

# A Review of the Current Status of Bald Eagles in North America

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**Abstract:** An analysis of Christmas Bird Count data suggests that about 70,000 Bald Eagles (*Haliaeetus leucocephalus*) are found in North America, i.e. 48,000 eagles in British Columbia and Alaska and about 22,000 eagles in the remainder of the continent. These estimates concur with the range of estimates derived from breeding censuses in North America. When compared to the National Wildlife Federation mid-winter count, estimates for the eastern states, those adjacent to the Mississippi River and states on the west coast are similar. Estimates for the interior western states are, however, significantly higher than current counts of eagles.

Bald Eagle numbers along the east coast of the U.S. and Florida are estimated to be 1/3 to 1/2 of the population 25 years ago. However, the trough of the decline was about 1970 and an upward trend is now evident. In the central and western regions of interior North America, Bald Eagle numbers appear to have increased by a factor of 2 to 3 over the last 25 years. On the west coast, changes in the status of Bald Eagles in the last 25 years are less clear, though data from southeast Alaska suggest little change in eagle numbers from 1967 to 1977.

There is a considerable amount of information available on the Bald Eagle (*Haliaeetus leucocephalus*), but much of it is difficult to interpret. Counts of birds wintering in the lower 48 states revealed up to 4,000 birds during the early 1960's (Sprunt and Ligas 1964), and about 12,500 in January 1980 (Pramstaller 1981). However, variations in searching methods made a comparison between these estimates virtually impossible. Even in January 1980 there were still many areas not covered, suggesting that the real number of wintering Bald Eagles in this part of the U.S. is higher yet.

Good breeding ground censuses are available for some areas, but only for the last 15 years. These data suggest that the number of Bald Eagles in the eastern U.S. and parts of Ontario decreased considerably from 1950 to 1970 (Sprunt 1969, Robbins 1971, Sprunt *et al.* 1973). However, the extent of the decline is unknown since there did not exist a good estimate of birds breeding in these regions in the early 1950's.

Swenson's (1983) analysis of pooled data indicated a considerable increase

W.F. - Eagles

in eagle numbers in the western United States in winter. Despite this, I remain skeptical. Bald Eagles are notoriously variable in their winter distribution, congregating and dispersing according to food availability. Dramatic increases in numbers at sites like Glacier National Park (McClelland 1982) may be associated with fewer birds occurring elsewhere. Christmas Bird Counts (CBC) represent a widespread sampling base, but I am not convinced of the reliability of studies which correct for changes in search effort using the number of birds per 100 party hours (Robbins 1971, Brown 1975). This might adequately correct for changes in search effort for small birds, but I do not believe it can really be used meaningfully for Bald Eagles. For example, 2 observers from 1 party, knowing that there is a major concentration on a wildlife refuge, may readily find and record most of the birds in the area. Additional parties may add to the count, but not in proportion to the effort spent. Some other means of correcting for changes in search efficiency must be used. Spurred on by Swenson's (1983) findings, I reevaluated the CBC data on Bald Eagles from 1955 to 1980 using a new approach.

## METHODS

Where they occur, the CBC meet several criteria used in estimating Bald Eagle numbers. These counts are designed to census all birds within a circle of 15 mi diameter (176.7 mi<sup>2</sup>) and are usually done by local people with a good knowledge of the local habitat and birds; these people are considered to be reasonably accurate in species identification. The CBC thus represent an attempt to count all the birds of every species in a given area.

A major problem in using the CBC stems from the distribution of Bald Eagles and the distribution of census areas. In some states where Bald Eagles are few, the distribution of birds fits the Poisson distribution, e.g. see Table 1. However, in many states, Bald Eagles are clumped due to groups of birds wintering in favorable habitat. Any analysis of Bald Eagle abundance using the CBC must deal with this problem.

Census locations are not chosen specifically to census Bald Eagles, nor are they chosen at random. In general, urban areas where one might expect to find fewer Bald Eagles are over-represented, as are National Wildlife Refuges or similar locations where Bald Eagles tend to concentrate. Nevertheless, where sufficient number of counts are made, a good representation of habitat types are included. However, data from Bald Eagle concentration areas included in the CBC must be modified during analysis.

