

A COMPARISON OF THREE SMALL LAKES IN SULLIVAN
COUNTY, TENNESSEE AND WASHINGTON COUNTY,
VIRGINIA AS HABITAT FOR WATERBIRDS DURING THE
WINTER OF 1997-1998.

Submitted to Ms. Bland Craig
Science Department
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By
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With Appreciation

This study is dedicated to Dr. Stephen M. Russell, who as a student at Abingdon High School in 1950, was a founder of the Bristol Bird Club. The club is named in his honor, recognizing his distinguished service as a prominent American ornithologist. Dr. Russell lives at Tucson, Arizona. He recently retired from the biology faculty at the University of Arizona. He is renowned for his study and book on the birds of British Honduras which was the American Ornithologist's Union's Monograph No. 1. He served as Secretary of the American Ornithologist's Union.

Go Falcons!

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INTRODUCTION

The purpose of this study is to: (1) document waterfowl populations and their diversity at three lakes, and (2) establish an explanation for the variation observed among the lakes by examining habitat characteristics of waterfowl.

In prior years members of the Bristol Bird Club observed a distinct difference in the number of waterfowl present during winter months at Middlebrook Lake, Bristol, Tennessee, Sullivan County and Clear Creek Lake, Washington County, Virginia compared to those present at Steele Creek Park Lake, Bristol, Tennessee, Sullivan County. No previous studies have been conducted which might quantify possible variations between the lakes.

Several conclusions have been drawn from studies of waterfowl in winter conditions in other regions. Waterfowl habitat management during the non-nesting period should provide food, cover, space, and water requirements of waterfowl (Pederson *et al.* 1988). Winter waterfowl species are distributed among habitats by water depths and structural features (Fredrickson and Heitmeyer 1988). Habitat selection may reflect an organism exercising a choice among available habitats, or its differential occurrence among habitats in response to ecological consequences such as availability of resources, predation, and competition (Kaminski *et al.* 1988). Humans play a vital role in the habitats which waterfowl utilize. Human populations and even steep mountains prevent maintenance of low flight altitudes of waterfowl (Prenzlowl and Loworn 1997). An increase in an uncomfortable behavior of waterfowl, significantly depresses the foraging time (Kehlert 1994).

Many Mallards *Anas rubripes* use park-type habitats where artificial feeding allows greater numbers of birds to over-winter than the sites could otherwise support (Heusmann 1988). Other habitats which provide value to migrant and wintering waterfowl are floodwater-retarding structures (FWRS) (Bates *et al.* 1988).

METHODS

The study was conducted at three area lakes located within a circle with a diameter of 17.7 Kilometers (11 miles) and centered at Virginia Intermont College, Bristol, Virginia. Counts were made between 25 October 1997 and 14 March 1998 for a total of 21 weeks. Observations were made and recorded Saturdays, from 0700 to 1200 hours, allowing one hour of field work per lake. Other counts which were taken into consideration included observations made by other birders at the lakes.

Throughout the study, weather information was collected on a daily basis from the weather pages of the *Bristol Herald Courier*. From this information the author concluded if fronts caused more waterfowl to appear at any of the lakes. The weather data taken from the paper was also used to record weather conditions for days field observations were made.

The water quality of each lake was tested. The primary tests included pH, dissolved oxygen by means of the *WINKLER METHOD*, and water clarity levels with the use of a Secchi disc. Research was done to determine how the above factors affected food utilization of waterfowl. A lack of dissolved oxygen (DO) in water creates the most problems. Oxygen provides for all oxidative metabolic processes in fish - which allows them to convert stored energy to power various bodily functions (Moyle and Cech 1988). Oxygen is important as an oxidant in water plant operation. One value is to oxidize iron and manganese into forms that will precipitate out of the water. It also removes excess carbon dioxide.

Levels of pH were tested for each lake. Lakes with pH values above 8.5 (alkaline) or below 5 (acidic) support only a few rather tolerant fish species. Alkaline lakes have higher fish production than acidic lakes (Moyle and Cech 1988). Therefore, the pH levels for each lake determined how high or low fish production is.

The turbidity and penetration of light were measured with a Secchi disc. This is a 20 cm (8 inches) in diameter disc which is divided into quadrangles that are patterned black and white. The disc is lowered into the water until it disappears and a reading is taken. The disc is then raised from the water until it reappears and another reading is taken. The two readings are then averaged to obtain the depth of visibility (Jackson 1971).

The turbidity reduces the amount of light that penetrates into the water, reducing the light available for algae and aquatic weeds to use photosynthesis. High levels of turbidity may coat gill membranes of fish, making it difficult for them to breathe and supporting only a few tolerant fish (Tennessee Valley Authority 1992). waterfowl are more likely to utilize areas where food organisms are visible in or under water.

How often and close human interaction was to each lake was determined along with the amount of shoreline accessible to humans. The shapes of each lake were compared, along with distances from major water impoundments.

STUDY AREAS

This study was conducted at two lakes in Northeast Tennessee and one in Southwest Virginia. All lakes are located within an area of a circle which has a diameter of 17.7 Kilometers (11 miles) and centered at Virginia Intermont College, Bristol, Virginia.

Clear Creek Lake is located in Washington County, Virginia (Figure 1). The length of its shoreline is 3218 meters (2 miles) and it covers 18.6 hectare (46 acres) of land. The deepest location is at six meters (18 feet). Clear Creek was built in 1965 for means of flood control and recreation. In 1997 a golf course was constructed around the lake and apparently increased the number of humans interacting with the lake. The percent of human interaction is 50 percent. For observation purposes three specific areas were chosen in which to conduct field work. The first site was located at the northern end of the lake on a fishing dock (Appendix A). The second was located at the middle of the lake bordering the road side of the golf course. The third was located next to the dam at the southeast corner of the lake across from one of the only wooded areas of shoreline. These sites made it possible to view the entire lake.

Middlebrook Lake is located in the City of Bristol, Tennessee, Sullivan County (Figure 2). The length of its shore line is 1432 meters (.89 mile) and covers 12.1 hectare (30 acres) of land. The deepest location is at 4 meters (12 feet). It is fed by two streams, with the main being Sinking Creek and the other a wet weather creek. The lake was built in 1970. The percent of human interaction is 86 percent. Surrounding part of the lake is a subdivision. Three sites were also chosen here to view the entirety of the lake. The first site was located at the east side of the lake located within the subdivision. The second along Redstone Drive, adjacent to the lake (Appendix A). The third, opposite Redstone Drive, allowed the view of a nearby pond where waterfowl were usually present.

Steele Creek Park Lake is located in Bristol, Tennessee, Sullivan County (Figure 6). It was built in 1962 for means of recreational use. The length of the shoreline is 4902 meters (3.05 miles) and the lake covers 21.85 hectare (54 acres). The deepest location is 9 meters (28 feet) at the base of the dam. Mill Creek and Steele Creek are the two streams which feed the lake. The amount of human interaction makes up 72 percent of the shoreline. Four observation sites were chosen to view the lake. The first site was located

below the Nature Center. The second and third were located along the existing miniature train tracks between the boat ramp and the train tunnel. The fourth was located at the confluence of Mill Creek and Steele Creek where they flow into the lake.

Middlebrook Lake

7

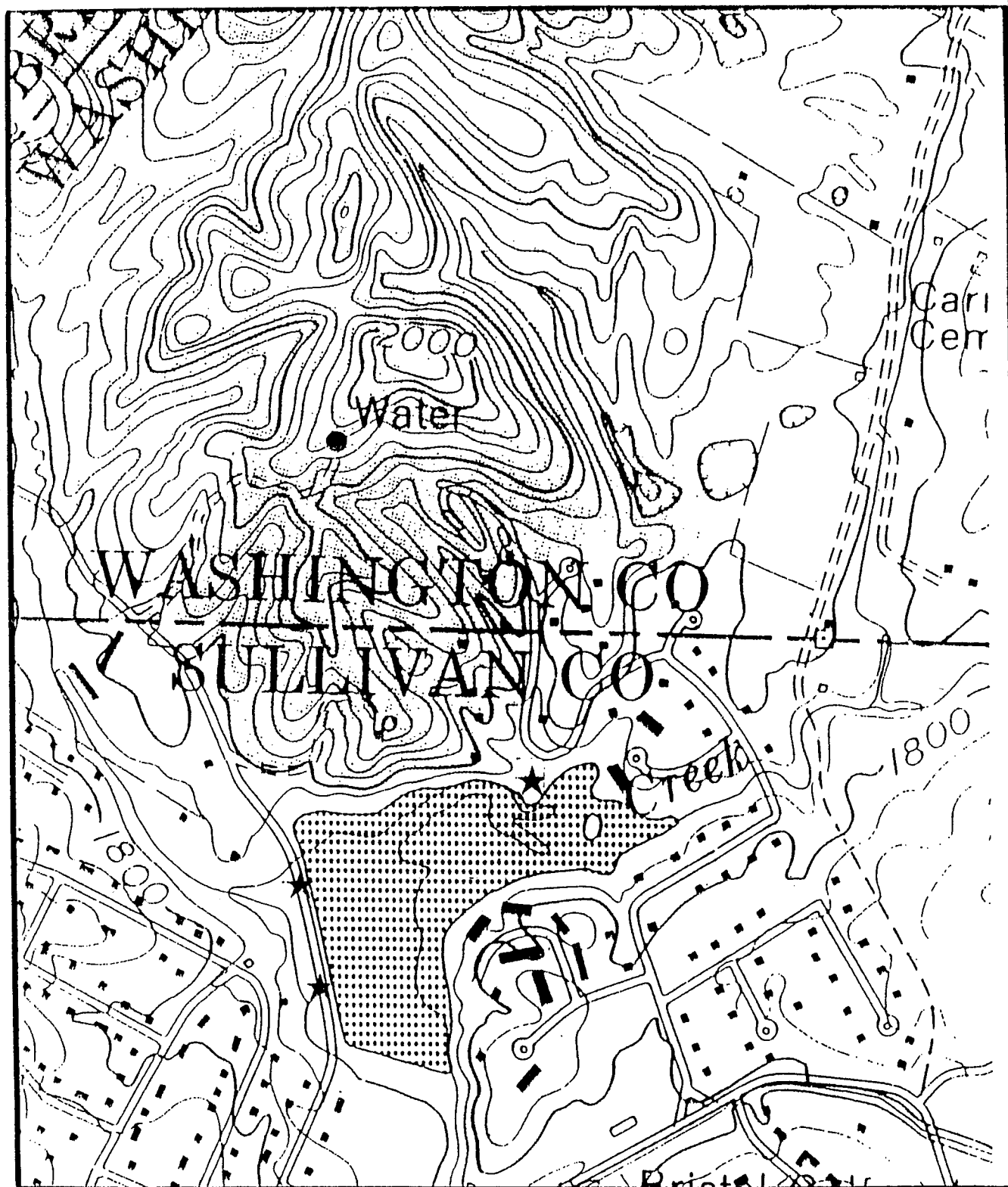


Figure 2 Map of Middlebrook Lake

★ Represents observation sites where field work was conducted

Steele Creek Lake

8

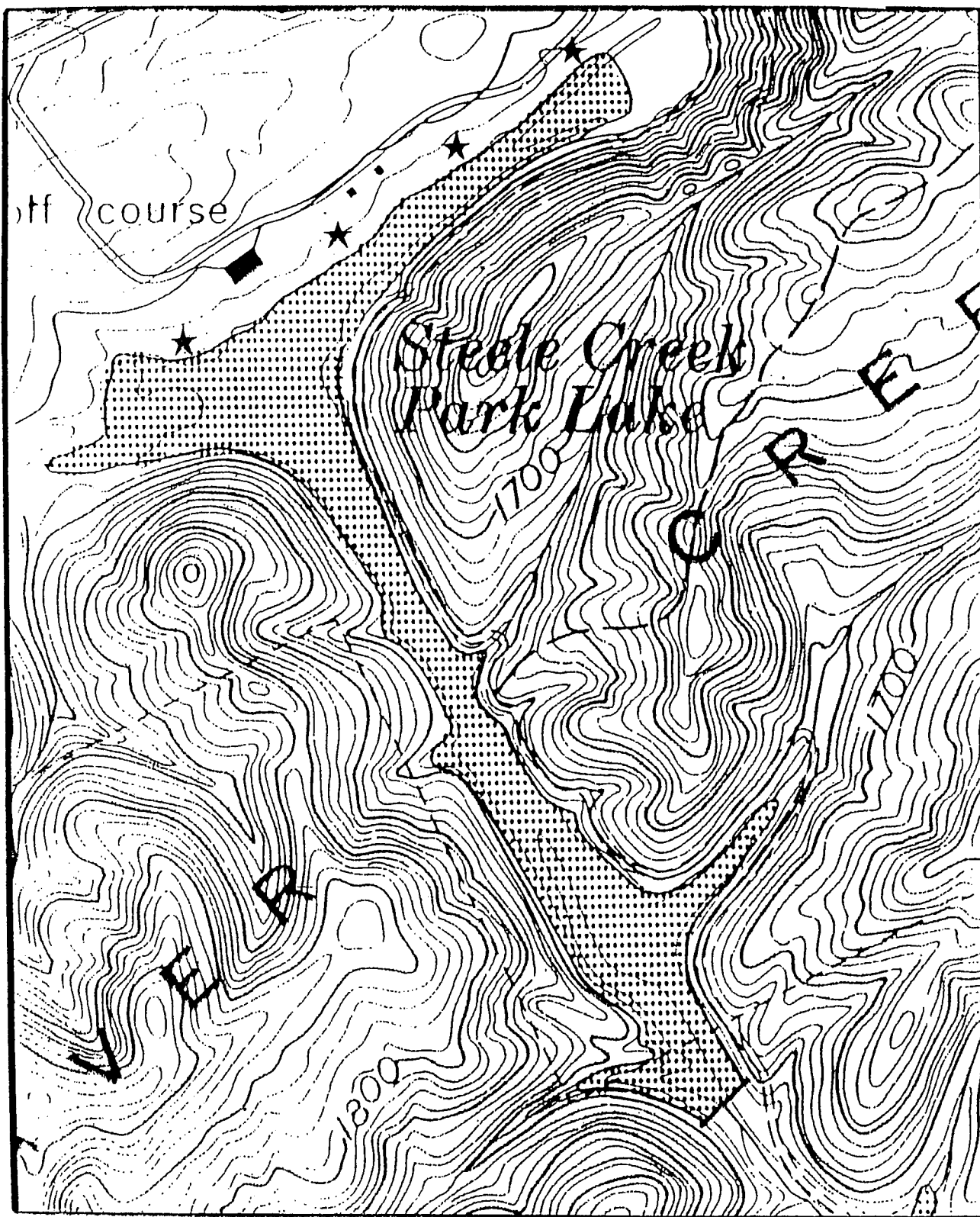


Figure 3 Map of Steele Creek Lake



Represents observation sites where field work was conducted

Clear Creek Lake

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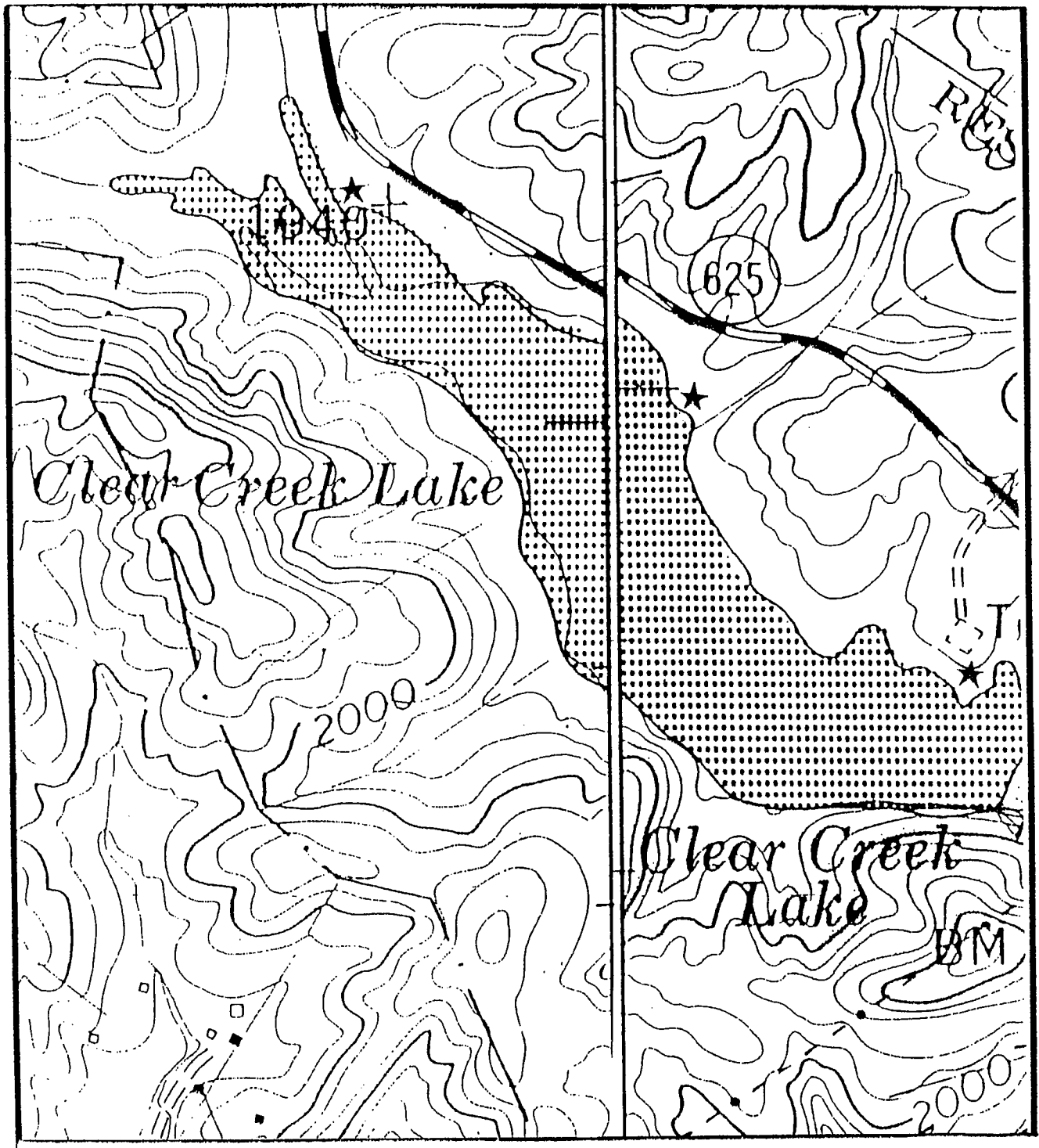


Figure 1 Map of Clear Creek Lake



Represents observation sites where field work was conducted

RESULTS

Several factors were found to have effects on the waterfowl populations at the lakes.

