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USING ELEPHANT CARCASS RATIOS TO DETERMINE POPULATION TRENDS

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Summary. Many African elephant populations have declined over the last two decades (Douglas-Hamilton. 1987). In most census zones, as the number of elephants decreases, the number of dead elephants increases. By counting both live and dead elephants a carcass ratio can be derived. This is the proportion of dead elephants to all elephants dead and live, and has been used as an index of relative elephant mortality (Douglas-Hamiton and Hillman, 1980).

In this paper successive counts of dead and live elephants in central, east, and southern Africa have been used to plot elephant trends against carcass ratios. It was found that the carcass ratio was correlated with the rate of decrease over a 4-yr period. The model was applied to new census data from Selous and Kilombero and found to give a close prediction of actual trends.

The model was then tentatively applied to census zones in Tanzania where only a single count had been made. It suggested that 2 of the 16 regions surveyed had stable elephant populations, but that several areas (such as Maasai Steppe and Tabora) were undergoing rapid declines in elephant numbers. The model suggested that Serengeti in 1977 had probably already suffered a 21% decline in the previous 4 yr, but that the decline outside the park had been more severe at *57%*. Ruaha national park in 1977 it suggested had increased by 7% over the previous 4 yr, but had decreased by 9% in the surrounding areas. Selous game reserve in 1976 had a probable increase of 35% inside the protected area and a decrease of 13% outside. Thus use of the model suggests that both the Ruaha and the Selous were undergoing compression of elephants in that period. Since that period, major declines have occurred in all these protected areas (Borner and Severre, 1984; Douglas-Hamilton *et al.*, 1986; Dublin and Douglas-Hamilton, 1987).

INTRODUCTION

Elephants have had special problems in the national parks and reserves since the mid 1950's. At first the problem was of overcrowding, resulting from compression of elephants into safe sanctuaries, that lasted to the end of the sixties. Then in the seventies a rash of poaching decimated supposedly protected elephant populations, including those that were formerly overpopulated. The result in many national parks has been an initial phase of elephant increase followed by decrease, giving a characteristic humpback curve (Douglas-Hamilton, 1987).

The future of elephant populations, in protected areas or elsewhere, will depend on whether or not African governments can control the ivory trade. A new approach has been suggested by the African governments of ivory exporting countries that are party to CITES. By common agreement the trade will be restricted to ivory quotas set by each country in advance. The aim is to eliminate the illegal trade outside the quotas and to restrict exports to ivory obtained from natural mortality, elephants shot on control, approved culling schemes, or that confiscated from poachers. An important element in making the system work is for each state to improve the inventory and monitoring of its elephant resource.

For the savannah areas which cover much of East Africa, aerial surveys remain the most effective means of elephant census. Methods vary from total counts, as employed in the Uganda parks (Eltringham and Malpas, 1980) and Lake Manyara national park, Tanzania (Douglas-Hamilton, 1972), to standardized sample surveys that have been widely adopted. However, aerial surveys are expensive and for many areas may be performed only occasionally.

It has been suggested that dead elephants may serve as a useful index of elephant mortality by Douglas-Hamilton and Hillman (1981). These authors drew attention to the general increase of elephant carcasses in areas where formerly they had been so infrequent that aerial survey teams tended not to record them. They presented each set of data as a carcass ratio, *i.e.*, the proportion of dead elephants expressed as a percentage of all live and dead elephants. In this paper the term carcass is taken to refer to all dead elephants. They concluded that high carcass ratios were indicative of a high mortality but were unable to give a quantitative relationship as data were lacking that could tie carcass ratios to rates of change. Since then such data have become available. This paper attempts to develop a model to derive elephant trends from carcass ratios and to apply the model to some other populations in Tanzania and Kenya. If this approach is valid, then a single elephant census could be used to derive an elephant trend.

THE MODEL

In order to establish the relationship between elephant carcass ratios and population trends, data were compiled and analyzed from census zones across eastern, central, and southern Africa. For each data point used in this study, there exist two or more surveys of elephant numbers from which the population trend was derived, as well as carcass ratio information obtained at the end of the trend period. Where census data are missing values have been calculated for each year on the assumption of a linear rate of change between the earlier and later censuses. Figure 1 shows the location and survey date for each of the data points. (The original data can be found in Appendix 1.)