In my evaluation, each count was treated as a census area of 176.7 mi<sup>2</sup> within the respective state or province. Except for 1980 when all states and provinces were included in the analysis, estimates for earlier years were made only when 10 or more count areas were located in a state or province, or where more than 25% of the total area of the state or province was covered. Where the distribution of Bald Eagles approximated a Poisson distribution,

TABLE 1. Examples of Distributions of Bald Eagles in 3 Regions and the Statistical Transformation Used in Data Analysis.

A) Poisson distribution - Ontario 1980				
	Number of birds			
	0	1	2	3
Observed	42	9	1	0
Expected	42.1	8.9	0.96	0.17

  

B) Square root of data points approaches a Poisson distribution - Florida 1980						
	Number of birds					
	0	1	2	3	4	5+
1) Observed	10	7	5	4	1	14
2) Square root of observed values*	10	12	7	5	4	3
3) Expected based on Poisson distribution (using data in 2)	6.5	11.9	11.0	6.8	3.1	1.7

  

C) Fourth root of data points approaches a Poisson distribution - Wisconsin 1980				
	Number of birds			
	0	1	2	3+
1) Observed	23	4	6	5
2) Fourth root of observed values*	23	13	2	0
3) Expected based on Poisson distribution (using data in 2)	24.3	10.8	2.4	0.4

\*For numbers representing the square root and the fourth root of the observed values, numbers from 0.5 to 1.4999 were pooled to give a total for those in the class of 1, those from 1.5 to 2.4999 for those in 2, and so on.

the data were transformed using the conventional manner for data in a Poisson distribution (i.e. for each data point  $x$ , a value  $y$  was generated where  $y = \sqrt{x + 0.5}$ ) (Snedecor and Cochran 1967). The mean, as well as the upper and lower 95% confidence intervals for the  $y$  values, were calculated, and these values were converted back, i.e. revised mean =  $y^2 - 0.5$ . Where the square root of the individual data points fitted the Poisson distribution, each data point was transformed to give a value  $y = \sqrt[4]{x + 0.5}$ . The mean and upper and lower 95% confidence intervals for these  $y$  values were calculated and converted as before (i.e. revised mean =  $y^4 - 0.5$ . Where the fourth root of the individual data points fitted a Poisson distribution each data point ( $x$ ) was transformed to give a value  $y = \sqrt[4]{x + 0.5}$ . As before, the mean and upper and lower 95% confidence intervals were calculated for these  $y$  values and the data converted using revised mean =  $y^4 - 0.5$  (examples are presented in Table 1). The mean and upper and lower 95% confidence intervals for the

TABLE 2. Estimation of the Relative Search Efficiency in Bird Censusing for Maryland and Delaware in 1955, 1970 and 1980.

Species	1955		1970		1980
	*No. of birds per census (16) <sup>b</sup>	Proportion of 1980 count	No. of birds per census (22)	Proportion of 1980 count	No. of birds per census (27)
Canada Goose	611	0.0588 <sup>c</sup>	6563	0.632	10,383
Great Blue Heron	10.85	0.525	21.68	1.048	20.69
Mallard	407.7	0.386	448.5	0.462	1,057
Common Goldeneye	82.0	1.79 <sup>c</sup>	61.9	1.339 <sup>c</sup>	46.2
Common and Red-breasted Merganser	44.3	1.89 <sup>c</sup>	30.0	1.266	23.7
Red-tailed Hawk	8.43	0.285 <sup>c</sup>	18.51	0.625	29.6
Rough-legged Hawk	0.71	0.339	1.87	0.893	2.08
Marsh Hawk	8.73	0.676	16.7	1.30	12.91
Red-shouldered Hawk	4.39	0.526	3.78	0.454 <sup>c</sup>	8.33
AVERAGE PROPORTION <sup>c</sup>		0.490		0.889	
Bald Eagle	2.39	1.58	0.92	0.61	1.51
Bald Eagle (after correcting for search efficiency)	4.88		1.03		1.51

<sup>a</sup> The mean value for each species was calculated assuming a Poisson distribution as described in methods.

<sup>b</sup> The number in brackets is the number of censuses in the region (Washington, D.C. was included with these 2 states).