Proximity to Large Reservoirs

South Holston Lake is a floodwater-retarding structure (FWRS) of 1011 hectare (2,500 acres) at winter elevation of 494 meters (1,621 feet), and 301 kilometers (187 miles) of shoreline at full pool (Tennessee Valley Authority 1957). Located 16 kilometers (10 miles) from Steele Creek Lake, 12 kilometers (7.5 miles) from Clear Creek Lake, and 11 kilometers (6.8 miles) from Middlebrook Lake.

Boone Lake is another FWRS which is 1113 hectare (2,750 acres) at winter elevation of 415 meters (1,362 feet), and 209 kilometers (130 miles) of shoreline at full pool (Tennessee Valley Authority 1957). Located 12 kilometers (7.5 miles) from Steele Creek Lake, 27 kilometers (16.8 miles) from Clear Creek Lake, and 21 kilometers (13 miles) from Middlebrook Lake.

These two large reservoirs may be providing smaller area reservoirs, such as the three studied, with populations of wintering waterfowl (Bates *et al.* 1988).

Human Interaction

Out of the 3218 meters (2.00 miles) of shore line at Clear Creek Lake, 50 percent is available for human interaction. At Middlebrook Lake, 86 percent of it's 1432 meters (.890 miles) of shoreline is in contact with humans. Of the 4902 meters (3.05 miles) of shore line at Steele Creek Lake, 72 percent comes in contact with human interaction.

Although there is a larger percentage of human interactive shoreline at Middlebrook Lake, the waterfowl there are able to maintain a safe distance from the human interaction. The closest a human can get to the wooded area, which the waterfowl primarily utilize, is 9-18 meters (30-60 feet) at Steele Creek Lake, 62 meters (200 feet) at Clear Creek Lake, and 31 meters (100 feet) at Middlebrook Lake.

Another factor adding to human interaction is the number of people who come into contact with the shorelines of the lakes. Because of the recent development of a golf course at Clear Creek Lake, human interaction has increased. However, the number of people interacting with Steele Creek Lake is greater than that of Middlebrook or Clear Creek Lakes.

Human interaction exists in many different forms. Fisherman, walkers, and vehicles effect the lakes. Fishing is not allowed at either Clear Creek or Middlebrook lakes. However, Steele Creek Lake has an abundance of fisherman and some use boats. Walking on trails and beach shoreline have the closest interaction with waterfowl at Steele Creek Lake. Vehicles have close interactions with waterfowl at Middlebrook Lake. Golf carts have close interaction with waterfowl at Clear Creek Lake.

Dabbling ducks are also affected by an increase in human interaction. As the amount of human interactions increases, the population of dabblers does also. Middlebrook had 86 percent human interaction and 1,194 dabblers. Steele Creek had 72 percent human interaction and 908 dabblers. Clear Creek had 50 percent human interaction and 153 dabblers.

Water Quality

Steele Creek Lake had the lowest average of DO (9.33 ppm). This suggests that fish are not receiving as much oxygen as preferred in order to carry out all oxidative metabolic processes (Moyle, Cech, 1988). Clear Creek Lake, however, had the highest average of DO (10.2 ppm) and Middlebrook ranked in-between (with an average of 9.82 ppm) (Table 1).

pH tests indicated that Middlebrook Lake had the lowest average (8.9), while Clear Creek Lake had 9.0-9.5 as an average and Steele Creek had an average of 9.1. The normal pH for high fish production is 8.3, therefore Middlebrook had the most suitable conditions for fish production (Table 2).

Secchi disc tests suggested that Clear Creek Lake had the greatest degree of clarity (1 meter), Middlebrook Lake had the median amount of clarity (0.9 meter), while Steele Creek had the least amount clarity (0.7 meter) (Table 2).

When comparing the depths of each lake to the clarity of each the results conclude that at the deepest point Steele Creek Lake has 8.6 percent clarity, Clear Creek has 19.5 percent clarity, and Middlebrook has 25 percent clarity (percent clarity was determined by dividing the clarity depth, measured using Secchi disc, by the greatest depth of the lake).

Water Quality Factors of Each Lake

Table 1 Dissolved Oxygen Comparison (ppm)

	Middlebrook	Clear Creek	Steele Creek
6 March 98	9.6	9.8	9.5
10 March 98	9.4	10.8	9.5
11 March 98	10.4	11.2	8.8
14 March 98	10.1	11.0	10.0
17 March 98	10.0	10.4	10.0
19 March 98	9.7	8.0	8.2

Table 2 pH and Secchi Disc Readings

10 March 98

	Middlebrook	Clear Creek	Steele Creek
pH	9.0	9.25	9.25
Secchi Disk	0.92 meters	1.30 meters	0.81 meters

19 March 98

	Middlebrook	Clear Creek	Steele Creek
pH	8.75	9.25	9.0
Secchi Disk	0.92 meters	1.30 meters	0.81 meters

Stream Channels

Stream channels bring an abundant supply of nutrients into a lake through the original channel reservoirs. Fish are especially attracted by the large amounts of nutrients streams provide. Therefore, the location at which the stream channels within a lake are found should produce an estimate to where most of the lakes population of fish are located. Diving ducks will forage where there is the highest percentage of food - stream channels being this place.

For both Clear Creek and Steele Creek lakes, the stream channel is located directly down the center of each lake. This is not at a location at which many waterfowl choose to utilize because of the lack of cover. However, one of the stream channels located at Middlebrook aligns itself with the area of the smallest human interaction, most wooded coverage, and is an area most frequented by wild waterfowl.

Winter Weather

Water surface conditions over the 21- week - period ranged from smooth, rippled, partly frozen, to mostly frozen. At both Clear Creek and Steele Creek Lakes 19 percent, (4 out of 21 days observed) , of the time the lakes were either partly or mostly frozen. However, 4.8 percent (1 out of 21 days observed), of the time the lake was mostly frozen at Middlebrook. Therefore, Middlebrook water remained more open for waterfowl during the coldest periods.

Weather conditions were compared to the increases in species diversity and numbers. The visible arrival of a weather front was observed on Saturday, 1 November 1997. On this date two Ring-necked Ducks *Aythya collaris* and 2 Green-winged Teal *Anas rubripes* were observed at Middlebrook Lake. Thursday, 13 November 1997 another front was observed as it begin to form. By Saturday, 15 November 1997, 5 Common Loon *Garvia immer*, 5 Lesser Scaupe *Aythya affinis* , and 1 Horned Grebe *Podiceps auritus* were observed at Middlebrook lake along with 1 Horned Grebe at Steele Creek Lake. On Thursday, 1 January 1998, a front began to form. On Friday, 2 January 1998, 1 Common Loon was observed at Steele Creek Lake and on Saturday, 3 January 1998, 3 American Black Ducks *Anas rubripes* and 5 Bonaparte's Gulls *Larus philadelphia* were observed at Middlebrook Lake and 5 Boanparte's Gulls also at Clear Creek Lake. After a front had passed through the region on Friday, 30 January 1998, 1 Redhead *Arthya americana* and 13 Greater Scaupe *Aythya marila* were observed at Clear Creek Lake.

DISCUSSION

The number and diversity of waterfowl, during the winter 1997-1998, was higher at Middlebrook Lake than those observed at Clear Creek Lake and Steele Creek Lake. Several factors seem to play key roles in the distribution variations of waterfowl at these three lakes.

Wintering waterfowl are known to rest on large impoundments and feed at smaller impoundments (Bates *et al.* 1988). Considering South Holston Lake a large impoundment (southeast of area lakes), and the study areas smaller impoundments, at the beginning of the study the author suggested that the shorter distance each smaller lake was from South Holston, an increase in the number of waterfowl would be observed. Steele Creek Lake being the furthest away at 16 kilometers (10 miles), Clear Creek the median at 12 kilometers (7.5 miles), and Middlebrook the closest at 11 kilometers (6.8 miles). Boone Lake (southwest of the three lakes) appeared to be an important impoundment. Clear Creek Lake is the furthest away for Boone Lake at 27 kilometers (16.8 miles), Middlebrook Lake the median at 21 kilometers (13 miles), and Steele Creek Lake the closest at 12 kilometers (7.5 miles). Therefore, it is concluded that large impoundments, such as South Holston Lake and Boone Lake, do provide smaller impoundments with larger populations and diversity of waterfowl, than would otherwise be present. However, opposite to what the author first thought, there is no specific impoundment in this area providing all waterfowl for smaller impoundments.

The author suggest that the percent of human interaction influenced the populations of waterfowl. However, it was found that Middlebrook Lake had the most human interaction (87 percent of shoreline), Steele Creek the next to largest (72 percent of shoreline), and Clear Creek Lake had the least (50 percent shoreline). This data was unexpected, but can be expanded. The number of people that interact with the shoreline at Middlebrook Lake and Clear Creek Lake is less than the number of people which interact with the shoreline at Steele Creek Lake. From the areas which waterfowl utilize frequently at Middlebrook Lake, the distance at which closest human interaction can occur is 30 meters (100 feet). However, at Steele Creek Lake human interaction comes within 9-18 meters (30-60 feet) of these areas. The type of human interaction which comes closest to waterfowl at each lake differs. Walkers are the main interaction at Steele Creek Lake, drivers are at Middlebrook Lake, and golf carts at Clear Creek Lake. Because waterfowl discriminate between different kinds of human activity (Kahlert 1994), walkers seem to be more effective toward waterfowl than moving vehicles.

As the amount of human interaction increases, so does the amount of dabbling ducks. The more humans, the more artificial food. Steele Creek has the largest number of human interaction and therefore the largest amount of artificial food is being fed to the dabblers. Artificial feeding allows greater numbers of birds to over winter (Heusmann 1988). This explains why Middlebrook Lake and Steele Creek Lake have higher numbers of dabblers than Clear Creek Lake does (Figure 4).

This concludes that due to the distance, percent, number, and types of human interaction-Steele Creek Lake is effected the greatest by human interaction.

Water quality was tested for DO, pH, and clarity. The results of the DO tests indicated that Steele Creek Lake had the lowest average (9.33 ppm), Middlebrook Lake had the middle average (9.82 ppm), and Clear Creek Lake had the highest (10.2 ppm). This enables the author to conclude that fish in Steele Creek are not provided optimal oxygen levels. Only a few fish species are able to adapt, therefore there is not as many fish for waterfowl to feed on (Moyle, Cech, 1988).

Middlebrook Lake had the closest to average pH (8.3) of any lake (average reading for Middlebrook Lake was 8.9). This means that Middlebrook has a better production of fish than Clear Creek Lake or Steele Creek Lake.

Middlebrook Lake also had the highest percent clarity (25 percent), Clear Creek the median (19.5 percent), and Steele Creek Lake had the lowest (8.6 percent). These results enable the author to conclude that waterfowl have a better chance of viewing organisms at Middlebrook Lake along with better conditions for fish production. It was found that as the percent clarity of each lake dropped, so did the number of diving ducks (Figure 5).

Because of location of the original stream channels, which the stream itself follows, more waterfowl are found foraging in these areas. waterfowl are found in this area because streams bring in nutrients, which attract fish, which in turn attract waterfowl. waterfowl expend a great deal of time foraging and because waterfowl want a certain degree of 'comfort' they are more likely to spend most of their time foraging along wooded shorelines. Middlebrook Lake's original stream channel is aligned with its wooded area of shoreline. Clear Creek Lake's and Steele Creek Lake's original stream channel is through the direct center of the lake where waterfowl might feel 'less comfortable' for foraging. Therefore, it can be concluded that waterfowl

Figure 4 % Human Interaction vs. Dabblers

15

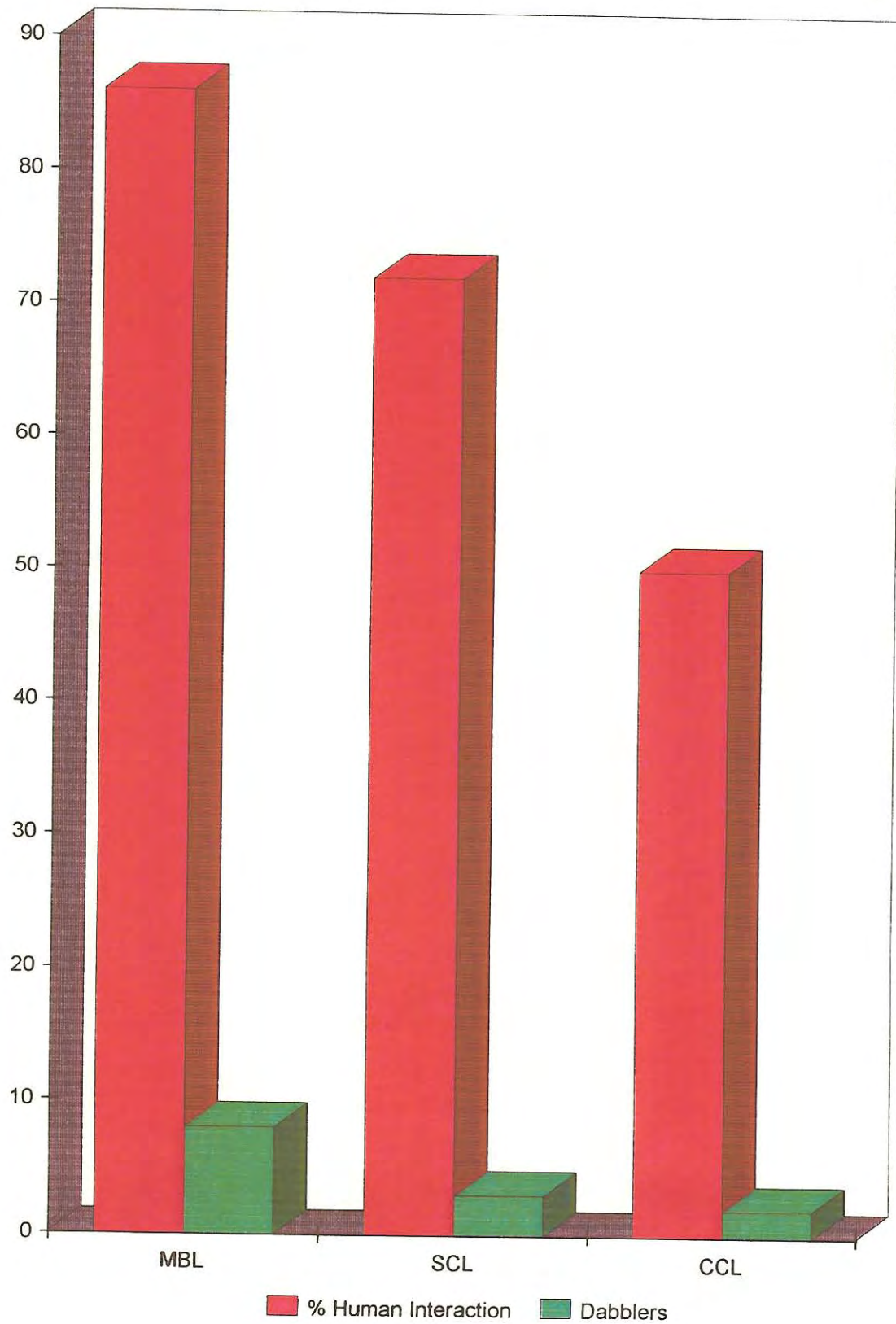
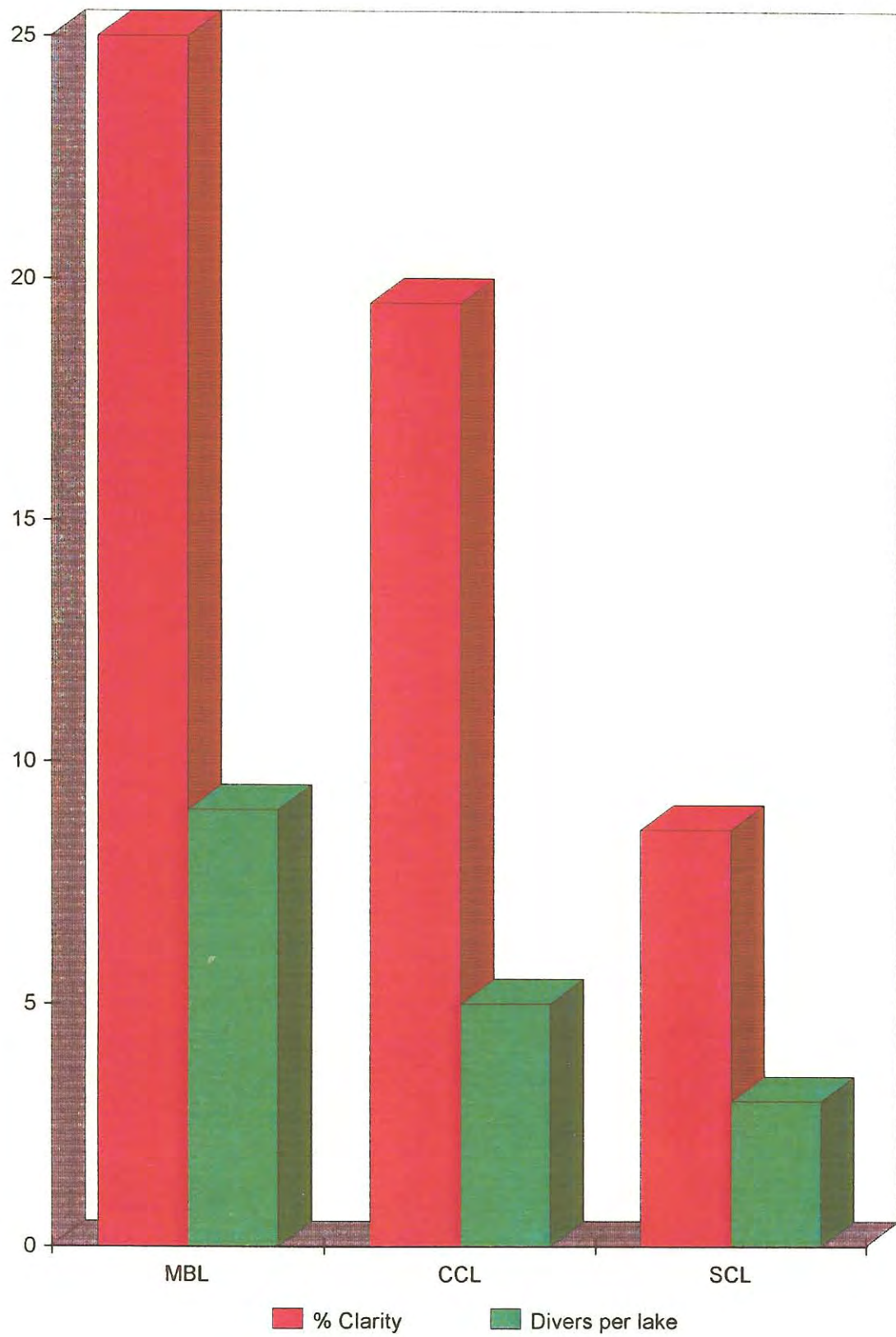


Figure 5

% Clarity vs. Divers

16



are choosing to spend more time at Middlebrook Lake due to its stream channel.

waterfowl use of lakes is affected by severe winter weather. Larger numbers of ducks can be observed on unfrozen compared to partly or mostly frozen lake (Bates *et al.* 1988). Middlebrook was frozen once out of the 21 days of field work, however, Creek Lake and Steele Creek Lake were frozen 4 out of the 21 observed. Therefore, Middlebrook remained more open for waterfowl.

