

**WINTERING RAPTORS AND WATERFOWL
ON THE MAURICE RIVER
CUMBERLAND COUNTY, NJ**

The Fifteenth Year of an On-going and Long-term Study

**Observed Status and Trends:
A Fifteen Year Review 1987-2002**

**Submitted to:
Citizens United to Protect the Maurice River and Tributaries, Inc.**



Am Black Ducks (and a single Am Wigeon) flush from a Maurice River marsh.

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BACKGROUND AND METHODS:

Numerous studies have been conducted by Citizens United on the birds of the Maurice River region. These research efforts have taken place throughout the seasons, investigating the breeding birds of the river and its tributaries (principally the Manumuskin), winter bird populations, and the use of the area by migratory birds in spring and fall. Also, key parcels of land have been specifically surveyed for bird use, an important aspect of assessing the preservation potential and priority of undeveloped or threatened lands.

The principal on-going Citizens United project is an investigation of the status and trends in wintering raptors and waterfowl on the Maurice River. This study is one of very few true long-term systematic monitoring studies conducted in the Delaware Estuary. The winter of 2001-2002 marked the fifteenth year of this study. The methodology employed was the same as the first 14 years; nine sites are surveyed for 50 minutes per site on an average of every ten days throughout the winter. Winter here is defined as the time between the last week of November and the third week of March. Raptors and waterfowl are counted concurrently. In the fifteen years of study, over 150 individual winter surveys have been carried out, creating a substantial and broad long-term data base.

RAPTOR STUDIES:

Raptors (hawks and eagles) have been monitored, concurrently with waterfowl, for fifteen winter seasons, beginning in 1987-1988. Raptor studies have yielded significant long-term data on the status and trends of birds of prey in the Maurice River region. Raptors are predators at the top of the food chain. Accordingly, raptor numbers are a good barometer of an area's environmental quality. The Maurice River system continues to support one of the largest wintering hawk and eagle concentrations known in New Jersey or the Delaware Estuary region. Fourteen species of raptors are recorded most winters.

Turkey Vultures are the most numerous species found. Regional Turkey Vulture roosts support up to 300 birds each winter. Formerly, Turkey Vultures were near the northern limit of their winter range in southern New Jersey, but mild winters continue to change winter vulture distribution in eastern North America, and increasing numbers are wintering farther and farther north.

Red-tailed Hawks are the second most numerous species on the winter river. Average daily counts of 40-50 birds are achieved along the 14 mile stretch of river surveyed. Northern Harrier, formerly known as "Marsh Hawk," are another representative species of the vast marshes of the Maurice River. Counts of over 30 N. Harriers per day are achieved most winters.

The Bald Eagle is a hallmark species on the Maurice River and its tributaries. The numbers found here each winter are regionally significant and generally the highest concentration in both New Jersey and in the entire Delaware Estuary region. Numbers have grown significantly over the fifteen years of study. Currently peak daily counts of up to 20 Bald Eagles are achieved each winter.

WATERFOWL STUDIES:

Ducks and geese have been counted, concurrently with raptors, along the tidal portions of the Maurice River for the past fifteen winters, beginning in 1987-1988. Surveys have been conducted between November 22 and March 22 each season, on an average of once every ten days. In this way, the status and trends of waterfowl on the Maurice River can be assessed. In all, 33 species of waterfowl have been recorded on the Maurice River between 1987 and 2001. Key species on the Maurice River and its tributaries include Snow Goose, Canada Goose, American Black Duck, Mallard, and Northern Pintail.

Snow Geese are characteristically found in the salt marshes on the lower river, with an average of 3,000 to 4,000 found each winter. The peak daily high count was 14,000 recorded early in 1990. Canada Geese are widespread along the river, but are usually most numerous on the brackish upper river. American Black Ducks are found in large numbers along the length of the river, with average counts between 1,000 and 3,000 each winter. Peaks have been as high as 8,000 birds for this species of special concern to the US Fish and Wildlife Service.

Mallard and Northern Pintail are found primarily on the brackish marshes of the upper river, with largest numbers usually recorded in late winter and early spring. Early March is generally best -- the time of spring migration "staging" for these handsome ducks. These species are found in highest numbers in the wild rice marshes north of the Maurice River Causeway. Average numbers vary considerably due to the severity of the winter, but peaks of nearly 4,000 Mallards and 3,000 N. Pintails have been recorded. Also found along the river in significant numbers each winter are Green-winged Teal, Bufflehead, and Red-breasted Merganser. Some winters, scaup are abundant in Maurice River Cove.

FINDINGS -- RAPTORS:

Fifteen years of data have now been accrued documenting wintering raptor status, distribution and trends on the Delaware Bayshore's Maurice River. **Table 1** presents a 15 year summary of winter raptors on the Maurice River. Both the daily **peak** flight and the **average** number per survey are shown for each season. This table is divided into three five-year segments. Data is shown for the first season studied, winter 1987–1988, to present.

Table 2 presents this same information in a different format. Shown in Table 2 are: A) the **best** count (best daily high count) for each five year segment; B) an **average of all five peak** counts for the segment; and C) an **average of the mean** counts for all five years of each segment. Finally, an **overall 15 year average** (combining all three segments) is shown as part of Table 2. For species sighted infrequently, the number of records (sightings) per five year segment are shown.

Figures 1A through **Figure 1I** present a **3-year running average** for each of the nine key raptor species. The running average, which in essence compares each year to the year before and the year after, is regarded as one of the better ways to assess true trends in populations. It is a method which to some degree mutes any spikes or valleys in the data, such as low numbers in an exceptionally mild winter or high numbers in a particularly cold winter.

DISCUSSION -- RAPTORS:

When applying a standard trend analysis to the three-year running averages, significant trends are seen for several species of birds of prey. The regression analyses, computed on the three-year running averages of the mean (average) counts, are shown below for key species:

Species	Correlation Coefficient	Significance	Trend
Black Vulture	r= 0.51	p= 0.08	Increasing trend suggested
Bald Eagle	r= 0.86	p <0.01	Strong increase indicated
Cooper's Hawk	r= 0.94	p <0.01	Strong increase indicated
Rough-lg. Hawk	r= 0.81	p <0.01	Strong decline indicated
Am. Kestrel	r= 0.92	p <0.01	Strong decline indicated

In the above summary of trend analysis, only species for which graphical results (three-year running average) suggested an increase or decline in numbers over the duration of the study were included. For the species shown above, however, significant trends are indicated. Significance at the $p = < 0.01$ level means that there is a 99% chance that the increase or decrease is not random or coincidental. In other words, the trend is real, not simply an artifact of the vagaries or inconsistencies of count technique.

In summary analysis, fifteen years of monitoring have shown clear increasing trends for Black Vulture, Bald Eagle, and Cooper's Hawk, and marked (statistically significant) declines for Rough-legged Hawk and American Kestrel. Turkey Vultures, Northern Harrier, Sharp-shinned Hawk and Red-tailed Hawk have shown remarkably consistent numbers over the fifteen year study period.

There are few surprises in this long-term data set. Bald Eagle increases on the Maurice River reflect well-known region-wide and continent-wide recovery for this DDT-era victim. Locally, in the most recent years, a marked increase in breeding pairs of eagles have offset the mild weather-related lack of eagles from farther north. The Cooper's Hawk also reflects a known region-wide comeback for this accipiter. Rapidly increasing Black Vulture numbers on-the-other-hand reflect a major permanent range expansion of this formerly "southern" vulture into the northeastern US. Black Vulture's increasing trend however is not as strong (significant) as that shown for Cooper's Hawk and Bald Eagle.

The Rough-legged Hawk decline is perhaps rooted in recent mild winters, resulting in few of these arctic breeders coming as far south as the Delaware Bayshore. It may however reflect an observed loss of its preferred "high marsh" *Spartina petens* (salt hay) winter habitat on the lower Maurice and throughout the bay region. More study of this species and comparisons to wintering numbers in other areas is warranted and recommended.

American Kestrel, although always a low density and low numbered species on the Maurice River, exhibits the most drastic and significant decline. Maurice River fifteen year trends reflect a known region-wide severe loss of resident, migratory and wintering Kestrel. No clear reason for this decline is known, yet loss of grassland habitat, decline in nest cavities, changing prey base, pesticides and herbicides, and even Cooper's Hawks (as predators of Kestrel) have been suggested and implicated. More study by the NJ DFW Endangered and Nongame Species Program is urged and urgent. American Kestrel is far less numerous than Bald Eagle as a wintering bird in New Jersey, and breeding Kestrel are probably even fewer than the number of breeding eagles in southern New Jersey. This fifteen year study confirms and corroborates those of others on the rapid and dramatic loss of American Kestrel in New Jersey.