<sup>c</sup> In 1955, the 2 highest and 2 lowest proportions were excluded. In 1970, the highest and lowest proportion were excluded when the average was computed.

estimate of the number of Bald Eagles in the 176.7 mi<sup>2</sup> count areas within a state or province were multiplied by the appropriate factor (area of the state or province/176.7) to give an estimate of the Bald Eagle population for that state or province.

An exception to the above procedure was made for the states of Maine, Delaware, Maryland, Virginia and Florida. In these states, most of the Bald Eagles present in late December appear to be local breeding birds, many of which are on or near their breeding territories. In these states, the distribution of Bald Eagles on the CBC in some years was more clumped than a Poisson distribution. However, the assumption of a Poisson distribution for these states for 1980 gives estimates of the state Bald Eagle population which most closely approximate known populations. Because birds in a breeding population are likely more evenly distributed than those in a purely wintering situation, the assumption of a Poisson distribution was made for all years for these states and the data analyzed accordingly.

The search effort and the searching efficiency have improved immensely from 1955 to 1980, considerably altering the estimate of Bald Eagle numbers. Therefore, an attempt was made to correct for the change in searching efficiency in selected states. Estimates were made separately for each state or region since variations in terrain, road access and the extent of coverage make it unlikely that changes in searching efficiency have occurred at a uniform rate throughout North America. The method employed assumed that other large raptor and waterfowl species would have similar visibility as Bald Eagles. It was also assumed that when several species of large raptors and waterfowl were evaluated together and those with a dramatic change in population status omitted, the group average change in population for the remaining species from 1955 to 1980 would approximate 0. Hence, changes in observed birds would have resulted from a change in search effort. An example is shown in Table 2 for Maryland and Delaware.

For the period 1955 to 1980, the 2 species with the greatest relative increase, Canada Geese (*Branta canadensis*) and Red-tailed Hawks (*Buteo jamaicensis*), and the 2 species' groups with the greatest decrease in numbers, Common Goldeneyes (*Bucephala clangula*) and the Common and Red-breasted Mergansers (*Mergus merganser* and *M. serrater*) were omitted. The remaining 5 species, Great Blue Herons (*Ardea herodias*), Mallards (*Anas platyrhynchos*), Rough-legged Hawks (*Buteo lagopus*), Marsh Hawks (*Circus cyaneus*) and Red-shouldered Hawks (*Buteo lineatus*), had average counts in 1955 which were 0.49 of the numbers seen in 1980. A search factor ( $1.00/0.49 = 2.04$ ) was generated in an attempt to correct the 1955 Bald Eagle count for an estimate suitable for a comparison with the 1980 count. The fact that the change in search efficiency was much greater from 1955 to 1970 than from 1970 to 1980 suggests that for large raptors and waterfowl in this region, the counts may be approaching a complete census.

TABLE JA. The Number of Bald Eagles in Canada as Estimated from Christmas Bird Counts (CBC) (Not Corrected for Changes in Search Efficiency) and National Wildlife Federation (NWF) Midwinter Surveys.

Province	1955	1960	1965	1970	1975	1980	Jan. 80 (NWF)	1980 <sup>a</sup> (alt. est.)
Nfld.	—	—	—	—	—	461*(7-1421) <sup>b</sup>	n	769
P.E.I.	—	—	—	—	—	0	n	0
N.S.	—	—	—	221*	59	235*(85-479)	106	382
N.B.	—	—	—	—	—	65*(5-269)	20	158
Que. - S. 1/2	—	—	—	—	—	112*(7-228)	0	140
Ont. - S.E. 1/4	327*	207*	110	29	71	108(43-178)		140
- N.W. 3/4	—	—	—	—	—	0		0
- Total						108	5	140
Man.	—	—	—	—	—	0	n	0
Sask. - S. 1/2	—	—	—	—	—	112** <sup>c</sup> (35-200)	n	202
Alta. - S. 1/2	—	—	—	—	—	569** <sup>c</sup> (12-2321)	n	1239
B.C. - N.E. 3/4	—	—	—	—	—	4652*(1873-9194)	n	5636
S.W. 1/4	—	—	—	—	13850	23855** <sup>c</sup> (12289-44636)	n	43198
SUB-TOTAL (excluding B.C.)						1664(194-5096)	131	3030
TOTAL						30171(14356-58926)		51864

<sup>a</sup> The number of eagles which would be estimated assuming an even distribution of eagles and census areas (derived from CBC).