Several indicators of elephant trend were examined in an effort to determine which one most closely correlated with observed carcass ratios. These indicators included maximum drop in population over 3, 4, and 5 years (maximum population in x years subsequent minimum population in x years for $x = 3, 4, 5$) and average change per year in population size over 2, 3, 4, and 5 yr:

Figure 1. Location of data points. I, Luangwa Valley; 2, Ruaha Rungwa; 3, Manyara; 4, Queen Elizabeth; 5, Murchison; 6. Bamingui; 7, Koumbala–Gounda.

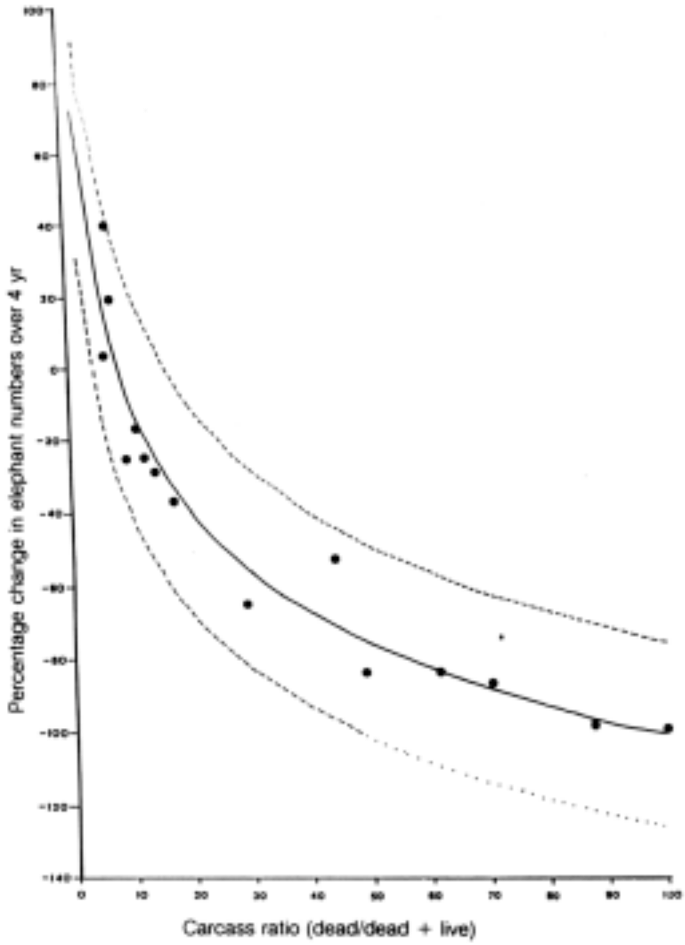

Figure 2. Carcass ratios demonstrating percentage decrease in elephant numbers over 4 yr.

$$\text{average change} = \frac{\dfrac{\text{pop x} - \text{pop t}}{\text{Pop t}}}{x}$$

for x = 2, 3, 4, and 5

Some census zones could not be used in all of the analyses because the interval between surveys was too short.

Of the seven tested indicators, "average change per year over four years" was found to correlate most closely with carcass ratio ($r^2 = 0.93$).

Figure 2 shows a graph of the original data points together with the regression curve having the equation;

$$\text{\% change over 4 yr} = \{E^{[4.8508 - 0.1168\ \text{In}(CF)]} - 100\} \times 4$$

where *CR* = carcass ratio.

Trends are expressed in terms of change over 4 yr as the original trend data were derived in this format, and in an effort to avoid confusion as to the meaning of "average change per year over *x* years." Figure 2 also shows the 95% confidence limits of the curve when used to predict trend from a specific carcass ratio. The confidence limits were calculated following the method of Steel and Tome (1960). The final regression equation is given by the following formula (Steel and Tome, 1960):

$$\text{\% change over 4 yr} = 4 \times [E^{(Y \pm CL)} - 100]$$

where Y = 4.8508 – 0.1168∗In(carcass ratio)

$$CL = 0.07629122 \sqrt{\frac{1.0667 + (x - 3.114)^2}{13.98113}}$$

Subsequent to performing the regression analysis on the original data, two additional data points were obtained for Kilombero and Selous, for a period ending in 1986. Figure 3 shows the location of these two points in relation to the regression curve. The proximity of the points to the curve, well within the confidence limits, serves as a qualitative confirmation of the curve's validity.

