x = C_1\Delta t + C_2\Delta t x + C_3\frac{\Delta t^2}{2} + C_4\frac{\Delta t^2}{2}x \qquad (8)$$

where C_i are coefficients estimated by a process similar to multiple linear regression. If the appropriate non-linear constraints were imposed on the C_i, Equation (8) would be a second order approximation of the von Bertalanffy model. These constraints are not necessary however for an empirical description of growth. Since the purpose of the analysis is to test whether there are significant differences in growth between country of release, country of recapture, and visit to a country, these variables were included in the analysis of covariance model as qualitative factors. Both visits and country of recapture were considered to be nested within country of release.

Several models, increasing in complexity and successively including more terms, were fitted in a stepwise fashion to each set of data using the general linear model analysis package, GLIM (Baker and Nelder 1978). The simplest model has a single term, the overall mean, which is used to predict the size increment for all cases; this model provides an estimate of the total sum of squares. The second level of complexity is a model with the four terms in Equation (8) and uses a single curve to predict size increments for all cases. The third level of complexity is a model with four terms corresponding to Equation (8) for each country and uses a separate curve for each country to predict the growth increment for all releases from that country. For an analysis comparing only countries of release, this is the most complex model; for analyses comparing visits to a country or comparing recaptures within and outside of country of release, an additional level of complexity is required. The fourth level of complexity is a model with four terms corresponding to Equation (8) for each visit to a country of release or for recapture within or outside of country of release. In all analyses, the model with the most terms is called the full model and the difference between the total sum of squares and residual sum of squares of the full model is used as an estimate of the error sum of squares. Fitting each of these successively to a more complex model achieves an incremental reduction in the residual sum of squares. The significance of the reduction is judged in relation to the full model by testing it against the error mean square (Nelder and Wedderburn 1972). If the inclusion of the additional terms does not reduce the sum of squares significantly, as measured by the F-statistic at the five per cent probability level, then the factors modelled by those terms are not significantly different from one another.

In order to calculate standardised increments and their confidence regions at a specified size-at-release and time-at-liberty, the vector of parameter estimates, B, and the variance-covariance matrix of the parameter estimates, $V(B)$, were extracted from GLIM and passed to a separate FORTRAN program. This program calculated the expected values according to the formula

$$\hat{y} = X'B \qquad (9)$$

and the variance ($s^2_{\hat{y}}$) of the expected values according to the formula

$$s^2_{\hat{y}} = X'V(B)X \qquad (10)$$

(Kendall and Stuart 1979). Here **X** is a vector incorporating sizes-at-release, times-at-liberty (see Equation 8) and a design matrix appropriate to the design of the model for which the predictions are to be made. For purposes of comparing different countries and visits, size-at-release equal to 50 cm and time-at-liberty equal to 90 days were used as standards. The 95 per cent confidence intervals about the expected values were then calculated using

$$\text{interval} = \pm t_\alpha s_{\hat{y}} \qquad (11)$$

where **t** is Student's **t** at the 95 per cent probability level and with degrees of freedom equal to that of the error sum of squares in the analysis of covariance.

2.4 von Bertalanffy Fitting and Simulation

For the purpose of fitting the von Bertalanffy model, data were selected using the same credibility criteria used for the analysis of covariance. No constraints were imposed on size at release; time-at-liberty were restricted to between 1 and 730 days. Maximum likelihood parameter estimates were obtained by fitting the data to the model using a direct numerical search method, the "simplex" algorithm of Nelder and Mead (1965), to maximise the likelihood function. Approximate 95 per cent joint confidence regions for L_∞ and **k** were calculated by the method outlined by Kimura (1979) and a numerical search algorithm which traces a contour on the sum of squares surface.

A computer simulation was written to investigate the combined effects of small growth increments and errors in length measurement on the von Bertalanffy model fitting procedure. The first step in the simulation was to construct a frequency distribution for the size of the fish at release (YM) by generating a set of random numbers from a normal distribution with mean YMA and standard deviation YMS. Next, a frequency distribution for time-at-liberty (DT) was constructed by generating a set of random numbers from a log-normal distribution with parameters DTA and DTS. Times-at-liberty were rounded to the next highest integer to exclude zero values. Using specified numerical values for the parameters **k** and L_∞ and calculated distributions for size-at-release and times-at-liberty, the predicted size-at-recovery (YR) was calculated using the von Bertalanffy equation (Equation 7). For fish tagged at sizes larger than L_∞, size-at-recovery was set to size-at-release; that is, these fish do not grow (and are not allowed to shrink). Error was introduced into size-at-release by adding a random normal variable with mean 0 and standard deviation YMERR to YM and rounding the sum to the nearest integer. Similarly, error was introduced into size-at-recapture by adding a random normal variable with mean 0 and standard deviation YRERR to YR and rounding to the nearest integer. Size increments (INCR) were calculated as the difference YR-YM. These sets of variables (YM,INCR,DT) were subjected to the same fitting procedure as the field data. Results were analysed by comparing the estimated values of the parameters with "true" values known from the simulation and by examining shapes of the approximate 95 per cent joint confidence regions for the parameter estimates.

TABLE 1. TIMING OF VISITS, NUMBER OF RETURNS SUITABLE FOR GROWTH ANALYSIS, NUMBER OF RETURNS IN THE 10-365-DAY TIME-AT-LARGE PERIOD, AND PER CENT OF RETURNS IN THE 10-365-DAY PERIOD WHICH DID NOT EXHIBIT MEASURABLE GROWTH. Country abbreviations are explained in Appendix B. See text for explanation of "visits" EAST and WEST.

Visit	Date	Total Suitable	Total in Range	Percent Non-Growers
FIJ1	30/01/78 - 06/04/78	683	434	50.46
FIJ2	10/04/80 - 27/04/80	746	217	20.27
KIR1	05/07/78 - 16/11/78	348	294	34.69
MAQ2	22/12/79 - 21/01/80	40	29	72.24
PAL1	19/10/78 - 20/10/78	30	14	21.43
PAL3	05/08/80 - 20/08/80	175	157	9.56
PNG0	22/05/72 - 28/06/74	403	306	29.74
PNG2	18/05/79 - 03/06/79	869	646	49.85
PON1	04/08/78 - 08/08/78	21	19	0.00
PON3	18/07/80 - 25/07/80	62	56	10.71
SOL1	25/10/77 - 03/12/77	55	40	35.00
TRK1	10/08/78 - 10/08/78	11	11	0.00
TRK2	10/11/79 - 10/11/79	9	7	14.29
VAN1	08/12/77 - 22/01/78	6	4	25.00
WAL1	06/05/78 - 31/05/78	77	22	40.91
WAL2	15/05/80 - 22/05/80	20	7	14.29
ZEA1	22/02/79 - 24/03/79	508	224	66.96
ZEA2	21/03/80 - 23/03/80	5	4	25.00
EAST		361	360	23.33
WEST		361	359	38.72

3.0 RESULTS

3.1 Analysis of Covariance and Standard Increments

Table 1 summarises information from each visit to the individual countries used in the analyses and indicates the number of returns suitable for growth analysis and the number of returns falling within the 10 to 365 day time-at-liberty range. A complete summary of all observations, including size-at-release, time-at-liberty, size-at-recapture, growth increment, and fraction of fish not exhibiting measurable growth by visit is presented in Appendix A. Table 2 contains an abstract of Appendix A for fish of all size-at-release (30-70 cm) and for all times-at-liberty. Mean size-at-release varies from 41 to 55 cm; mean time-at-liberty varies from 0 to over 300 days; size increments vary from -0.3 to over 12 cm. The effects of time-at-liberty can be seen by noting the difference in growth increment between visits FIJ1 and FIJ2 where the fish were released at approximately the same size but the mean times-at-liberty were different. Similarly, the effects of size-at-release can be seen by noting the difference in growth increment between visits PAL3 and PON1 where the fish were at liberty for approximately the same period of time but the mean sizes-at-release were different. On the whole, growth increments are small for fish recaptured in the country of release and the overall percentage of fish which did not show any measurable growth is high (40.1%).

TABLE 2. EXTRACT OF TABLES IN APPENDIX A SUMMARISING SIZE AND GROWTH INFORMATION BY VISIT. Country abbreviations are explained in Appendix B. See text for explanation of "visits" EAST and WEST.

	RECAPTURES WITHIN COUNTRY OF RELEASE						RECAPTURES OUTSIDE COUNTRY OF RELEASE					
Country and Visit	Sample Size	Mean Size at Release	Mean Size at Recapture	Mean Days at Liberty	Increment Mean	Increment SD	Sample Size	Mean Size at Release	Mean Size at Recapture	Mean Days at Liberty	Increment Mean	Increment SD
FIJ1	431	48.0	48.6	23.9	0.65	2.29	3	51.3	55.3	68.7	4.00	2.65
FIJ2	208	51.2	55.3	108.7	4.09	5.34	9	51.7	61.3	237.8	9.67	11.86
KIR1	279	48.4	49.8	56.0	1.43	2.18	15	51.0	55.2	137.3	4.20	3.43
MAQ2	26	48.3	48.0	18.9	-0.27	1.31	3	48.0	60.0	273.7	12.00	3.00
PAL1	0						14	59.0	63.1	113.6	4.14	4.59
PAL3	14	40.8	47.8	85.3	7.00	5.55	143	40.6	49.3	171.0	8.71	6.49
PNG0	290	54.6	56.4	87.6	1.78	2.46	16	53.4	57.6	229.7	4.25	3.86
PNG2	609	54.6	55.2	51.5	0.63	3.17	37	51.5	56.8	197.8	5.32	4.58
PON1	7	53.9	57.7	84.7	3.86	2.67	12	53.9	57.6	152.4	3.67	3.37
PON3	13	51.4	57.2	168.0	5.77	2.31	43	55.4	59.9	186.0	4.47	4.30
SOL1	38	51.8	54.3	192.5	2.45	4.28	2	52.5	57.5	199.0	5.00	0.00
TRK1	1	50.0	56.0	121.0	6.00	-	10	49.7	56.7	152.6	7.00	2.79
TRK2	1	53.0	54.0	21.0	1.00	-	6	53.5	60.0	186.2	6.50	4.04
VAN1	1	52.0	52.0	0.0	0.00	-	3	50.7	57.3	261.0	6.67	2.89
WAL1	0						22	53.0	54.4	198.5	1.36	2.77
WAL2	0						7	52.9	57.1	242.7	4.29	5.22
ZEA1	213	45.8	46.4	37.9	0.64	2.30	11	47.5	54.2	305.7	6.64	3.41
ZEA2	1	54.0	54.0	76.0	0.00	-	3	50.3	57.7	323.7	7.33	4.51
EAST	360	51.1	53.6	47.1	2.50	2.89	0					
WEST	361	51.5	52.8	46.9	1.37	2.96	0					

Analysis of covariance was used to test the linear model of growth. Table 3 shows the effects of successively adding higher terms to the model. Clearly there is no benefit from adding terms of order higher than two, i.e. the four terms of Equation (8) are sufficient.

TABLE 3. ANALYSIS OF COVARIANCE FOR ADDITION OF HIGHER ORDER TERMS TO LINEAR MODEL OF GROWTH FOR A SAMPLE OF 100 RETURNS FROM VISIT FIJ1

Component	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	371.5	99	3.75	
First order terms	134.9	1	134.90	61.41 *
Second order terms	26.0	2	13.00	5.92 *
Third order terms	1.2	2	0.60	0.27
Fourth order terms	0.7	1	0.70	0.32
Fifth order terms	2.4	1	2.40	1.09
Sixth order terms	6.4	1	6.40	2.91
Error	199.9	91	2.20	

* Indicates a significant contribution with p>95 per cent.