<sup>b</sup> Numbers in brackets are the 95% confidence intervals.

<sup>c</sup> Based on 53 CBC's for 1981 (Blue Jay 39:13).

\*. \*\* All estimates were derived assuming a Poisson distribution, except that \* indicates the square root of the data points approached a Poisson distribution, while \*\* indicates the fourth root of the data points approached a Poisson distribution. Data were treated as described in Methods to obtain each individual estimate.

Less than 10 counts for the province or part of province for 1955-1975.

n No count done.

## RESULTS

My analysis estimates a total of roughly 70,000 Bald Eagles in North America during the winter with 48,000 in British Columbia and Alaska and 22,000 in the rest of the continent. There appears to have been a large decline in birds wintering in southeastern Ontario from 1955 to 1970 but an increase in the last 10 years (Table 3A). Data from the other provinces are insufficient to draw conclusions about long term trends. As of 1980, it is clear nevertheless that the huge majority of Bald Eagles wintering in Canada are found in British Columbia.

Most of the eastern states for which data exist (Table 3B) show a similar trend to Ontario with a decline from 1955 to 1970 and an increase from 1970 to 1980. After correcting for changes in search efficiency in Delaware, Maryland and Florida (see Table 4), the uncorrected figures in Table 3B would seem to considerably understate the extent of the decline. The corrected estimates for Bald Eagles in Delaware and Maryland combined are 349 in 1955, 39 in 1970 and 112 in 1980. This suggests that the number of Bald Eagles in 1970 was only a small fraction of those present 15 years earlier, and is now only about a third of those present in 1955. The decline of Bald Eagles in Florida has been less precipitous and present numbers appear to be about half that in 1955. No correction for search efficiency was calculated for the other states in the eastern United States. However, if a factor of about 2.0 is generally applicable to this region, then present numbers of Bald Eagles in these states range from 1/3 to 1/2 those in 1955.

Data from states adjacent to the Mississippi River indicate a considerable increase in numbers of Bald Eagles from 1955 to 1980 (Table 3C). However, when the figures are adjusted for changes in search effort, the magnitude of these increases is somewhat less. Nevertheless, data from Wisconsin, Iowa and Illinois indicate that their total number of wintering Bald Eagles has almost doubled from 1,000 in 1955 to 1,900 in 1980.

Bald Eagle numbers have appeared to increase over the last 25 years in the western interior states (Table 3D). After correcting for search efficiency (Table 4), the total number of Bald Eagles in South Dakota, Nebraska, Kansas, Oklahoma, Texas, New Mexico, Colorado, Montana, Wyoming, Idaho and Utah was estimated to be about 5,500 birds in 1955 and just over 12,300 in 1980. The increase was not evenly distributed. There were large increases in some states like South Dakota while other states, notably Oklahoma, may have had a slight decline.

On the U.S. west coast the Bald Eagle data are more difficult to interpret (Table 3E). Although their numbers declined in California after 1955, there is reasonable evidence to suggest an increase after 1965. The data also show an increase in Oregon since 1965.

TABLE 3B. The Number of Bald Eagles in the Eastern United States as Estimated from Christmas Bird Counts (CBC) (Not Corrected for Changes in Search Efficiency) and National Wildlife Federation (NWF) Midwinter Surveys.