Appendix 2 includes a table with these values calculated for integer carcass ratios from 1 to 100 inclusive. This can be applied by managers in the field more readily than the above equation.

DISCUSSION OF MODEL

There are various factors that will affect the carcass ratio, which have bearing on how the model works.

The visibility of carcasses is affected by the state of the vegetation. Data used here were all collected under good visibility conditions in the dry season when the grass was short or burnt.

Carcasses are harder to see than live elephants and on every count some are missed. However, by using narrow strips of less than 200 m wide conditions were kept relatively consistent between counts.

Total counts that employ wider strip widths miss more carcasses and may need carcass estimates to be corrected upward. In the 1980 counts Murchison and QEP total counts for elephants were combined with sample estimates for carcasses. This was because the elephants that live in large clumped herds were more

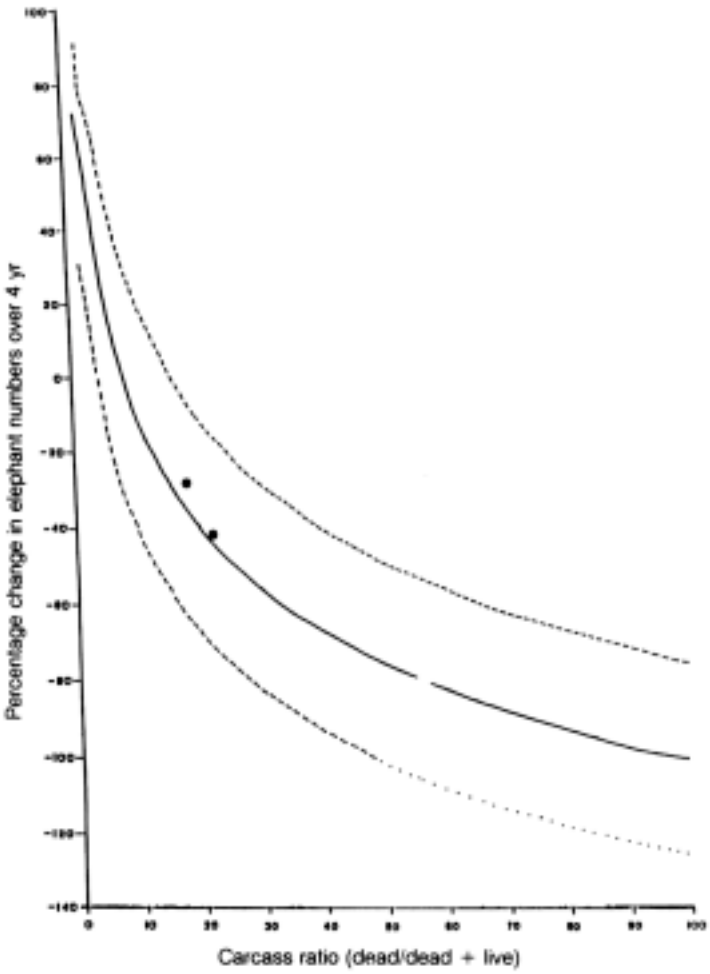

Figure 3. Carcass ratio as in Figure 2, but with data points plotted for Kilombero and Selous.