Table 1
Wintering Raptors on the Maurice River
Fifteen Year Summary

Species	Segment I										Segment II									
	1987-88	1988-89	1989-90	1990-91	1991-92	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1992-93	1993-94	1994-95	1995-96	1996-97
Black Vulture	Peak	Avg	Peak	Avg	Peak	Peak	Avg	Peak	Avg	Peak	Peak	Avg	Peak	Avg	Peak	Peak	Avg	Peak	Avg	Peak
Turkey Vulture	6	0.5	3	0.7	9	2.4	35	9	45	12	22	9	58	25	45	21	30	14	21	8
Osprey	82	44	209	116	123	58	105	61	160	79	77	59	266	107	99	59	120	84	93	55
Bald Eagle	10					1						10					10		15	
Northern Harrier	6	2.7	4	2.6	15	5.7	10	5.4	10	5.9	11	8.4	16	9.5	6	3.9	20	10.1	14	7
Sharp-shinned Hawk	32	20.5	32	21	22	18	23	17	31	24	30	16	33	19	28	24	29	20	23	15
Cooper's Hawk	12	3	8	2	5	2.3	5	2.7	13	3.7	11	2.5	8	2	6	2.8	16	3.5	5	1.6
Northern Goshawk	3	1.1	2	0.7	5	1.3	3	1.4	3	1.1	5	1.5	4	1.7	3	1.4	4	1.5	7	2.2
Red Sh. Hawk			1								1						1			
Red-tailed Hawk	1		1		2					1	3		1		2		2		2	
Rough-legged Hawk	40	33	44	33	59	38	53	37	58	41	57	41	47	36	52	42	52	41	59	41
Golden Eagle	3	1	2	1	4	2	4	2	3	2	1	0.25	1	0.22	1	0.44	3	1.2	1	0.3
American Kestrel	1		1		2				1		1				1		1		1	
Merlin	6	2.5	4	2.9	8	2.3	4	2	5	2.6	4	1.9	5	1.7	3	1.1	3	1.5	3	0.7
Peregrine Falcon					1						1		2				1		1	
	1		1				1		1				1		1		1		2	

5

Species	Segment III										Segment IV									
	1997-98	1998-99	1999-00	2000-01	2001-02	1997-98	1998-99	1999-00	2000-01	2001-02	1997-98	1998-99	1999-00	2000-01	2001-02	1997-98	1998-99	1999-00	2000-01	2001-02
Black Vulture	Peak	Avg	Peak	Avg	Peak	Peak	Avg	Peak	Avg	Peak	Peak	Avg	Peak	Avg	Peak	Peak	Avg	Peak	Avg	Peak
Turkey Vulture	76	17	37	10	18	9	31	13	51	20	89	60	137	81	133	84	195	96	175	108
Osprey			1		19		31		13											
Bald Eagle	11	6.6	12	7	17	9.3	20	10.4	15	8.5										
Northern Harrier	25	22	34	23	33	23	38	23	30	24										
Sharp-shinned Hawk	7	2.6	7	3.2	6	2.1	6	2.8	7	2.9										
Cooper's Hawk	5	3	4	1.7	4	2.4	5	2.2	4	2.1										
Northern Goshawk					1															
Red Sh. Hawk	1		1		2		2		1											
Red-tailed Hawk	56	42	57	45	49	37	52	42	53	42										
Rough-legged Hawk					1		1		1											
Golden Eagle	1		1		1		1		1											
American Kestrel	2	0.5	3	0.9	2	0.66	2	1.3	4	1.3										
Merlin					1		1		1											
Peregrine Falcon	1		1		1		1		1	2										

All surveys conducted between the 4th week of November and the 3rd week of March

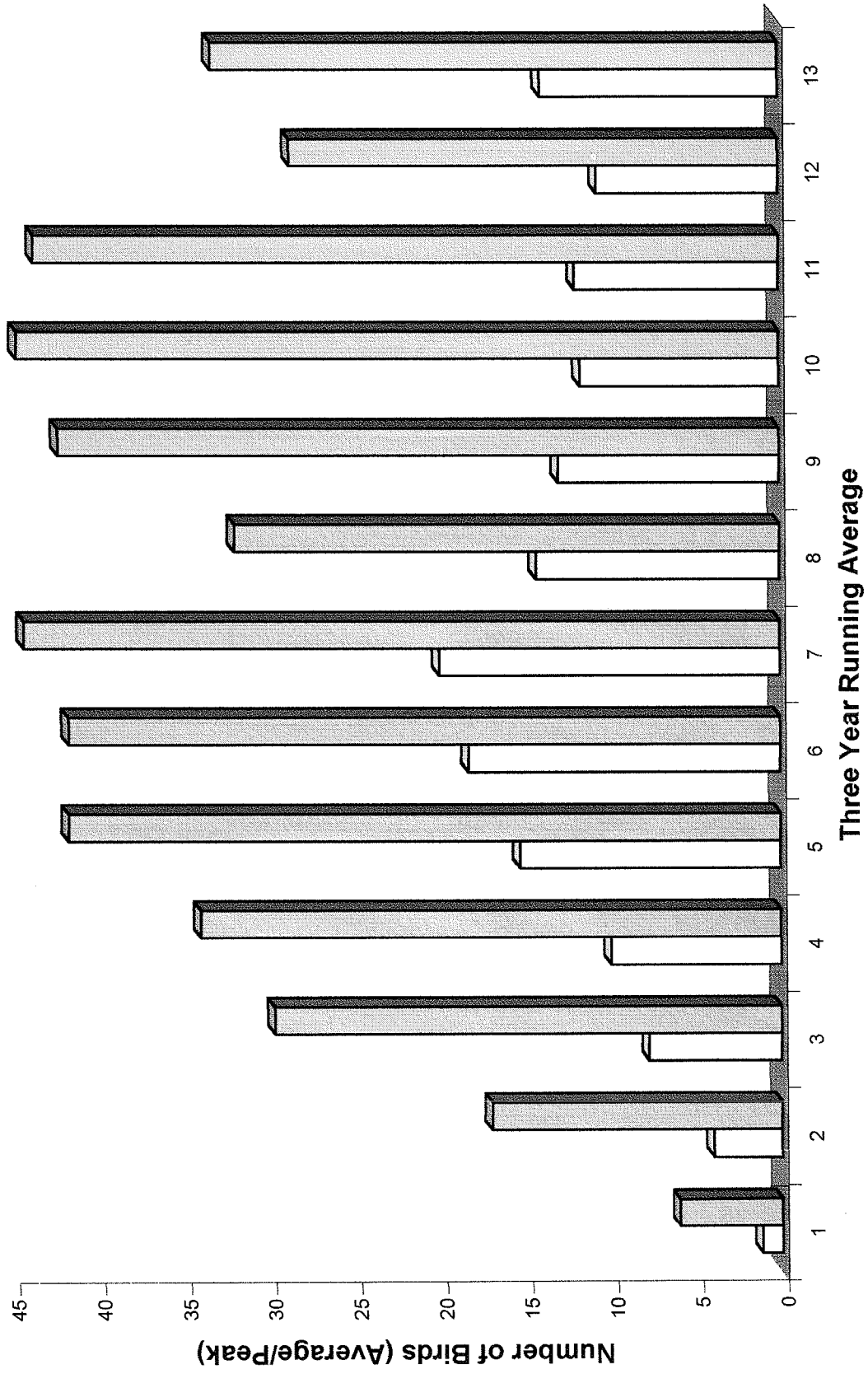
Table 2

Wintering Raptors on the Maurice River, Cumberland County, N.J

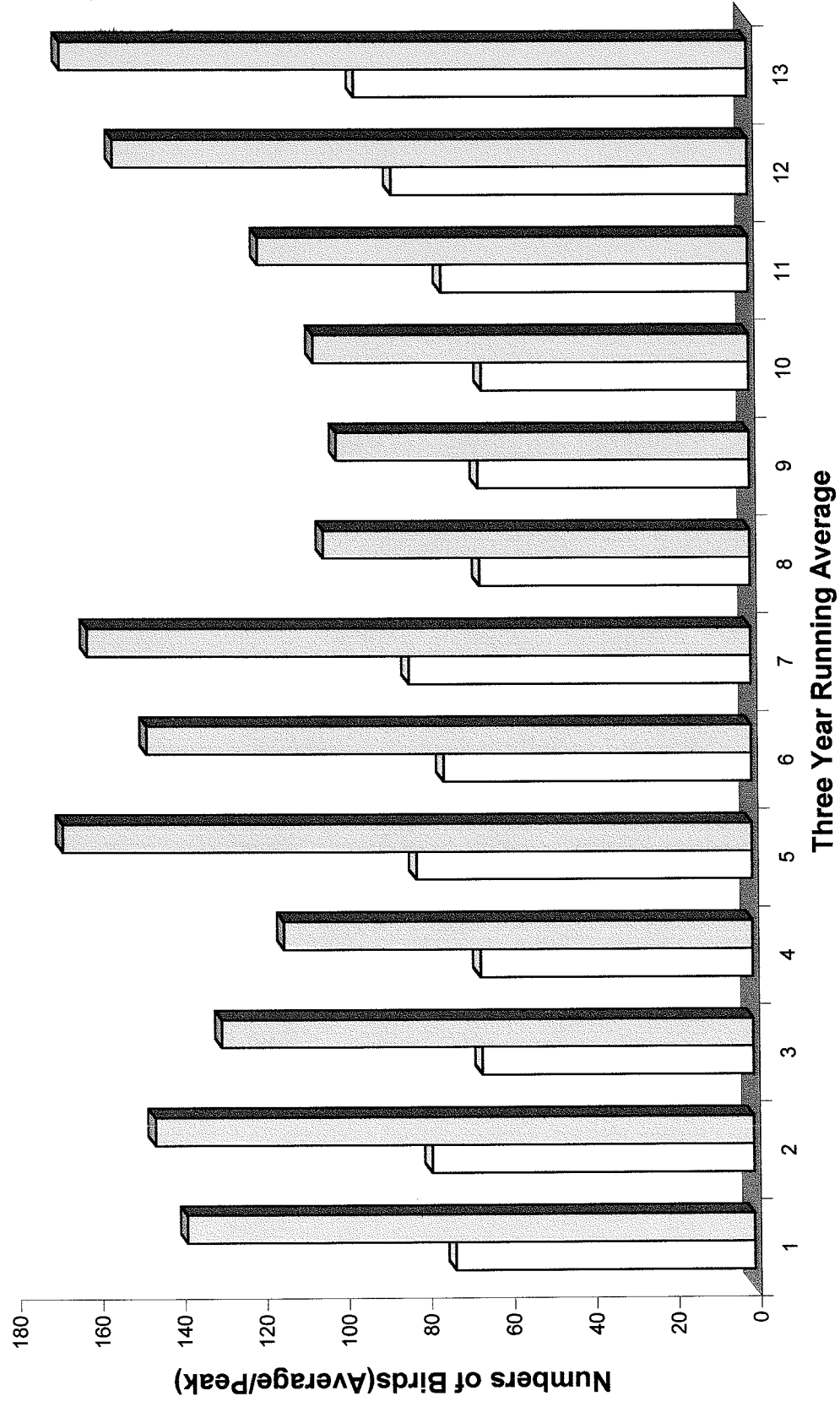
Fifteen Year Summary

Species	1987-1992 Segment			1992-1997 Segment			1997-2002 Segment			15 Year Overall		
	Best	Avg. Peak Count	Mean of Means	Best	Avg. Peak Count	Mean of Means	Best	Avg. Peak Count	Mean of Means	All-time High	Avg. Peak Count	Mean of Means
Black Vulture	45	19.6	4.92	58	35.2	15.4	76	42.6	13.8	76	32.46	11.37
Turkey Vulture	209	135.8	71.6	266	131	72.8	195	145.8	85.8	266	137.53	76.73
Bald Eagle	15	9	4.46	20	13.4	7.78	20	15	8.36	20	12.46	6.87
Northern Harrier	32	28	20.1	33	28.6	18.8	38	32	23	38	29.53	20.63
Sharp-shinned Hawk	13	8.6	2.74	16	9.2	2.48	7	6.6	2.72	16	8.13	2.65
Cooper's Hawk	5	3.2	1.12	7	4.6	1.66	5	4.4	2.28	7	4.06	1.69
Goshawk		2 total			2 total			4 total		1	@ 1 every 2 years	
Red-shouldered Hawk		9 total			14 total			11 total		3	@ 2/year	
Red-tailed Hawk	59	50.8	36.4	59	53.4	40.2	57	53.4	41.6	59	52.53	39.4
Rough-legged Hawk		51 total			24 total			6 total		4	currently @ 1/year	
Golden Eagle		10 total			5 total			5 total		2	@ 1/year	
American Kestrel	8	5.4	2.46	5	3.6	1.38	4	2.6	.93	8	3.87	1.59
Merlin		1 total			8 total			7 total		1	@ 1/year	
Peregrine Falcon		5 total			12 total			18 total		2	@ 2/year	