The results of the analysis of covariance for differences between countries are presented in Table 4. The first line is an estimate of the total variance. The second line tests the overall effects of fitting the growth model without considering country of release (that is, a single curve for all countries); there is a statistically significant reduction in sums of squares attributable to the general effects of time and size. The third line tests differences between countries by fitting a different curve for each country; the improvement in fit is statistically significant. Standardised growth increments derived from the full model, fitting different curves for each country, are presented in Table 5.

TABLE 4. ANALYSIS OF COVARIANCE FOR DIFFERENCES IN GROWTH INCREMENT BETWEEN COUNTRIES OF RELEASE. Degrees of freedom for F tests given in parentheses after each value of F. All tests are significant at p>95 per cent.

Component	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	6349.8	439	14.46	
Single curve	2779.8	3	926.60	129.61 (3,412)
Different curve for each country	624.6	24	26.02	3.64 (24,412)
Error	2945.4	412	7.15	

TABLE 5. STANDARDISED INCREMENTS (cm) AT Δt=90 DAYS, $\bar{x}$=50 CM FOR FISH RECAPTURED WITHIN COUNTRY OF RELEASE USING ALL VISITS. The 95 per cent confidence interval of each increment given in parentheses. Country abbreviations are explained in Appendix B.

Country	Increment	Visits Included
FIJ	4.5 (±1.2)	FIJ1, FIJ2
KIR	1.4 (±1.2)	KIR1
PAL	8.5 (±6.4)	PAL3
PNG	3.6 (±1.9)	PNG2
PON	4.1 (±4.1)	PON3
SOL	2.5 (±1.4)	SOL1
ZEA	1.5 (±5.2)	ZEA1

The results of the analysis of covariance comparing size increments of recaptures within the country of release with those recaptured outside are presented in Table 6. The first three lines of Table 6 are similar to Table 4 and indicate again that there are significant differences in growth increment between countries. Line four of Table 6 tests the effects of allowing predicted size increments to depend additionally on whether recapture occurred within or outside of country of release; there is a significant improvement. Table 7 presents standardised growth increments by country of release and area of recapture.

TABLE 6. ANALYSIS OF COVARIANCE FOR DIFFERENCES IN GROWTH INCREMENT COMPARING RECAPTURES FROM WITHIN AND OUTSIDE OF COUNTRY OF RELEASE. Degrees of freedom for F tests given in parentheses after each value of F. All tests are significant at p>95 per cent.

Component	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	7390.4	271	27.27	
Single curve	4378.4	3	1459.47	162.59 (3,240)
Curve for each release country	346.8	12	28.90	3.24 (12,240)
Curves for each release and recapture combination	514.8	16	32.18	3.59 (16,240)
Error	2150.4	240	8.96	

TABLE 7. STANDARDISED INCREMENTS (cm) AT Δt= 90 DAYS, $\bar{x}$= 50 CM FOR FISH RECAPTURED INSIDE AND OUTSIDE OF COUNTRY OF RELEASE. The 95 per cent confidence interval of each increment given in parentheses. Country abbreviations are explained in Appendix B.

	Release Country (Visit)			
	KIR(1)	PAL(3)	PNG(2)	PON(3)
IN	1.7 (±1.8)	9.1 (±4.4)	7.1 (±3.3)	3.6 (±3.3)
OUT	3.4 (±2.2)	-1.8 (±2.2)	2.2 (±1.2)	2.8 (±1.2)

The results of the analyses of covariance comparing size increments between visits to a country are presented in Table 8. As above, the first three lines of Table 8 are similar to Table 4 and indicate that there are significant differences between countries irrespective of visit. Line four tests the effects of allowing predicted size increments to depend additionally on visit to a country; there is a significant improvement. Table 9 presents standardised growth increments by country and visit.

TABLE 8. ANALYSIS OF COVARIANCE FOR DIFFERENCES IN GROWTH INCREMENTS COMPARING DIFFERENT VISITS TO A COUNTRY. Degrees of freedom for F tests given in parentheses after each value of F. All tests are significant at p>95 per cent.

Component	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	5816.6	399	14.58	
Single curve	2414.4	3	804.80	100.34 (3,384)
Curve for each country	107.2	4	26.80	3.34 (4,384)
Curve for each visit to a country	215.0	8	26.88	3.35 (8,384)
Error	3080.0	384	8.02	

TABLE 9. STANDARDISED INCREMENTS (cm) AT Δt = 90 DAYS, x = 50 CM FOR DIFFERENT VISITS TO COUNTRIES. Date and visit code for each visit given in parentheses after the increments; The 95 per cent confidence interval of each increment given in parentheses below the increments. Country abbreviations are explained in Appendix B.

Country	Visit	
FIJ	3.7 (FIJ1; 1978) (±6.9)	5.6 (FIJ2; 1980) (±1.3)
PNG	2.6 (PNG0; 1972-74) (±1.5)	3.2 (PNG2; 1979) (±1.5)

3.2 von Bertalanffy Fitting and Simulation

The results of fitting the von Bertalanffy growth model are summarised in Table 10 which indicates differences in the parameter estimates for different countries and visits. The significance of these differences may be seen in Figure 1 which shows approximate 95 per cent joint confidence intervals for both L_∞ and k. Regions which do not overlap indicate significantly different sets of von Bertalanffy parameters.

TABLE 10. SUMMARY OF VON BERTALANFFY PARAMETERS FOR SEVERAL DATA SETS. Maximum likelihood estimates of L_∞ (cm) and k (both in days and years) are presented. For visit ZEA1 a second set of data (marked with an asterisk) is included, which selected fish between 43 and 52 cm at release and at large from 1 to 64 days. Average indicates average of parameter estimates from SSAP visits excluding those of visit ZEA1. Visits EAST and WEST are described in text. Country abbreviations are explained in Appendix B.

Visit	L_∞	k (per day)	k (per year)	Per cent of Variance Explained
FIJ1	53.5	0.00732	2.67	71.8
FIJ2	79.3	0.00132	0.482	63.5
KIR1	52.2	0.00993	3.63	44.5
PAL3	54.2	0.0107	3.91	55.4
PNG2	60.9	0.00425	1.55	44.4
PON3	76.9	0.00148	0.539	72.5
SOL1	60.2	0.00336	1.23	44.6
ZEA1	171.0	0.0003	0.110	54.0
ZEA1 *	46.6	0.0161	5.88	53.1
Average	62.5	0.00548	2.00	
WEST	61.3	0.00342	1.25	69.2
EAST	75.5	0.00211	0.772	56.9

The results of the simulation are given in Figures 2 through 5; Figure 2 shows the effects of increasing the standard deviation of the measurement error in size-at-recovery. The point estimates of the parameters remain close to their actual values while the confidence regions become increasingly large until the ranges of acceptable values of k and L_∞ are extensive. Figure 3 shows the effects of increasing the standard deviation of the measurement error in size-at-release. Point estimates become significantly biased in the direction of large k and small L_∞ with the "true" values not included within the 95 per cent confidence region and the confidence regions become larger. Figure 4 shows the effects of progressively decreasing the value of k in the simulation. As k in the simulation approaches zero, point estimates of k and L_∞ remain unbiased while confidence regions become extremely exaggerated in the L_∞ dimension. Finally, Figure 5 shows the effects of increasing the average size-at-release (YMA). As YMA approaches the value of L_∞ in the

FIGURE 1. APPROXIMATE 95 PER CENT JOINT CONFIDENCE REGIONS OF THE VON BERTALANFFY PARAMETERS ESTIMATED FOR THE DATA SETS SHOWN IN TABLE 10. Positions of visit codes indicate point estimates of parameters.

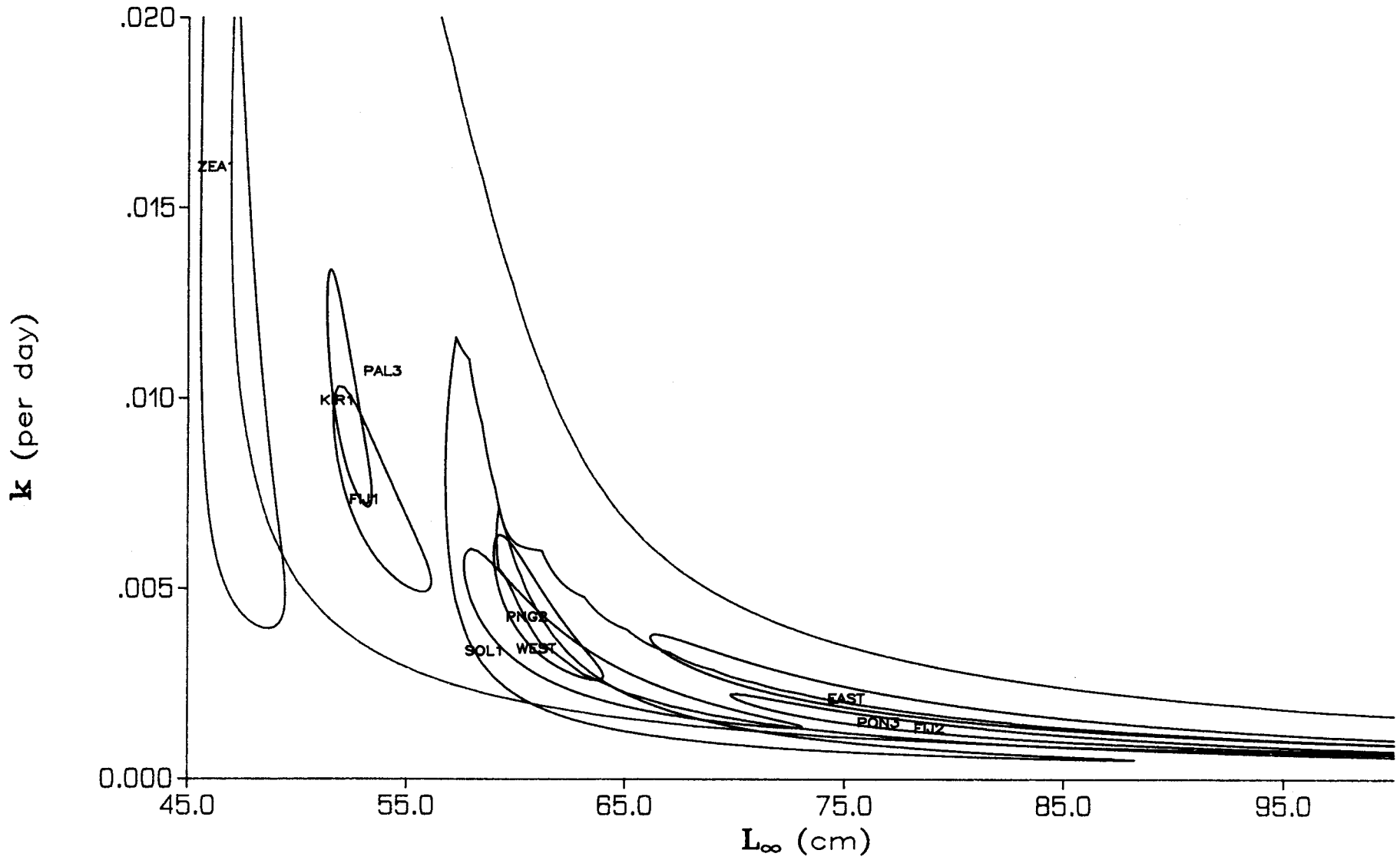


FIGURE 2. EFFECTS OF INCREASING STANDARD DEVIATION OF SIZE-AT-RECOVERY MEASUREMENTS IN THE SIMULATION. Curves are 95 per cent confidence regions for the parameter estimates for the standard deviations shown. L_∞ and **k** fixed at 55 cm and 0.0075 per day respectively in the simulation (dashed lines). Point estimates for all standard deviations fall within curve 2 but are omitted for clarity.