State	1955	1960	1965	1970	1975	1980	Jan. 80 (NWF)	1980 <sup>a</sup> (alt. est.)
ME - S. 1/2	—	—	—	82	105	142 (54-259) <sup>b</sup>		106
- N. 1/2	—	—	—	—	—	57 (2-255)		63
total						199 (56-514)	107	269
NH			0	0	4	4 (1-13)	3	5
VT					0	7 (2-19)	0	9
MA	25	16	6	6	0	7 (5-15)	25	10
RI	3	3	0	0	0	0	0	0
CT	—	2	3	2	4	8 (6-19)	11	11
NY	38*	30	32	22	26	8 (2-18)	36	10
NJ	30	15*	5	5	3	11 (9-46)	13	17
PA	14	7	6	11	18	23 (7-54)	11	38
DE	34	27	27	8	3	3 (2-16)	7	5
MD and D.C.	137	70	66	27	56	112 (69-230)	66	189
VA - E. 1/2	263	195	65	52	46	134 (47-301)		258
- W. 1/2	—	—	—	0	0	0		0
- total						134	165	258
NC	185**	107**	69	0	0	0	5	0
SC	—	—	—	—	—	58*(8-169)	5	117
GA	—	24	0	0	0	49 (3-141)	10	71
FL	1128	1034	1283	934	1140	1395 (742-2223) <sup>c</sup>		2255
OH	48	24	32	15	20	26 (8-50)	6	37
WV	—	—	—	—	0	0	0	0
MI	49	14	11	0	15	49 (8-102)	30	49
IN	37	20	19	0	22	42 (8-84)	3	59
KY - E. 1/2	—	—	—	—	—	0	d	0
TN - E. 1/2	—	—	—	—	—	40*(6-138)	d	80
AL					47	229**(20-877)	35	649
TOTAL						2404 (1009-5029)	1528	4162

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NUMBERS IN PARENTS ARE THE 95% CONFIDENCE INTERVALS.

<sup>a</sup> Since no NWF count was done in Florida in 1980, the result from 1981 is substituted.

<sup>c</sup> NWF data does not break down the numbers into those from eastern and western Kentucky and Tennessee.

- Less than 10 counts.

\*, \*\* All estimates were derived assuming a Poisson distribution, except that \* indicates that the square root of the data points approached a Poisson distribution, while \*\* indicates the fourth root of the data points approached a Poisson distribution.

TABLE 3C. The Number of Bald Eagles in States Adjacent to the Mississippi River as Estimated from Christmas Bird Counts (Not Corrected for Changes in Search Efficiency) and National Wildlife Federation (NWF) Midwinter Surveys.

State	1955	1960	1965	1970	1975	1980	Jan. 80 (NWF)	1980 <sup>a</sup> (alt. est.)
MN - N.W. 3/4						93*(8-233)		178
- S.E. 1/4						101**(35-236)		231
- total	0	0	95	183**	180**	194 (43-469)	16 <sup>b</sup>	409
WI	190**	113	182**	156*	112*	209**(85-383)	70 <sup>b</sup>	710
IA	169**	244**	316**	504**	2071**	1073**(308-2768)	128 <sup>b</sup>	4127
IL	247**	550**	194**	356**	402**	618**(438-1273)	599 <sup>b</sup>	3410
MO	—	—	812**	565**	613**	1286**(496-2775)	948 <sup>b</sup>	4034
KY - W. 1/2	—	—	—	—	—	79**(25-417)	64 <sup>bc</sup>	357
TN - W. 1/2	—	—	—	—	65**	168**(112-1159)	272	1487
AR	—	—	182	125	210	478*(157-1002)	471	902
MS	—	—	—	—	—	190*(8-512)	13	287
LA	—	—	—	—	41	63 (6-164)	10	94
TOTAL						4358 (1678-10922)	3536	15817

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<sup>a</sup> The number of eagles estimated assuming an even distribution of eagles and census areas (derived from CBC).

<sup>b</sup> Counts from the NWF did not include counts from along the Mississippi River. 945 eagles counted along the Mississippi River were added to the numbers from the individual states to give the total NWF count of eagles for this region.

<sup>c</sup> NWF counts for Kentucky and Tennessee include the whole state.

\*, \*\* All estimates were derived assuming a Poisson distribution, except that \* indicates that the square root of the data points approached a Poisson distribution, while \*\* indicates the fourth root of the data points approached a Poisson distribution.

- Less than 10 counts.

## DISCUSSION

In view of the many assumptions underlying the present analysis of CBC, the estimates given here should be used with some caution. Nevertheless, the estimates are probably the best available and are consistent with other knowledge. This analysis of CBC provides an estimate of 70,000 Bald Eagles in North America in December 1980. The 95% confidence intervals are considerable and the true number might even double this total. In general, the method used provides a conservative estimate. This is witnessed by the much higher estimate (alternate estimate for 1980 seen in Table 3) obtained when the birds and census areas were assumed to be evenly distributed. Furthermore, there is a close parallel between estimated numbers and the survey by the National Wildlife Federation (NWF) for many states in the eastern U.S. where coverage is particularly thorough. However, an over-estimate for some areas is possible since good Bald Eagle habitat may be over-represented in the survey.