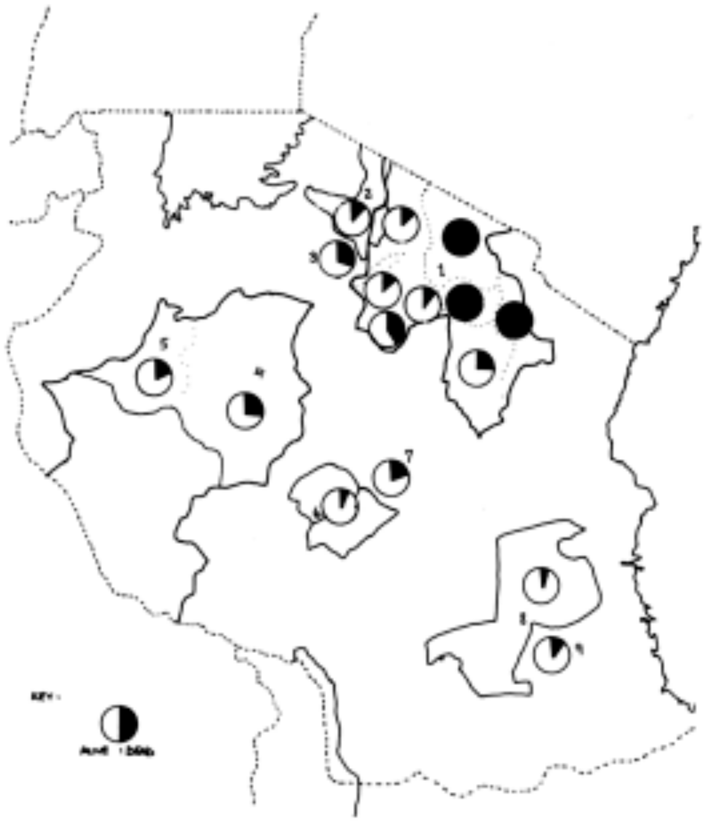

Figure 4. Tanzania: elephant carcass ratios. 1, Arusha region, 1980; 2, Serengeti in, 1977; 3, Serengeti out, 1977; 4, Tabora east, 1979; 5, Tabora West, 1979; 6, Ruaha in; 7, Ruaha out; 8, Selous in; 9, Selous out.

accurately assessed by means of total counts, whereas the more evenly distributed carcasses can be more accurately estimated by sampling. It was found on average that carcasses were estimated 2.4 times higher in sample counts than they were in total counts made in the same area at the same time.

However, the Queen Elizabeth and Murchison Falls national park total counts of 1976 and 1982 and the Manyara total counts of 1981 and 1984 were highly intensive with narrow strip widths and were treated in the same way as sample counts and used in the equation without correction upwards.

Finally, the number of carcasses seen is affected by the rate at which they disappear, which has been shown to be faster in wet areas than in dry areas (Douglas-Hamilton and Hillman, 1981). Very young elephants will also be underrepresented as their small bodies are more readily dismembered by predators and scattered around.

The carcass ratio itself will also be affected by a number of factors. It may be high due to high mortality, but it may equally be affected by movements of elephants. Immigration will cause it to drop and emigration will cause it to rise. A high carcass ratio then does not necessarily mean that the elephants have been killed, it may equally signify emigration.

The carcass ratio should therefore only be applied to counts where the visibility is adequate. In many cases this means that carcass counts should only be applied to dry conditions, preferably at the end of the dry season when the grass is short or burnt and the vegetation permits good visibility. The data points used in developing the model all come from counts where visibility conditions were good for counting carcasses.

An advantage of presenting carcass ratios is that they should even out observer bias, in that a poor observer may miss both elephants and carcasses, but there seems no reason to suppose that this will change the carcass ratio.

Despite all the variables affecting carcass visibility the results give a good fit, and can be used cautiously to determine trends. With more information separate curves could be worked out for wet and dry areas, and further computer modeling of the different factors affecting carcass visibility could refine the model. The confidence limits could also be improved by including the recent Kilombero and Selous results.

APPLICATION OF MODEL

Having established the basic validity of this model, we will illustrate its application. As has been noted, the major benefit of using this model is that it enables the derivation of information on elephant population trends from a single count, provided the count enumerates elephant carcasses as well as live elephants.

Such counts were conducted in various areas of Tanzania between 1976 and 1980 by Douglas-Hamilton and Eco-Systems Ltd. Carcass ratios were calculated for each count as shown graphically in Figure 4. Trends could not be calculated for these areas by reference to earlier counts, as such counts were nonexistent. However, by applying the regression equation we can now estimate the trend in elephant population for the period ending at the year of the carcass counts.