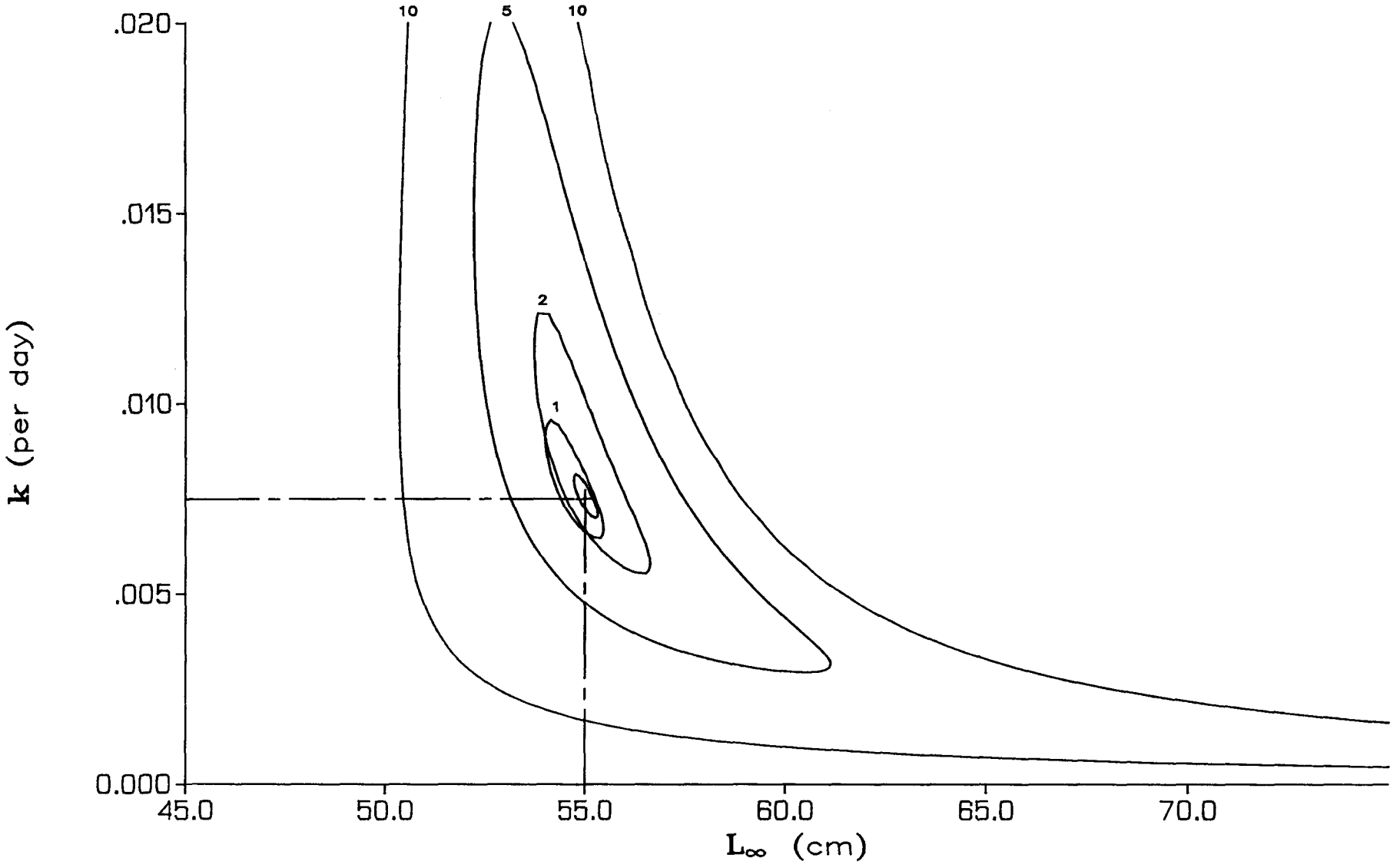


FIGURE 3. EFFECTS OF INCREASING STANDARD DEVIATION OF SIZE-AT-RELEASE MEASUREMENTS IN THE SIMULATION. Curves are 95 per cent confidence regions for the parameter estimates for the standard deviations shown. L_∞ and **k** fixed at 55 cm and 0.0075 per day respectively in the simulation (dashed lines). Point estimates are indicated by crosses (+).

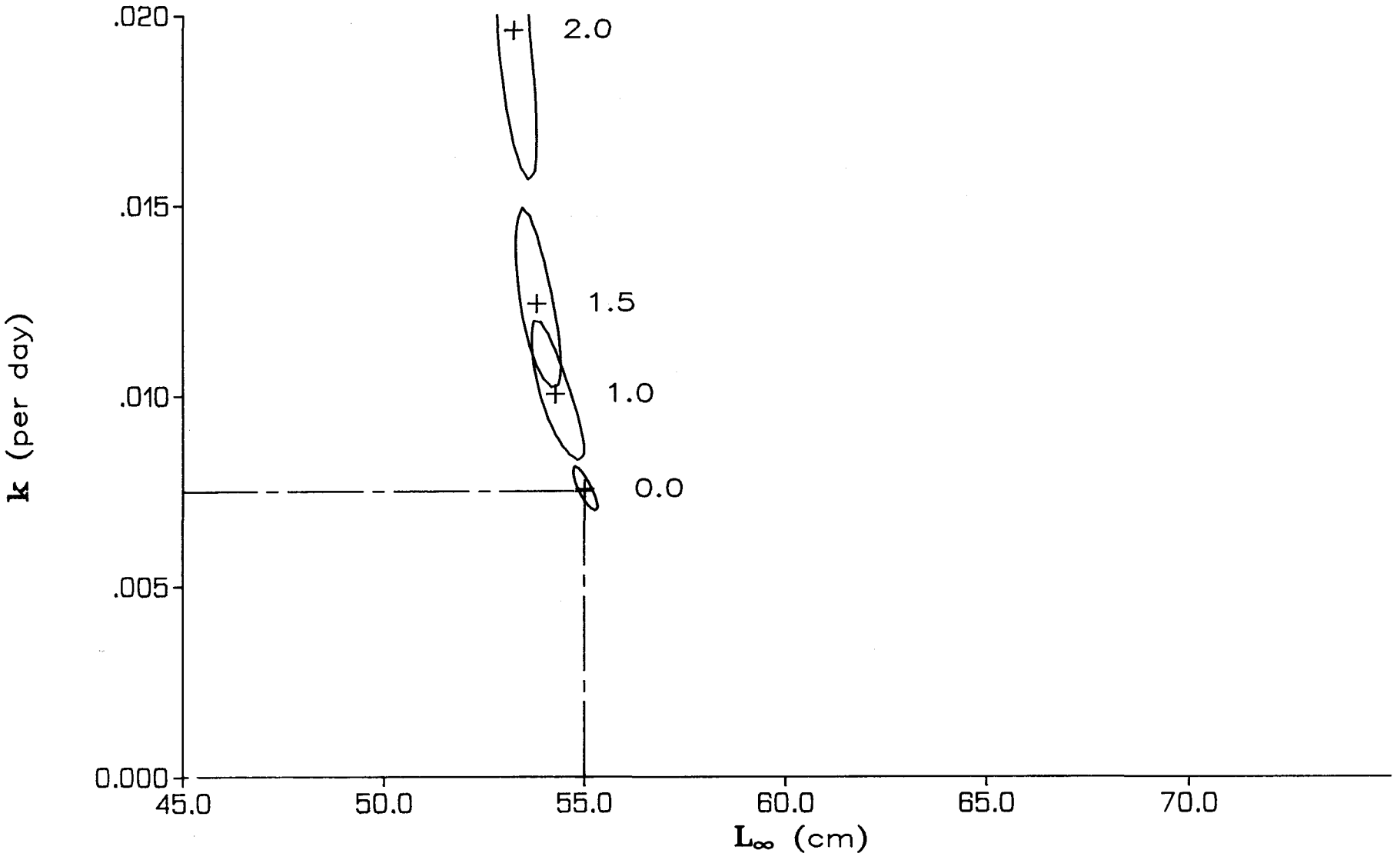


FIGURE 4. EFFECTS OF DECREASING k IN THE SIMULATION WHILE HOLDING L_∞ CONSTANT AT 55 CM. Curves are 95 per cent confidence regions for the parameter estimates. Point estimates are indicated by crosses (+); stars indicate values used in simulation.