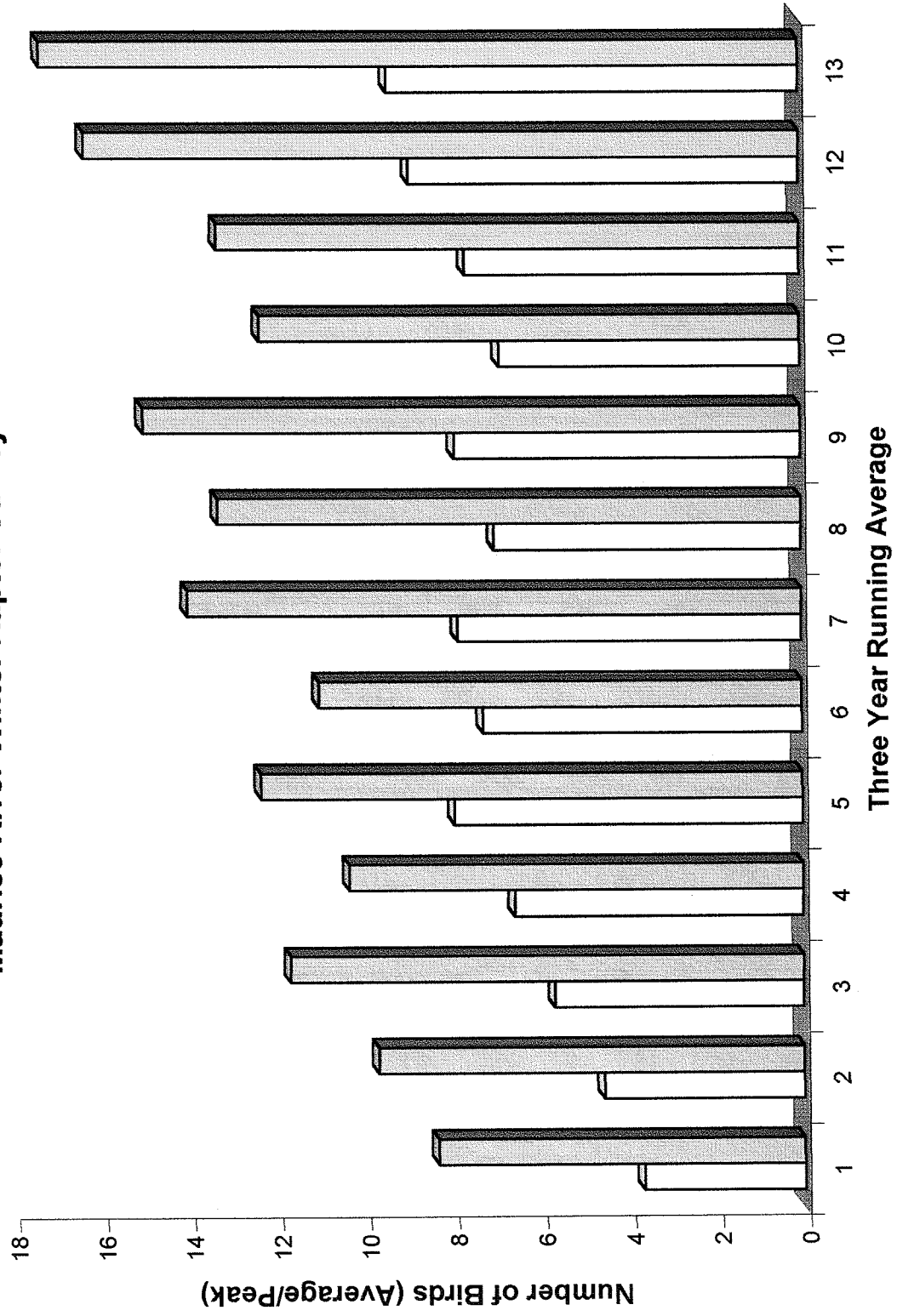
**Figure 1A. Black Vulture
Maurice River Winter Raptor Survey - 1987-2002**



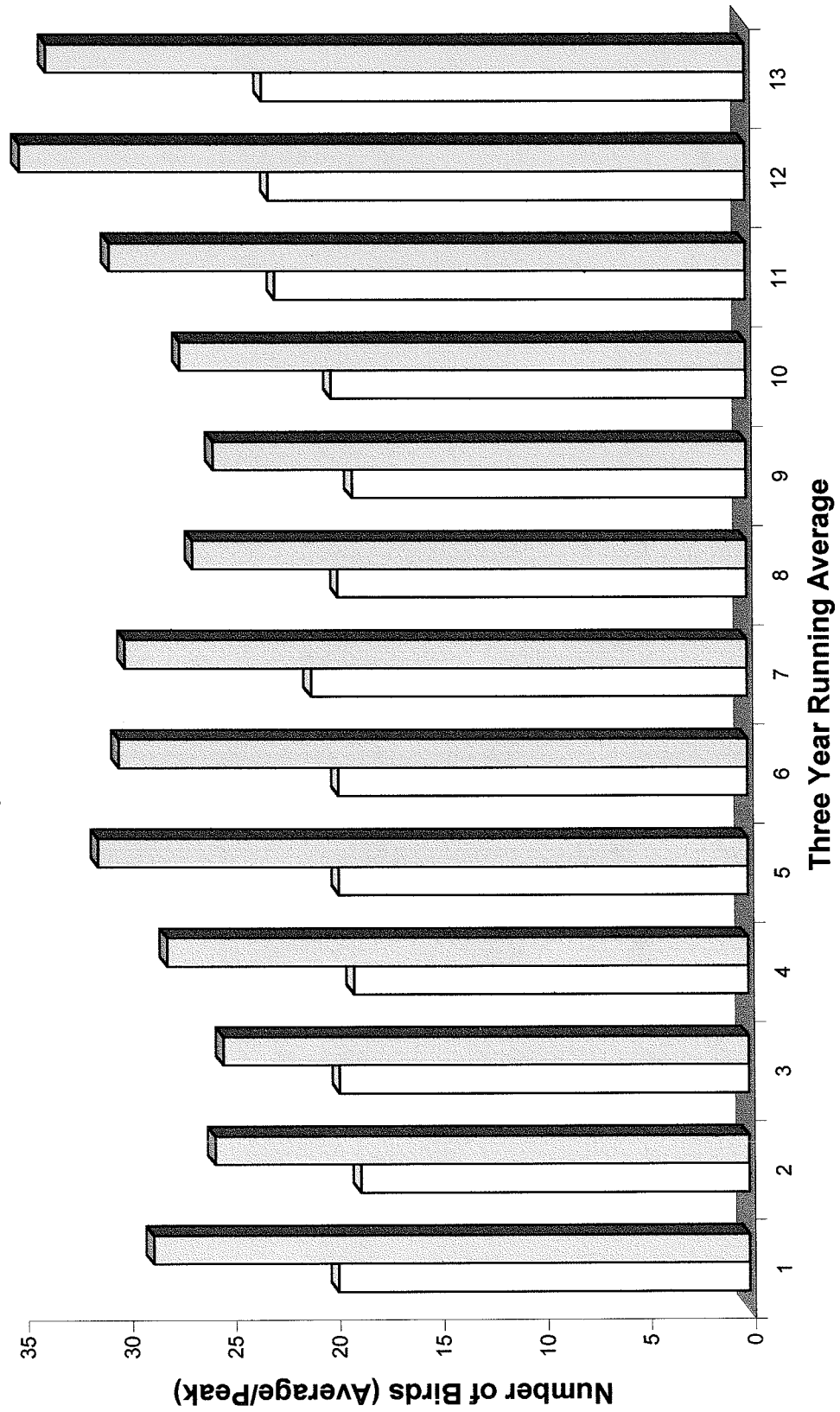
**Figure 1B. Turkey Vulture
Maurice River Winter Raptor Surveys - 1987-2002**