Table 1. Dates and locations of changes in elephant carcass ratios over 4 yr.

Place	Date	Carcass ratio	Estimated change over 4 yr (95% conf. range)	Estimated 1 yr change
Selous (inside)	1976	4%	+ 34.9% (– 1.2% to +74%)	+ 8.7%
Selous (outside)	1976	11%	– 13.5% (– 43.2% to + 18.8%)	– 3.4%
Ruaha (inside)	1977	7%	+ 7.4% (– 24.8% 10 + 42.4%)	+ 1.9%
Ruaha (outside)	1977	10%	– 9.2% (– 39.6% to 23.6%)	– 2.3%
Serengeti (inside)	1977	13%	– 21.0% (– 5.0% to + l0.4%)	– 5.3%
Serengeti (outside)	1977	31%	– 57.6% (– 83.6% to – 29.6%)	– 14.4%
Natron, Logido, MtoWa Mbu	1980	100%	– 100.0% (—)	– 25.0%
Loliondo, Ngorongoro, Endulen	1980	13%	– 21.0% (– 50.0% to + 10.4%)	– 5.3%
Yaidi Chini	1980	13%	– 21.0% (– 50.0% to + 10.4%)	– 5.3%
Tarangire	1980	10%	– 9.2% (– 39.6% to + 23.6%)	– 2.3%
Lolkisale, Simanjiro	1980	100%	– 100.0% (—)	– 25.0%
Sanya Plains, Ruvu River, Kitwai	1980	100%	– 100.0% (—)	– 25.0%
Maasai Steppe	1980	25%	– 48.9% (– 75.6% to – 20%)	– 12.2%
Harrang	1980	34%	– 61.3% (– 87.2% to – 33.2%)	– 15.3%
Tabora, Nzega, Igunga	1979	27%	– 52.0% (78.4% to – 23.6%)	– 13.0%
Urambo	1979	19%	– 37.4% (– 64.8% to – 7.6%)	– 9.4%

Table 1 shows the results. By this method, we can see that probably only 2 of the 16 regions surveyed had stable elephant populations and several areas with what appear to be relatively moderate carcass ratios (such as Maasai Steppe and Tabora) were, in fact, suffering from rapid declines in elephant numbers.

In terms of the protected areas the model suggests that Serengeti in 1977 had most probably suffered a 21% decline in the previous 4 yr, but that the decline outside the park had been more severe at 57.6%. Ruaha national park in 1977 had increased by 7.4% over the previous 4 yr, but had decreased by 9.2% in the surrounding areas. Selous game reserve in 1976 had a probable increase of 35% inside the protected area and a decrease of 1 3.5% outside. Thus use of the model suggests that both the Ruaha and the Selous were undergoing compression of elephants in that period. Since that period major declines have occurred in all these protected areas (Bomer and Severre, 1984; Douglas-Hamilton *et al.*, 1986; Dublin and Douglas-Hamilton, 1987).

Applied to the Eco-Systems counts, which were made mainly in unprotected areas, the declines suggested by the model were on the whole more severe, varying from – 9.2% in Tarangire to 100% in three of the census zones.

We have also applied our model to Cobb's 1974 survey of the Tsavo region (Cobb, 1976). This survey (the only one in which he recorded all dead elephants) gave a carcass ratio of 25% and an estimated elephant population of 34,700. Our equation suggests that a carcass ratio of 25% results from a loss of 48.9% of the population over the previous 4 yrs, placing the 1970 population at 67,900 (95% confidence range: 43,374—142,209). If this were correct it would imply a dieoff of the order of 33,000 in the drought years of 1970—1973. However, because Tsavo is an arid area, the carcasses are likely to remain visible for much longer than in wet areas, and the true value of the 1970 population is therefore likely to be at the lower end of the confidence limits. Nevertheless it would probably be higher than the 40,000 elephants estimated for the Tsavo ecosystem by Laws (1969) and would suggest that more elephants died in the drought than has previously been suggested.

CONCLUSIONS

It is concluded that the model works well for wet areas but seems high for dry areas like Tsavo. It is recommended for use in wet areas, but only to be used with caution in dry areas.