Another effect of severe winter weather were fronts bringing in different types of wild waterfowl. A total of three cold fronts, swinging off low pressure systems, passed through this region from the 1 November - 7 November (Figure 6). On the 1 November two Ring-necked Ducks were seen on Middlebrook Lake, on the 8 November four American Wigeon were seen on Middlebrook Lake, and on the 9 November seven Ring-necked Ducks, 14 Lesser Scaup, and one Redhead were seen on Middlebrook Lake.

On the 13 November temperatures plunged into the 10's, snow began to fall, and a low pressure system formed with a cold front swinging off of it in the Upper-Mid West of the United States. On the 14 November temperatures were still in the 10's, snow was still falling, and the front began to plunge toward the east coast. By the 15 November temperatures were in the 20's in the Upper-Mid West and the cold front had entered our area. By the 17 November the cold front had passed through, and we now had a high pressure system in our area. On the same day a strip of cold weather came down out of the New England States (Figure 7). The seasonal arrival of Hooded Mergansers came through on the 15 November.

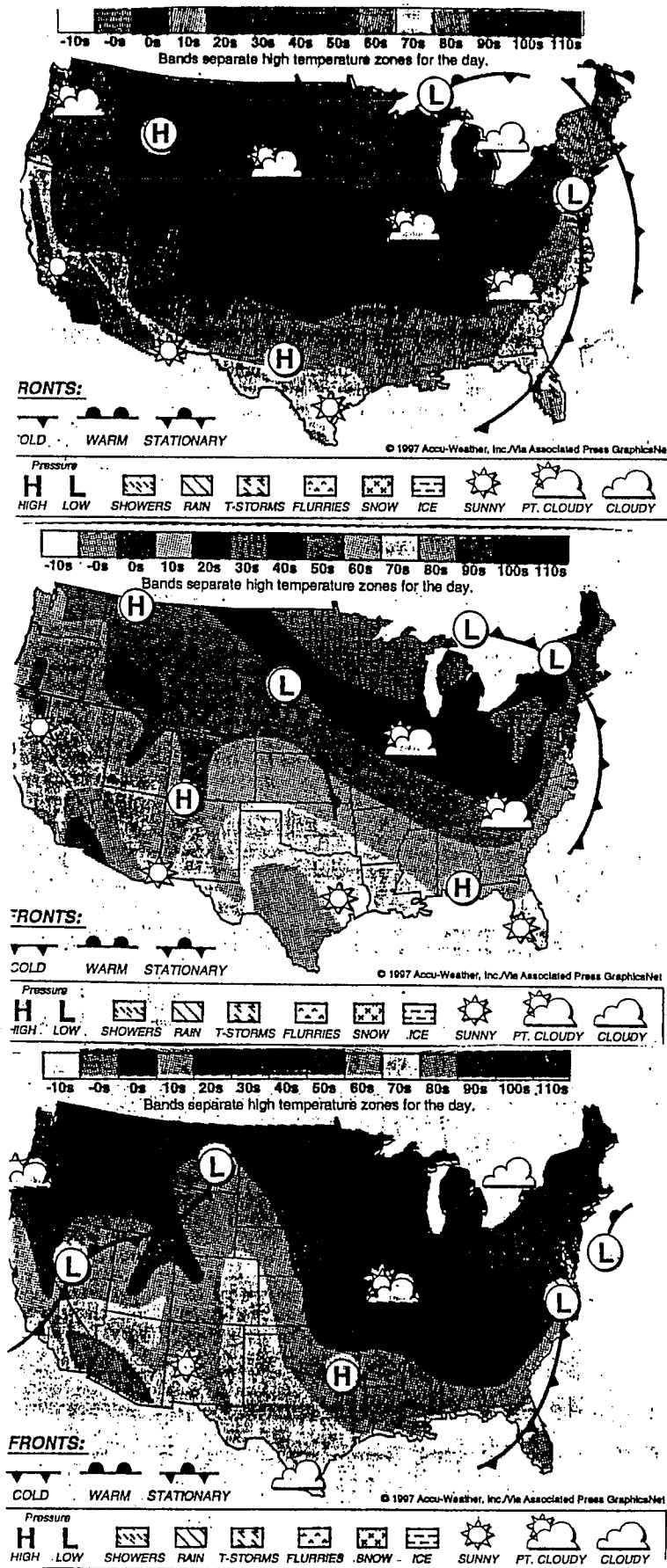


Figure 6 Weather maps from the 2 November 1997 (top), the 4 November 1997 (middle), and the 7 November 1997 (bottom) showing the movement of fronts through Northeast Tennessee and Southwest Virginia.

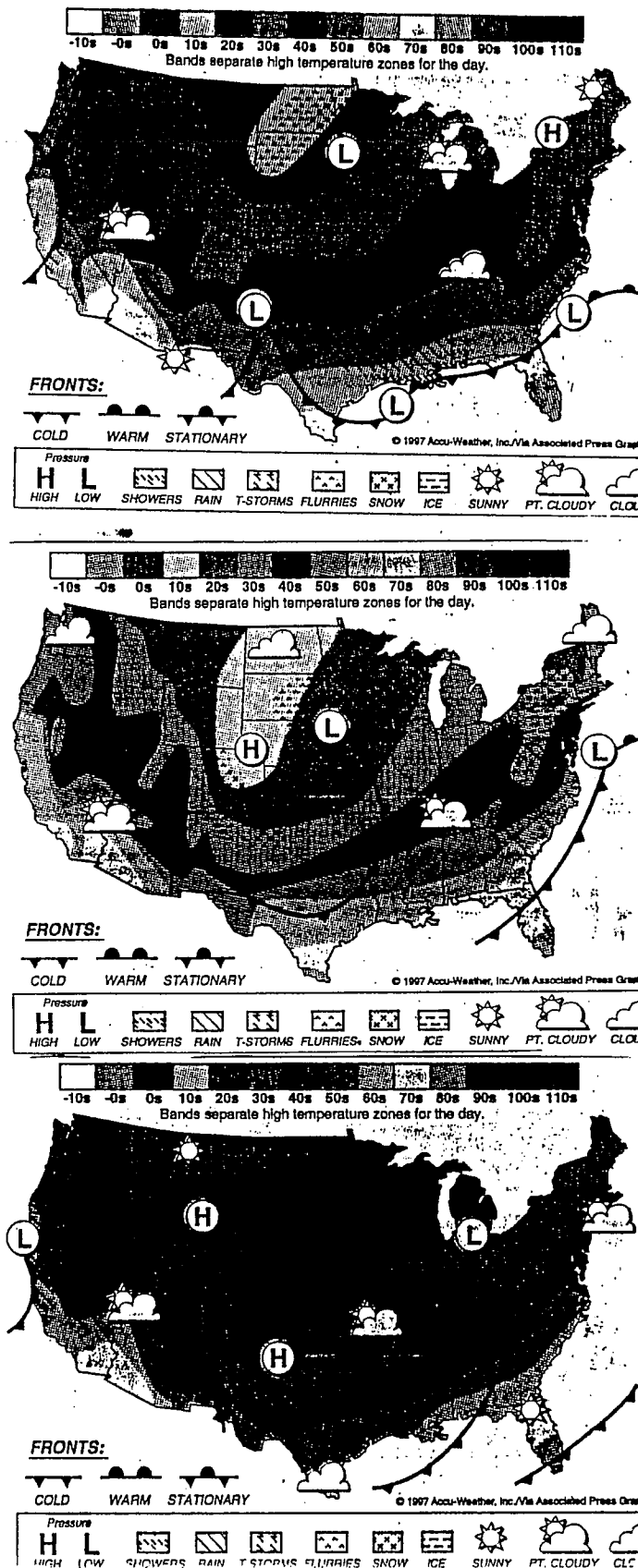


Figure 7 Weather maps from the 13 November 1997 (top), the 14 November 1997 (middle), and the 15 November 1997 (bottom) showing the movement of fronts through Northeast Tennessee and Southwest Virginia

CONCLUSION

The purpose of this study was to document waterfowl populations and their diversity at three lakes and to establish an explanation for the variation observed among the lakes.

The waterfowl survey provided documentation of waterfowl at the three lakes. From the survey sheets (Appendix B), taken from waterfowl survey, the author was able to gather the following data concerning waterfowl populations at each lake.

Middlebrook Lake had a total of 25 waterfowl species (Table 3). There were eight diving duck and eight dabbling duck species out of the total 25 waterfowl documented (Table 4). A total of 428 divers and 1,194 dabblers were seen during the survey of Middlebrook (Table 5). Out of the 25 species of waterfowl at Middlebrook nine were exclusive species. When compared with the other lakes, Clear Creek Lake had 12 of the same species as Middlebrook and Steele Creek Lake had ten of the same species as Middlebrook.

Clear Creek Lake had a total of 14 waterfowl species (Table 3). Out of the 14 waterfowl there were 5 diving duck and 2 dabbling duck species (Table 4). A total of 345 divers and 153 dabblers were documented at Clear Creek Lake (Table 5). Clear Creek Lake had one exclusive waterfowl. Of the 14 species documented at Clear Creek only seven of the same species were documented at Steele Creek Lake.

Steele Creek Lake had 11 total waterfowl species (Table 3). Of the 11 waterfowl documented three were dabbling ducks and three were diving ducks (Table 4). A total of four divers and 908 dabblers were recorded during the waterfowl survey at Steele Creek Lake (Table 5). There were no exclusive species present at Steele Creek Lake.

Table 6 shows the occurrence of Pied-billed Grebes and American Coots at the three lakes. These two target species occurred more often and in greater numbers at Middlebrook and Clear Creek Lakes than at Steele Creek Lake.

Table 7 is the number of diving ducks and dabbling ducks recorded for each lake. This table shows the distinct difference in water bird species and

Table 3

Waterbird Diversity

	Middlebrook	Clear Creek	Steele Creek
Common Loon	x		x
Pied-billed Grebe	x	x	x
Horned Grebe	x		x
Great Blue Heron	x	x	x
Black-crowned Night Heron	x		
Mute Swan	x	x	
Canada Goose	x	x	x
Chinese Goose	x		
Gray Lag		x	x
Wood Duck	x		x
Green-winged Teal	x		
American Black Duck	x	x	
Mallard	x	x	x
Northern Pintail	x		
Gadwall	x		
American Wigeon	x		
Redhead	x	x	
Ring-necked Duck	x	x	
Greater Scaup		x	
Lesser Scaup	x		
Bufflehead	x		
Hooded Merganser	x	x	
Ruddy Duck	x		
American Coot	x	x	x
Ring-billed Gull	x	x	x
Bonaparte's Gull	x	x	
Muscovy	x		x
Total Species	<hr/> 25	<hr/> 14	<hr/> 11

Table 4 Number of Diver and Dabbling Waterbird Species per Lake

	Middlebrook	Clear Creek	Steele Creek
Divers	8	5	3
Dabblers	8	2	3

Table 5 Number of Diver and Dabbling Waterbird Individuals per Lake

	Middlebrook	Clear Creek	Steele Creek
Divers	428	345	4
Dabblers	1,194	153	908

Table 6 Occurrences of Two Target Species per Lake per Month**Pied-billed Grebe**

	Middlebrook	Clear Creek	Steele Creek
October	1	0	2
November	13	1	0
December	3	1	0
January	9	3	0
February	9	2	0
March	4	0	0

American Coot

	Middlebrook	Clear Creek	Steele Creek
October	29	41	0
November	172	328	10
December	114	214	8
January	164	255	12
February	130	161	12
March	42	49	6

Table 7 Number of Diver and Dabbler Records Per Lake

Divers	Middlebrook	Clear Creek	Steele Creek
Common Loon	5	0	1
Pied-billed Grebe	39	7	2
Horned Grebe	1	0	1
Redhead	1	1	0
Ring-necked Duck	2	1	0
Greater Scaup	0	13	0
Lesser Scaup	5	0	0
Bufflehead	2	0	0
Hooded Merganser	363	323	0
Ruddy Duck	10	0	0
Dabblers	Middlebrook	Clear Creek	Steele Creek
Wood Duck	10	0	1
Green-winged Teal	2	0	0
American Black Duck	12	1	0
Mallard	1104	152	878
Northern Pintail	3	0	0
Gadwall	10	0	0
American Wigeon	8	0	0
Muscovy	45	0	29

their amounts between lakes. Middlebrook Lake has higher diver and dabbling documented accounts than does Clear Creek and Steele Creek Lakes.

By studying waterfowl habitat characteristics conclusions were made for why there were varying populations of waterfowl among lakes.

Of the three lakes studied, Middlebrook Lake supports the best conditions for waterfowl to live. Although 86 percent of the lakes shoreline comes into contact with human interaction, the number of people who come into contact with the lake is less than that of Clear Creek Lake and Steele Creek Lake.

Middlebrook Lake has a pH of 8.9 and is better able to support fish populations than Clear Creek Lake and Steele Creek Lake, which both have higher pH levels.

The original stream channel in Middlebrook Lake is located closest to the shoreline covered by wooded area. The stream channel attracts fish because of the abundant supply of nutrients it provides. waterfowl forage in areas where the largest percent of fish are located, this being the original stream channel sector. In Middlebrook the stream channel is located in an area where human interaction is far enough away that waterfowl feel 'comfortable'. However, in both Clear Creek Lake and Steele Creek Lake, the stream channels run through the middle. waterfowl are not as likely to forage in an open area in which these two lakes provide.

The depth of each lake seemed to effect the number of diving ducks found on them. Steele Creek Lake had the greatest depth of the three lakes and the least number of diving ducks. Clear Creek Lake had the median depth of the lakes and the median number of diving ducks. Middlebrook Lake had the least depth and the largest number of diving ducks (Figure 8).

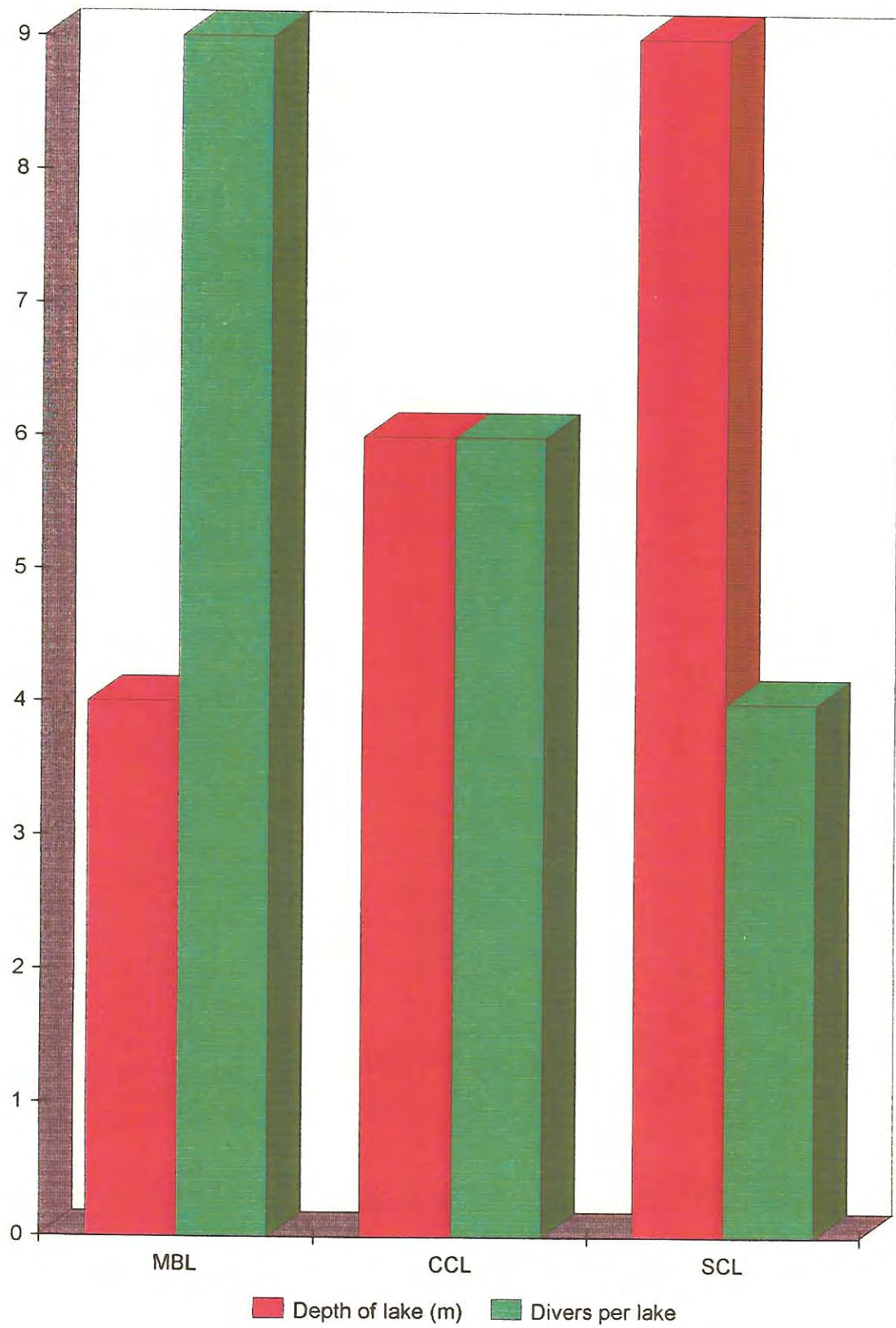
Middlebrook also had a higher percent clarity than Clear Creek and Steele Creek. High clarity of water allows waterfowl to have a more applicable view of the animal or plant matter they are foraging on.

Middlebrook Lake was frozen once during the 21 week survey, while Clear Creek Lake and Steele Creek Lake were frozen a total of four times during the survey. Middlebrook, therefore, remained more open for waterfowl.