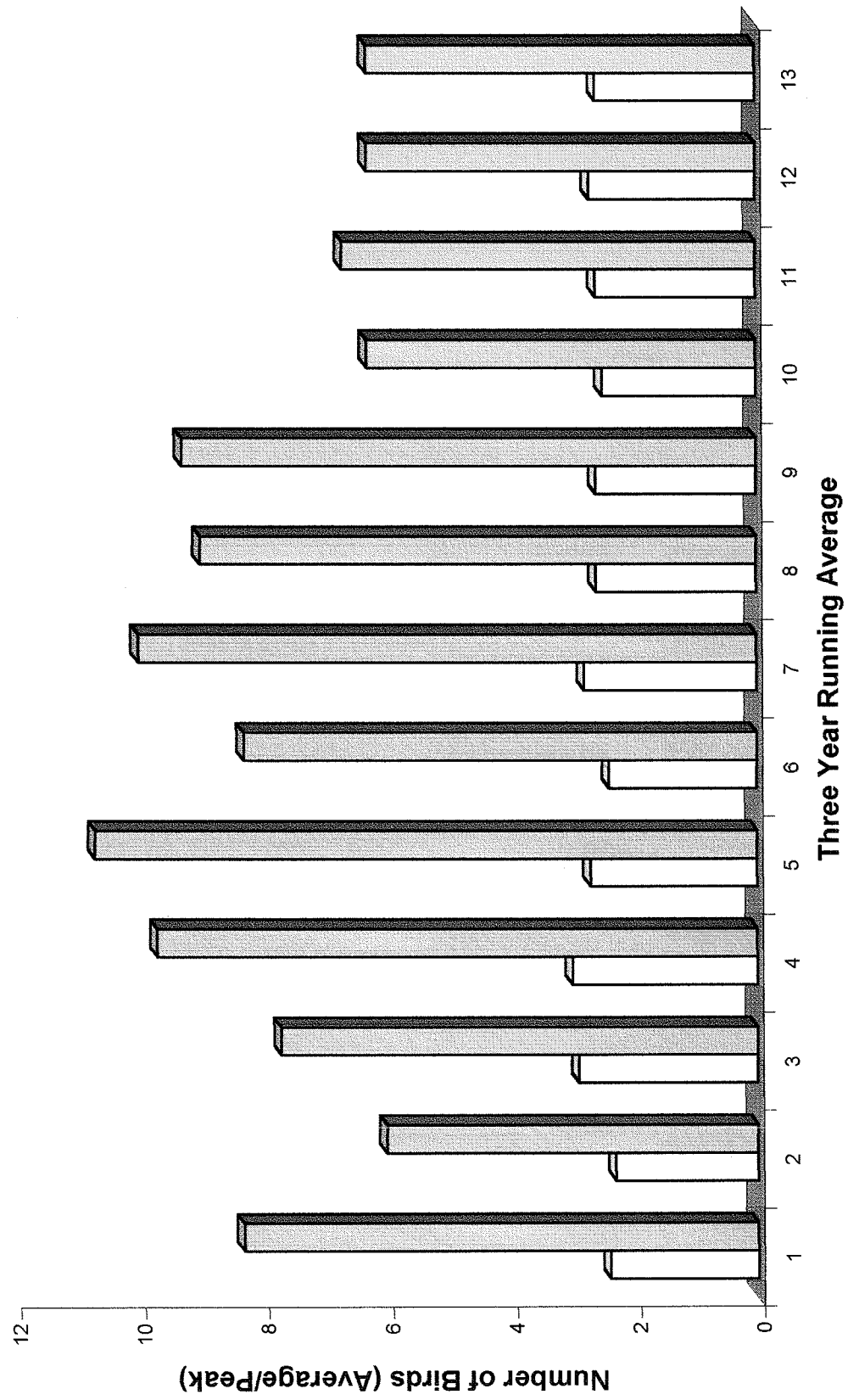
**Figure 1C. Bald Eagle
Maurice River Winter Raptor Survey - 1987-2002**



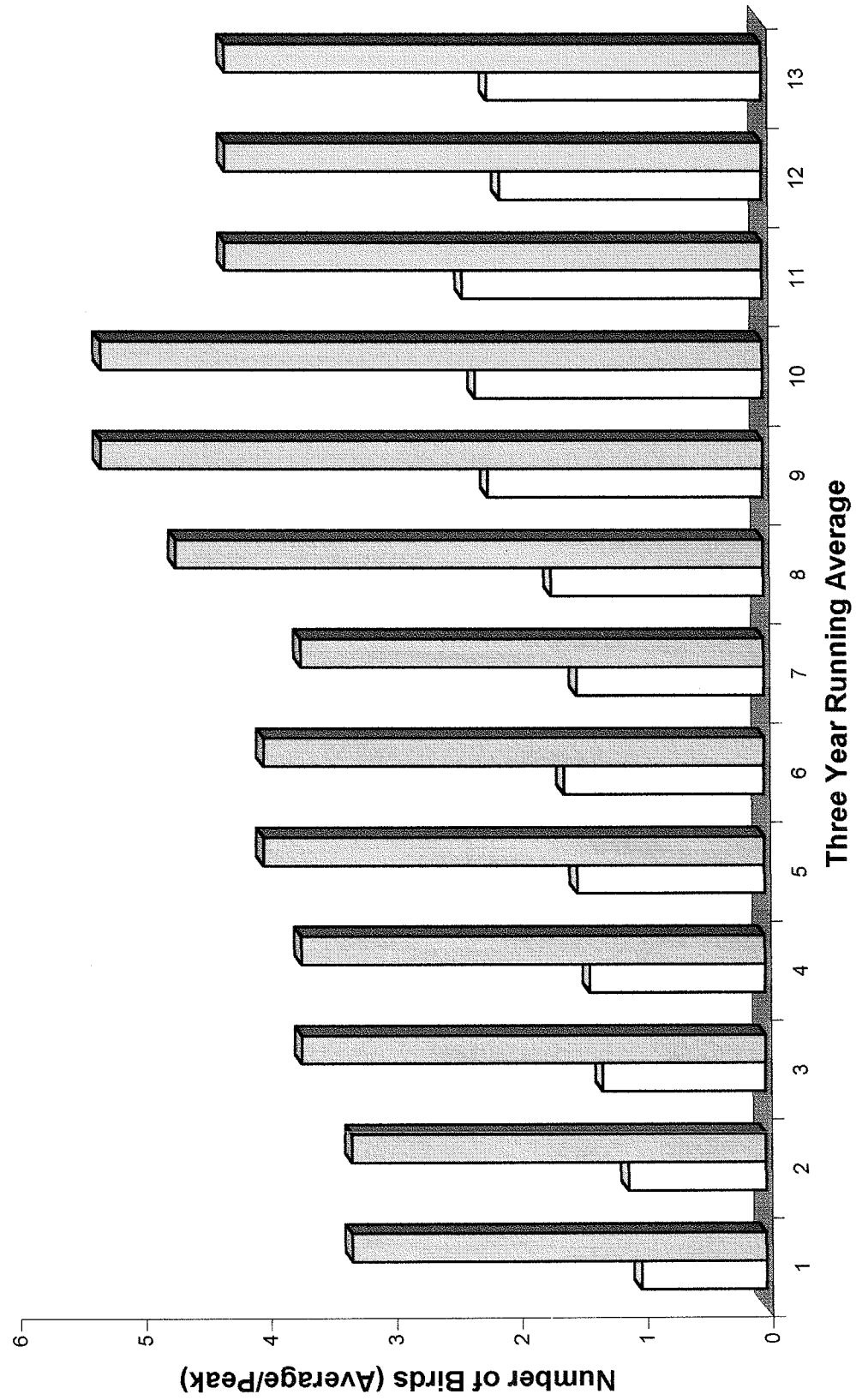
**Figure 1D. Northern Harrier
Maurice River Winter Raptor Survey - 1987-2002**



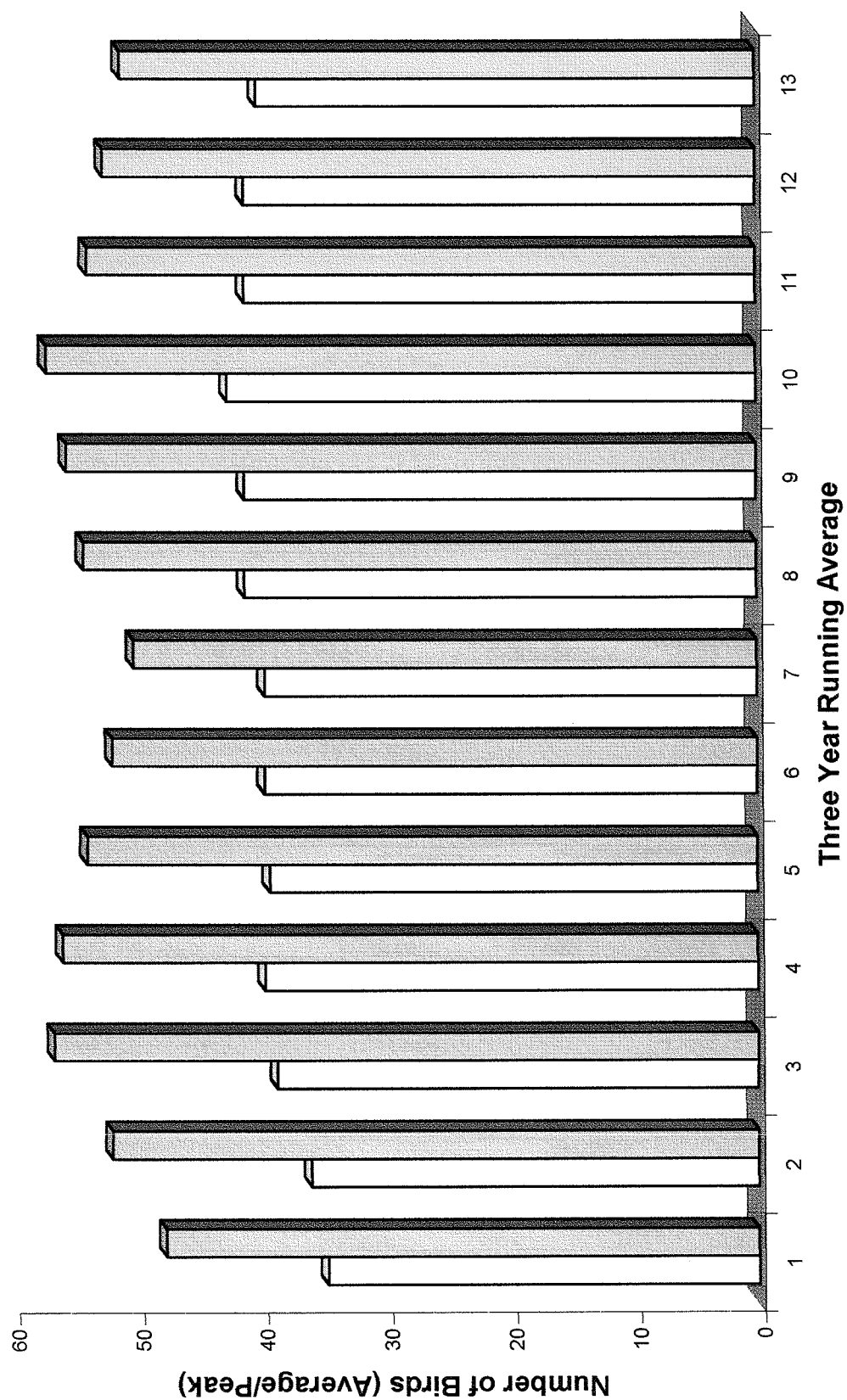
**Figure 1E. Sharp-shinned Hawk
Maurice River Winter Raptor Survey - 1987-2002**