The model could probably be refined to account better for variations in visibility, decomposition rate of carcasses, and effect of rainfall. It would benefit also from addition of trend and carcass ratio data in the low end of the spectrum from those areas in southern Africa not yet hit by waves of ivory poaching. Nevertheless the model demonstrates the usefulness of collecting data on carcass ratios as a management tool, especially as an early warning of negative trends in protected areas.

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APPENDIX ONE: ORIGINAL DATA

			Elephants	Carcass						
Place	Year	(Ib)	ratio	Avg. 2	Avg. 3	**Avg. 4**	**Avg. 5**	**Min. 3**	Min. 4	Min.
Ruaha	*1972	14,816								
	1973	16,423								
	1974	18,030								
	1975	19,638								
	1976	21,245								
	*1977	22,852	7	8%	9%	10%	11%	+++	+++	+++
	1978	21,032								
	1979	19,211								
	1980	17,391								
	1981	15.570								
	1982	13,750								
	*1983	11,929	17	—12%	—10%	—9%	—9%	—31%	—38%	—43
Ruaha Rungwa Zone	*1977	40,540								
	1978	39,034								
	1979	37,528								
	1980	36,022								
	1981	34,516								
	1982	33,010								
	*1983	31,504	11	—4%	—4%	—4%	—4%	—13%	—16%	—19
Luangwa	*1973	56,000								
	1974	52.580								
	1975	49,159								
	1976	45,739								
	1977	42,319								
	1978	38,898								
	*1979	35,478	14	—8%	—7%	—7%	—7%	—22%	—28%	—33
Manyara	*1976	453								
	1977	459								
	1978	466								
	1979	472								
	1980	479								
	*1981	485	6	1%	1%	1%	1%	+++	+++	+++
	1982	448								
	1983	410								
	*1984	373	12	—8%	—8%	—6%	—4%	—23%	—23%	—23
Queen Elizabeth	*1971	2,177								
	1972	2,475								
	*1973	2,773								
	*1974	1,861								
	*1975	1,047								
	*1975	854								
	*1976	1,232	44	—17%	—19%	—13%	—9%	—56%	—56%	—56
	*1976	704								
	—1977	764								
	—1978	561								
	—1979	357								
	*1980	153	61	—36%	—27%	—21%	—17%	—80%	—88%	—88
	1981	291								
	*1982	428	9	90%	7%	—6%	—9%	+++	—24%	—44
Murchison South	*1965	7,344								
	1966	7,849								
	1967	8,354								
	1968	8,859								
	*1969	9,364								
	1970	9,516	7	4%	5%	5%	6%	+++	+++	+++
	1971	9,668								
	1972	9,819								
	*1973	9,971								
	*1974	4,072								
	*1975	1,061								
	*1976	1,682	49	—29%	—28%	—21%	—17%	—83%	—83%	—83
	*1976	1,113								
	—1977	1,088								

APPENDIX ONE (Continued)

Place	Year	(Ib)	Elephants ratio	Carcass Avg. 2	Avg. 3	**Avg.** *4*	**Avg. 5**	**Min. 3**	Min. 4	Min.
	—1978	779								
	—1979	469								
	*1980	160	70	—40%	—28%	—22%	—17%	—85%	—90%	—90
Bamingui	*1977	2,550								
	1978	2,302								
	1979	2,055								
	1980	1,807								
	1981	1,560								
	1982	1,312								
	1983	1,064								
	1984	817								
	*1985	569	29	—23%	—19%	—16%	—14%	—57%	—46%	—69
Koumbala–Gounda	*1980	1,256								
	1981	1,014								
	1982	771								
	1983	529								
	1984	286								
	*1985	44	87	—46%	—31%	—24%	—19%	—94%	—96%	—96
Manovo–St. Floris	*1978	6,278								
	1979	5,381								
	1980	4,484								
	1981	3,587								
	1982	2,691								
	1983	1,794								
	1984	897								
	*1985	0	100	—50%	—33%	—25%	—20%	100%	—100%	—100