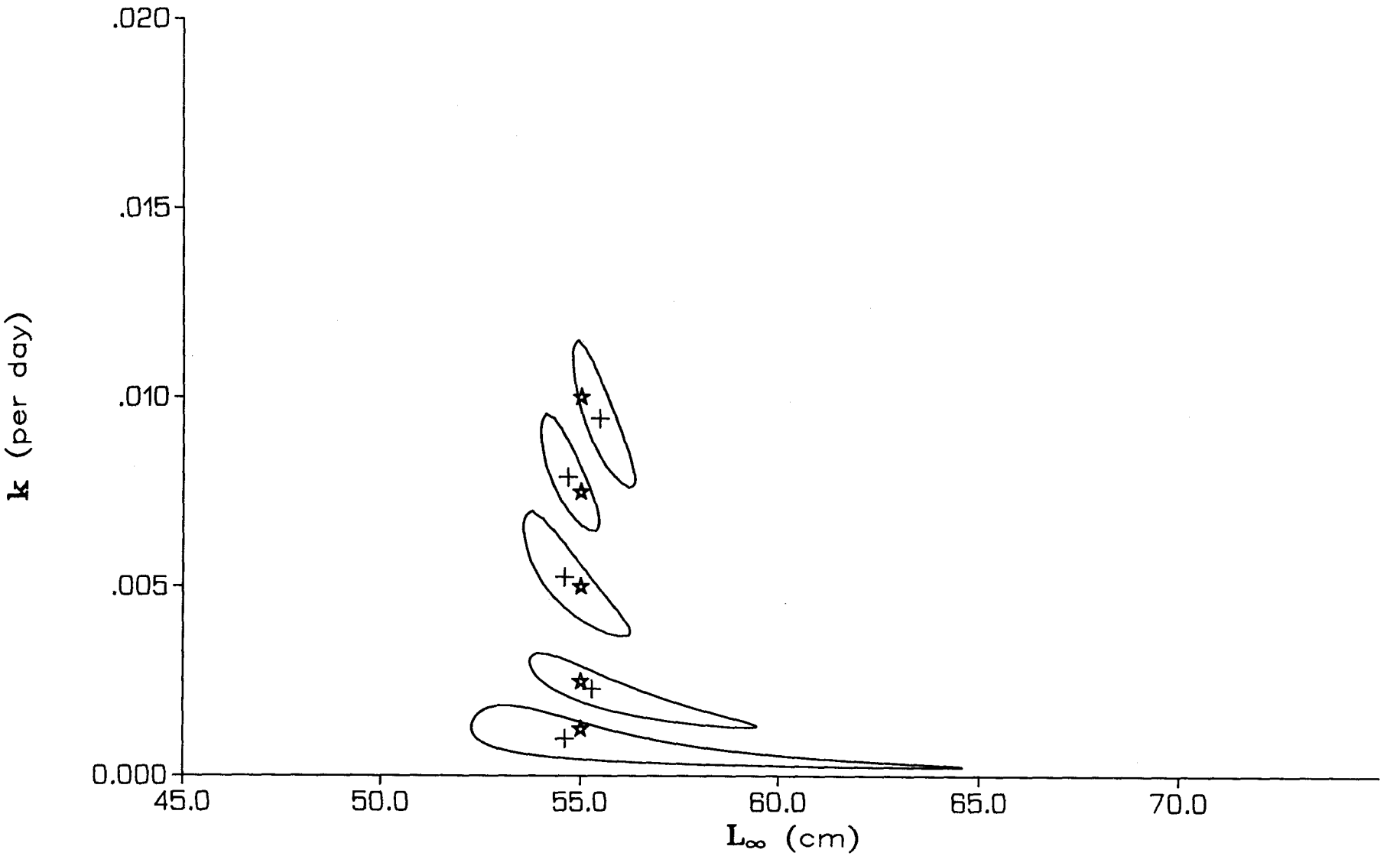
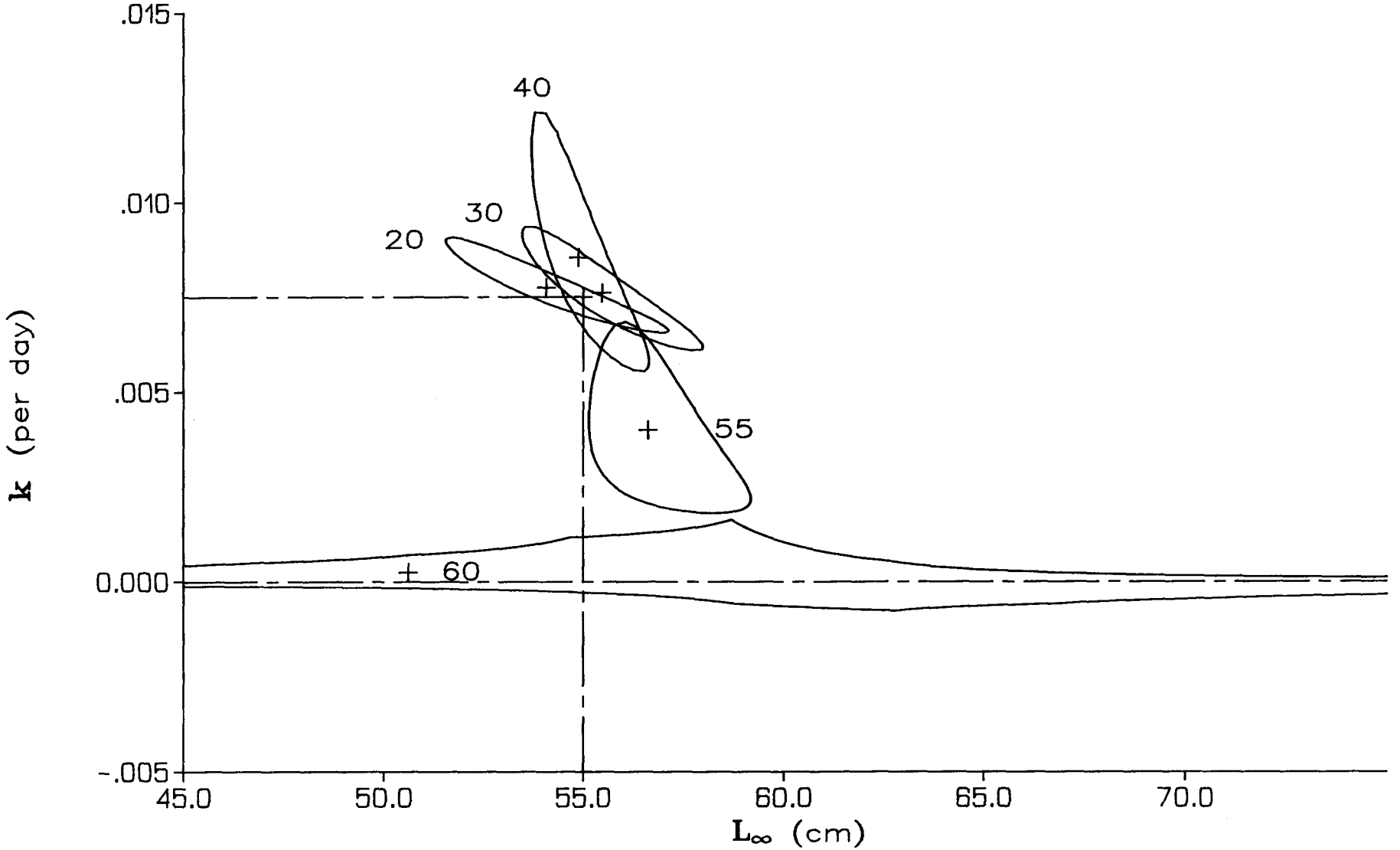


FIGURE 5. EFFECTS OF INCREASING MEAN SIZE-AT-RELEASE IN SIMULATION. L_∞ and k fixed at 55 cm and 0.0075 per day respectively in the simulation (dashed lines). Curves are the 95 per cent confidence regions for the values of size-at-release shown. Point estimates are indicated by crosses (+).



simulation, the point estimates are unaffected and the confidence regions again become elongated in the L_∞ dimension. When YMA is numerically equal to L_∞, point estimates become unreliable and the "true" values of k and L_∞ are not included within the 95 per cent confidence region. When YMA exceeds L_∞, the estimation procedure breaks down completely.

4.0 DISCUSSION AND CONCLUSIONS

4.1 Growth Increments

In a tag and recovery experiment of this type, it often is impractical to ensure that fish are tagged at a uniform size and impossible to ensure that fish are recovered after a consistent period of time. These two factors are dependent on the size of the fish available at the time of tagging and on the rather complex suite of processes that affect the recapture of a tagged fish. In other words, there is little control over certain aspects of the experiment. The result is that each episode of capture and release will produce a unique set of size at release and time-at-large combinations. Since the fish are growing and their growth is strongly influenced by their size, the observed increment in growth could be different for each set of releases even if the biological parameters controlling growth were constant. To attempt to draw conclusions about increase in size without accounting for both time-at-liberty and size-at-release is without meaning.

There are large differences in size at release and time-at-liberty in the data presented here. Analysis of covariance facilitates evaluation of these differences by fitting curves to the data and assessing the differences between the curves. The results of all analyses of covariance are in general agreement. In each case, the data are better described by fitting a unique curve to the points for each country of release than a single curve for all countries. Further, the data are still better described by fitting a unique curve for each visit to a country or for recaptures within and outside the country of release. Thus differences in size increments are due to variation in growth between countries of release, times of release, and countries of recapture.

The standardised growth increments in Tables 5, 7 and 9 give an expression of the amount of growth achieved during a particular time in a particular area. There is considerable overlap in these estimates indicating that differences are often small and the variability is high. It is at first puzzling why these standardised increments overlap when the analysis of covariance indicates that the growth curves are distinct. There are two reasons for this apparent contradiction. First, the analysis of covariance merely indicates that there are significant differences between some of the growth curves. Second, the analysis of covariance compares the entire curve whereas the standardised increments refer to single points on different curves. Growth curves may approach, and even cross one another, but remain distinct. The standard increments within a visit appear to vary between analyses, for example in PNG (Tables 5, 7 and 9). This variation is an artifact of the analysis of covariance which finds the best fit to all curves simultaneously.

4.2 von Bertalanffy model

The results of fitting the von Bertalanffy model to the data are consistent with the analysis of covariance. As can be seen from Figure 1,

fish released and recaptured at different times and different places grow according to von Bertalanffy curves with different parameters. This approach is not without problems, however. The parameter estimates are very sensitive to the way in which the data are screened. Small changes in the time-at-liberty or size-at-release criteria cause large shifts in the parameter estimates. Figure 6 illustrates the parameter estimates from a number of data sets. Different symbols indicate different visits; different positions of the same symbol are the result of applying different time and size selection criteria. Although not included in the figure for reasons of clarity, the joint confidence regions for some of the subsets of the same general data set do not overlap (i.e. the parameter estimates are significantly different). Such unstable parameter estimates are troublesome because, if the von Bertalanffy model is considered to be a valid description of skipjack growth, then one is forced to conclude that different, but overlapping, subsets of the same data are not compatible. Furthermore, there are cases where rather wide ranges of k and L_∞ are consistent with data provided they retain an inverse relationship to one another. The apparent hyperbolic shape of some of these confidence regions is due to this inverse relationship; the L_∞ parameter is a function of the reciprocal of the k parameter (see Equation 2).

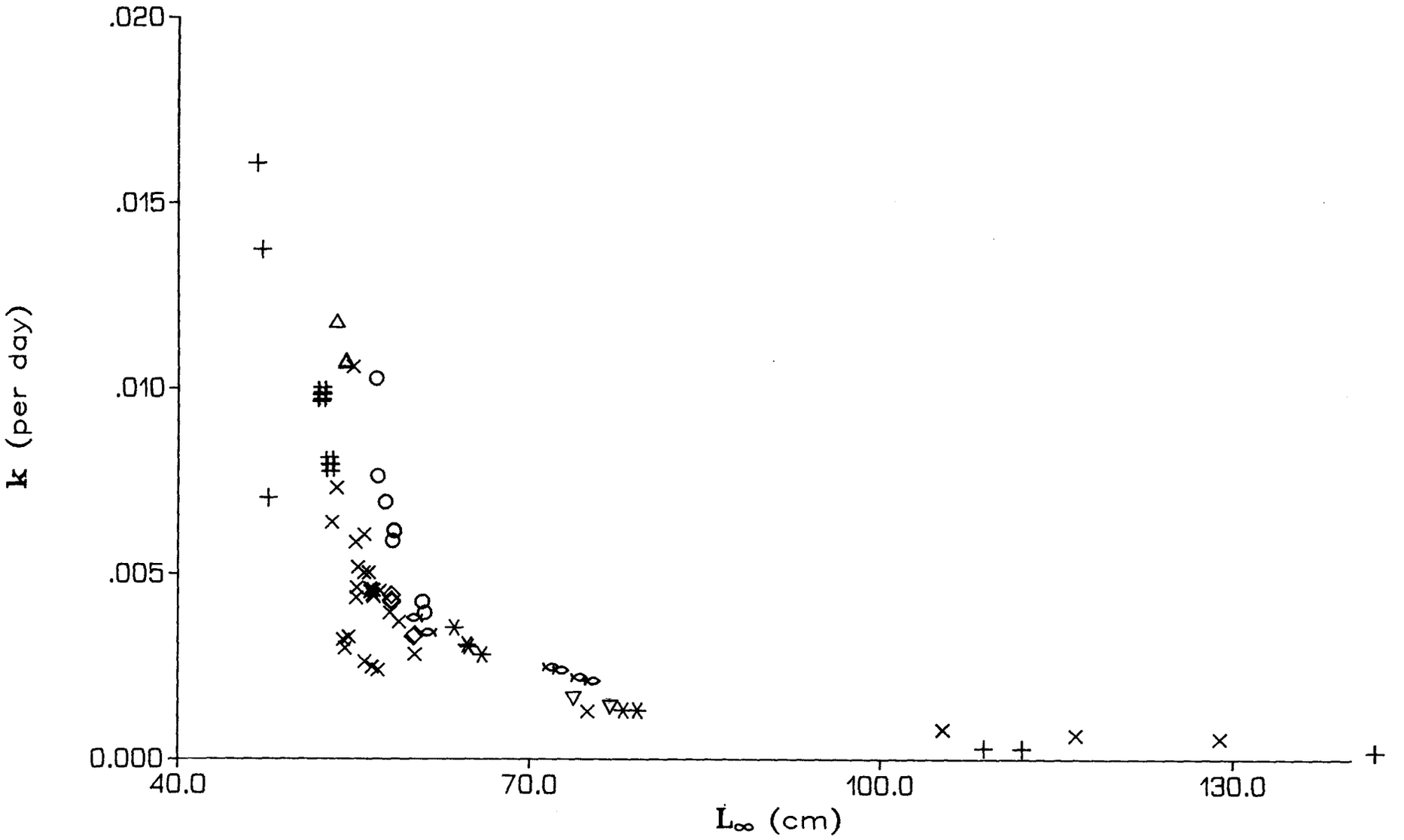
These problems with the von Bertalanffy model can be attributed, in part, to the rather small growth increments observed for skipjack. As can be seen in Table 1, non-growing fish comprised a large proportion of the data set. Many of these were recovered shortly after release, but there were also considerable numbers of non-growers among fish at large for longer periods (Appendix A). There are two obvious reasons why growth increments may be perceived to be small: either fish in fact did not grow, or errors in length measurements masked the real growth. Failure to grow can be due to many causes and one of the purposes of fitting a growth model may be to determine how lack of growth is expressed by the parameters of the model. In the context of the von Bertalanffy model, lack of growth during a given period at liberty may be due either to a low value of k or to releasing fish at a size near L_∞. Errors in length measurement may occur at both tagging and at recovery and may have no effect or may either hide or exaggerate small growth increments.