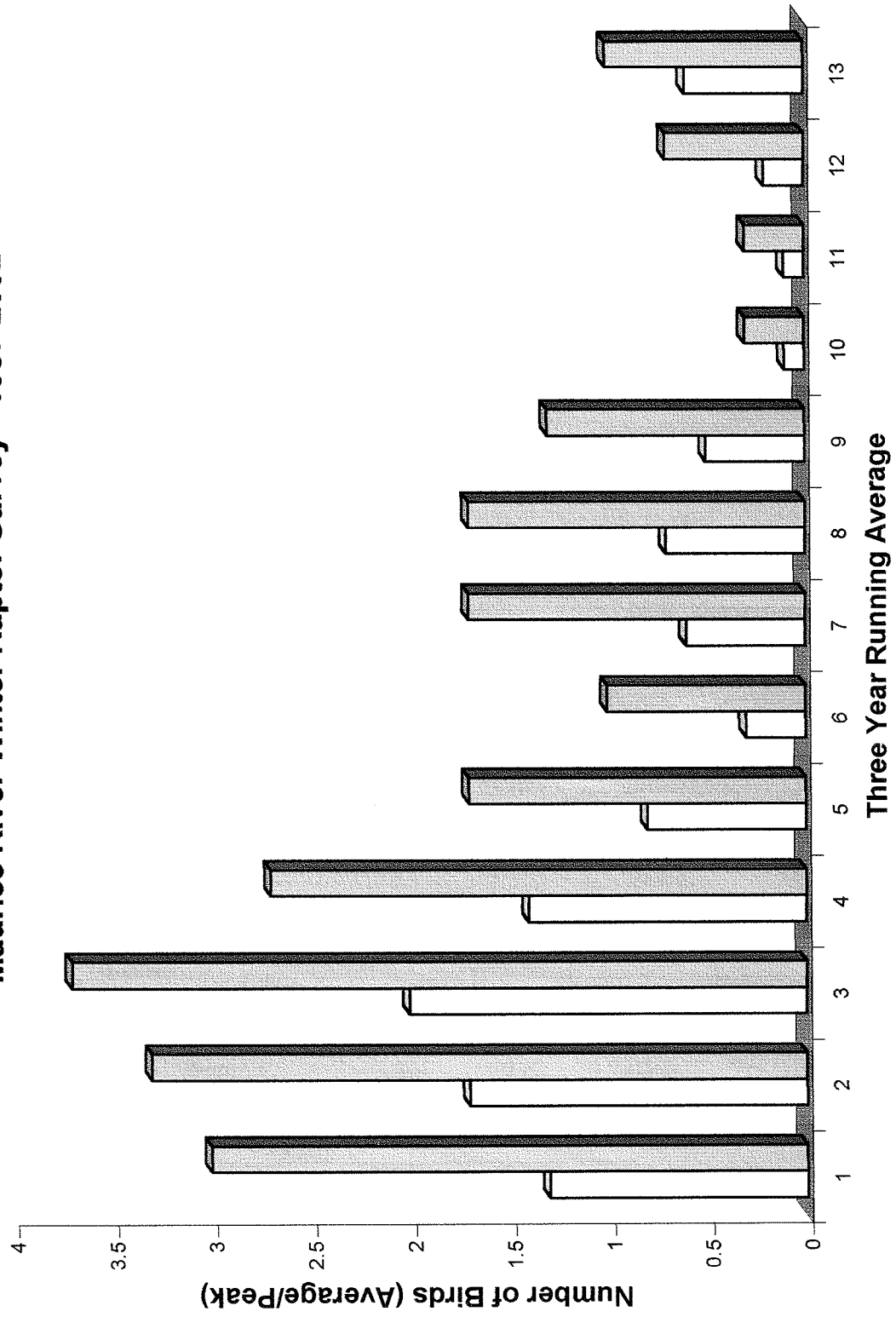
**Figure 1F. Cooper's Hawk
Maurice River Winter Raptor Survey - 1987-2002**



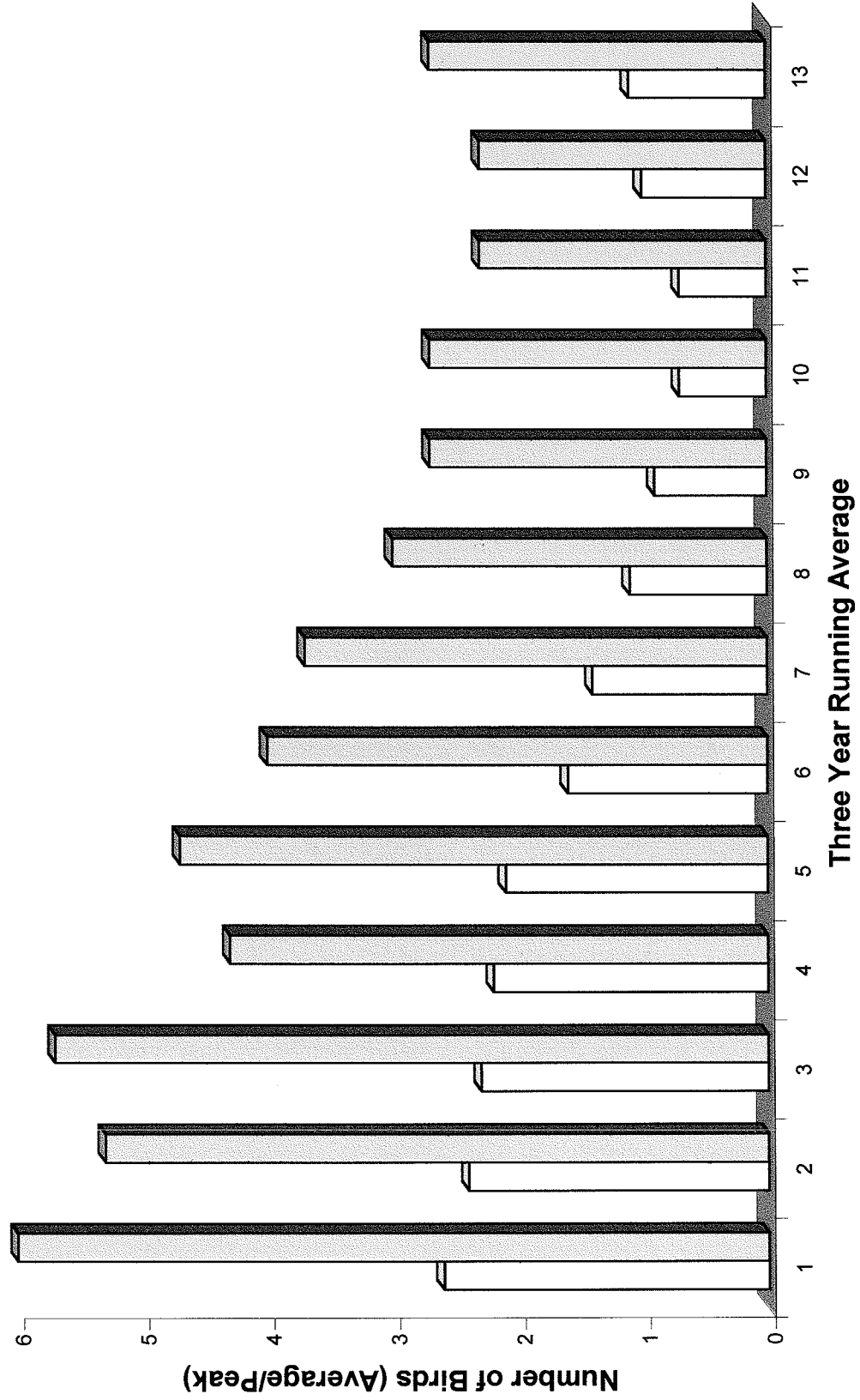
**Figure 1G. Red-tailed Hawk
Maurice River Winter Raptor Survey - 1987-2002**



**Figure 1H. Rough-legged Hawk
Maurice River Winter Raptor Survey - 1987-2002**



**Figure 11. American Kestrel
Maurice River Winter Raptor Survey - 1987-2002**



FINDINGS -- WATERFOWL:

Fifteen years of winter waterfowl studies have recorded 33 species of ducks and geese on the Maurice River. **Table 3** shows all fifteen years of data for all species. The three five year segments are highlighted. **Table 4** shows **peak** and **average** numbers for key species of wintering waterfowl on the Maurice River: Snow Goose, Canada Goose, American Black Duck, Mallard, and Northern Pintail. **Table 5** is shown in the same format as Table 2 (Raptors), with **best** count, **average peak** count, and **average of mean** counts shown for each five year segment along with the **overall 15 year average**.

Figures 2A through **Figure 2I** present the **3-year running average** for each of the five key waterfowl species, allowing for a visual depiction and understanding of true trends in Maurice River waterfowl.

DISCUSSION -- WATERFOWL:

As was seen with raptors, applying statistical trend analyses to waterfowl reveals a number of significant trends. Below is the summary of trend analysis for selected species of ducks and geese. The trend analysis is computed on the three-year average of the mean (average) count for each season.