APPENDIX TWO: TREND ESTIMATES FROM CARCASS RATIOS

Carcass ratio	Low 4 yr	4 yr change	High 4 yr	Low 1 yr	Estimated 1 yr	High 1 yr
1	62.0	111.4	166.9	15.5	27.8	41.5
2	29.6	71.6	117.6	7.4	17.9	29.4
3	11.6	49.8	91.6	2.9	12.4	22.9
4	—1.2	34.9	74.0	—0.3	8.7	18.5
5	—10.8	23.7	61.2	—2.7	5.9	15.3
6	—18.4	14.8	50.8	—4.6	3.7	12.7
7	—24.8	7.4	42.4	—6.2	1.9	10.6
8	—30.4	1.1	35.2	—7.6	0.3	8.8
9	—35.2	—4.4	28.8	—8.8	—1.1	7.2
10	—39.6	—9.2	23.6	—9.9	—2.3	5.9
11	—43.2	—13.5	18.8	—10.8	—3.4	4.7
12	—46.8	—17.5	14.4	—11.7	—4.4	3.6
13	—50.0	—21.0	10.4	—12.5	—5.3	2.6
14	—52.8	—24.3	6.8	—13.2	—6.1	1.7
15	—55.6	—27.3	3.6	—13.9	—6.8	0.9
16	—58.4	30.1	0.4	—14.6	—7.5	0.1
17	—60.8	—32.7	—2.4	—15.2	—8.2	—0.6
18	—62.8	—35.1	—5.2	—15.7	—8.8	—1.3
19	—64.8	—37.4	—7.6	—16.2	—9.4	—1.9
20	—66.8	—39.6	—10.0	—16.7	—9.9	—2.5
21	—68.8	—41.7	—12.4	—17.2	—10.4	—3.1
22	—70.8	—43.6	—14.4	—17.7	—10.9	—3.6
23	—72.4	—45.4	—16.4	—18.1	—11.4	—4.1
24	—74.0	—47.2	—18.4	18.5	—11.8	—4.6
25	—75.6	—48.9	—20.0	—18.9	—12.2	—5.0
26	—76.8	—50.5	—22.0	—19.2	—12.6	—5.5
27	—78.4	—52.0	—23.6	—19.6	—13.0	—5.9
28	—79.6	—53.5	—25.2	—19.9	—13.4	—6.3
29	—81.2	—54.9	—26.4	—20.3	—13.7	—6.6
30	—82.4	—56.3	—28.0	—20.6	—14.1	—7.0
31	—83.6	—57.6	—29.6	—20.9	—14.4	—7.4
32	—84.8	—58.9	—30.8	—21.2	—14.7	—7.7
33	—86.0	—60.1	—32.0	—21.5	—15.0	—8.0
34	—87.2	—61.3	—33.2	—21.8	—15.3	—8.3
35	—88.0	—62.4	—34.3	—22.0	—15.6	—8.6
36	—89.2	—63.5	—35.6	—22.3	—15.9	—8.9
37	—90.4	—64.6	—36.8	—22.6	—16.1	—9.2
38	—91.2	—65.6	—38.0	—22.8	—16.4	—9.5
39	—92.0	—66.7	—39.2	—23.0	—16.7	—9.8
40	—93.2	—67.6	—40.0	—23.3	—16.9	—10.0
41	—94.0	—68.6	—41.2	—23.5	—17.1	—10.3
42	—94.8	—69.5	—42.0	—23.7	—17.4	—10.5
43	—95.6	—70.4	—43.2	—23.9	—17.6	—10.8
44	—96.4	—71.3	—44.0	—24.1	—17.8	—11.0
45	—97.2	—72.2	—44.8	—24.3	—18.0	—11.2
46	—98.0	—73.0	—45.6	—24.5	—18.3	—11.4
47	—98.8	—73.8	—46.4	—24,7	—18.5	—11.6
48	—99.6	—74.6	—47.6	—24.9	—18.7	—11.9
49	—100.4	—75.4	—48.4	—25.1	—18.9	—12.1
50	—101.2	—76.2	—49.2	—25.3	—19.0	—12.3

APPENDIX TWO (Continued)