The estimate might be altered if it were known what proportion of birds was found within a given census area. Some birds may have been counted more than once. Coverage in most areas is relatively complete. However, incompletely censused areas probably occur, particularly in hilly or mountainous terrain with few roads in the west, and in the numerous offshore islands of Alaska and B.C.

Estimates for both wintering and breeding birds in several Canadian provinces can be correlated. Largely non-migratory, the 106 known breeding pairs of Nova Scotia in 1980 (Austin-Smith *et al.* 1981) probably reflect a total population of 320-425 birds. Assuming that immatures make up at least 1/3 of this population, 320 would represent 3 times the number of breeding pairs. Hawk Mountain fall counts from 1931 to 1945 where 36.5% of Bald Eagles seen were immature tends to support my assumption. However, in a stable population like Saskatchewan's (Gerrard *et al.* 1973) where non-breeding adults exist, the total population might approximate 4 times the number of breeding pairs to give the higher estimate of 425 birds (Gerrard *et al.* 1980). The estimate of 235 Bald Eagles in Nova Scotia based on the CBC is probably low, although some outward migration might occur in winter.

Stocek and Pearce (1981) reported 12 occupied breeding areas in 1980 for New Brunswick for an estimated total population of 36-48 birds. The estimate of 65 birds from the CBC for New Brunswick in 1980 does not seem out of line with possible emigration from Nova Scotia, for example.

A recent breeding census of coastal British Columbia estimated about 9,000 adults (Hodges *et al.* 1981). Assuming that 1/3 of the population is immature, a total of about 13,000 birds might exist on the coast with some additional birds in the interior. The estimate is 1/2 the estimate of 28,500 from the CBC for December 1980. The larger estimate may be due to an influx of Bald Eagles from Alaska in December. Considered together, British Columbia and



TABLE 3D. The Number of Bald Eagles in the Interior Western States as Estimated from Christmas Bird Counts (Not Corrected for Changes in Search Efficiency) and National Wildlife Federation (NWF) Midwinter Surveys.

State	1955	1960	1965	1970	1975	1980	Jan. 80 (NWF)	1980 (alt. est.)
ND				0	58	63*(8-197)	40	178
SD				196*	767**	712**(66-2395)	407	2362
NB		73*				450**(28-2117)	442	1530
KS	142	284**	260*	648**	690**	879**(327-1856)	324	2777
OK	561***	735**	382*	252*	908*	977*(370-1522)	569	1297
TX	89	182	166	328*	386*	919*(453-1510)	491	2716
MT	--	--	--	--	3241*	3617*(2083-5766)	427	4955
WY	--	--	--	--	1474*	1570**(311-4748)	456	4617
CO	178	266*	166	176*	477**	700**(289-1344)	595	1973
NM	--	--	192*	359*	266	400**(47-951)	135	918
ID	--	--	--	--	--	707*(142-1904)	433	2128
UT	--	--	--	--	--	1243**(308-3353)	661	2547
AZ	--	--	0	--	191	149*(13-391)	121	399
NV	--	--	--	--	--	83 (1-332)	53	104
TOTAL						12600 (4446-28386)	5154	27647

\* The number of eagles estimated assuming an even distribution of eagles and census areas (derived from CBC).

\*, \*\* All estimates were derived assuming a poisson distribution, except that \* indicates that the square root of the data points approached a poisson distribution, while \*\* indicates the fourth root of the data points approached a poisson distribution.

- Less than 10 counts.

Alaska account for a total of about 48,000 birds, approximating the Bald Eagle population for Alaska (35,000-50,000) estimated by Nickerson (1974) including coastal B.C.'s 13,000 birds.