The results of the simulation illustrate the effects of non-growth or of measurement errors. Figures 4 and 5 show the model and fitting procedure to be reasonably robust to genuinely small increments. When k is small or when fish are released near L_∞, the parameters are estimated with little or no systematic bias. It is only when $k=0$, or when fish are released at a size greater than or equal to L_∞, that the model breaks down.

The model and fitting procedure are also robust with respect to errors in size measurement at recovery (Figure 2). The effect of these errors is merely to enlarge the joint confidence region of k and L_∞. In fact, the mean squared difference between the observed and predicted size at recapture is approximately equal to the variance specified in the simulation, as is to be expected.

The model and fitting procedure are not at all robust to errors in size measurement at release (Figure 3), which cause estimates of k and L_∞ to be significantly different from the "true" values in the simulation at the 95 per cent level. This result should not be surprising since by Equation (7) errors in size at release are propagated by a factor of $e^{-b\Delta t}$.

FIGURE 6. ESTIMATES OF VON BERTALANFFY PARAMETERS FOR SEVERAL DATA SETS. Symbols indicate different visits; different positions of the same symbol are the results of application of different time-at-liberty and size-at-release criteria to extract the data (see Section 4.2).



Estimation of growth parameters from tag and recapture data superficially resembles a problem in multiple regression, in which the "independent" variables (size-at-release and time-at-liberty) are assumed to be known exactly without error. In reality, it is an example of a "structural relationship" problem (Kendall and Stuart 1979) in which errors are acknowledged to occur in the so-called "independent" variable. The exact solution to the structural relationship problem requires some *a priori* knowledge of the variance of the error in all variables. Such information is usually not available, and therefore no generally useful solution exists. The present case is no exception, and the problem would appear to be a very serious one for tag and recovery experiments. An error with mean 0 and standard deviation as low as one centimetre added to the size at release produces biased parameter estimates which differ significantly from their true values at the 95 per cent level. It should be pointed out that this conclusion is not restricted to data generated by the Skipjack Programme but applies to all estimates of growth model parameters from tag and recapture data without regard to the model being fitted or the animal to which the model is applied.

4.3 Regional Comparisons

Differences in both maximum size and growth rate between eastern and western Pacific skipjack have been previously noted (Skipjack Programme 1981). Differences in size increments can be seen in Table 4 for data sets EAST and WEST. These data sets were paired so that the mean sizes at release and mean days at liberty were very similar. Thus differences in size increments can be attributed to differences in growth rate. For a 47-day period at liberty, the mean size increase for eastern Pacific fish is more than one centimetre greater than that for western Pacific fish. Differences in growth are also expressed in differences in the von Bertalanffy parameters. The eastern Pacific fish show higher L_∞ and smaller k values than the western Pacific fish (Table 10). Eastern Pacific skipjack thus appear able to grow to a larger size than those in the western Pacific. The western fish, although not achieving such a large size, reach their maximum size more rapidly than the eastern fish. The reasons for this difference are unknown. From the distribution of juvenile skipjack, Klawe (1963) concluded that there is very little spawning activity in the eastern Pacific. Perhaps the lack of reproductive activity enables eastern Pacific fish to invest more metabolic resources into growth.

To the extent that biological parameters regulating growth are stable during the life of a fish, variation in growth may be used as an indicator of biologically distinct groups. Results presented here show that there are significant geographical differences in both growth increments and von Bertalanffy parameter estimates. These differences are not stable, however. Repeated visits to the same region yield significantly different estimates of growth increments. Further, growth increments of fish released in one area, but recovered in different areas, also produce significantly different growth increments. Thus analysis of growth does not support the hypothesis of genetically distinct subpopulations of skipjack in the central and western Pacific. Rather, variation of growth is more likely attributable to temporal and spatial variation in environmental conditions.

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APPENDIX A. COMPLETE SUMMARY OF GROWTH INCREMENTS BY VISIT. Results are reported by three size-at-release classes: 30-49, 50-70 and 30-70 cm, and by seven time-at-liberty classes: 0-9, 10-29, 30-89, 90-179, 180-365, 366-730, and 10-365 days. Country abbreviations are explained in Appendix B.

Growth Summary for Skipjack Tagged During Visit FIJ1

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
FIJ	30.0 - 49.0	0 - 9	138	46.4	1.8	46.8	2.2	6.5	2.3	0.38	1.83	60.9
FIJ	30.0 - 49.0	10 - 29	252	45.8	1.6	46.3	2.2	19.1	6.0	0.48	1.59	56.0
FIJ	30.0 - 49.0	30 - 89	31	45.8	1.6	48.0	2.4	42.3	13.7	2.19	1.83	19.4
FIJ	30.0 - 49.0	90 - 179	12	45.8	1.4	53.3	1.7	110.3	17.8	7.50	2.28	0.0
FIJ	30.0 - 49.0	180 - 365	1	49.0	0.0	52.0	0.0	322.0	0.0	3.00	0.00	0.0
FIJ	30.0 - 49.0	366 - 730	1	48.0	0.0	51.0	0.0	434.0	0.0	3.00	0.00	0.0
FIJ	30.0 - 49.0	10 - 365	296	45.8	1.6	46.8	2.7	26.3	26.7	0.95	2.19	49.7
FIJ	50.0 - 70.0	0 - 9	103	51.8	2.1	51.4	2.3	7.0	2.4	-0.43	2.01	74.8
FIJ	50.0 - 70.0	10 - 29	126	52.6	2.9	52.5	2.9	14.1	5.1	-0.08	2.30	54.8
FIJ	50.0 - 70.0	30 - 89	7	53.1	4.1	53.1	2.2	49.9	15.2	0.00	3.32	42.9
FIJ	50.0 - 70.0	90 - 179	1	50.0	0.0	55.0	0.0	95.0	0.0	5.00	0.00	0.0
FIJ	50.0 - 70.0	180 - 365	1	53.0	0.0	56.0	0.0	315.0	0.0	3.00	0.00	0.0
FIJ	50.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
FIJ	50.0 - 70.0	10 - 365	135	52.6	2.9	52.6	2.8	18.8	28.3	-0.01	2.39	53.3
FIJ	30.0 - 70.0	0 - 9	241	48.7	3.3	48.8	3.2	6.7	2.4	0.03	1.94	66.8
FIJ	30.0 - 70.0	10 - 29	378	48.1	3.8	48.4	3.8	17.5	6.2	0.29	1.87	55.6
FIJ	30.0 - 70.0	30 - 89	38	47.1	3.6	48.9	3.1	43.7	14.0	1.79	2.29	23.7
FIJ	30.0 - 70.0	90 - 179	13	46.1	1.8	53.4	1.7	109.1	17.5	7.31	2.29	0.0
FIJ	30.0 - 70.0	180 - 365	2	51.0	2.8	54.0	2.8	318.5	4.9	3.00	0.00	0.0
FIJ	30.0 - 70.0	366 - 730	1	48.0	0.0	51.0	0.0	434.0	0.0	3.00	0.00	0.0
FIJ	30.0 - 70.0	10 - 365	431	48.0	3.8	48.6	3.8	23.9	27.4	0.65	2.29	50.8
Other	30.0 - 70.0	10 - 365	3	51.3	0.6	55.3	2.3	209.0	68.7	4.00	2.65	0.0

Growth Summary for Skipjack Tagged During Visit FIJ2

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
FIJ	30.0 - 49.0	0 - 9	154	47.7	1.8	48.7	2.2	5.0	2.0	0.99	1.80	42.2
FIJ	30.0 - 49.0	10 - 29	27	47.7	1.8	50.9	2.3	14.1	2.6	3.19	2.72	7.4
FIJ	30.0 - 49.0	30 - 89	3	44.0	3.6	51.0	5.6	81.3	2.1	7.00	6.24	0.0
FIJ	30.0 - 49.0	90 - 179	6	47.3	2.4	47.5	7.7	121.7	22.7	0.17	8.13	33.3
FIJ	30.0 - 49.0	180 - 365	32	46.7	2.5	57.9	6.1	314.3	27.6	11.22	5.74	3.1
FIJ	30.0 - 49.0	366 - 730	1	49.0	0.0	68.0	0.0	473.0	0.0	19.00	0.00	0.0
FIJ	30.0 - 49.0	10 - 365	68	47.0	2.4	53.9	6.3	167.8	143.8	6.87	6.54	7.4
FIJ	50.0 - 70.0	0 - 9	368	52.6	2.2	52.7	2.5	4.6	2.6	0.07	1.78	64.7
FIJ	50.0 - 70.0	10 - 29	98	53.0	2.3	54.5	3.2	13.8	2.3	1.43	2.40	31.6
FIJ	50.0 - 70.0	30 - 89	7	52.3	1.8	53.4	4.9	66.0	17.4	1.14	4.71	42.9
FIJ	50.0 - 70.0	90 - 179	9	55.8	2.6	62.3	4.3	120.8	10.5	6.56	4.00	0.0
FIJ	50.0 - 70.0	180 - 365	26	53.5	1.7	60.3	5.6	318.9	24.5	6.81	5.25	15.4
FIJ	50.0 - 70.0	366 - 730	4	54.0	2.4	72.3	6.2	636.0	65.2	18.25	7.50	0.0
FIJ	50.0 - 70.0	10 - 365	140	53.3	2.3	56.0	4.8	79.9	118.4	2.74	4.03	27.1
FIJ	30.0 - 70.0	0 - 9	522	51.2	3.1	51.5	3.1	4.7	2.4	0.34	1.83	58.0
FIJ	30.0 - 70.0	10 - 29	125	51.9	3.1	53.7	3.3	13.8	2.4	1.81	2.56	26.4
FIJ	30.0 - 70.0	30 - 89	10	49.8	4.6	52.7	4.9	70.6	16.0	2.90	5.61	30.0
FIJ	30.0 - 70.0	90 - 179	15	52.4	4.9	56.4	9.4	121.1	15.7	4.00	6.58	13.3
FIJ	30.0 - 70.0	180 - 365	58	49.7	4.1	59.0	6.0	316.3	26.2	9.24	5.91	8.6
FIJ	30.0 - 70.0	366 - 730	5	53.0	3.1	71.4	5.7	603.4	92.2	18.40	6.50	0.0
FIJ	30.0 - 70.0	10 - 365	208	51.2	3.7	55.3	5.4	108.7	133.5	4.09	5.34	20.7
Other	30.0 - 70.0	10 - 365	9	51.7	3.2	61.3	11.1	237.8	93.7	9.67	11.86	11.1