Figure 8

Depth of lake vs. Divers

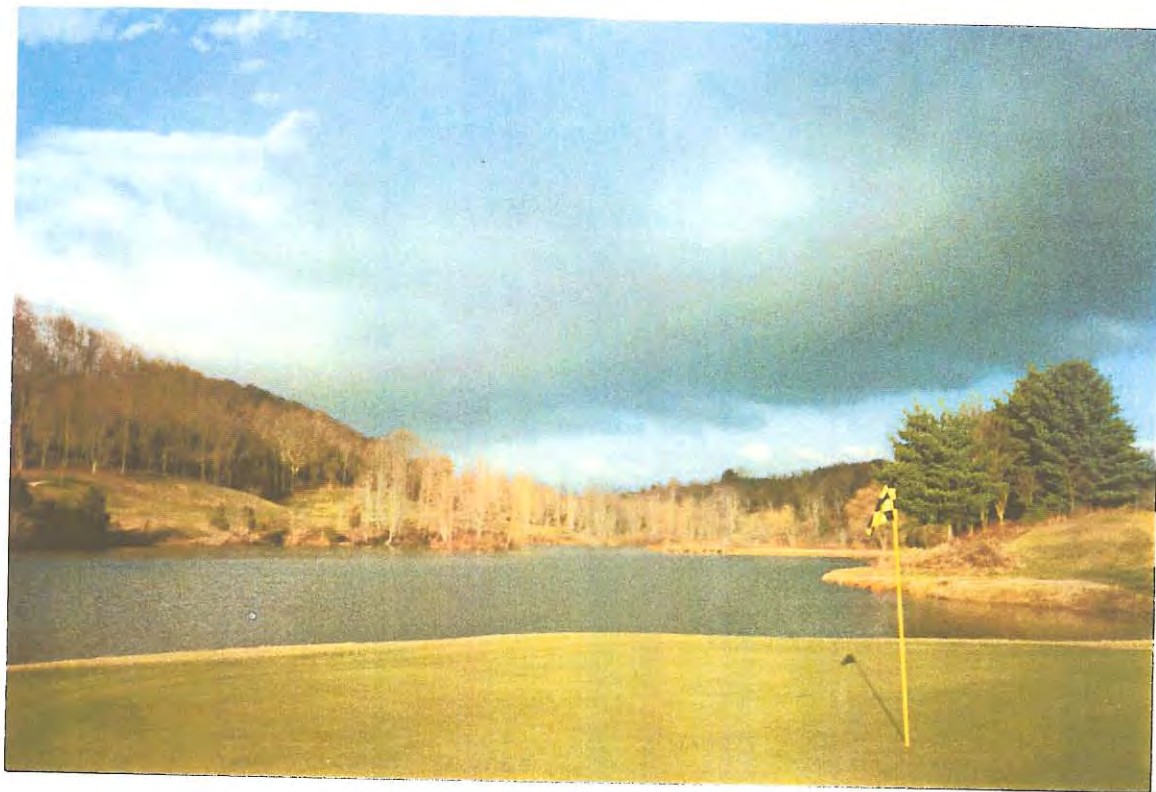
26



In conclusion it was found that due to effects of human interaction, water quality, original stream channels, lake depth, and winter weather, more waterfowl are attracted to Middlebrook Lake and Clear Creek Lake than they are to Steele Creek Lake.

Appendix A

Perspective Pictures from Three Lakes



View of Clear Creek Lake from golf course facing northern end of lake where fishing dock is located.



View of Middlebrook Lake from Redstone Drive, road adjacent to lake, facing the area of lake shoreline where divers are often located.



View of Steele Creek Lake from beach area of shoreline below Nature Center. Visible walking path to left and wooded area to right.



Herald Courier/Andre Teague

Fowl and foliage

David and Louise Hughes spend time Tuesday feeding the ducks and taking in the fall colors at Steele Creek Park in Bristol Tennessee.

Steele Creek Park Lake had the second highest number of dabblers due to the lake's amount of human interaction.

Appendix B
Waterfowl Survey Sheets

October 25 Waterfowl Survey

Clear Creek Lake in 745 -- out 820

Canada Goose	653
Domestic White Duck	4
Mallard/Muscovy Cross	1
American Coots	41
Mallard	8

Middlebrook Lake in 855 -- out 946

Pied-billed Grebe	1
Great Blue Heron	3
Black-Crowned Night Heron	2
Mute Swan	2
China Goose	1
Canada Goose	14
Wood Duck	8
American Black Duck	1
Mallard	49
Muscovy	3
American Coots	29

Steele Creek Lake in 1022-- out 1035

Greylag	12
Canada Goose	48
Mallard	24
Muscovy	1

Sarah Garrett

WATERFOWL SURVEY

Time Out:	0800	AM/PM	Beginning Miles:	481	Trip No:	2
Time In:	1146	AM/PM	Ending Miles:	502	Page No:	1
Total Time:	338		Total Miles:	21	Month:	11
Date:	1 November 1997			Recorder: Sarah Garrett		

Water Conditions:	Regional Weather
Clear Creek Lake: smooth SURFACE	Sky Cover: overcast
	High Temp: 62
Middlebrook Lake: SMOOTH SURFACE	Low Temp: 48
	Precipitation: .11"
Steele Creek Lake: SMOOTH SURFACE	Ground Cover: clear
	Wind Direction: SW
	Wind Speed: 10-15 mph

Other Participants:	Wallace Coffey, Rob Biller, Janet Brown (Johnson City resident)
Special Notes:	Clear Creek - machines preparing greens
	Steele Creek - Party @ Pool House

Lake Count			
	Clear Creek	Middlebrook	Steele Creek
Time Out:	808	932	1105
Time In:	903	1053	1146
Common Loon			
Pied-billed Grebe		4	
Double-crested Cormorant		1	
Great Blue Heron			
	5 Domestic White Duck		3 Domestic White Duck
Mute Swan		6	
Snow Goose			
Canada Goose	3	2	28
Greylag Goose		1 Chinese Goose	12
Wood Duck			
Green-winged Teal		2	
American Black Duck		2	
Mallard		82	112
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck		2	
Lesser Scaup			
Muskrat			
Bufflehead			
Hooded Merganser		4	
Ruddy Duck			
American Coot	51	20	

Sarah Garrett

WATERFOWL SURVEY

Time Out:	0819	AM/PM	Beginning Miles:	397	Trip No:	3
Time In:	1140	AM/PM	Ending Miles:	415	Page No:	2
Total Time:	3:21		Total Miles:	18	Month:	11
Date:	8 November 1997			Recorder: Sarah Garrett		

Water Conditions:		Regional Weather	
Clear Creek Lake:	Rippled Surface	Sky Cover	cloudy
		High Temp.	46
Middlebrook Lake:	Smooth Surface	Low Temp.	42
		Precipitation	.02
Steele Creek Lake:	Smooth Surface/Rippled	Ground Cover	clear
	@ creek @ lake	Wind Direction	NW
		Wind Speed	10-15 mph

Other Participants: Mary Garrett, Emily Chafin

Special Notes: @ Middlebrook there was an individual blowing leaves across their yard

Lake Count

	Clear Creek	Middlebrook	Steele Creek
Time Out:	819	918	1030
Time In:	843	1023	1140
Common Loon			
Pied-billed Grebe		1	
Double-crested Cormorant			
Great Blue Heron		3	
	5 Domestic White Duck	6	3 Domestic White Duck
Mute Swan			
Snow Goose			
Canada Goose			27
Greylag Goose	10	1 Chinese Goose	12
Wood Duck			
Green-winged Teal			
American Black Duck			
Mallard	2	55	68
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon		4	
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup			
Muscovy		4	1
Bullhead			
Hooded Merganser			
Ruddy Duck			
American Coot	76	57	7

Sarah Garrett

WATERFOWL SURVEY

Time Out:	0726	AM/PM	Beginning Miles:	807	Trip No:	4
Time In:	1051	AM/PM	Ending Miles:	818	Page No:	3
Total Time:	325		Total Miles:	17	Month:	11
Date:	15 November 1997			Recorder: Sarah Garrett		

Water Conditions:		Regional Weather	
Clear Creek Lake:	SMOOTH SURFACE	Sky Cover	overcast
Middlebrook Lake:	SMOOTH SURFACE	High Temp.	40
Steele Creek Lake:	SMOOTH SURFACE	Low Temp.	36
		Precipitation	.85" (monthly thru Feb)
		Ground Cover	clear
		Wind Direction	W
		Wind Speed	15-20 mph

Other Participants: Roger Garrett (clear creek lake)
 Wallace Coffey (middlebrook) Kevin Hammed (steele creek lake)

Special Notes:

Lake Count

	Clear Creek	Middlebrook	Steele Creek
Time Out:	726	834	1000
Time In:	750	945	1051
Common Loon		5	
Pied-billed Grebe		1 Horned Grebe	1 Horned Grebe
Double-crested Cormorant			
Great Blue Heron			
Mute Swan	5 Domestic White Duck		
Snow Goose			
Canada Goose	291		112
Greylag Goose	10		
Wood Duck			
Green-winged Teal			
American Black Duck			
Mallard	4	64	60
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup		5	
Bufflehead			
Hooded Merganser		43	
Ruddy Duck			
American Coot	81	49	3
Pink-billed Gull		3	

Sarah Garrett

WATERFOWL SURVEY

Time Out:	0812	AM/PM	Beginning Miles:	009	Trip No:	5
Time In:	1359	AM/PM	Ending Miles:	030	Page No:	4
Total Time:	5:47		Total Miles:	21	Month:	11
Date:	22 November 1997			Recorder: Sarah Garrett		

Water Conditions:		Regional Weather	
Clear Creek Lake:	SMOOTH SURFACE	Sky Cover	overcast
		High Temp.	55
Middlebrook Lake:	SMOOTH SURFACE	Low Temp.	45
		Precipitation	0.09"
Steele Creek Lake:	SMOOTH SURFACE	Ground Cover	clear
		Wind Direction	W
		Wind Speed	5-10 mph

Other Participants: Janet Brown, Wallace Coffey, Amanda Martin, Reece Jamerson, J. N. Howard, Ella Howard, Dave Worley, JoAnn Delta, Special Notes: Bristol Bird Club, Waterfowl Field Trip, Marty Huber, Emily Burkey, Jennifer Burkey

Lake Count			
	Clear Creek	Middlebrook	Steele Creek
Time Out:	812	951	1040
Time In:	910	1016	1359
Common Loon			
Pied-billed Grebe			
Double-crested Cormorant			
Great Blue Heron			
Mute Swan	5 domestic white duck	6	
Snow Goose			
Canada Goose	275	23	57
Gravelled goose		Chinese goose	12
Wood Duck			
Green-winged Teal			
American Black Duck			
Mallard	31	26	47
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup			
Bufflehead			
Hooded Merganser	16	185	
Ruddy Duck			
American Coot	66	26	
Pink-billed Gull		6	

Sarah Garrett

WATERFOWL SURVEY

Time Out:	810	AM/PM	Beginning Miles:	166	Trip No:	6
Time In:	1040	AM/PM	Ending Miles:	186	Page No:	5
Total Time:	2:30		Total Miles:	20	Month:	11
Date:	29 November 1997			Recorder: Sarah Garrett		

Water Conditions:	Regional Weather
Clear Creek Lake: SMOOTH SURFACE	Sky Cover overcast
	High Temp. 54°
Middlebrook Lake: SMOOTH SURFACE	Low Temp. 32°
	Precipitation 1.22" (thru FRI mid.)
Steele Creek Lake: SMOOTH SURFACE	Ground Cover clear
	Wind Direction S
	Wind Speed 5-10 mph

Other Participants: (clear creek) Mary Garrett

Special Notes: new 'no trespassing' sign @ Middlebrook
 - had to walk around clear creek to see view from site three

Lake Count

	Clear Creek	Middlebrook	Steele Creek
Time Out:	810	915	1019
Time In:	851	1000	1040
Common Loon			
Pied-billed Grebe		2	
Double-crested Cormorant			
Great Blue Heron		2	
	5 Domestic white ducks	1 Domestic white ducks	3 Domestic white ducks
Mute Swan		6	
Snow Goose			
Canada Goose	75	46	
Greylag Goose	10	1 Chinese Goose	12
Wood Duck			
Green-winged Teal			
American Black Duck		1	
Mallard		50	64
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall		1	
American Wigeon		4	
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup			
Muscovy		4	
Bufflehead			
Hooded Merganser	52	38	
Ruddy Duck			
American Coot	54	11	
Ring-billed Gull	3		

Sarah Garrett

WATERFOWL SURVEY

Time Out:	1300	AM/PM	Beginning Miles:	397	Trip No:	7
Time In:	1620	AM/PM	Ending Miles:	416	Page No:	6
Total Time:	3:20		Total Miles:	19	Month:	12
Date:	06 December 1997			Recorder:	Sarah Garrett	

Water Conditions:	Regional Weather
Clear Creek Lake: RIPPLED SURFACE	Sky Cover: overcast
Middlebrook Lake: RIPPLED SURFACE	High Temp: 40°
Steele Creek Lake: RIPPLED SURFACE	Low Temp: 30°
	Precipitation: 8pm FRI - 02
	Ground Cover: snow/ice
	Wind Direction: —
	Wind Speed: —

Other Participants: Kevin Hamed - Steele Creek Park Lake

Special Notes:

Lake Count

	Clear Creek	Middlebrook	Steele Creek
Time Out:	1554	1514	1300
Time In:	1620	1634	1657
Common Loon			
Pied-billed Grebe			
Double-crested Cormorant			
Great Blue Heron		1	
Mute Swan	5 Domestic White Ducks		3 Domestic White Ducks
Snow Goose			
Canada Goose	232	3	48
Green-winged Teal	7		12
American Black Duck			
Mallard	89	162	31
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup			
Muscovy			1
Bufflehead			
Hooded Merganser	62	18	
Ruddy Duck			
American Coot	45	21	2
Ring-billed Gull	2		

Sarah Garrett

WATERFOWL SURVEY

Time Out:	8:34	AM/PM	Beginning Miles:	598	Trip No:	8
Time In:	11:45	AM/PM	Ending Miles:	613	Page No:	7
Total Time:	3:11		Total Miles:	15	Month:	12
Date:	13 December 1997			Recorder: Sarah Garrett		

Water Conditions:	Regional Weather
Clear Creek Lake: SMOOTH SURFACE	Sky Cover: partly cloudy
Middlebrook Lake: SMOOTH SURFACE	High Temp.: 36°
Steele Creek Lake: SMOOTH SURFACE	Low Temp.: 28°
	Precipitation: —
	Ground Cover: clear
	Wind Direction: W
	Wind Speed: 10 mph

Other Participants: Roger Garrett (clear creek)

Special Notes:

Lake Count

	Clear Creek	Middlebrook	Steele Creek
Time Out:	8:34	9:43	10:55
Time In:	9:25	10:35	11:45
Common Loon			
Pied-billed Grebe		1	
Double-crested Cormorant			
Great Blue Heron		2	
Mute Swan	5 Domestic White Ducks		3 Domestic White Ducks
Snow Goose			
Canada Goose	98	25	81
Green-winged Teal	16		12
American Black Duck			
Mallard		42	33
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup			
Muskrat			1
Bufflehead			
Hooded Merganser	66	12	
Ruddy Duck			
American Coot	49	41	3
Ring-billed Gull	37	15	

Sarah Garrett

WATERFOWL SURVEY

Time Out:	0840	AM/PM	Beginning Miles:	794	Trip No:	9
Time In:	1120	AM/PM	Ending Miles:	814	Page No:	8
Total Time:	2:06		Total Miles:	20	Month:	12
Date:	20 December 1997			Recorder: Sarah Garrett		

Water Conditions:	Regional Weather
Clear Creek Lake: partly frozen surface	Sky Cover: overcast
Middlebrook Lake: smooth surface	High Temp: 57°
Steele Creek Lake: partly frozen surface	Low Temp: 24°
	Precipitation: —
	Ground Cover: frost
	Wind Direction: —
	Wind Speed: —

Other Participants: Clear creek lake - Mary Garrett

Special Notes:

Lake Count			
	Clear Creek	Middlebrook	Steele Creek
Time Out:	840	936	1040
Time In:	920	1022	1120
Common Loon			
Pied-billed Grebe		2	
Double-crested Cormorant			
Great Blue Heron		2	
Mute Swan	1 Domestic white ducks	3	3 Domestic white ducks
Snow Goose			
Canada Goose	26	107	(6)
Green-winged Teal			
American Black Duck			
Mallard	2	71	39
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup			
Muskrat			1
Bufflehead			
Hooded Merganser		10	
Ruddy Duck			
American Coot	64	18	
Ring-billed Gull	50	78	

Sarah Garrett

WATERFOWL SURVEY

Time Out:	0822 AM/PM	Beginning Miles:	905	Trip No:	10
Time In:	1040 AM/PM	Ending Miles:	925	Page No:	9
Total Time:	218	Total Miles:	20	Month:	12
Date:	27 December 1997		Recorder: Sarah Garrett		

Water Conditions:

Clear Creek Lake: partly frozen surface

Middlebrook Lake: smooth surface

Steele Creek Lake: partly frozen surface

Regional Weather

Sky Cover	overcast
High Temp.	35°
Low Temp.	32°
Precipitation	.04"
Ground Cover	snow
Wind Direction	GUSTY
Wind Speed	

Other Participants: Many Garrett (clear creek lake)

Special Notes: Hard snow @ middlebrook

Lake Count

	Clear Creek	Middlebrook	Steele Creek
Time Out:	822	916	1009
Time In:	900	950	1040
Common Loon			
Pied-billed Grebe	1 Horned Grebe		
Double-crested Cormorant			
Great Blue Heron		1	
Mute Swan	5 Domestic White Duck	6	
Snow Goose			
Canada Goose	36	2	21
Green-winged Goose	9		12
Wood Duck			
Green-winged Teal			
American Black Duck			
Mallard		25	50
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck	1		
Lesser Scaup			
Muskrat			1
Bufflehead			
Hooded Merganser	88		
Ruddy Duck			
American Coot	56	34	3
Ring-billed Gull	75		

Sarah Garrett

WATERFOWL SURVEY

Time Out:	0808	AM/PM	Beginning Miles:	062	Trip No:	11
Time In:	1130	AM/PM	Ending Miles:	091	Page No:	10
Total Time:	3:22		Total Miles:	29	Month:	1
Date:	3 January 1998			Recorder:	Sarah Garrett	

Water Conditions:	Regional Weather
Clear Creek Lake: mostly frozen surface	Sky Cover: partly cloudy
Middlebrook Lake: mostly frozen surface (not along woods, though)	High Temp: 59°
Steele Creek Lake: mostly frozen surface (not around golfing green)	Low Temp: 22°
	Precipitation: —
	Ground Cover: frost
	Wind Direction: —
	Wind Speed: —

Other Participants: Mary Garrett - clear creek lake

Special Notes:

Lake Count

	Clear Creek	Middlebrook	Steele Creek
Time Out:	808	922	1078
Time In:	905	1011	1130
Common Loon			
Pied-billed Grebe			
Double-crested Cormorant			
Great Blue Heron	1	1	
Mute Swan			
Snow Goose			
Canada Goose	5	225	72
Greylag Goose	2		
Wood Duck			
Green-winged Teal			
American Black Duck		3	
Mallard		88	29
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup			
Muscovy			1
Bufflehead			
Hooded Merganser			
	5 Bonaparte's Gull	5 Bonaparte's Gull	
Ruddy Duck			
American Coot	55	32	
Ring-billed Gull	4	32	

Sarah Garrett

WATERFOWL SURVEY

Time Out:	0816	AM PM	Beginning Miles:	233	Trip No:	12
Time In:	1110	AM PM	Ending Miles:	256	Page No:	11
Total Time:	254		Total Miles:	23	Month:	1
Date:	10 January 1998			Recorder:	Sarah Garrett	