In the eastern U.S., there is a reasonable similarity among estimates from the CBC in 1980, surveys made by NWF, and estimates of breeding birds. Green (1982) reported 60-70 breeding pairs in Maine, indicating a population of 180-250 birds. The estimate from the CBC data (199) is well within this range. The NWF count of 109 eagles for Maine in 1980 was probably very low (M. McCullough, pers. comm.). Estimates for Massachusetts and New York from the CBC are somewhat lower than the corresponding counts from the NWF survey. More Bald Eagles move south into these states by January, raising the actual number of birds during the NWF survey.

The population of 249 Bald Eagles estimated for the Chesapeake Bay region using the CBC is very close to the NWF count of 238. However, Taylor (1982) reported just over 100 current occupied breeding areas in Delaware, Maryland and Virginia, which should translate into a total population of 300-400 birds.

In 1981, there were 359 occupied breeding areas in Florida (Green 1982). Multiplying this figure by 3-4 gives an estimate of 1077-1436. The estimate of 1395 eagles from the CBC is within this range. There was no 1980 NWF survey in Florida. However, the 1981 count was only 920 birds.

It is not possible to directly compare state-by-state the estimates from the CBC data and the NWF survey for those states adjacent to the Mississippi River. The NWF survey classified all observed eagles along the Mississippi into a separate group without assigning them to any state, whereas CBC estimates are on a state-by-state basis. However, the estimate for all states from the CBC (4,358) is only 23% greater than the number produced by the NWF survey (3,536). Birds that winter along the Mississippi River and adjacent states originate primarily from breeding areas in the Great Lakes states (Gerrard *et al.* 1975, Griffin *et al.* 1980), and probably from the regions surveyed by Grier (1977, 1978) in northwestern Ontario and eastern Manitoba. Some birds certainly move further west to winter, but this may be offset by breeding birds from further west, e.g. Saskatchewan, moving into western Iowa and Missouri (Gerrard *et al.* 1978). In 1981, 494 known occupied breeding areas existed in the Great Lakes states. Grier's 1974 census of northwestern Ontario and eastern Manitoba estimated 579 breeding areas in this region (Grier 1977), but this estimate was not corrected for search efficiency which would adjust this number to 681 breeding areas (Grier *et al.* 1981). In 1978, Grier covered an additional area east of his 1974 census, adding some 80 more breeding areas. This brings the total number of occupied breeding areas north of the Mississippi region to approximately 1255. This estimate suggests a population of 3,765 to 5,020 birds which is in close agreement with the CBC estimate of 4,358 Bald Eagles.

TABLE 3E. The Number of Bald Eagles on the West Coast of the United States as Estimated from Christmas Bird Counts (Not Corrected for Changes in Search Efficiency) and National Wildlife Federation (NWF) Midwinter Surveys.

State	1955	1960	1965	1970	1975	1980	Jan. 80 (NWF)	1980 <sup>a</sup> (alt. est.)
WA	—	—	—	—	692*	1005**(378-2165)	1619	2573
OR	—	—	101*	338	382*	790**(389-1390)	610	1666
CA	223**	54	30	153	377*	437**(239-685)	772	1427
SUB-TOTAL						2130 (1006-4240)	3001	5666
AK S. 1/2					50237**	18990**(4723-58564)	n	68137
AK N. 1/2						0	n	0
Total in the Lower 48 U.S.						21492 (8139-48577)	13219 <sup>b</sup>	53292
Total in the U.S.						20482 (12862-107141)		121429
Total in North America						70653 (27218-166067)		173293

<sup>a</sup> The number of eagles estimated assuming an even distribution of eagles and census areas (derived from CBC).

<sup>b</sup> Total differs from the Jan. 1980 NWF count due to a substitution by the preliminary estimate for Jan. 1981 for the eastern United States since Florida was drastically undercounted in Jan. 1980 (see Table 3B).

\*, \*\* All estimates were derived assuming a Poisson distribution, except that \* indicates that the square root of the data points approached a Poisson distribution, while \*\* indicates the fourth root of the data points approached a Poisson distribution.

- Less than 10 counts.

n No. counts done.