Growth Summary for Skipjack Tagged During Visit KIR1

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
KIR	30.0 - 49.0	0 - 9	14	47.4	1.1	48.8	1.5	6.4	2.2	1.36	1.45	42.9
KIR	30.0 - 49.0	10 - 29	34	47.6	1.3	48.9	1.7	20.6	5.5	1.26	1.60	50.0
KIR	30.0 - 49.0	30 - 89	149	47.5	1.3	48.8	1.7	52.9	17.5	1.34	1.67	32.2
KIR	30.0 - 49.0	90 - 179	39	47.4	1.0	51.3	1.9	100.2	12.0	3.87	2.04	0.0
KIR	30.0 - 49.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
KIR	30.0 - 49.0	366 - 730	1	46.0	0.0	52.0	0.0	408.0	0.0	6.00	0.00	0.0
KIR	30.0 - 49.0	10 - 365	222	47.5	1.3	49.3	2.0	56.3	27.9	1.77	1.98	29.3
KIR	50.0 - 70.0	0 - 9	3	50.7	1.2	51.7	1.2	7.3	1.5	1.00	2.00	33.3
KIR	50.0 - 70.0	10 - 29	14	51.6	1.4	51.7	1.3	18.0	7.2	0.07	.92	64.3
KIR	50.0 - 70.0	30 - 89	34	51.9	2.7	51.6	2.5	57.7	18.2	-0.29	2.74	67.6
KIR	50.0 - 70.0	90 - 179	9	51.3	2.1	52.8	1.2	100.7	17.7	1.44	2.24	33.3
KIR	50.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
KIR	50.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
KIR	50.0 - 70.0	10 - 365	57	51.8	2.3	51.8	2.1	54.8	30.6	0.07	2.39	61.4
KIR	30.0 - 70.0	0 - 9	17	48.0	1.7	49.3	1.8	6.5	2.1	1.29	1.49	41.2
KIR	30.0 - 70.0	10 - 29	48	48.8	2.3	49.7	2.1	19.9	6.1	0.92	1.53	54.2
KIR	30.0 - 70.0	30 - 89	183	48.3	2.4	49.3	2.1	53.8	17.7	1.04	2.01	38.8
KIR	30.0 - 70.0	90 - 179	48	48.2	2.0	51.6	1.9	100.3	13.1	3.42	2.27	6.3
KIR	30.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
KIR	30.0 - 70.0	366 - 730	1	46.0	0.0	52.0	0.0	408.0	0.0	6.00	0.00	0.0
KIR	30.0 - 70.0	10 - 365	279	48.4	2.3	49.8	2.2	56.0	28.4	1.43	2.18	35.8
Other	30.0 - 70.0	10 - 365	15	51.0	3.5	55.2	3.8	137.3	67.3	4.20	3.43	13.3

Growth Summary for Skipjack Tagged During Visit MAQ2

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
MAQ	30.0 - 49.0	0 - 9	10	46.5	2.1	46.3	2.0	4.5	3.3	-0.20	0.42	100.0
MAQ	30.0 - 49.0	10 - 29	17	47.4	1.3	47.7	1.3	15.6	4.7	0.29	0.69	70.6
MAQ	30.0 - 49.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
MAQ	30.0 - 49.0	90 - 179	1	46.0	0.0	42.0	0.0	120.0	0.0	-4.00	0.00	100.0
MAQ	30.0 - 49.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
MAQ	30.0 - 49.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
MAQ	30.0 - 49.0	10 - 365	18	47.3	1.3	47.4	1.9	21.4	25.0	0.06	1.21	72.2
MAQ	50.0 - 70.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
MAQ	50.0 - 70.0	10 - 29	8	50.5	0.8	49.5	1.6	13.3	2.3	-1.00	1.31	100.0
MAQ	50.0 - 70.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
MAQ	50.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
MAQ	50.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
MAQ	50.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
MAQ	50.0 - 70.0	10 - 365	8	50.5	0.8	49.5	1.6	13.3	2.3	-1.00	1.31	100.0
MAQ	30.0 - 70.0	0 - 9	10	46.5	2.1	46.3	2.0	4.5	3.3	-0.20	0.42	100.0
MAQ	30.0 - 70.0	10 - 29	25	48.4	1.9	48.3	1.6	14.9	4.2	-0.12	1.09	80.0
MAQ	30.0 - 70.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
MAQ	30.0 - 70.0	90 - 179	1	46.0	0.0	42.0	0.0	120.0	0.0	-4.00	0.00	100.0
MAQ	30.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
MAQ	30.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
MAQ	30.0 - 70.0	10 - 365	26	48.3	1.9	48.0	2.0	18.9	21.0	-0.27	1.31	80.8
Other	30.0 - 70.0	10 - 365	3	48.0	2.6	60.0	1.0	273.7	23.0	12.00	3.00	0.0

Growth Summary for Skipjack Tagged During Visit PAL1

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
PAL	30.0 - 49.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 49.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 49.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 49.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 49.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 49.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 49.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	50.0 - 70.0	0 - 9	16	57.6	3.9	57.1	4.3	6.7	0.8	-0.50	3.93	68.8
PAL	50.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	50.0 - 70.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	50.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	50.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	50.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	50.0 - 70.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 70.0	0 - 9	16	57.6	3.9	57.1	4.3	6.7	0.8	-0.50	3.93	68.8
PAL	30.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 70.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 70.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
Other	30.0 - 70.0	10 - 365	14	59.0	2.7	63.1	3.8	113.6	49.5	4.14	4.59	21.4

Growth Summary for Skipjack Tagged During Visit PAL3

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
PAL	30.0 - 49.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 49.0	10 - 29	3	40.3	3.5	45.7	4.0	25.7	2.1	5.33	5.13	0.0
PAL	30.0 - 49.0	30 - 89	7	38.4	1.8	44.6	4.8	44.0	5.7	6.14	4.34	0.0
PAL	30.0 - 49.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 49.0	180 - 365	3	38.7	2.1	51.7	7.6	253.3	7.2	13.00	5.57	0.0
PAL	30.0 - 49.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 49.0	10 - 365	13	38.9	2.3	46.5	5.7	88.1	94.7	7.54	5.36	0.0
PAL	50.0 - 70.0	0 - 9	1	62.0	0.0	62.0	0.0	0.0	0.0	0.00	0.00	100.0
PAL	50.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	50.0 - 70.0	30 - 89	1	65.0	0.0	65.0	0.0	49.0	0.0	0.00	0.00	100.0
PAL	50.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	50.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	50.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	50.0 - 70.0	10 - 365	1	65.0	0.0	65.0	0.0	49.0	0.0	0.00	0.00	100.0
PAL	30.0 - 70.0	0 - 9	1	62.0	0.0	62.0	0.0	0.0	0.0	0.00	0.00	100.0
PAL	30.0 - 70.0	10 - 29	3	40.3	3.5	45.7	4.0	25.7	2.1	5.33	5.13	0.0
PAL	30.0 - 70.0	30 - 89	8	41.8	9.5	47.1	8.5	44.6	5.6	5.38	4.57	12.5
PAL	30.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 70.0	180 - 365	3	38.7	2.1	51.7	7.6	253.3	7.2	13.00	5.57	0.0
PAL	30.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PAL	30.0 - 70.0	10 - 365	14	40.8	7.3	47.8	7.4	85.3	91.5	7.00	5.53	7.1
Other	30.0 - 70.0	10 - 365	143	40.6	5.0	49.3	5.7	171.0	90.0	8.71	6.49	9.8

Growth Summary for Skipjack Tagged During Visit PNG0

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
PNG	30.0 - 49.0	0 - 9	3	48.7	0.6	50.7	4.7	6.7	1.5	2.00	5.29	66.7
PNG	30.0 - 49.0	10 - 29	5	48.6	0.5	49.8	1.3	21.8	7.4	1.20	0.84	20.0
PNG	30.0 - 49.0	30 - 89	3	47.0	2.0	49.3	1.5	58.7	27.7	2.33	0.58	0.0
PNG	30.0 - 49.0	90 - 179	3	47.0	1.7	52.3	4.0	149.0	45.0	5.33	4.16	0.0
PNG	30.0 - 49.0	180 - 365	4	47.5	1.7	53.3	3.2	244.8	58.0	5.75	2.22	0.0
PNG	30.0 - 49.0	366 - 730	1	49.0	0.0	52.0	0.0	390.0	0.0	3.00	0.00	0.0
PNG	30.0 - 49.0	10 - 365	15	47.7	1.5	51.1	2.9	114.1	99.9	3.47	2.85	6.7
PNG	50.0 - 70.0	0 - 9	62	54.6	2.4	55.4	3.4	4.8	2.6	0.73	3.03	51.6
PNG	50.0 - 70.0	10 - 29	86	55.2	2.3	56.2	2.6	17.7	6.1	0.93	2.18	41.9
PNG	50.0 - 70.0	30 - 89	110	54.5	2.0	55.6	2.7	53.8	17.2	1.13	1.89	38.2
PNG	50.0 - 70.0	90 - 179	36	55.4	3.2	58.0	3.6	124.8	25.5	2.61	2.06	8.3
PNG	50.0 - 70.0	180 - 365	43	55.3	3.0	59.2	3.0	273.2	57.3	3.84	2.84	16.3
PNG	50.0 - 70.0	366 - 730	21	54.5	2.9	60.8	3.0	436.9	66.7	6.33	2.65	4.8
PNG	50.0 - 70.0	10 - 365	275	55.0	2.5	56.7	3.1	86.1	91.0	1.68	2.41	32.0
PNG	30.0 - 70.0	0 - 9	65	54.4	2.6	55.2	3.6	4.9	2.6	0.78	3.11	52.3
PNG	30.0 - 70.0	10 - 29	91	54.9	2.7	55.8	2.9	18.0	6.2	0.95	2.13	40.7
PNG	30.0 - 70.0	30 - 89	113	54.3	2.4	55.5	2.9	54.0	17.4	1.16	1.88	37.2
PNG	30.0 - 70.0	90 - 179	39	54.7	3.8	57.5	3.9	126.7	27.4	2.82	2.32	7.7
PNG	30.0 - 70.0	180 - 365	47	54.7	3.6	58.7	3.4	270.7	57.3	4.00	2.82	14.9
PNG	30.0 - 70.0	366 - 730	22	54.2	3.1	60.4	3.5	434.7	65.8	6.18	2.68	4.5
PNG	30.0 - 70.0	10 - 365	290	54.6	2.9	56.4	3.4	87.6	91.5	1.78	2.46	30.7
Other	30.0 - 70.0	10 - 365	16	53.4	3.6	57.6	2.9	229.7	74.5	4.25	3.86	12.5

Growth Summary for Skipjack Tagged During Visit PNG2

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
PNG	30.0 - 49.0	0 - 9	16	47.7	1.5	51.1	4.6	6.6	2.4	3.44	4.59	50.0
PNG	30.0 - 49.0	10 - 29	17	45.9	3.6	47.8	4.7	21.4	6.2	1.82	2.13	29.4
PNG	30.0 - 49.0	30 - 89	15	45.9	3.5	51.0	5.9	56.7	18.9	5.07	5.42	0.0
PNG	30.0 - 49.0	90 - 179	3	44.7	2.3	53.7	4.7	125.7	46.4	9.00	7.00	0.0
PNG	30.0 - 49.0	180 - 365	3	44.7	4.2	55.0	3.0	198.0	17.8	10.33	2.89	0.0
PNG	30.0 - 49.0	366 - 730	1	46.0	0.0	58.0	0.0	412.0	0.0	12.00	0.00	0.0
PNG	30.0 - 49.0	10 - 365	38	45.7	3.4	50.1	5.5	57.5	53.5	4.34	4.89	13.2
PNG	50.0 - 70.0	0 - 9	163	54.6	3.2	54.6	4.0	5.3	2.7	0.05	3.04	66.3
PNG	50.0 - 70.0	10 - 29	210	54.6	2.2	54.5	2.3	19.9	5.8	-0.10	1.87	69.0
PNG	50.0 - 70.0	30 - 89	271	55.3	2.6	55.7	3.1	48.8	17.6	0.34	2.39	50.2
PNG	50.0 - 70.0	90 - 179	82	56.0	2.8	57.5	5.1	115.2	19.3	1.44	5.08	37.8
PNG	50.0 - 70.0	180 - 365	8	56.0	3.3	60.3	3.8	288.5	54.4	4.25	2.76	12.5
PNG	50.0 - 70.0	366 - 730	15	54.3	3.1	62.7	5.4	441.7	27.4	8.33	5.35	6.7
PNG	50.0 - 70.0	10 - 365	571	55.2	2.5	55.6	3.4	51.1	44.6	0.39	2.87	54.8
PNG	30.0 - 70.0	0 - 9	179	54.0	3.7	54.3	4.2	5.5	2.7	0.35	3.33	64.8
PNG	30.0 - 70.0	10 - 29	227	54.0	3.3	54.0	3.1	20.0	5.9	0.04	1.95	66.1
PNG	30.0 - 70.0	30 - 89	286	54.8	3.3	55.4	3.4	49.2	17.7	0.58	2.82	47.6
PNG	30.0 - 70.0	90 - 179	85	55.6	3.5	57.3	5.1	115.6	20.4	1.71	5.30	36.5
PNG	30.0 - 70.0	180 - 365	11	52.9	6.3	58.8	4.3	263.8	62.6	5.91	3.88	9.1
PNG	30.0 - 70.0	366 - 730	16	53.8	3.6	62.4	5.3	439.8	27.4	8.56	5.25	6.3
PNG	30.0 - 70.0	10 - 365	609	54.6	3.5	55.2	3.8	51.5	45.2	0.63	3.17	52.2
Other	30.0 - 70.0	10 - 365	37	51.5	4.1	56.8	5.9	197.8	93.3	5.32	4.58	10.8