Water Conditions:		Regional Weather	
Clear Creek Lake: MUDDY	} constant rain during previous days	Sky Cover	cloudy
Middlebrook Lake: MUDDY		High Temp.	52°
Steele Creek Lake: MUDDY		Low Temp.	40°
		Precipitation	.2" (thru FEB)
		Ground Cover	saturated w/H ₂ O
		Wind Direction	—
		Wind Speed	—

Other Participants: Roger Garrett (clear creek lake)

Special Notes:

Lake Count

	Clear Creek	Middlebrook	Steele Creek
Time Out:	816	920	1030
Time In:	900	1010	1110
Common Loon			
Pied-billed Grebe		2	
Double-crested Cormorant			
Great Blue Heron			
Mute Swan	3 domestic white duck	1 domestic white duck	1
Snow Goose		6	
Canada Goose		5	58
Greylag Goose	9	1 Chinese Goose	12
Wood Duck			
Green-winged Teal			
American Black Duck		1	
Mallard	7	51	28
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup			
Muscovy		4	1
Bufflehead			
Hooded Merganser	40		
Ruddy Duck			
American Coot	58	23	3
Ring-billed Gull	11		

Sarah Garrett

WATERFOWL SURVEY

Time Out:	0815	AM/PM	Beginning Miles:	461	Trip No:	13
Time In:	1117	AM/PM	Ending Miles:	490	Page No:	12
Total Time:	302		Total Miles:	29	Month:	1
Date:	17 January 1998			Recorder:	Sarah Garrett	

Water Conditions:	Regional Weather
Clear Creek Lake: smooth surface	Sky Cover overcast
Middlebrook Lake: rippled surface	High Temp. 42°
Steele Creek Lake: smooth surface	Low Temp. 36°
	Precipitation .05"
	Ground Cover saturated w/H ₂ O
	Wind Direction W
	Wind Speed 10-15 mph

Other Participants: Mary Garrett - Clear Creek Lake

Special Notes:

Lake Count

	Clear Creek	Middlebrook	Steele Creek
Time Out:	815	927	1027
Time In:	905	1017	1117
Common Loon			
Pied-billed Grebe	3	3	
Double-crested Cormorant			
Great Blue Heron		2	
Mute Swan	2	6	
Snow Goose			
Canada Goose	13		15
greylag goose	9	1 Chinese Goose	12
Wood Duck			
Green-winged Teal			
American Black Duck			
Mallard		32	32
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup			
Muscovy		2	1
Bufflehead			
Hooded Merganser		1	
Ruddy Duck			
American Coot	56	40	3
Ring-billed Gull	20		

Sarah Garrett

WATERFOWL SURVEY

Time Out:	0755	AM/PM	Beginning Miles:	628	Trip No:	14
Time In:	1045	AM/PM	Ending Miles:	653	Page No:	13
Total Time:	250		Total Miles:	25	Month:	1
Date:	24 January 1998			Recorder: Sarah Garrett		

Water Conditions:	Regional Weather
Clear Creek Lake: smooth surface	Sky Cover overcast
	High Temp. 43°
Middlebrook Lake: rippled surface	Low Temp. 33°
	Precipitation .08"
Steele Creek Lake: smooth surface	Ground Cover clear
	Wind Direction NW
	Wind Speed 10-15mph

Other Participants: Roger Garrett - clear creek lake

Special Notes:

Lake Count			
	Clear Creek	Middlebrook	Steele Creek
Time Out:	755	831	1000
Time In:	835	943	1045
Common Loon			
Pied-billed Grebe		2	
Double-crested Cormorant			
Great Blue Heron		1	
Mute Swan		6	
Snow Goose			
Canada Goose		28	36
Greenlag Goose	7		12
Wood Duck			
Green-winged Teal			
American Black Duck			
Mallard		31	37
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall		2	
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup			
Muskrat		4	1
Bufflehead			
Hooded Merganser			
Ruddy Duck			
American Coot	46	21	3
Ring-billed Gull		200	

Sarah Garrett

WATERFOWL SURVEY

Time Out:	813	AM/PM	Beginning Miles:	731	Trip No:	15
Time In:	1110	AM/PM	Ending Miles:	758	Page No:	14
Total Time:	337		Total Miles:	27	Month:	1
Date:	31 January 1998			Recorder: Sarah Garrett		

Water Conditions:	Regional Weather
Clear Creek Lake: partly frozen surface	Sky Cover overcast
Middlebrook Lake: smooth surface	High Temp. 39°
Steele Creek Lake: partly frozen surface	Low Temp. 32°
	Precipitation —
	Ground Cover snow
	Wind Direction GUSTY
	Wind Speed

Other Participants: Mary Garrett - clear creek lake

Special Notes:

Lake Count			
	Clear Creek	Middlebrook	Steele Creek
Time Out:		920	1025
Time In:		1008	1110
Common Loon		2	
Pied-billed Grebe			
Double-crested Cormorant		2	
Great Blue Heron	1		
Mute Swan		5	
Snow Goose		2	4
Canada Goose			12
Grey lag goose	3	1 chinese goose	
Wood Duck			
Green-winged Teal			
American Black Duck			
Mallard		22	20
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup			
MUSCOW		2	1
Bufflehead			
Hooded Merganser			
Ruddy Duck			
American Coot	40	45	3
Pink-billed gull	3	25	

Sarah Garrett

WATERFOWL SURVEY

Time Out:	8 ⁰⁰	(AM/PM)	Beginning Miles:	858	Trip No:	16
Time In:	11 ³⁰	(AM/PM)	Ending Miles:	883	Page No:	15
Total Time:	330		Total Miles:	25	Month:	2
Date:	7 February 1998			Recorder: Sarah Garrett		

Water Conditions:		Regional Weather	
Clear Creek Lake:	SMOOTH SURFACE	Sky Cover	cloudy
		High Temp.	45°
Middlebrook Lake:	SMOOTH SURFACE	Low Temp.	36°
		Precipitation	—
Steele Creek Lake:	SMOOTH SURFACE	Ground Cover	saturated
		Wind Direction	—
		Wind Speed	—

Other Participants: Mary Garrett - clear creek

Special Notes:

Lake Count

	Clear Creek	Middlebrook	Steele Creek
Time Out:	8 ⁰⁰	9 ¹⁸	10 ³⁰
Time In:	9 ⁰⁰	10 ¹⁸	11 ³⁰
Common Loon		1	
Pied-billed Grebe			
Double-crested Cormorant			
Great Blue Heron		2 Domestic White Duck	3 Domestic White Duck
Mute Swan			
Snow Goose			
Canada Goose	6	29	3
Graylag Goose	6		12
Wood Duck			
Green-winged Teal			
American Black Duck		86	53
Mallard			
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup		6	1
Muscovy			
Bufflehead			
Hooded Merganser			
Ruddy Duck			3
American Coot	45	37	
Ring-billed Gull	62	200	

Sarah Garrett

WATERFOWL SURVEY

Time Out:	806	AM/PM	Beginning Miles:	045	Trip No:	17
Time In:	1145	AM/PM	Ending Miles:	069	Page No:	16
Total Time:	339		Total Miles:	24	Month:	2
Date:	14 February 1998			Recorder: Sarah Garrett		

Water Conditions:	Regional Weather
Clear Creek Lake: SMOOTH SURFACE	Sky Cover: cloudy
	High Temp: 46°
Middlebrook Lake: RIPPLED SURFACE	Low Temp: 36°
	Precipitation: trace
Steele Creek Lake: SMOOTH SURFACE	Ground Cover: clear
	Wind Direction: NW
	Wind Speed: 5-10mph

Other Participants: Mary Garrett - clear creek lake

Special Notes:

Lake Count

	Clear Creek	Middlebrook	Steele Creek
Time Out:	806	925	1045
Time In:	908	1028	1145
Common Loon			
Pied-billed Grebe	1	3	
Double-crested Cormorant			
Great Blue Heron	1	1	
Mute Swan		5	
Snow Goose			
Canada Goose	36	14	12
Greylag Goose	6		12
Wood Duck			
Green-winged Teal			
American Black Duck			
Mallard		33	31
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup			
Muscovy		4	1
Bufflehead			
Hooded Merganser			
Ruddy Duck			
American Coot	41	41	3
Ring-billed Gull		300	

Sarah Garrett

WATERFOWL SURVEY

Time Out:	823 AM/PM	Beginning Miles:	96	Trip No:	18
Time In:	1145 AM/PM	Ending Miles:	120	Page No:	17
Total Time:	322	Total Miles:	24	Month:	2
Date:	21 February 1998		Recorder: Sarah Garrett		

Water Conditions:	Regional Weather
Clear Creek Lake: SMOOTH SURFACE	Sky Cover
Middlebrook Lake: SMOOTH SURFACE	High Temp. 47°
Steele Creek Lake: SMOOTH SURFACE	Low Temp. 40°
	Precipitation trace
	Ground Cover Saturated
	Wind Direction NW
	Wind Speed 5 mph

Other Participants: Mary Garrett - clear creek lake

Special Notes:

Lake Count			
	Clear Creek	Middlebrook	Steele Creek
Time Out:	823	940	1050
Time In:	920	1035	1145
Common Loon			
Pied-billed Grebe		2	
Double-crested Cormorant			
Great Blue Heron		3	
Mute Swan	1 Domestic White Duck		3 Domestic White Duck
Snow Goose			
Canada Goose	83	8	
Greylag Goose	6	1 Chinese Goose	12
Wood Duck			
Green-winged Teal			
American Black Duck	1		
Mallard		37	1
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon			
Canvasback			
Redhead	1		
Ring-necked Duck			
Lesser Scaup			
Bufflehead	13 Greater Scaup	6 Muscovy	1 Muscovy
Hooded Merganser			
Ruddy Duck			
American Coot	40	30	3
Ring-billed Gull	10	20	

Sarah Garrett

WATERFOWL SURVEY

Time Out:	1026	AM/PM	Beginning Miles:	377	Trip No:	19
Time In:	1252	AM/PM	Ending Miles:	401	Page No:	18
Total Time:	226		Total Miles:	24	Month:	2
Date:	28 February 1998			Recorder: Sarah Garrett		

Water Conditions:	Regional Weather
Clear Creek Lake: SMOOTH SURFACE	Sky Cover: partly cloudy
	High Temp: 65°
Middlebrook Lake: SMOOTH SURFACE	Low Temp: 45°
	Precipitation: —
Steele Creek Lake: SMOOTH SURFACE	Ground Cover: clear
	Wind Direction: —
	Wind Speed: —

Other Participants:

Special Notes:

Lake Count

	Clear Creek	Middlebrook	Steele Creek
Time Out:	1026	1121	1221
Time In:	1106	1206	1252
Common Loon			
Pied-billed Grebe	1	3	
Double-crested Cormorant			
Great Blue Heron		1	
	2 Domestic White Duck	5	
Mute Swan			
Snow Goose			
Canada Goose	23	21	18
Greylag Goose	6		12
Wood Duck			
Green-winged Teal			
American Black Duck			
Mallard		45	26
Northern Pintail		2	
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup			
Muskrat			1
Bufflehead			
Hooded Merganser			
Ruddy Duck			
American Coot	37	22	3
Ring-billed Gull	3	50	

Sarah Garrett

WATERFOWL SURVEY

Time Out:	750	AM/PM	Beginning Miles:	154	Trip No:	20
Time In:	1115	AM/PM	Ending Miles:	177	Page No:	19
Total Time:	253		Total Miles:	23	Month:	3
Date:	7 March 1998			Recorder: Sarah Garrett		

Water Conditions:	Regional Weather
Clear Creek Lake: SMOOTH SURFACE	Sky Cover: cloudy
Middlebrook Lake: RIPPLED SURFACE	High Temp: 63°
Steele Creek Lake: SMOOTH SURFACE	Low Temp: 41°
	Precipitation: .01"
	Ground Cover: clear
	Wind Direction: —
	Wind Speed: —

Other Participants: Roger Garrett - clear creek lake

Special Notes:

Lake Count

	Clear Creek	Middlebrook	Steele Creek
Time Out:	750	908	1015
Time In:	853	958	1115
Common Loon			
Pied-billed Grebe		1	
Double-crested Cormorant			
Great Blue Heron			
Mute Swan	2 Domestic White Duck	2 Black-crowned Night-Heron	
Snow Goose			
Canada Goose	1	9	10
Grey lag goose	6		12
Wood Duck			
Green-winged Teal			
American Black Duck			
Mallard		33	38
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall			
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup			
Muscovy		6	1
Bufflehead			
Hooded Merganser			
Ruddy Duck			
American Coot	23	23	3
Ring-billed Gull	1	150	

Sarah Garrett

WATERFOWL SURVEY

Time Out:	816	AM/PM	Beginning Miles:	395	Trip No:	21
Time In:	1156	AM/PM	Ending Miles:	416	Page No:	20
Total Time:	342		Total Miles:	21	Month:	3
Date:	14 March 1998			Recorder:	Sarah Garrett	

Water Conditions:	Regional Weather
Clear Creek Lake: SMOOTH SURFACE	Sky Cover: cloudy
Middlebrook Lake: RIPPLED SURFACE	High Temp: 57°
Steele Creek Lake: SMOOTH SURFACE	Low Temp: 22°
	Precipitation: —
	Ground Cover: frozen
	Wind Direction: W
	Wind Speed: 15-25 mph

Other Participants:	Mary Garrett - clear creek lake
Special Notes:	

Lake Count			
	Clear Creek	Middlebrook	Steele Creek
Time Out:	816	1005	1056
Time In:	941	1048	1156
Common Loon			
Pied-billed Grebe		3	
Double-crested Cormorant			
Great Blue Heron		1	
Mute Swan	2 Domestic White Duck	5	
Snow Goose			
Canada Goose	20	15	10
Green-winged Teal	6		12
American Black Duck			
Mallard	9	20	22
Northern Pintail			
Blue-winged Teal			
Northern Shoveler			
Gadwall		6	
American Wigeon			
Canvasback			
Redhead			
Ring-necked Duck			
Lesser Scaup			
Muscovy			1
Bufflehead			
Hooded Merganser			
Ruddy Duck		10	
American Coot	20	19	3
Ring-billed Gull	6	100	

Appendix C
Waterfowl Analysis

Common Loon

Gavia immer

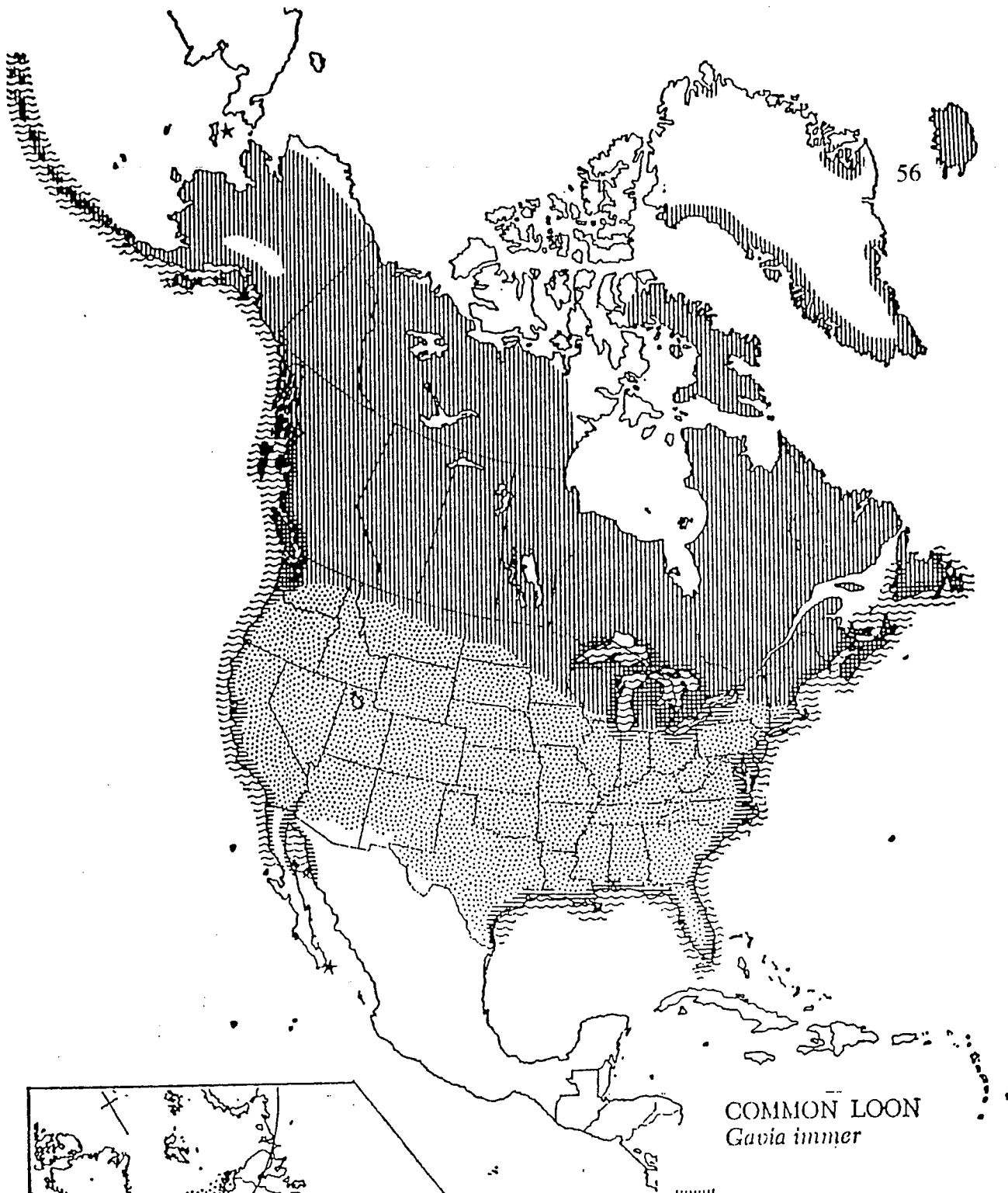
Arrival/Departure Date In Region: Winter resident (Knight 1994)

Habitat: Primarily marine, frequently coastal waters, bays, and large fresh water lakes near coast (Palmer 1962).






Winter Food: 80% of their diet is made up of fish, crustaceans, mollusks, and insects. The other 20% is aquatic plants (Palmer 1962).

Flocking Behavior: Flight swift, powerful, direct, single or in group of 2-15 (Palmer 1962).

Plumage: Sexes similar in appearance. Forehead, crown, and back of neck are dark brown, while the chin, throat, and foreneck are white with dark brown tips. The bill is brownish gray. Upper parts are dark brown, each feather margined with smoke gray (except scapulars which have light subterminal bands). Sides of upper breast are white with brown centers (looked streaked). The rest of innerparts are white with brown bands. Under tail feathers are brown with white tips. Legs and feet are black on the outer parts and gray on the inner. Wings are narrow and pointed (Palmer 1962).