Species	Correlation Coefficient	Significance	Trend
Canada Goose	r= 0.92	p <0.01	Strong increase indicated
Mallard	r= 0.70	p <0.01	Strong decline indicated
N. Pintail	r= 0.58	p= 0.04	Declining trend suggested
Am. Black Duck	r= 0.61	p= 0.03	Declining trend suggested

In the above summary of trend analysis, only species for which graphical results (three-year running average) suggested an increase or decline in numbers over the duration of the study were included. For the species shown above, however, significant trends are indicated. Significance at the $p < 0.01$ level means that there is a 99% chance that the increase or decrease is not random or coincidental. In other words, the trend is real, not simply an artifact of the vaqueries or inconsistencies of count technique.

As expected, Canada goose numbers have increased dramatically over the course of the fifteen year study. This is of course no surprise, and reflects well-publicized region-wide and continent-wide trends. Canada goose herbivory (feeding) on the wild rice marshes of the upper Maurice River is proving to have an adverse impact on many other species -- Mallard and Pintail included. Our data confirms, corroborates, and bolsters State DFW findings on increasing trends, and their impacts, of Canada Geese.

Conversely, Snow Geese numbers have remained remarkably consistent over the fifteen year study period, despite well-known flyway and continental burgeoning populations. In the Delaware Bayshore region, there is dramatic upward trend in Snow Geese, but this has not been the case on the Maurice River. They may be limited on the lower Maurice by the (comparative) small acreage of *Spartina alterniflora* available to them.

American Black Duck on the Maurice River is a conundrum. Despite flyway-wide significant declines over many decades, Maurice numbers have been somewhat consistent over the past fifteen years, with only a moderate decline inconclusively suggested. There was a notable decrease in the middle five year segment, perhaps linked to mild winters, yet a considerable recovery in the past five years. It is possible that high quality habitat throughout the length of the Maurice may be preferred habitat for Bayshore regional Black Ducks, therefore masking wider geographical trends. If so, the Maurice River is highly important habitat for Black Ducks. Although a species of high concern for the US Fish and Wildlife Service, American Black Ducks remain a fairly stable and dependable hallmark of the Maurice River. They appear to exhibit a slight decline on the Maurice, yet not a statistically strong decline.

Mallard and Northern Pintail populations have not fared so well, with significantly strong decreases noted, particularly (statistically) for Mallard. Not as plastic in their habitat selection as Black Ducks, Mallard and Pintail have declined significantly in the fifteen years of study (Mallard more so than Pintail). Both Mallard and Pintail exhibit a possible "warm winter" dip in the second of the three year segments; they have recovered slightly, but not as fully as Black Ducks. While peak counts are somewhat similar, average seasonal counts are still much lower than during the early years of the project. Of concern, Maurice River numbers have not reflected USFWS flyway-wide recovery trends. Mallard in particular shows a strong decline over the fifteen years of study.

It is theorized that the degradation and loss of quality brackish and fresh water habitat on the middle and upper Maurice is impacting Mallards and Pintails. The loss of wild rice has been well-established and documented, and Canada Goose herbivory is a major factor. Increasing salinity and the advancing salt line are also well known, perhaps relating to dredging, rising sea level (and global warming), and diminished fresh water input to the Maurice -- a factor associated with upriver withdrawals and drought.

Targeted and ongoing study is needed. It is known that Northern Pintail decline would be much more significant if the Bivalve PSE&G were had not attracted and

contributed so many Pintail to the survey in the most recent five year segment. Pintails have dwindled on the upper river, yet good numbers are currently now counted at Bivalve. These are probably the "same" ducks; as habitat quality declines on the upper river, regional Pintails are theorized to be simply selecting the emergent high quality Bivalve restoration site as their preferred feeding area. Of interest, though, is that very few Mallards are ever found at Bivalve -- they still clearly prefer the upper river marshes -- and therefore show the most significant declining trend over the past fifteen years.

REFLECTION:

While these fifteen years of winter raptor and waterfowl studies are perhaps not "rocket science", this ongoing and systematic survey effort is one of the few long-term ornithological studies being carried out in the entire Delaware Estuary, and have proven to be a valuable tool in the determination of status and trends in the avian resources of the Maurice River.

While some of the trends discussed above, the increases and decreases, may be somewhat well-known, much of our information has, for many years, been largely anecdotal. For the Maurice River, fifteen years of intensive study has now taken our perceptions of status and trends from suspected to proven and documented. Over 150 individual surveys have given us a data-base of significant proportion, and a true baseline from which to draw our conclusions on the health of the river system and the species dependant upon it. And, importantly, we have a baseline to which we can compare the effects and impacts of future changes on the river, be they man-made or natural.

Very few areas, on the bayshore or elsewhere in New Jersey, can today offer such solid proof of its environmental quality as can the Maurice, and the strong confidence that the environmental trends are either positive or negative. Citizens United, through their foresight and commitment to sound and long-term environmental studies, offers such a solid foundation and strength to their exemplary protection efforts.

Of that, CU can be proud, and we as the "field team" and the authors of this report, are privileged and proud to be a part of this effort.

Table 3

Peak Numbers of Wintering Waterfowl on the Maurice River -- Fifteen Year Summary

Species	Segment I					Segment II					Segment III				
	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02
Tundra Swan	19	12	14		3	7			13	4	10	1			2
Mute Swan	8	9	21	25	21	25	19	40	14	17	45	76	11	26	21
Snow Goose	5000	1550	14000	3500	3500	6500	9200	2355	13100	5150	8500	4300	7910	4300	6107
Ross' Goose					1		1								
Brant			2	2	25				5	20	9				13
Canada Goose	899	110	450	37	1000	187	880	290	475	660	709	650	775	1038	620
Wood Duck	1	1	4	6	3	4	5	2	12	4	1	13	4	2	5
Green-winged Teal	1378	330	625	1045	562	765	355	544	229	1170	1495	950	3914	4071	3521
Common Teal													2		
A. Black Duck	8120	4470	4867	5448	4290	4877	1488	1509	1149	1495	2660	8060	3310	3027	2270
Mallard	3250	2660	2179	3758	2180	3896	547	671	356	1320	2868	3325	370	958	703
Northern Pintail	3020	547	1227	1503	850	3293	347	680	240	1712	1012	569	300	810	1069
Blue-winged Teal	3	1		1		1	1		1	2	3		12	2	2
Northern Shoveler	6		2	1		1	3	4		3	130	154	105	20	62
Gadwall	60	39	20	40	11	3	7	8	6	25	132	400	565	270	130
American Wigeon	38	32	8	30	10	6		7	1	4	147	160	260	8	42
Eurasian Wigeon													1		
Canvasback	5	51	6	9		23	32	9	50	32	20	27	19	23	19
Redhead							1								
Ring-necked Duck	7	3	79		4	1	1	31	60	1	10	22	3	1	430
Greater Scaup	18	12	226	930	40	83	67	4	10	19	140	50	126	160	500
Lesser Scaup	26	3		12	1	10	19	68	21	19	30	53	3	1	140
Scaup species		690	20	400		50	40	1000	100	50	61	5100	100	135	2500
Long-tailed Duck	1	3			4	1	2	5	1	1	4	1		1	
Black Scoter	1	1		2				3	1	1		6	5		
Surf Scoter				2160			1	6	2		1	75	61		2
White-winged Scoter				200			1	2		1					
Scoter species				1000		5		15	15	8					5
Common Goldeneye	20	24	36	48	305	55	900	22	65	51	11	47	30	160	12
Barrow's Goldeneye														1	
Bufflehead	55	154	125	60	108	108	150	125	181	177	110	259	180	482	210
Hooded Merganser	3	3		12	3	20	19	8	20	10	30	25	14	10	35
Common Merganser	9	74	51	5	1	4	4	33	34	32	4	9	51	47	1
Red-breasted Merganser	25	20	150	28	62	32	85	82	144	47	63	164	35	308	144
Ruddy Duck		1				1	34	3	2	6	53	4	52		74
Unid diving ducks							4000								

All surveys conducted between the 4th week of November and the 3rd week of March

Table 4
Peak and Average Numbers of Wintering Waterfowl on the Maurice River
Fifteen Year Summary for Key Species

Segment I	1987-88		1988-89		1989-90		1990-91		1991-92	
	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg
Snow Goose	5000	1333	1550	299	14000	3898	3500	1352	3500	2356
Canada Goose	899	112	110	30	450	110	37	21	1000	249
Am. Black Duck	8120	2611	4470	2343	4867	2411	5448	3804	4290	1983
Mallard	3250	1247	2660	1010	2179	825	3758	2585	2180	846
Northern Pintail	3020	968	547	261	1227	348	1503	852	850	266

Segment II	1992-93		1993-94		1994-95		1995-96		1996-97	
	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg
Snow Goose	6500	2724	9200	3796	2355	779	13100	3422	5150	1288
Canada Goose	187	96	880	144	290	96	475	134	660	193
Am. Black Duck	4877	2916	1488	953	1509	810	1149	595	1495	893
Mallard	3896	2048	547	318	671	375	356	185	1320	687
Northern Pintail	3293	1630	347	131	680	360	240	72	1712	532

Segment III	1997-98		1998-99		1999-00		2000-01		2001-02	
	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg
Snow Goose	8500	3212	4300	2121	7910	2432	4300	1743	6107	2461
Canada Goose	709	337	650	262	775	326	1038	436	620	245
Am. Black Duck	2660	1465	8060	2456	3310	1285	3027	1381	2270	1387
Mallard	2868	906	3325	1189	370	160	958	469	703	396
Northern Pintail	1012	410	569	369	300	122	810	327	1069	518

All surveys conducted between the 4th week of November and the 3rd week of March.