Growth Summary for Skipjack Tagged During Visit PON1

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
PON	30.0 - 49.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 49.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 49.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 49.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 49.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 49.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 49.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	50.0 - 70.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	50.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	50.0 - 70.0	30 - 89	5	52.4	0.9	56.0	3.1	55.4	23.4	3.60	3.21	0.0
PON	50.0 - 70.0	90 - 179	1	52.0	0.0	56.0	0.0	130.0	0.0	4.00	0.00	0.0
PON	50.0 - 70.0	180 - 365	1	63.0	0.0	68.0	0.0	186.0	0.0	5.00	0.00	0.0
PON	50.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	50.0 - 70.0	10 - 365	7	53.9	4.1	57.7	5.2	84.7	56.0	3.86	2.67	0.0
PON	30.0 - 70.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 70.0	30 - 89	5	52.4	0.9	56.0	3.1	55.4	23.4	3.60	3.21	0.0
PON	30.0 - 70.0	90 - 179	1	52.0	0.0	56.0	0.0	130.0	0.0	4.00	0.00	0.0
PON	30.0 - 70.0	180 - 365	1	63.0	0.0	68.0	0.0	186.0	0.0	5.00	0.00	0.0
PON	30.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 70.0	10 - 365	7	53.9	4.1	57.7	5.2	84.7	56.0	3.86	2.67	0.0
Other	30.0 - 70.0	10 - 365	12	53.9	2.2	57.6	2.5	152.4	100.4	3.67	3.37	0.0

Growth Summary for Skipjack Tagged During Visit PON3

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
PON	30.0 - 49.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 49.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 49.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 49.0	90 - 179	1	48.0	0.0	57.0	0.0	170.0	0.0	9.00	0.00	0.0
PON	30.0 - 49.0	180 - 365	3	48.3	0.6	55.3	2.1	196.3	16.2	7.00	2.00	0.0
PON	30.0 - 49.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 49.0	10 - 365	4	48.3	0.5	55.8	1.9	189.8	18.6	7.50	1.91	0.0
PON	50.0 - 70.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	50.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	50.0 - 70.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	50.0 - 70.0	90 - 179	5	54.4	4.9	58.0	4.5	111.2	32.7	3.60	0.55	0.0
PON	50.0 - 70.0	180 - 365	4	50.8	0.5	57.5	2.4	217.3	1.7	6.75	2.06	0.0
PON	50.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	50.0 - 70.0	10 - 365	9	52.8	4.0	57.8	3.5	158.3	60.5	5.00	2.12	0.0
PON	30.0 - 70.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 70.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 70.0	90 - 179	6	53.3	5.1	57.8	4.1	121.0	37.8	4.50	2.26	0.0
PON	30.0 - 70.0	180 - 365	7	49.7	1.4	56.6	2.4	208.3	14.6	6.86	1.86	0.0
PON	30.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
PON	30.0 - 70.0	10 - 365	13	51.4	3.9	57.2	3.2	168.0	52.5	5.77	2.31	0.0
Other	30.0 - 70.0	10 - 365	43	55.4	6.1	59.9	6.4	186.0	81.9	4.47	4.30	14.0

Growth Summary for Skipjack Tagged During Visit SOL1

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
SOL	30.0 - 49.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
SOL	30.0 - 49.0	10 - 29	1	49.0	0.0	47.0	0.0	14.0	0.0	-2.00	0.00	100.0
SOL	30.0 - 49.0	30 - 89	1	48.0	0.0	47.0	0.0	33.0	0.0	-1.00	0.00	100.0
SOL	30.0 - 49.0	90 - 179	1	46.0	0.0	55.0	0.0	167.0	0.0	9.00	0.00	0.0
SOL	30.0 - 49.0	180 - 365	5	48.2	1.1	53.6	2.4	310.2	73.3	5.40	2.79	0.0
SOL	30.0 - 49.0	366 - 730	3	49.0	0.0	59.7	10.0	481.3	84.6	10.67	10.02	0.0
SOL	30.0 - 49.0	10 - 365	8	48.0	1.2	52.1	3.7	220.6	142.6	4.13	4.26	25.0
SOL	50.0 - 70.0	0 - 9	1	50.0	0.0	48.0	0.0	6.0	0.0	-2.00	0.00	100.0
SOL	50.0 - 70.0	10 - 29	6	52.3	1.0	49.3	0.8	15.5	5.1	-3.00	1.55	100.0
SOL	50.0 - 70.0	30 - 89	4	53.3	1.5	51.5	1.3	35.0	3.4	-1.75	0.96	100.0
SOL	50.0 - 70.0	90 - 179	3	51.0	1.0	56.3	2.1	172.0	8.7	5.33	1.15	0.0
SOL	50.0 - 70.0	180 - 365	17	53.3	2.0	57.4	2.7	282.4	46.0	4.06	3.47	11.8
SOL	50.0 - 70.0	366 - 730	11	52.8	1.3	58.8	2.7	392.9	18.3	6.00	2.90	0.0
SOL	50.0 - 70.0	10 - 365	30	52.9	1.8	54.9	4.0	185.0	125.7	2.00	4.24	40.0
SOL	30.0 - 70.0	0 - 9	1	50.0	0.0	48.0	0.0	6.0	0.0	-2.00	0.00	100.0
SOL	30.0 - 70.0	10 - 29	7	51.9	1.6	49.0	1.2	15.3	4.7	-2.86	1.46	100.0
SOL	30.0 - 70.0	30 - 89	5	52.2	2.7	50.6	2.3	34.6	3.0	-1.60	0.89	100.0
SOL	30.0 - 70.0	90 - 179	4	49.8	2.6	56.0	1.8	170.8	7.5	6.25	2.06	0.0
SOL	30.0 - 70.0	180 - 365	22	52.1	2.8	56.5	3.0	288.7	52.7	4.36	3.32	9.1
SOL	30.0 - 70.0	366 - 730	14	52.0	2.0	59.0	4.6	411.9	52.7	7.00	5.08	0.0
SOL	30.0 - 70.0	10 - 365	38	51.8	2.6	54.3	4.1	192.5	128.2	2.45	4.28	36.8
Other	30.0 - 70.0	10 - 365	2	52.5	0.7	57.5	0.7	199.0	4.2	5.00	0.00	0.0

Growth Summary for Skipjack Tagged During Visit TRK1

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
TRK	30.0 - 49.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 49.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 49.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 49.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 49.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 49.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 49.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	50.0 - 70.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	50.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	50.0 - 70.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	50.0 - 70.0	90 - 179	1	50.0	0.0	56.0	0.0	121.0	0.0	6.00	0.00	0.0
TRK	50.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	50.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	50.0 - 70.0	10 - 365	1	50.0	0.0	56.0	0.0	121.0	0.0	6.00	0.00	0.0
TRK	30.0 - 70.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 70.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 70.0	90 - 179	1	50.0	0.0	56.0	0.0	121.0	0.0	6.00	0.00	0.0
TRK	30.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 70.0	10 - 365	1	50.0	0.0	56.0	0.0	121.0	0.0	6.00	0.00	0.0
Other	30.0 - 70.0	10 - 365	10	49.7	0.9	56.7	2.7	152.6	42.0	7.00	2.79	0.0

Growth Summary for Skipjack Tagged During Visit TRK2

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
TRK	30.0 - 49.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 49.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 49.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 49.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 49.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 49.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 49.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	50.0 - 70.0	0 - 9	1	52.0	0.0	52.0	0.0	0.0	0.0	0.00	0.00	100.0
TRK	50.0 - 70.0	10 - 29	1	53.0	0.0	54.0	0.0	21.0	0.0	1.00	0.00	0.0
TRK	50.0 - 70.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	50.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	50.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	50.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	50.0 - 70.0	10 - 365	1	53.0	0.0	54.0	0.0	21.0	0.0	1.00	0.00	0.0
TRK	30.0 - 70.0	0 - 9	1	52.0	0.0	52.0	0.0	0.0	0.0	0.00	0.00	100.0
TRK	30.0 - 70.0	10 - 29	1	53.0	0.0	54.0	0.0	21.0	0.0	1.00	0.00	0.0
TRK	30.0 - 70.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
TRK	30.0 - 70.0	10 - 365	1	53.0	0.0	54.0	0.0	21.0	0.0	1.00	0.00	0.0
Other	30.0 - 70.0	10 - 365	6	53.5	1.6	60.0	3.4	186.2	96.1	6.50	4.04	16.7

Growth Summary for Skipjack Tagged During Visit VAN1

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
VAN	30.0 - 49.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	30.0 - 49.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	30.0 - 49.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	30.0 - 49.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	30.0 - 49.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	30.0 - 49.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	30.0 - 49.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	50.0 - 70.0	0 - 9	1	52.0	0.0	52.0	0.0	0.0	0.0	0.00	0.00	100.0
VAN	50.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	50.0 - 70.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	50.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	50.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	50.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	50.0 - 70.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	30.0 - 70.0	0 - 9	1	52.0	0.0	52.0	0.0	0.0	0.0	0.00	0.00	100.0
VAN	30.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	30.0 - 70.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	30.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	30.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	30.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
VAN	30.0 - 70.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
Other	30.0 - 70.0	10 - 365	3	50.7	1.2	57.3	2.5	261.0	7.5	6.67	2.89	0.0

Growth Summary for Skipjack Tagged During Visit WAL1

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
WAL	30.0 - 49.0	0 - 9	1	49.0	0.0	50.0	0.0	1.0	0.0	1.00	0.00	0.0
WAL	30.0 - 49.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 49.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 49.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 49.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 49.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 49.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	50.0 - 70.0	0 - 9	39	53.4	4.4	53.4	4.3	0.4	1.2	0.00	0.79	94.9
WAL	50.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	50.0 - 70.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	50.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	50.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	50.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	50.0 - 70.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 70.0	0 - 9	40	53.3	4.4	53.3	4.3	0.4	1.2	0.02	0.80	92.5
WAL	30.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 70.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 70.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
Other	30.0 - 70.0	10 - 365	22	53.0	4.0	54.4	5.3	198.5	74.7	1.36	2.77	40.9

Growth Summary for Skipjack Tagged During Visit WAL2

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
WAL	30.0 - 49.0	0 - 9	2	49.0	0.0	49.5	0.7	0.0	0.0	0.50	0.71	50.0
WAL	30.0 - 49.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 49.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 49.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 49.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 49.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 49.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	50.0 - 70.0	0 - 9	11	52.4	1.9	52.5	2.6	0.0	0.0	0.18	2.09	90.9
WAL	50.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	50.0 - 70.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	50.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	50.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	50.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	50.0 - 70.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 70.0	0 - 9	13	51.8	2.2	52.1	2.6	0.0	0.0	0.23	1.92	84.6
WAL	30.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 70.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WAL	30.0 - 70.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
Other	30.0 - 70.0	10 - 365	7	52.9	5.3	57.1	5.1	242.7	76.3	4.29	5.22	14.3