COMMON LOON
Gavia immer

-  Breeding
-  } Winter
-  Breeding and winter
-  Migration
-  ★ Straggler

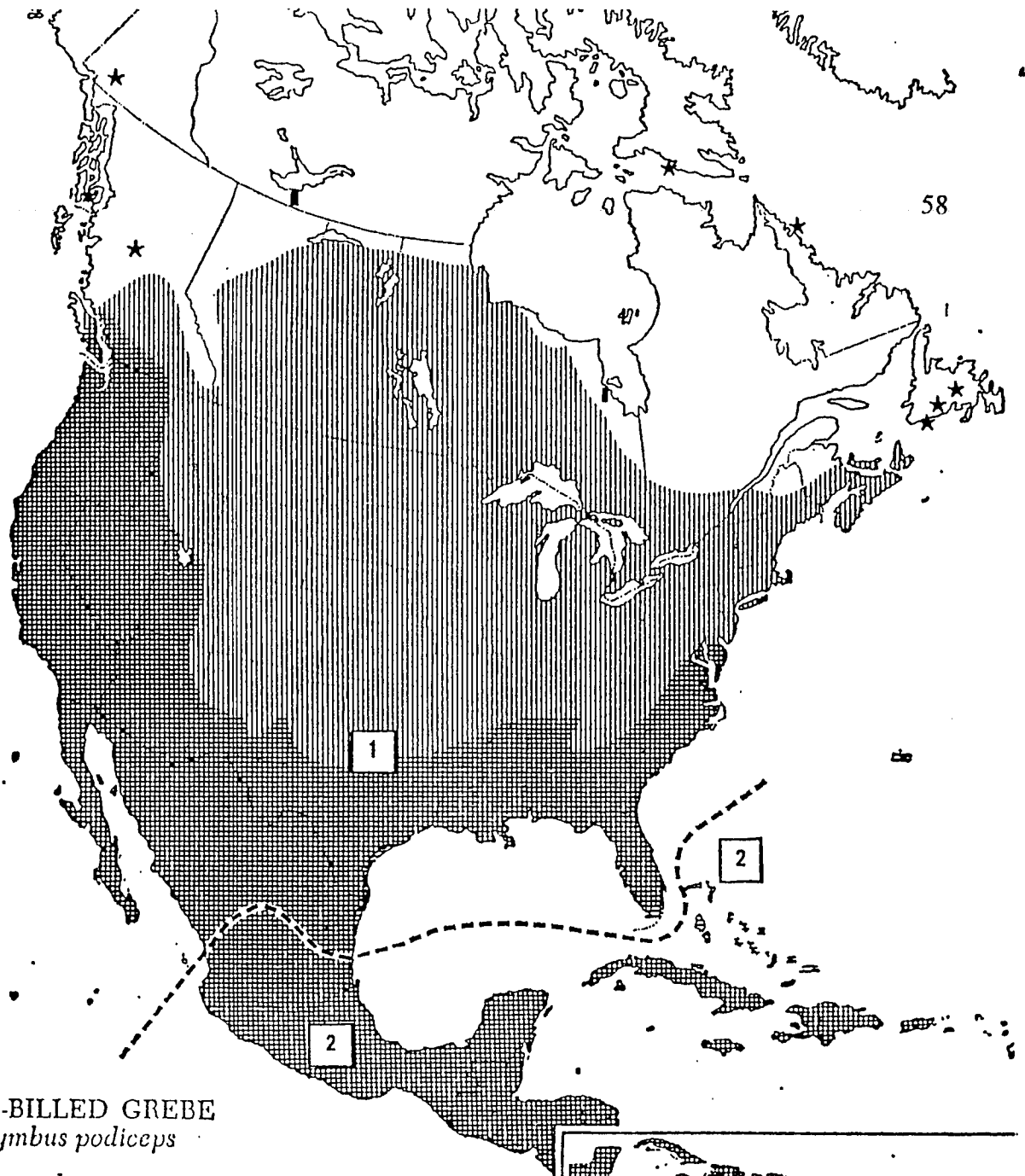
Pied-billed Grebe
Podilymbus podiceps

Arrival/Departure Date In Region: Winter resident (Knight 1994)

Habitat: Ponds, lakes, marshes; in winter -- salt bays (Peterson 1980).

Winter Food: Animal matter (24.2% fish, 27% crayfish, 4.1% crustaceans, 46.3% insects) (Palmer 1962)


Plumage: Head crown is brownish black, throat is whitish with traces of black, bill ("chicken bill") is yellowish with a dark ring. Neck, breast, and flanks are reddish tawny, stern is puffy white, and wings are dusky brownish. In winter the throat path is more brown and there is no ring (Palmer 1962).





PIED-BILLED GREBE
Podilymbus podiceps


1 *p. podiceps*


2 Other subspecies (2)


 Breeding

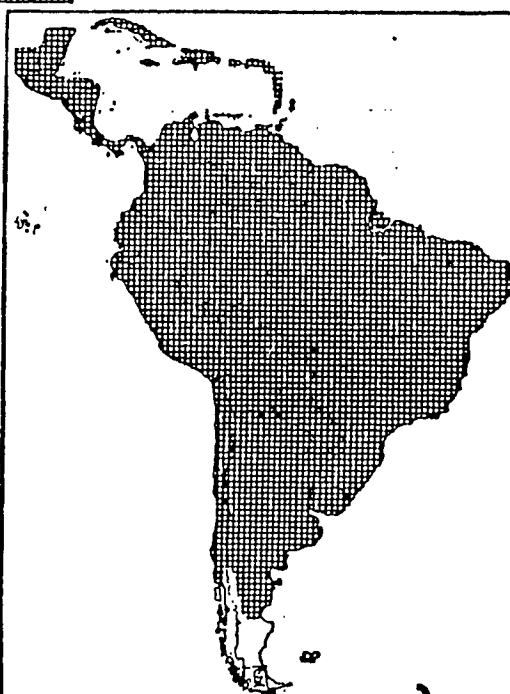
 Breeding and winter

 Winters

 Casual breeding record

 Straggler

 Approximate boundary of subspecies' breeding range



(Palmer 1962)

Great Blue Heron

Ardea herodias

Arrival/Departure Date In Region: Winter resident (Knight 1994)

Habitat: Shallow waters and shores of lakes, ponds, marshes, streams, bays and oceans (Palmer 1962).

Winter Food: Diet is made of 71.55% fish, 8.15% insect, 8.91% crustaceans, 4.25% amphibians / reptiles, 4.66% shrew, 2.48% Miscellaneous (Palmer 1962).

Flocking Behavior: Fight is slow and deliberate. Head down and feet out stretched. Glides through air at times. More active at dawn and toward dusk (Palmer 1962).

Plumage: Largest of all heron. Bluish gray body with white head, cinnamon on neck, and black legs. Forehead and crown are white and lower neck has long / tapering plumelike feathers. Shoulder patch of black and the tail is slate gray (Palmer 1962).

GREAT BLUE HERON

Ardea herodias

60

4

5

3

1

1

3

2

6

6

1 *A. h. herodias*

2 *A. h. wardi*

3 *A. h. treganzai*

4 *A. h. fannini*

5 *A. h. hyperonca*

6 Extralimital subspecies (several)

Breeding

Breeding and winter

Winter

Postbreeding dispersal (may breed locally)

★ Straggler

--- Approximate boundary of subspecies' breeding range

(Palmer 1962)

Mute Swan
Cygnus olor

Population Number: 4,000 in United States (Bellrose 1976)

Arrival/Departure Date In Region: 28 December - 20 March (Knight 1994)
Most are believed to have been introduced in the area.

Habitat: Ponds, fresh and salt water, coastal lagoons and salt bays (Peterson 1980).

Winter Food: Aquatic plants (grasses, leaves, seeds), algae, snails, worms, tadpoles, frogs, larvae, and small fish (Palmer 1976).

Flocking Behavior: Motion of wings produces unique whistle sound (Palmer 1976).

Plumage: Both sexes have white plumage, long necks (held in S-curve) with orange bill pointed downward. Bill has a black base that extends to a fleshy knob at forehead (Bellrose 1976).

Juvenile Plumage: Grayish brown head, neck, and back. Whitish belly and gray bill and feet. Third year resemble adult traits (Bellrose 1976).

Canada Goose
Branta canadensis

Population Number: 3 million (per hunting season in US); increase in last 3 decades; mid winter 1973 130,000 in Tennessee Valley (Bellrose 1976).

Arrival/Departure Date In Region: Permanent resident (Knight 1994)

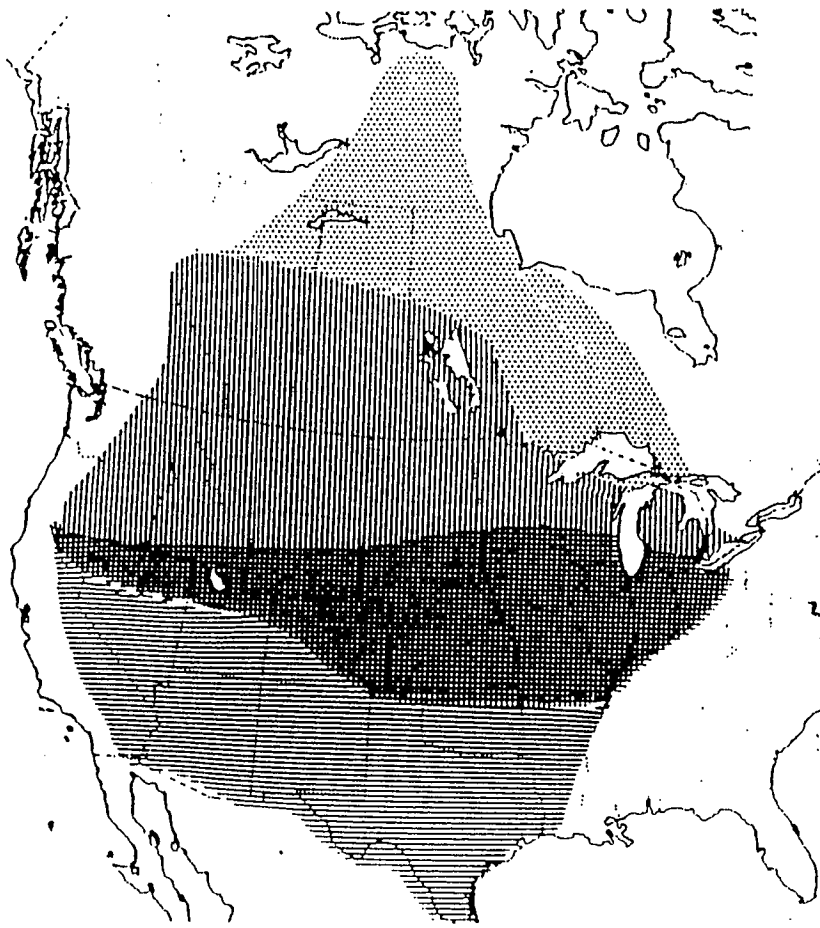
Habitat: Lakes, ponds, bays, marshes, and fields (Peterson 1980).





Winter Food: Grasses, aquatic plants, seeds, insects, crustaceans, mollusks (take advantage of feed, grain, and cereal fields) (Palmer 1976).

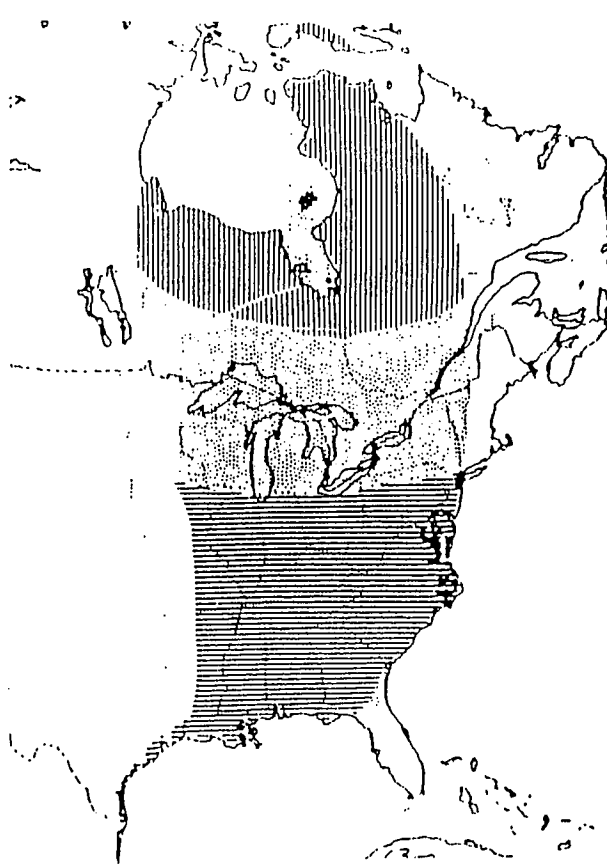
Flocking Behavior: Fly in V formation in trailing lines distinguishing family groups (Bellrose 1976).

Plumage: Black bill / legs / feet, along with black head and neck. White check patch (usually covers throat), gray-brown to dark brown back and wings, and gray to bark brown sides / breast. All sex and age groups are alike (Bellrose 1976).




GIANT CANADA GOOSE *Branta canadensis moffitti*



-  Molt migration beyond breeding range
-  Probable natural breeding range
-  Probable natural breeding range
-  Probable natural winter range



INTERIOR CANADA GOOSE *Branta canadensis interior*

-  Breeds (approximate overall natural range)
-  Occurs in migrations
-  Winter (approximate overall recorded occurrence)

(Palmer 1976)

Wood Duck

Aix sponsa

Population Number: 1,694,000 (in 1966 the population estimate of adults after breeding season) (Bellrose 1976)

Arrival/Departure Date In Region: Permanent resident (Knight 1994)

Habitat: Sheltered water (swamps, ponds and marshes) (Palmer 1975)

Winter Food: Early in life ducklings feed almost entirely on animal life. Then changes to plant food as they grow older (90.2% vegetation -- 9.8% animal matter) (Palmer 1975).

Flocking Behavior: Occur in pairs or in flocks of 4-15. (hundreds may gather at fall/winter roost sites) Moderately swift (Bellrose 1976).

Drake Plumage: Crest is green in front, purplish in rear, and burgundy behind each eye. Sides of head are purple / blue-green / bronze. Eye is red, bill is short with black tip, white sides, and yellow line border. Sides of male are bronze. There is a white border along the green / purple / bronze rump and back. Dark burgundy flanks and feet / legs are dull straw-yellow (Bellrose 1976).

Hen Plumage: Brown crest, glossed with green. Bill is dark blue-green, eyes are brown-black, back is olive-brown with green, and belly / undertail are white. Juveniles resemble females (Bellrose 1976).

NORTH AMERICAN
WOOD DUCK

Aix sponsa

65



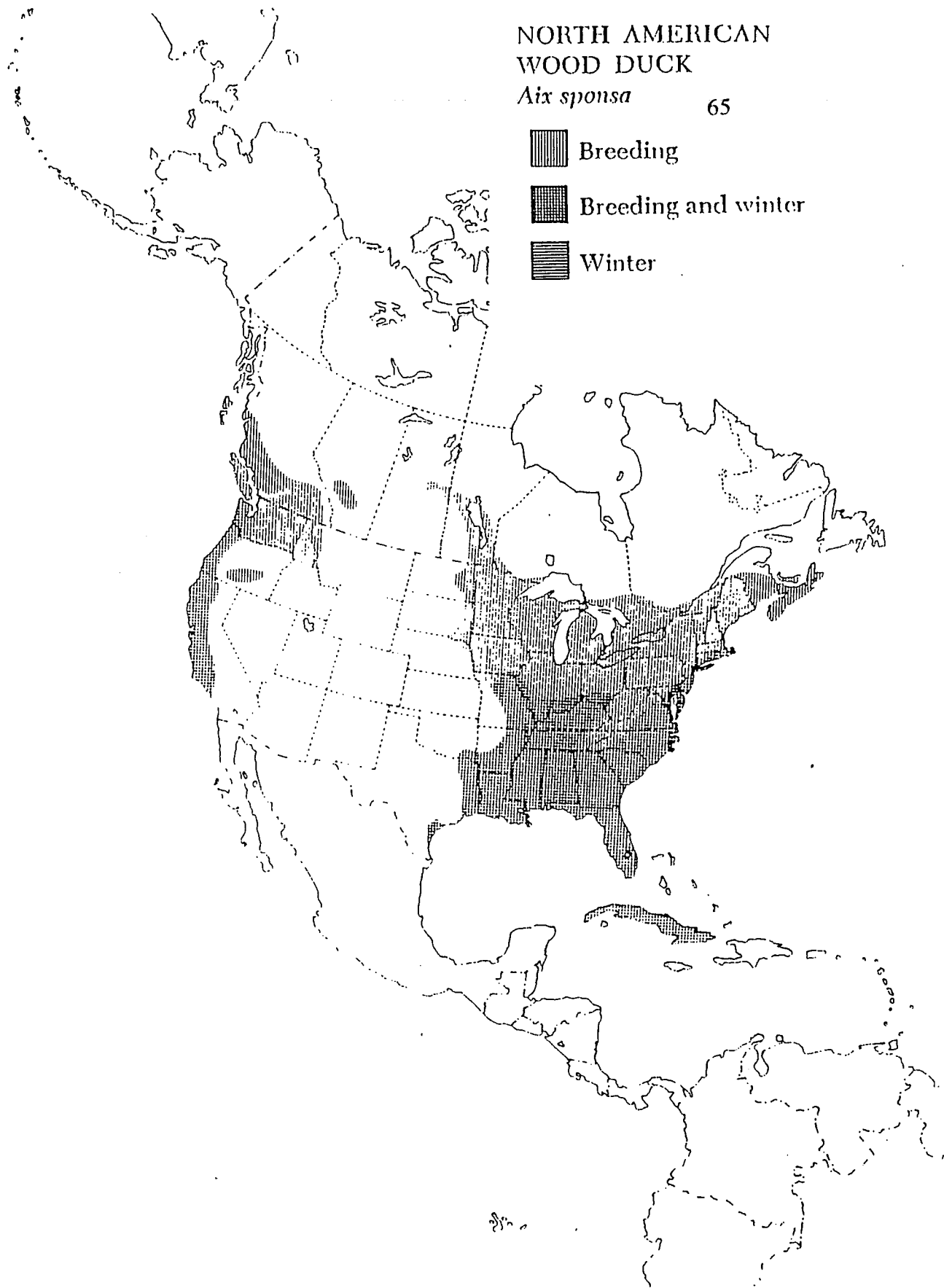
Breeding



Breeding and winter



Winter



(Palmer 1975)

Green-winged Teal

Anas crecca

Arrival/Departure Date In Region: Winter resident (Knight 1994)