The CBC estimate (12,600) from the interior western states is much higher than the NWF count (5,154). Birds wintering in this region come from breeding areas in Saskatchewan (Gerrard *et al.* 1978), the Northwest Territories and northern Alberta (Young *et al.* 1981), and probably western Manitoba. Leighton *et al.* (1979) estimated 11,600 Bald Eagles in Saskatchewan in spring 1974, a number slightly high due to their method of estimating numbers on secondary shoreline. The number of eagles in the latter regions might add another 3,000 to 9,000 birds. The estimate from the CBC apparently concurs better with these figures than the NWF count. Many counties in this region are not covered at all in the NWF survey. Moreover, in this region Bald Eagles are widely distributed and not necessarily associated with water (Higby 1975), making an accurate count difficult.

The estimate of 3,617 eagles from the 1980 CBC for Montana seems high. However, Montana in late December still contains many of the birds concentrating at Glacier National Park. Eastern Montana also serves as a major route for Saskatchewan Bald Eagles migrating south (Gerrard *et al.* 1978). Many of these birds have likely moved south before the January NWF count.

Wyoming is the only state where aerial transects (Higby 1975) have been used to estimate Bald Eagle numbers. However, as the survey was conducted primarily for Golden Eagles (*Aquila chrysaetos*), immature Bald Eagles were undercounted and there were more unidentified eagles than Bald Eagles. Nevertheless, a considerable number of Bald Eagles were observed away from waterways.

In the west coast states, the numbers of Bald Eagles from CBC were lower than those from NWF counts (Table 3E). The CBC may have underestimated the number of Bald Eagles, but alternatively more birds may have moved south in January from Alaska and British Columbia. The latter is consistent with the timing of the peak numbers of Bald Eagles in these states.

### Changes in Bald Eagle populations in the last 25 years

Analyses of the CBC in 1955 and 1980 indicate a decrease in the number of Bald Eagles in the eastern U.S. and an increase in the western U.S. This is consistent with other evidence (Sprunt 1969, Robbins 1971, Swenson 1983). These estimates represent the first attempt to quantify these changes over large regions.

This decline in the eastern U.S. and Ontario may be ascribed primarily to the effects of DDT (Postupalsky 1971). Habitat changes in some areas like the west coast of Florida (J. Lincer, pers. comm.) are important.

Swenson (1983) attributes the increase in the western U.S. population to improvements in the wintering habitat as a result of many new dams and lakes, and an increase in the northerly breeding range due to a warming trend in the last 50 years. Two other factors may also be important. The increased numbers of commercial fishermen since WW II leave remains of coarse fish

TABLE 4. Estimates of Bald Eagle Numbers for Selected Regions Corrected for Search Efficiency

Region		1955			1980 estimate	1980 population as a proportion of the 1955 population
		Original estimate	Search factor	Revised estimate		
Eastern United States	MD and DE	171	2.04	349	112	0.32
	FL	1128	2.30	2594	1395	0.54
Mississippi River States	WI	190	1.20	228	209	0.92
	IA	169	1.996	337	1073	3.18
	IL	247	1.74	430	618	1.44
Western Interior States	SD and ND	33	1.59	52	1051	20.2
	KS	142	1.89	268	879	3.3
	OK <sup>b</sup>	561	2.51	1408	977	0.69
	TX and NM <sup>a</sup>	265	1.68	445	1560	3.51
	CO	178	2.72	484	701	1.45
	MT, WY, ID and UT	1468	1.92	2819	7137	2.53

<sup>a</sup> Because of fewer than 10 counts in 1 or more of these states, all counts from the region were grouped together to form 1 region for the 1955 estimate.

<sup>b</sup> The 1955 estimate for Oklahoma is based in 1954 CIB's since fewer than 10 counts were conducted in the state in 1955.

on the ice during the winter, thus providing an unexpected food source for birds on frozen lakes and in northern Canada in early spring. Second, the shooting of Bald Eagles was widespread in some western states up to the 1950's and 1960's, but has lessened considerably due to protection and greater public awareness.

Changes in the Bald Eagle population along the west coast of North America in the last 25 years are not clear. Careful surveys of the numbers of adult birds in southeast Alaska in 1967 and 1977 indicate a stable adult population during this period (Hodges *et al.* 1979). In the late 1970's, though, there has been a drastic increase in non-breeding birds (Hansen and Hodges 1981) and there may be more Bald Eagles currently than can be supported by the existing habitat and food resource.

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