Growth Summary for Skipjack Tagged During Visit ZEA1

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
ZEA	30.0 - 49.0	0 - 9	244	45.8	1.6	46.0	1.7	3.2	2.2	0.14	1.43	79.1
ZEA	30.0 - 49.0	10 - 29	191	45.5	1.3	45.7	1.8	13.7	5.3	0.16	1.58	76.4
ZEA	30.0 - 49.0	30 - 89	2	45.0	2.8	45.0	1.4	51.5	16.3	0.00	1.41	50.0
ZEA	30.0 - 49.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	30.0 - 49.0	180 - 365	13	46.8	1.0	52.8	1.3	327.2	16.4	6.08	1.38	0.0
ZEA	30.0 - 49.0	366 - 730	3	46.3	1.5	52.3	5.0	428.7	51.9	6.00	6.56	33.3
ZEA	30.0 - 49.0	10 - 365	206	45.6	1.3	46.1	2.5	33.9	76.7	0.53	2.12	71.4
ZEA	50.0 - 70.0	0 - 9	31	52.4	3.6	51.0	2.1	2.8	1.2	-1.32	4.22	80.6
ZEA	50.0 - 70.0	10 - 29	2	52.0	2.8	51.5	3.5	13.0	4.2	-0.50	0.71	100.0
ZEA	50.0 - 70.0	30 - 89	2	53.0	4.2	53.5	3.5	55.5	3.5	0.50	0.71	50.0
ZEA	50.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	50.0 - 70.0	180 - 365	3	50.7	1.2	59.3	0.6	322.0	8.5	8.67	0.58	0.0
ZEA	50.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	50.0 - 70.0	10 - 365	7	51.7	2.4	55.4	4.3	157.6	154.9	3.71	4.68	42.9
ZEA	30.0 - 70.0	0 - 9	275	46.6	2.8	46.5	2.4	3.1	2.1	-0.03	2.00	79.3
ZEA	30.0 - 70.0	10 - 29	193	45.6	1.4	45.7	1.9	13.7	5.3	0.16	1.57	76.7
ZEA	30.0 - 70.0	30 - 89	4	49.0	5.5	49.3	5.4	53.5	9.9	0.25	0.96	50.0
ZEA	30.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	30.0 - 70.0	180 - 365	16	47.5	1.9	54.1	2.9	326.3	15.1	6.56	1.63	0.0
ZEA	30.0 - 70.0	366 - 730	3	46.3	1.5	52.3	5.0	428.7	51.9	6.00	6.56	33.3
ZEA	30.0 - 70.0	10 - 365	213	45.8	1.7	46.4	3.1	37.9	82.8	0.64	2.30	70.4
Other	30.0 - 70.0	10 - 365	11	47.5	4.2	54.2	6.4	305.7	71.3	6.64	3.41	0.0

Growth Summary for Skipjack Tagged During Visit ZEA2

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
ZEA	30.0 - 49.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	30.0 - 49.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	30.0 - 49.0	30 - 89	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	30.0 - 49.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	30.0 - 49.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	30.0 - 49.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	30.0 - 49.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	50.0 - 70.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	50.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	50.0 - 70.0	30 - 89	1	54.0	0.0	54.0	0.0	76.0	0.0	0.00	0.00	100.0
ZEA	50.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	50.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	50.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	50.0 - 70.0	10 - 365	1	54.0	0.0	54.0	0.0	76.0	0.0	0.00	0.00	100.0
ZEA	30.0 - 70.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	30.0 - 70.0	10 - 29	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	30.0 - 70.0	30 - 89	1	54.0	0.0	54.0	0.0	76.0	0.0	0.00	0.00	100.0
ZEA	30.0 - 70.0	90 - 179	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	30.0 - 70.0	180 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	30.0 - 70.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
ZEA	30.0 - 70.0	10 - 365	1	54.0	0.0	54.0	0.0	76.0	0.0	0.00	0.00	100.0
Other	30.0 - 70.0	10 - 365	3	50.3	8.1	57.7	4.5	323.7	14.6	7.33	4.51	0.0

Growth Summary for Skipjack Tagged During Visit EAST

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
EAST	30.0 - 49.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
EAST	30.0 - 49.0	10 - 29	40	46.9	1.6	48.9	2.7	18.3	4.6	2.00	2.73	32.5
EAST	30.0 - 49.0	30 - 89	34	46.9	1.7	49.2	2.6	50.0	15.4	2.26	3.01	29.4
EAST	30.0 - 49.0	90 - 179	6	46.2	2.5	50.2	2.3	113.2	15.6	4.00	2.37	0.0
EAST	30.0 - 49.0	180 - 365	2	48.0	1.4	58.0	0.0	208.0	32.5	10.00	1.41	0.0
EAST	30.0 - 49.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
EAST	30.0 - 49.0	10 - 365	82	46.9	1.7	49.4	2.9	43.0	38.6	2.45	3.06	28.0
EAST	50.0 - 70.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
EAST	50.0 - 70.0	10 - 29	140	52.7	3.2	54.0	4.0	18.1	4.5	1.36	2.35	32.9
EAST	50.0 - 70.0	30 - 89	96	51.8	2.7	54.5	3.3	49.7	17.7	2.74	2.21	14.6
EAST	50.0 - 70.0	90 - 179	33	52.9	2.9	58.2	3.4	124.0	26.5	5.24	2.62	3.0
EAST	50.0 - 70.0	180 - 365	9	52.1	2.7	60.2	3.5	224.2	38.2	8.11	2.85	0.0
EAST	50.0 - 70.0	366 - 730	1	54.0	0.0	68.0	0.0	368.0	0.0	14.00	0.00	0.0
EAST	50.0 - 70.0	10 - 365	278	52.4	3.0	54.9	4.0	48.2	48.9	2.51	2.84	21.9
EAST	30.0 - 70.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
EAST	30.0 - 70.0	10 - 29	180	51.4	3.8	52.9	4.3	18.1	4.5	1.50	2.45	32.8
EAST	30.0 - 70.0	30 - 89	130	50.5	3.3	53.1	3.9	49.8	17.1	2.62	2.44	18.5
EAST	30.0 - 70.0	90 - 179	39	51.9	3.7	56.9	4.4	122.3	25.3	5.05	2.60	2.6
EAST	30.0 - 70.0	180 - 365	11	51.4	2.9	59.8	3.2	221.3	36.3	8.45	2.70	0.0
EAST	30.0 - 70.0	366 - 730	1	54.0	0.0	68.0	0.0	368.0	0.0	14.00	0.00	0.0
EAST	30.0 - 70.0	10 - 365	360	51.1	3.6	53.6	4.4	47.1	46.8	2.50	2.89	23.3
Other	30.0 - 70.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0

Growth Summary for Skipjack Tagged During Visit WEST

Recapture Country	Release Length Range	Days at Liberty Range	Sample Size	Release Length (cm) Mean	Release Length (cm) SD	Recapture Length (cm) Mean	Recapture Length (cm) SD	Days at Liberty Mean	Days at Liberty SD	Growth (cm) Mean	Growth (cm) SD	Percent Non-Growers
WEST	30.0 - 49.0	0 - 9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WEST	30.0 - 49.0	10 - 29	47	47.1	1.6	47.6	2.5	19.6	5.6	0.53	2.03	48.9
WEST	30.0 - 49.0	30 - 89	28	46.8	1.8	50.3	2.6	57.7	17.3	3.50	3.23	10.7
WEST	30.0 - 49.0	90 - 179	7	47.4	2.1	50.7	8.2	110.1	21.9	3.29	9.32	28.6
WEST	30.0 - 49.0	180 - 365	2	48.5	0.7	54.0	2.8	205.5	30.4	5.50	3.54	0.0
WEST	30.0 - 49.0	366 - 730	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0
WEST	30.0 - 49.0	10 - 365	84	47.0	1.7	48.9	3.6	44.3	39.5	1.87	3.81	33.3
WEST	50.0 - 70.0	0 - 9	1	51.0	0.0	52.0	0.0	9.0	0.0	1.00	0.00	0.0
WEST	50.0 - 70.0	10 - 29	152	52.7	2.9	53.7	3.4	18.0	5.3	1.01	2.41	45.4
WEST	50.0 - 70.0	30 - 89	81	52.9	2.3	53.5	2.9	52.9	17.3	0.64	2.01	40.7
WEST	50.0 - 70.0	90 - 179	33	53.4	2.6	55.6	4.1	122.9	25.6	2.27	3.48	27.3
WEST	50.0 - 70.0	180 - 365	9	52.9	2.1	59.1	2.5	227.8	36.7	6.22	1.56	0.0
WEST	50.0 - 70.0	366 - 730	1	54.0	0.0	64.0	0.0	368.0	0.0	10.00	0.00	0.0
WEST	50.0 - 70.0	10 - 365	275	52.8	2.7	54.0	3.5	47.7	49.6	1.22	2.64	40.4
WEST	30.0 - 70.0	0 - 9	1	51.0	0.0	52.0	0.0	9.0	0.0	1.00	0.00	0.0
WEST	30.0 - 70.0	10 - 29	199	51.3	3.6	52.2	4.1	18.4	5.4	0.89	2.33	46.2
WEST	30.0 - 70.0	30 - 89	109	51.3	3.5	52.7	3.1	54.1	17.3	1.38	2.68	33.0
WEST	30.0 - 70.0	90 - 179	40	52.3	3.4	54.8	5.3	120.7	25.2	2.45	4.84	27.5
WEST	30.0 - 70.0	180 - 365	11	52.1	2.6	58.2	3.2	223.7	35.3	6.09	1.81	0.0
WEST	30.0 - 70.0	366 - 730	1	54.0	0.0	64.0	0.0	368.0	0.0	10.00	0.00	0.0
WEST	30.0 - 70.0	10 - 365	359	51.5	3.5	52.8	4.1	46.9	47.4	1.37	2.96	38.7
Other	30.0 - 70.0	10 - 365	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0

APPENDIX B. ABBREVIATIONS FOR COUNTRIES, TERRITORIES AND SUBDIVISIONS THEREOF

AMS - American Samoa
CAL - New Caledonia
COK - Cook Islands
EAST - see text
FIJ - Fiji
GAM - Gambier Islands (French Polynesia)
GIL - Gilbert Islands (Kiribati)
GUM - Guam
HAW - Hawaii
HOW - Howland and Baker Islands (U.S. Territory)
IND - Indonesia
INT - International waters
JAP - Japan
JAR - Jarvis (U.S. Territory)
KOS - Kosrae (Federated States of Micronesia)
LIN - Line Islands (Kiribati)
MAQ - Marquesas Islands (French Polynesia)
MAR - Northern Mariana Islands
MAS - Marshall Islands
MTS - Minami-tori shima (Japan)
NAU - Nauru
NCK - Northern Cook Islands
NIU - Niue
NOR - Norfolk Island
NSW - New South Wales (Australia)
PAL - Palau
PAM - Palmyra (U.S. Territory)
PHL - Philippines
PHO - Phoenix Islands (Kiribati)
PIT - Pitcairn Islands
PNG - Papua New Guinea
POL - French Polynesia
PON - Ponape (Federated States of Micronesia)
QLD - Queensland (Australia)
SCK - Southern Cook Islands
SOC - Society Islands (French Polynesia)
SOL - Solomon Islands
TOK - Tokelau
TON - Tonga
TRK - Truk (Federated States of Micronesia)
TUA - Tuamotu Islands (French Polynesia)
TUV - Tuvalu
VAN - Vanuatu
WAK - Wake Island (U.S. Territory)
WAL - Wallis and Futuna
WES - Western Samoa
WEST - see text
YAP - Yap (Federated States of Micronesia)
ZEA - New Zealand