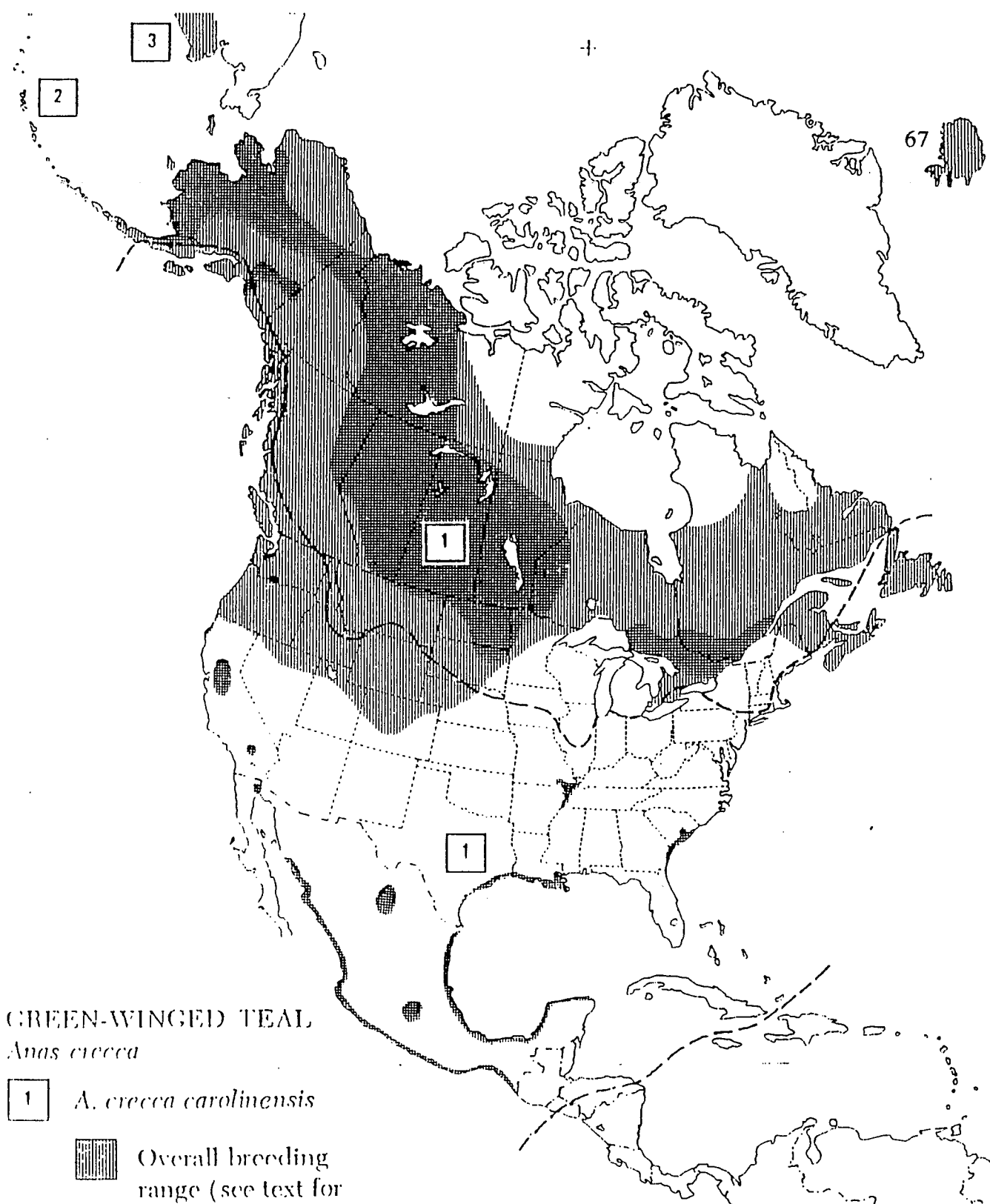
Habitat: Brackish tidal marshes, creeks, estuarine areas, shallow fresh waters inland, and rice fields (Palmer 1976).

Food: Vegetable makes up 90.67% of their diet. This includes pondweeds, Wigeon grass, eelgrass, algae, bulrushes, and yellow foxtail. 9.33% of their diet is animal matter. Including larvae of sorts, flies, beetles, mollusk, crustaceans, and spiders (Palmer 1976).

Flocking Behavior: Taking flight, birds form in compact bunches which may twist and turn. Over a hundred consist in a flock (Bellrose 1976).

Drake Plumage: Chestnut head with large green area on both sides. No white shows in scapulas, broad white transverse bar or crest on side in front wing. There is a cream-colored patch, bordered black at side base of tail. White belly, green speculum, bill is nearly black (Palmer 1976).

Hen plumage: Gray plumage, upper bill is greenish / grayish blotched with darker colors. At very edges and the tip, the bill is black. Tail feathers are slender, pointed, dusky, with light edging. Legs and feet are gray and belly is white (Palmer 1976).



GREEN-WINGED TEAL *Anas crecca*

1 *A. crecca carolinensis*

Overall breeding range (see text for scattered more southerly breeding)

Principal breeding areas within overall breeding range

Approximate limits of wintering

Abundant in winter

2 *A. crecca nimia*
3 *A. crecca crecca* } See text

[*Anas crecca* has a large range across Eurasia]

American Black Duck

Anas rubripes

Population Number: Winter population, plus kill for proceeding fall, 1,311,000 during 1952-54 (Bellrose 1976)

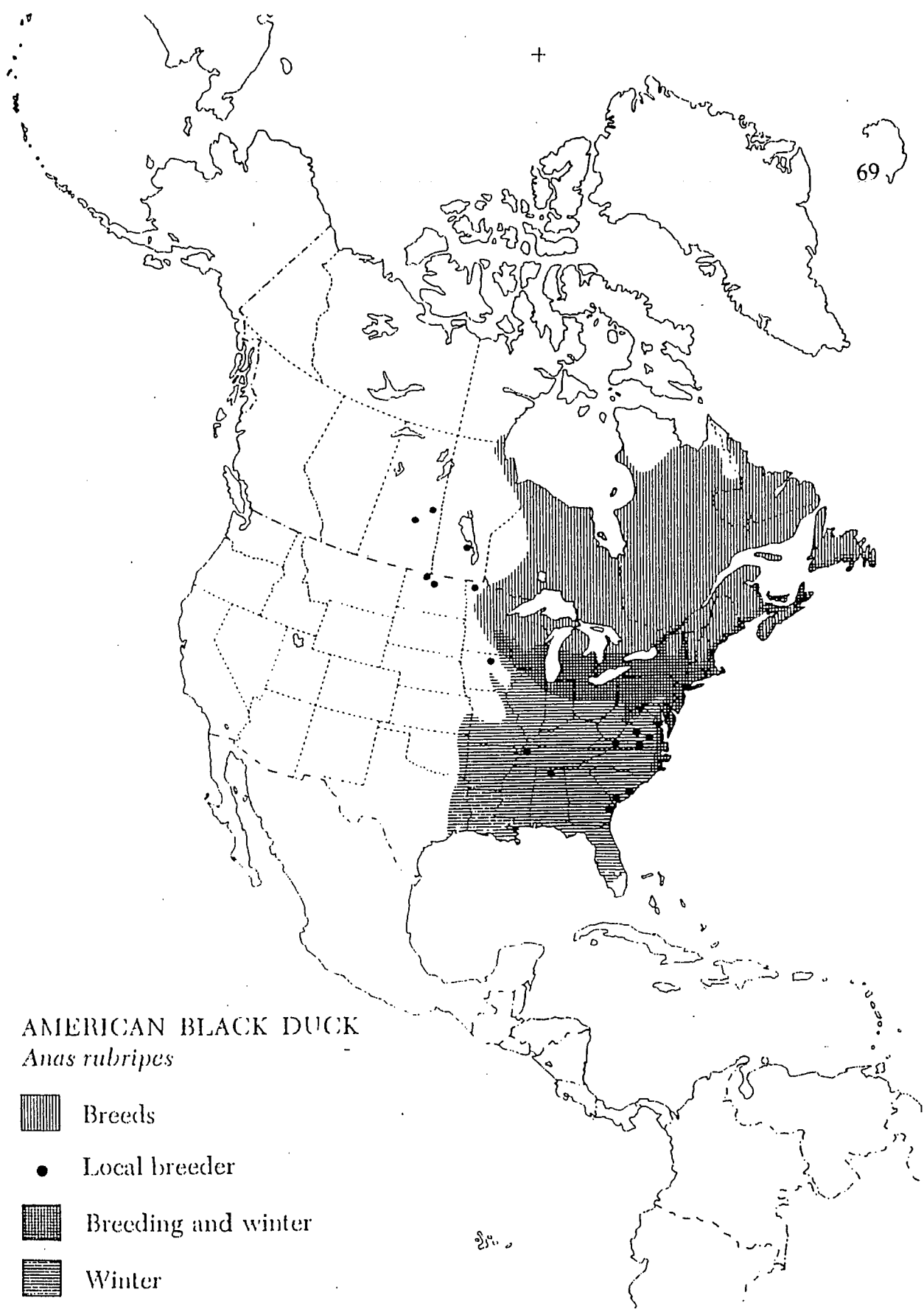
Arrival/Departure Date In Region: 25 August - 18 May (Knight 1994)

Habitat: Atlantic coast and larger river valleys with open water. Prefer freedom from disturbance (Palmer 1976).

Winter Food: Variety of seeds and grains, some leafy and fibrous materials in moderate amounts, a few tubers, nuts and fruits (Palmer 1976).

Flocking Behavior: Flocks number from 5-25 individuals. Can be observed frequently in flocks of mallards (Bellrose 1976).

Plumage: Similar sexes. Sooty-brown plumage of both sexes is darker than the mottled straw-brown plumage of the hen. Their speculum is also darker blue and bordered by black. Drakes have yellow bills and coral legs. Hens have olive-green bills with black centers and their legs are dull carmine. Immature have plain olive-green bills and yellowish-coral legs (Bellrose 1976).



(Palmer 1975)

Mallard
Anas platyrhynchos

Population Number: 8,700,000 (average 20 year population) (Bellrose 1976)

Arrival/Departure Date In Region: Permanent resident (Knight 1994)

Habitat: Marshes, wooded swamps, ponds, rivers, lakes, and bays (Palmer 1976).

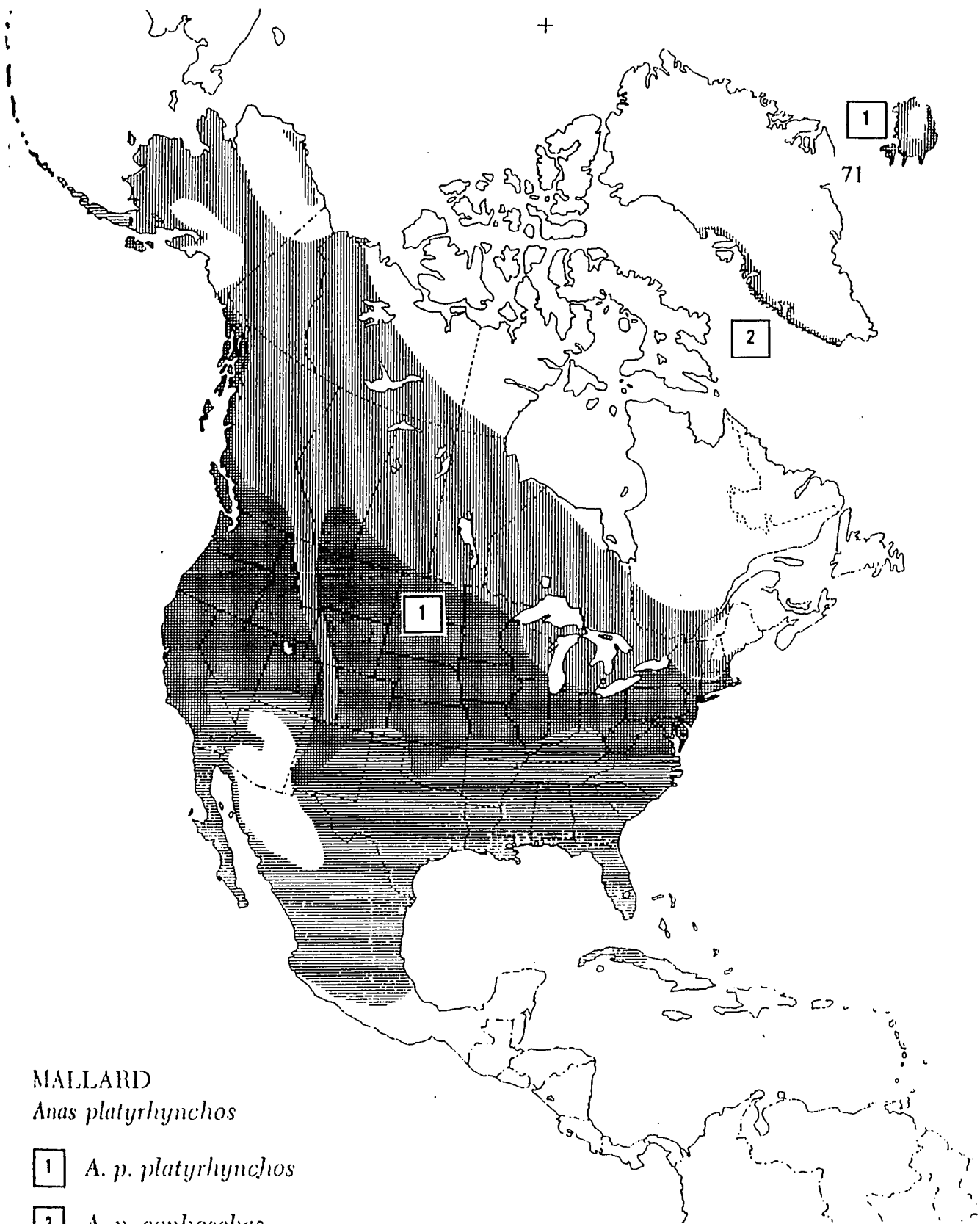
Winter Food: Highly adaptable to use of food (90% diet consist of vegetation and 10% of animal matter) (Palmer 1976).

Flocking Behavior: Fly in V shapes with 40-60 members (Bellrose 1976).

Drake Plumage: The male bill is yellowish-green and has coral red feet. Head is green, white neck-ring, brown chest, violet-blue speculum, white outer tail feathers, brownish rump and gray sides (Bellrose 1976).

Hen Plumage: The female bill is orange splotched with black and has orange feet. Crown is dark brown with dark brown stripe through eye (remainder of head is lighter brown). In flight a white bar is visible on either side of the blue speculum (Bellrose 1976).

Other: Local breeding began in mid-late 1960's -- widespread today. Began with a flock of 8 pairs nesting at Steele Creek Lake 1970 (Knight 1994).



MALLARD
Anas platyrhynchos

1 *A. p. platyrhynchos*

2 *A. p. conboschas*



Breeds



Breeding and winter



Winter

[The Mallard is not recorded from South America; it ranges widely in Eurasia and part of Africa]

(Palmer 1976)

Northern Pintail

Anas acuta

Population Number: 6,193,000 (1955-1977) Average number on major breeding grounds (in North America). Second and third most abundant in North America (Bellrose 1976).

Arrival/Departure Date in Region: 7 September - 10 April (Knight 1994)

Habitat: Marshes, fresh ponds, lakes, salt bays, sheltered areas. They prefer to feed in very shallow water, rarely do they submerge entirely, and they also prefer to rest on fairly exposed places (Palmer 1976).

Winter Food: Vegetative parts of pondweeds, fly to rain, flooded rice, and corn fields to feed, and 87.15% of their diet consists of vegetation. Animal matter makes up 12.85% of their diets (Palmer 1976).




Flocking Behavior: Flying flocks have a wavy appearance and individuals are closely spaced (Bellrose 1976).

Drake Plumage: During breeding times males have a chocolate brown head, white forehead which extends onto back of head (stripe). Sides / back of neck are gray and they have black / gray tail feathers with a pointed tail. During the winter, they have a brown head, dorsal / sides are gray, scapulars are narrow and taper, and foreneck is white (Bellrose 1976).

Hen Plumage: Mantle feathers have light bar and wide palish edging. Gray bill, pointed tail, slender neck (Bellrose 1976).

NORTHERN PINTAIL

Anas acuta

-  Overall breeding range
(approximate)
-  Breeding and winter
-  Overall winter range
(approximate)

[Total range of the species
also includes Eurasia and
part of Africa]

(Palmer 1976)

Gadwall
Anas strepera

Population Number: 1,432,000 Average annual status (Bellrose 1976)

Arrival/Departure Date In Region: 20 September - 13 May (Knight 1994)

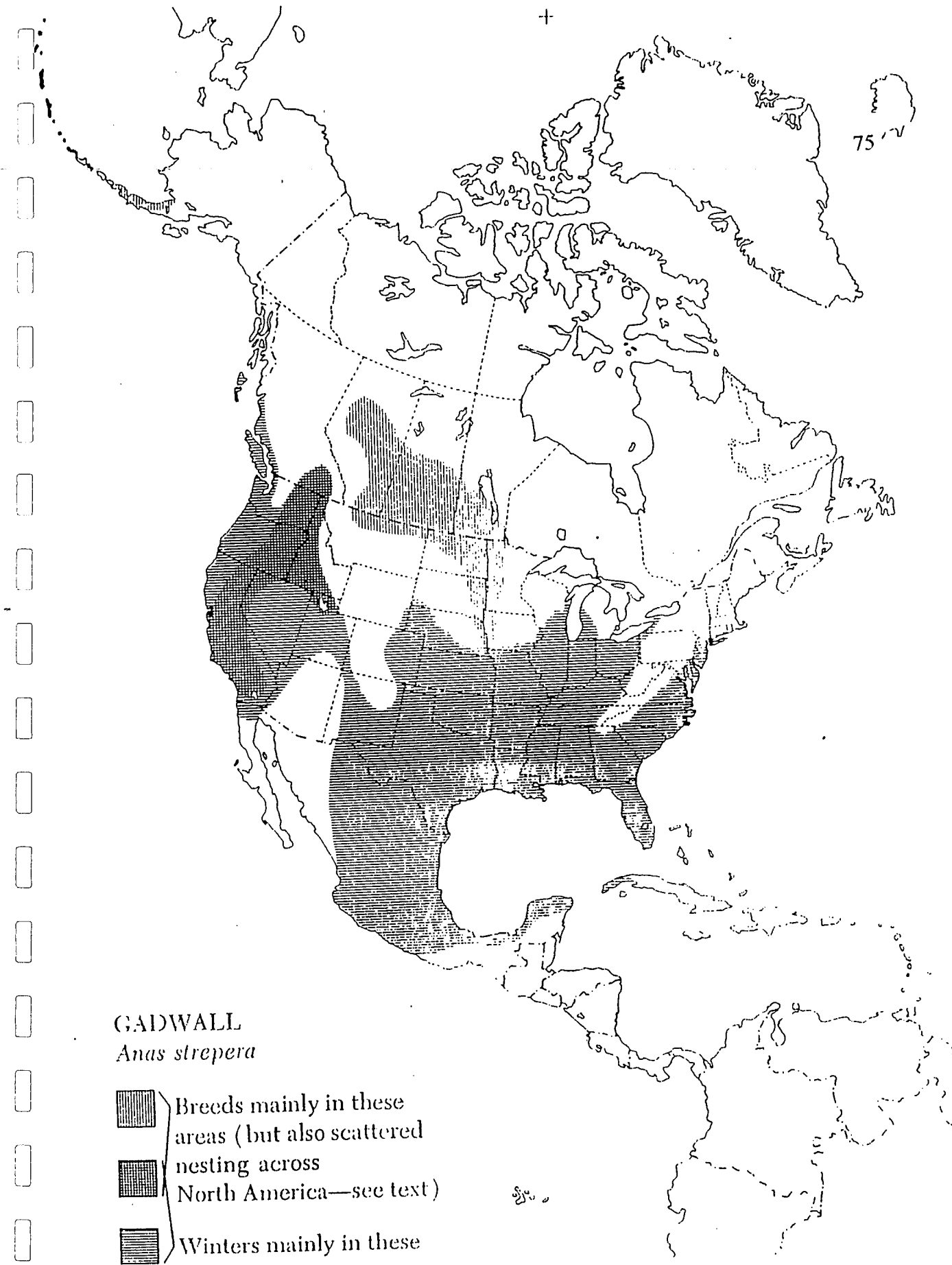
Habitat: In winter, open water with or near food source, lakes with wooded shores are not avoided, and may rest on saltwater bays. Can also be found yearly on lakes ponds, and marshes (Palmer 1976).