Carcass ratio	Low 4 yr	4 yr change	High 4 yr	Low 1 yr	Estimated 1 yr	High 1 yr
51	—102.0	—76.9	—50.0	—25.5	—19.2	—12.5
52	—102.8	—77.7	—50.8	—25.7	—19.4	—12.7
53	—103.2	—78.4	—51.2	—25.8	—19.6	—12.8
54	—104.0	—79.1	—52.0	—26.0	—19.8	—13.0
55	—104.8	—79.8	—52.8	—26.2	—19.9	13.2
56	—105.2	—80.4	—53.6	—26,3	—20.1	—13.4
57	—106.0	—81.1	—54.0	—26.5	—20.3	—13.5
58	—106.4	—81.8	—54.8	—26.6	—20.4	13.7
59	—107.2	—82.4	—55.6	—26.8	—20.6	—13.9
60	—107.6	—83.0	—56.0	26.9	—20.8	—14.0
61	—108.4	—83.6	—56.8	—27.1	—20.9	14.2
62	—108.8	—84.2	—57.6	—27.2	21.1	—14.4
63	—109.6	—84.8	—58.0	—27.4	—21.2	14.5
64	—110.0	—85.4	—58.8	—27.5	—21.3	—14.7
65	—110.4	—86.0	—59.2	—27.6	—21.5	—14.8
66	—111.2	—86.5	—59.6	—27.8	—21.6	—14.9
67	—111.6	—87.1	—60.4	—27.9	—21.8	—15.1
68	—112.0	—87.6	—60.8	—28.0	—21.9	—15.2
69	—112.8	—88.1	—61.6	—28.2	—22.0	—15.4
70	—113.2	—88.7	—62.0	—28.3	—22.2	—15.5
71	—113.6	—89.2	—62.4	—28.4	—22.3	—15.6
72	—114.4	—89.7	—63.2	—28.6	—22.4	—15.8
73	—114.8	—90.2	—63.6	—28.7	—22.5	—15.9
74	—115.2	—90.7	—64.0	—28.8	—22.7	—16.0
75	—115.6	—91.2	—64.4	—28.9	—22.8	—16.1
76	—116.0	—91.6	—65.2	—29.0	—22.9	—16.3
77	—116.4	—92.1	—65.6	—29.1	—23.0	—16.4
78	—116.8	—92.6	—66.0	—29.2	—23.1	—16.5
79	—117.6	—93.0	—66.4	—29.4	—23.3	—16.6
80	—118.0	—93.5	—66.8	—29.5	—23.4	—16.7
81	—118.4	—93.9	—67.6	—29.6	—23.5	—16.9
82	—118.8	—94.4	—68.0	—29.7	—23.6	—17.0
83	—119.2	—94.8	—68.4	—29.8	—23.7	—17.1
84	—119.6	—95.2	—68.8	—29.9	—23.8	—17.2
85	—120.0	—95.6	—69.2	—30.0	—23.9	—17.3
86	—120.4	—96.1	—69.6	—30.1	—24.0	—17.4
87	—120.8	—96.5	—70.0	—30.2	—24.1	—17.5
88	—121.2	—96.9	—70.4	—30.3	—24.2	—17.6
89	—121.6	—97.3	—70.8	—30.4	—24.3	—17.7
90	—122.0	—97.7	—71.2	—30.5	—24.4	—17.8
91	—122.4	—98.1	—71.6	—30.6	—24.5	—17.9
92	—122.8	—98.4	—72.0	—30.7	—24.6	—18.0
93	—123.2	—98.8	—72.4	—30.8	—24.7	—18.1
94	—123.6	—99.2	—72.8	—30.9	—24.8	—18.2
95	—124.0	—99.6	—73.2	—31.0	—24.9	—18.3
96	—124.0	—99.9	—73.6	—31.0	—25.0	—18.4
97	—124.4	—100.3	—74.0	—31.1	—25.1	—18.5
98	—l24.8	—100.7	—74.4	—31.2	—25.2	—18.8
99	—125.2	—101.0	—74.8	—31.3	—25.3	—18.7
100	—125.6	—101.4	—75.2	—31.4	—25.3	—18.8