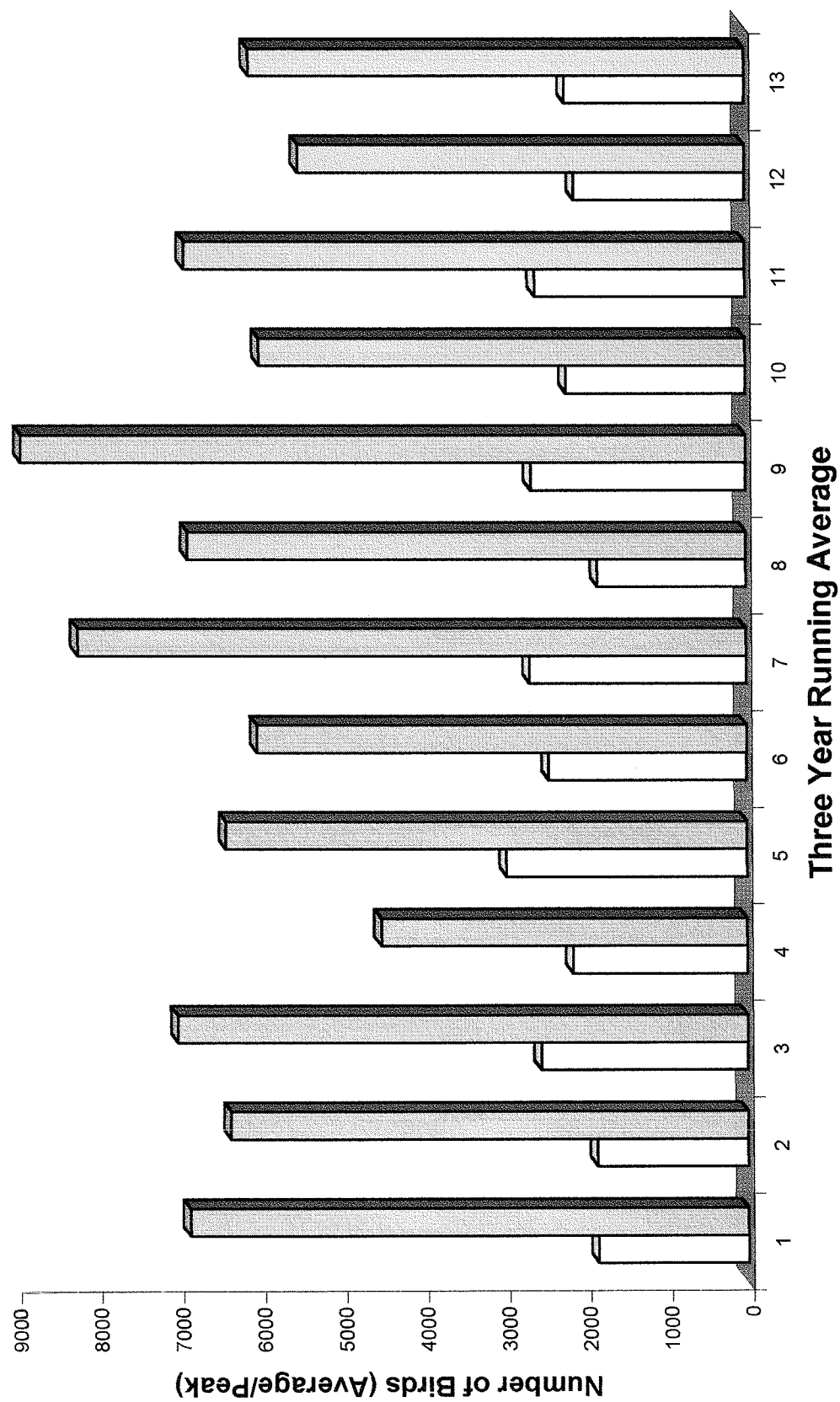
Table 5

Wintering Waterfowl on the Maurice River, Cumberland County, N.J

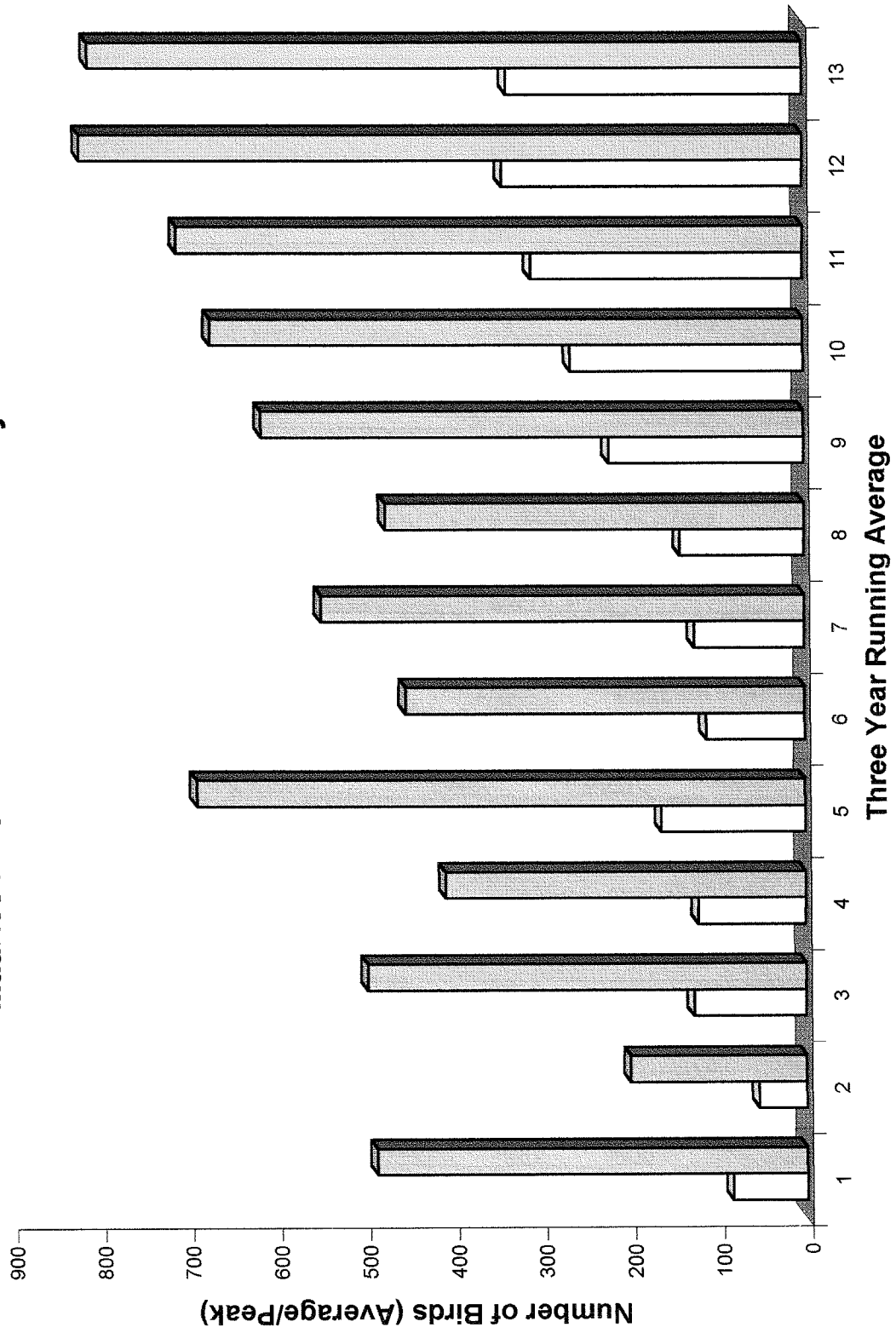
Fifteen Year Summary

Species	1987-1992 Segment			1992-1997 Segment			1997-2002 Segment			15 Year Overall		
	Best	Avg. Peak Count	Mean of Means	Best	Avg. Peak Count	Mean of Means	Best	Avg. Peak Count	Mean of Means	All-time High	Avg. Peak Count	Mean of Means
Snow Goose	14,000	5,510	1,848	13,100	7,261	2,402	7,910	6,223	2,394	14,000	6,331	2,215
Canada Goose	1,000	499	104	880	498	133	1,038	758	321	1,038	585	186
Black Duck	8,120	5,439	2,630	4,877	2,103	1,233	8,060	3,865	1,595	8,120	3,802	1,819
Mallard Duck	3,758	2,805	1,303	3,896	1,358	723	3,325	1,645	624	3,896	1,936	883
Northern Pintail	3,020	1,429	539	3,293	1,254	545	1,069	752	349	3,293	1,145	478

**Figure 2A. Snow Goose
Maurice River Winter Waterfowl Survey - 1987-2002**



**Figure 2B. Canada Goose
Maurice River Winter Waterfowl Survey - 1987-2002**



**Figure 2C. American Black Duck
Maurice River Winter Waterfowl Survey - 1987-2002**

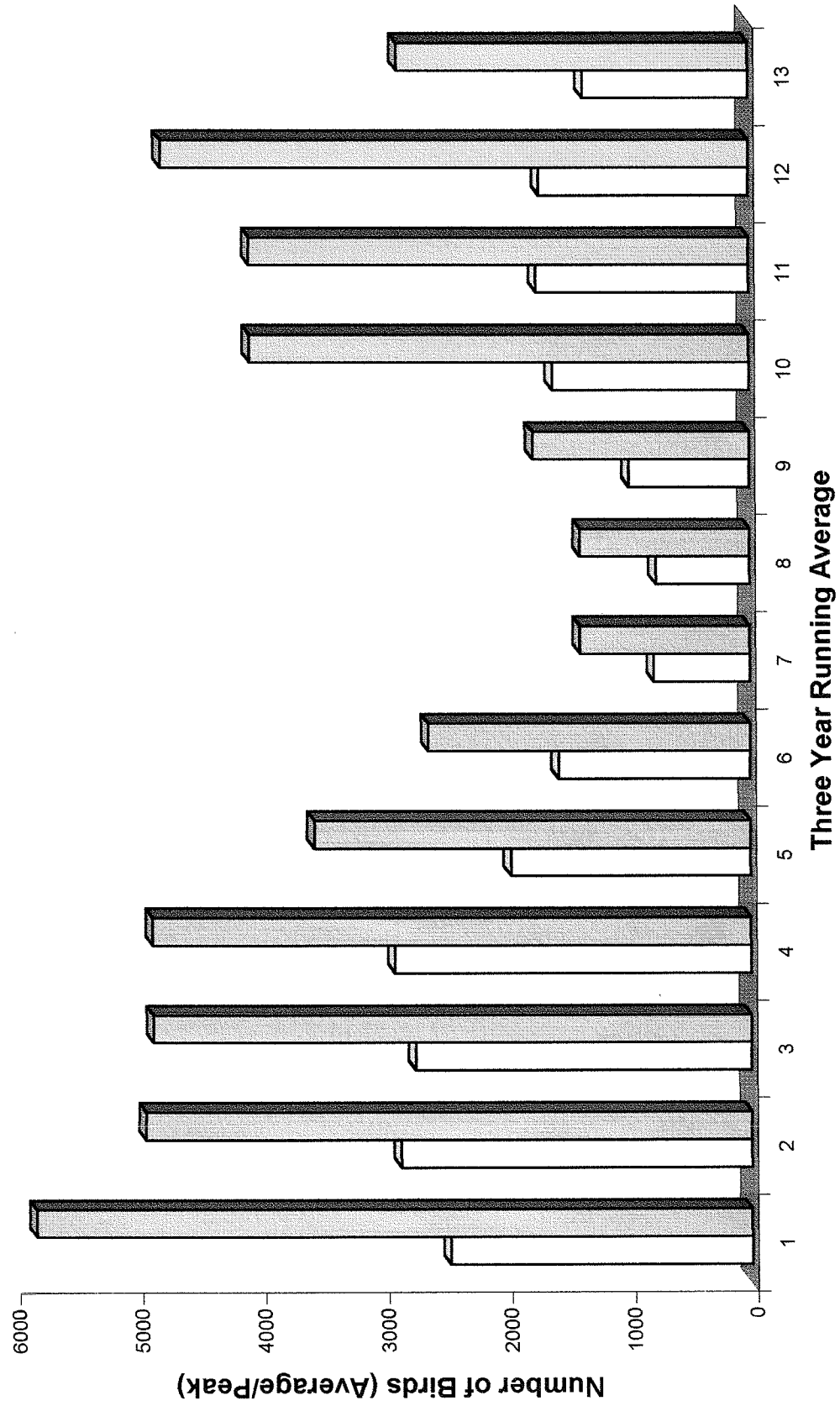


Figure 2D. Mallard
Maurice River Winter Waterfowl Survey - 1987-2002

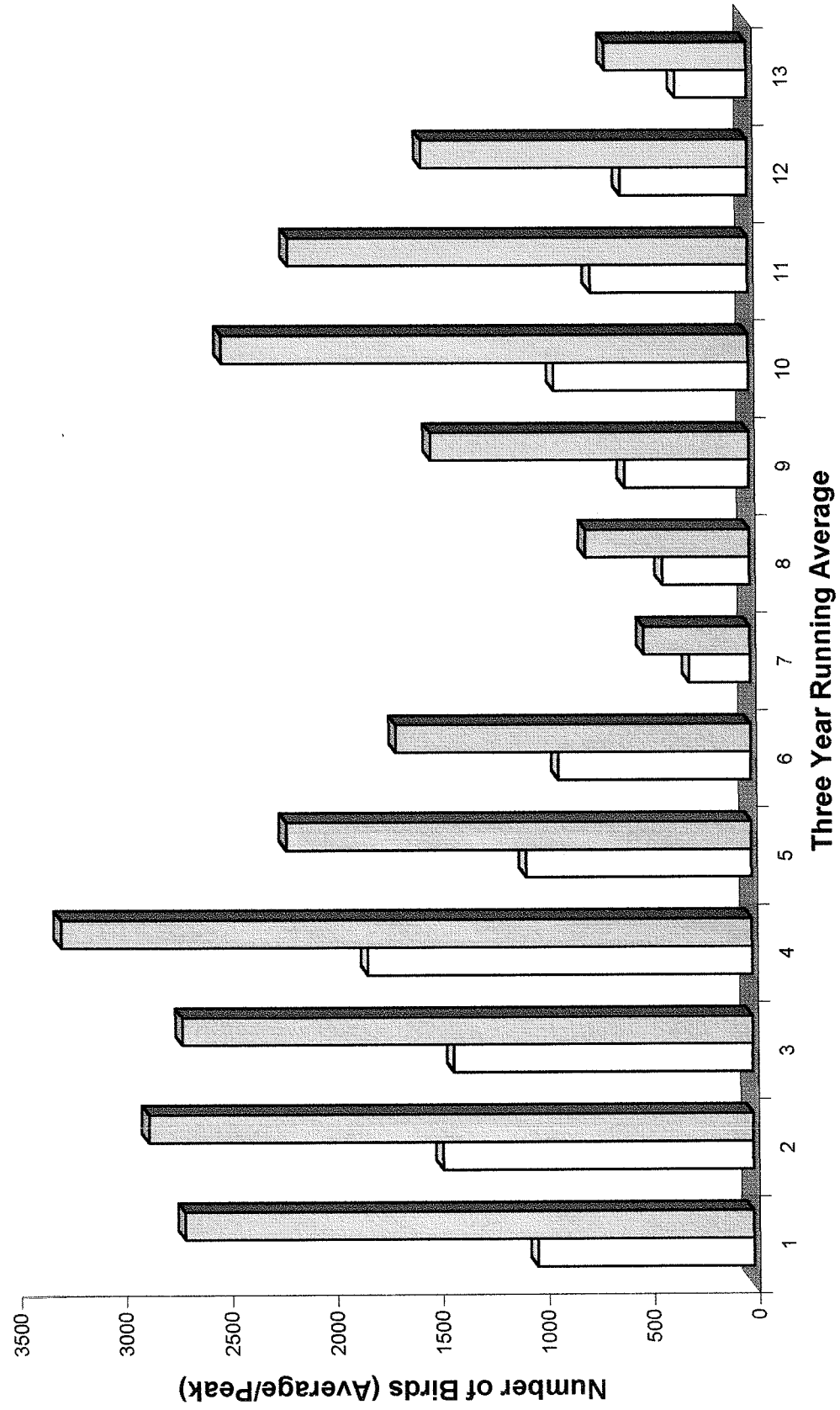
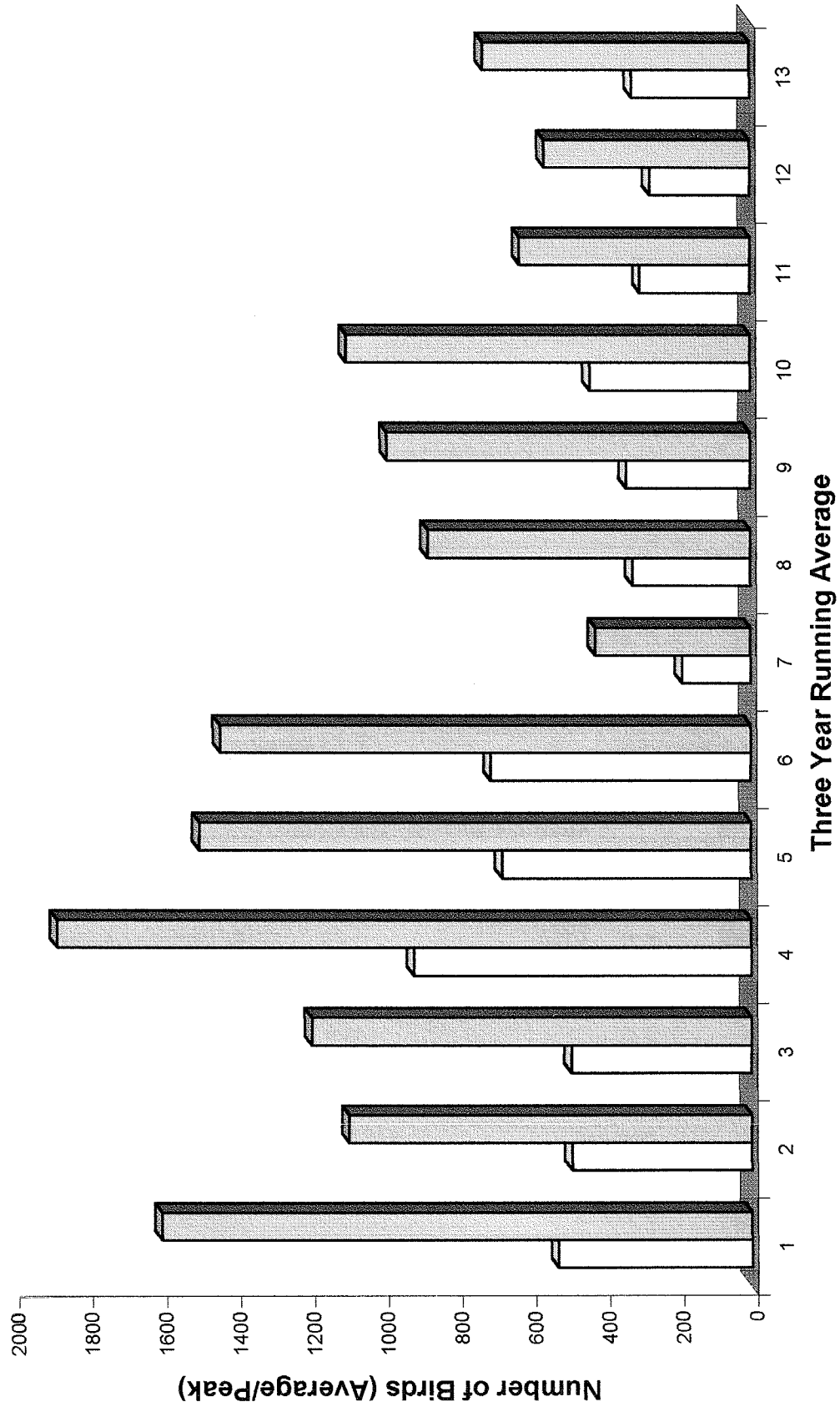


Figure 2E. Northern Pintail
Maurice River Winter Waterfowl Survey - 1987-2002



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FOR FURTHER REFERENCE:

All Maurice River ornithological studies have been directed and co-authored by Clay Sutton, either as an independent contractor or formerly as staff ornithologist of Herpetological Associates, Inc., Plant and Wildlife Consultants. Principal publications resulting (either wholly or in part) from the above studies (either funded or co-funded by CU) are as follows:

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