Winter Food: 97.85% of diet is made up of vegetation (seeds, leaves) 2.15% of diet is made up of animal matter (Palmer 1976).

Flocking Behavior: Flocks usually smaller than Mallards and Wigeons (Bellrose 1976).

Drake Plumage: Chestnut feathers on shoulders, inner area of speculum has a white pattern and outer portion a black patch, chest / flanks / sides / back are varying shades of gray, bill is narrower to most dabblers, gray with black tip (Bellrose 1976).

Hen Plumage: Dusky brown head / neck / back, gray brown chest / sides / flanks. Bill is narrower to most dabblers, and is dusky yellow with black dots on lower edge (Bellrose 1976).



[The Gadwall's range also includes much of Eurasia]

(Palmer 1976)

American Wigeon

Anas americana

Population Number: 6,500,000 (Fall population in North America) (Bellrose 1976)

Arrival/Departure Date in Region: 15 September - 21 May (Knight 1994)

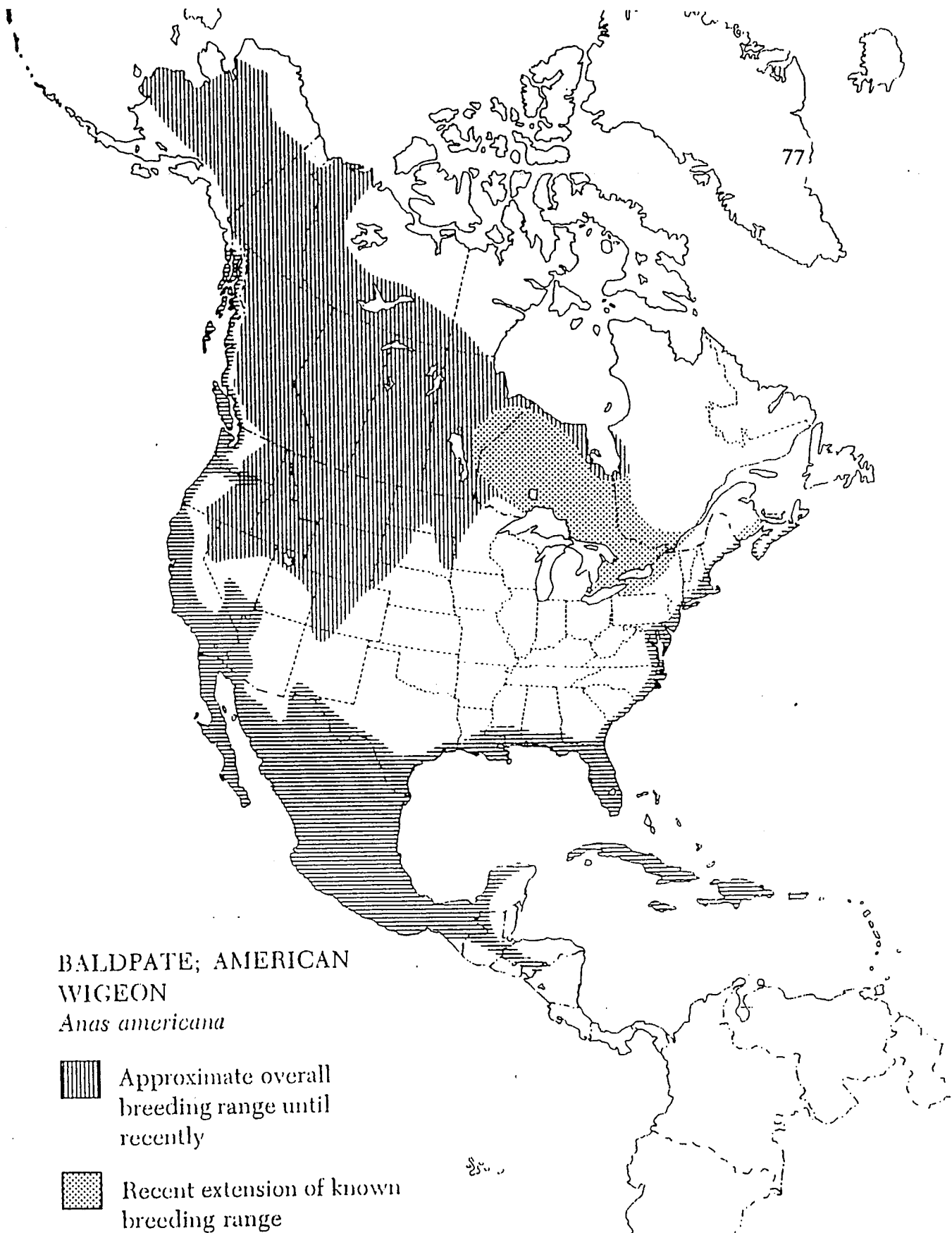
Habitat: Large inland marshes, sheltered bays, while a few winter on lakes and rivers (Palmer 1976).

Winter Food: Because they are dabbling ducks, Wigeons feed on the stems and leafy parts of aquatic plants (makes up around 93% of diet). However, mollusks and insects make up 7%. Wigeons feeding in bays feed on inland fields (Palmer 1976).

Flocking Behavior: Small, compact flocks - which fly rapidly (Bellrose 1976).

Drake Plumage: Forehead and crown are white and sometimes appear with black markings. They have a greenish patch which begins around the eye and tapers to an end at the nape. The neck is white and heavily spotted black. The chin and throat are sometimes black. They have a distinct white rectangular shoulder patch (in flight) which is separated from the speculum by a black stripe. Their legs and feet are a bluish gray. Tail feathers are a medium-darkish gray and the breast / sides / flanks are between a rose and magenta color (Bellrose 1976).

Hen Plumage: The female breast / sides / flanks are a pink like tan. Their belly is tan, while the tail feathers are a dark gray-brown, edged in white. In flight females have a indistinct gray-tinged shoulder patch. Their heads / necks / buff are streaked with black, except for the white crown and green head stripe on an adult (Bellrose 1976).



BALDPATE; AMERICAN
WIGEON

Anas americana



Approximate overall
breeding range until
recently



Recent extension of known
breeding range



Breeding and winter



Overall winter range
(approximate)

(Palmer 1976)

Redhead
Aythya americana

Population Number: From 1955-74 populations on breeding grounds 649,000 (Bellrose 1976)

Arrival/Departure Date In Region: 2 September - 1 May (Knight 1994)

Habitat: Texas and Mexico 78% winter, Chesapeake Bay 9%, Florida 5%, Pacific Coast of Mexico 2%, and the last areas make up less than 1% of wintering waters (Palmer 1975).


Winter Food: 90% of diet is vegetable and 10% is animal matter (Palmer 1975).

Flocking Behavior: Occur as singles, pairs, or in flocks of 5-15. Flights form tight, wedge-shaped flocks (Bellrose 1976).


Drake Plumage: Round chestnut-red head and upper neck. It's lower neck and chest, gray back forms by dense dusky gray vermiculations. White belly, black tail. Bill is long, gray-blue, tipped with black. Feet are slate gray, eyes are yellow (Bellrose 1976).

Hen Plumage: Round head that is tawny-brown, side of head is lighter brown. The chin and belly are white (Bellrose 1976).

REDHEAD
Aythya americana

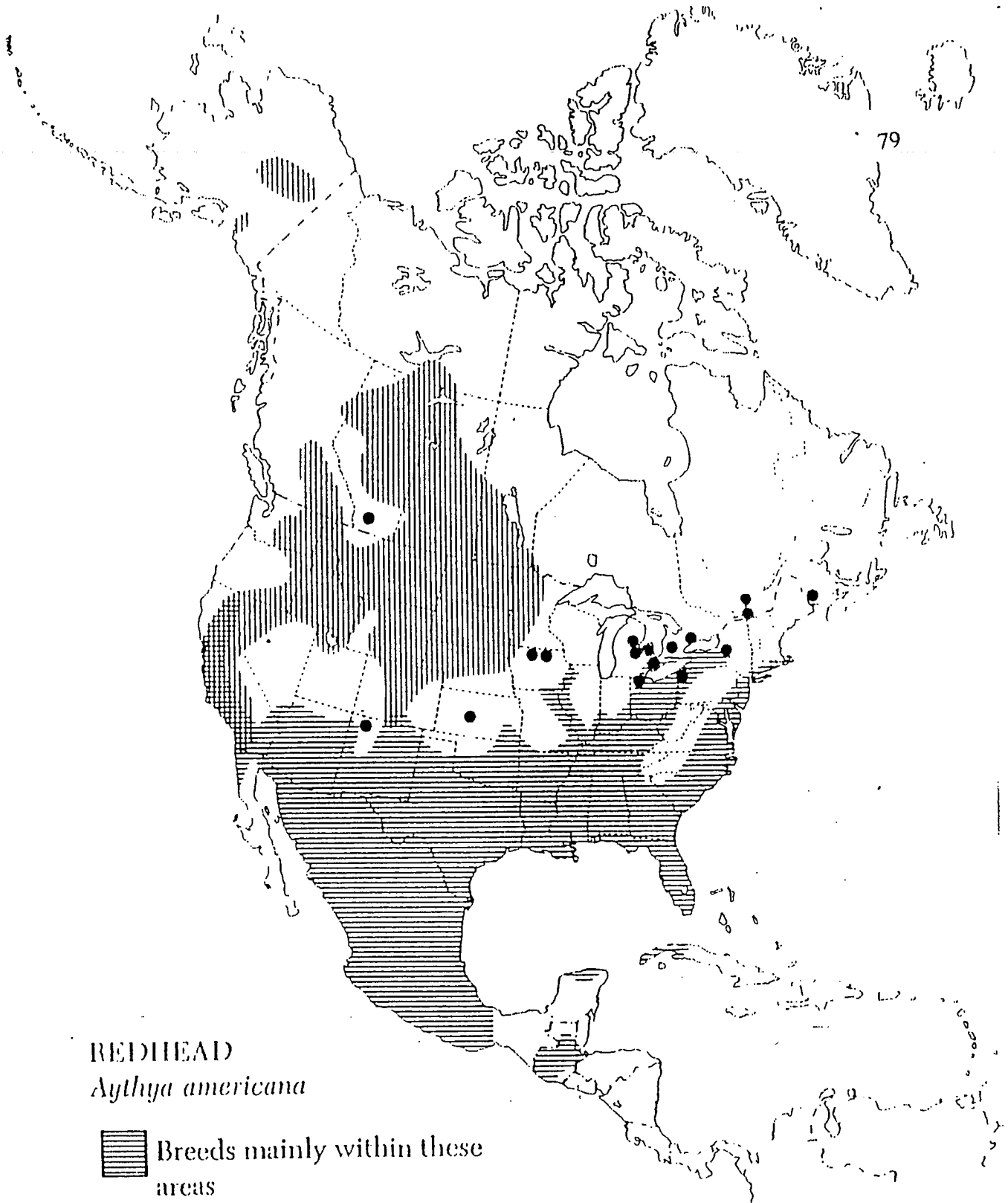
 Breeds mainly within these areas

• Breeds or has bred

 Breeding and winter

 Winter

(Palmer 1975)



Ring-necked Duck

Aythya collaris

Population Number: 460,000 (principal breeding grounds) (Bellrose 1976)

Arrival/Departure Date In Area: Fairly common in fall winter and spring (rare in summer) (Knight 1976)

Habitat: Wooded lakes, ponds; while they winter on rivers and bays (Palmer 1975).


Winter Food: Because they are diving ducks, Ring-necked Ducks eat pond weeds, seeds of water shield, coon tail, sedges, and other vegetation making up 81.5% of their diet. Invertebrate animal matter makes up 18.5% of their diet (Palmer 1975).

Flocking Behavior: Fly as small flocks in open formation (Bellrose 1976).

Drake Plumage: White bar separates its black bill tip from the gray-blue upper part of the bill. Golden eyes and feet / legs are a gray-blue color. Males have a vertical white mark before wing. In flight a broad gray wing stripe is visible (Bellrose 1976).

Hen Plumage: Same white bar separating black tip, from upper part of bill. The female has an indistinct light face patch and a whitish eye-ring with a dark eye. The feet and legs are gray-blue (Bellrose 1976).

RING-NECKED DUCK
Aythya collaris

 Current main breeding range (approximate)

• Breeds or has bred
(see text)

 Winter

(Palmer 1975)

Lesser Scaup

Aythya affinis

Population Number: 6,900,000 breeding population of Greater Scaup and Lesser Scaup (Bellrose 1976)

Arrival/Departure Date in Region: Winter resident (Knight 1994)

Habitat: Sheltered bays, estuarine waters, flooded coastal marches, and unfrozen fresh water near coasts (Palmer 1975).

Winter Food: Diving duck which diet consist of 60% seeds and aquatic plants and 40% animal matter (Palmer 1975).

Flocking Behavior: Fly in compact flights of 25-50 birds (Bellrose 1976).

Drake Plumage: Black head has a purple appearance. Back feathers are a light gray with broad , heavy vermiculations of sooty black. Sides and flanks are olive-brown and not as broad as those on the back. White breast and upper belly, lower belly is sooty black shading to a deeper black. Bill is blue-gray with a black nail (Bellrose 1976).

Hen Plumage: Head, neck and chest are brown. Back and rump are dark brown. Has a white oval facial patch, which by fall may be indistinct. Bill is blue-gray (Bellrose 1976).

LESSER SCAUP
Aythya affinis



Breeds mainly within this area

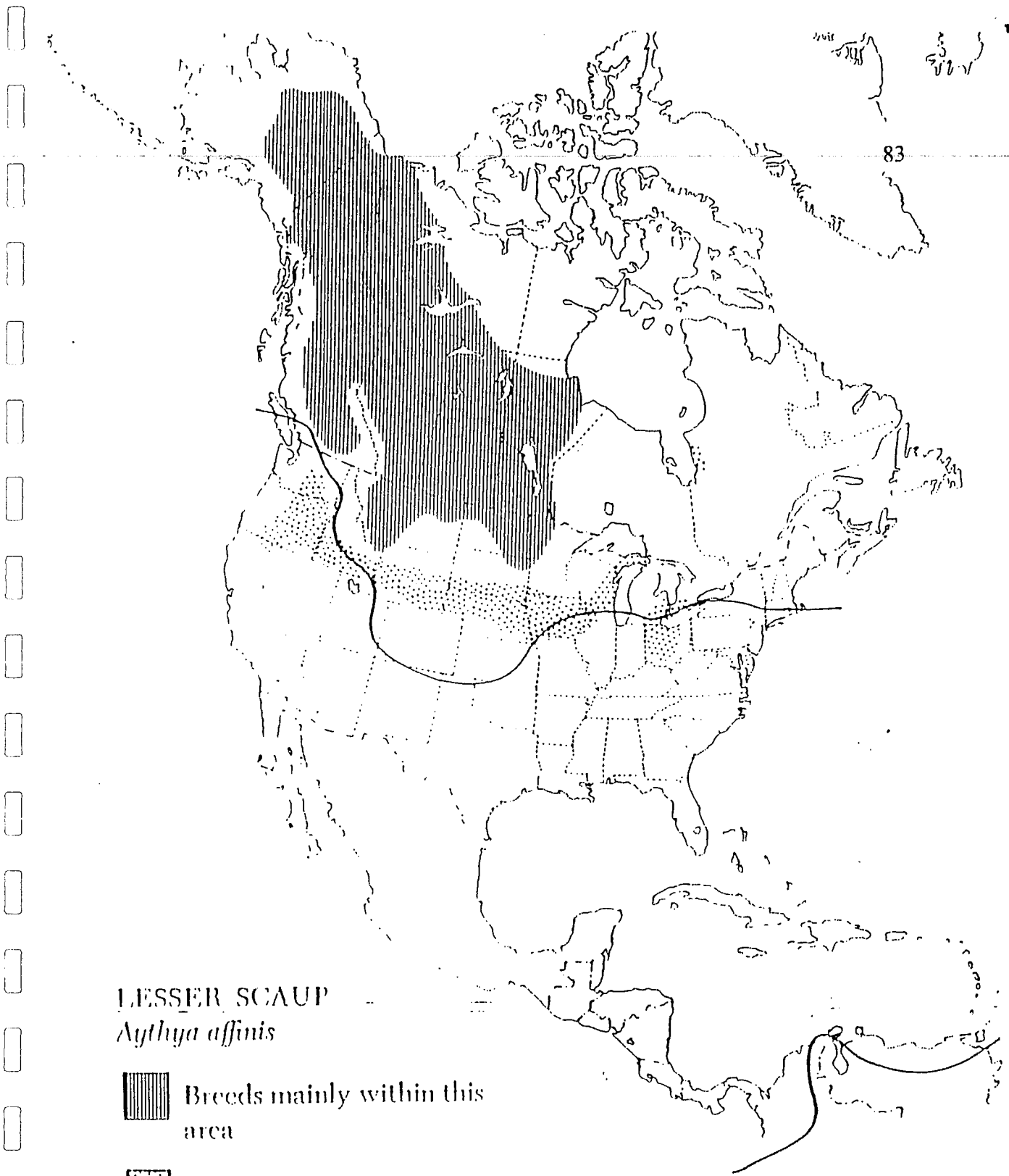


Breeds or has bred at scattered localities within these areas



Upper and lower limits of wintering

(Palmer 1975)



Greater Scaup

Aythya marila

Population Number: In 1957-73 there were 515,000 in Alaska Breeding Grounds (Bellrose 1976).

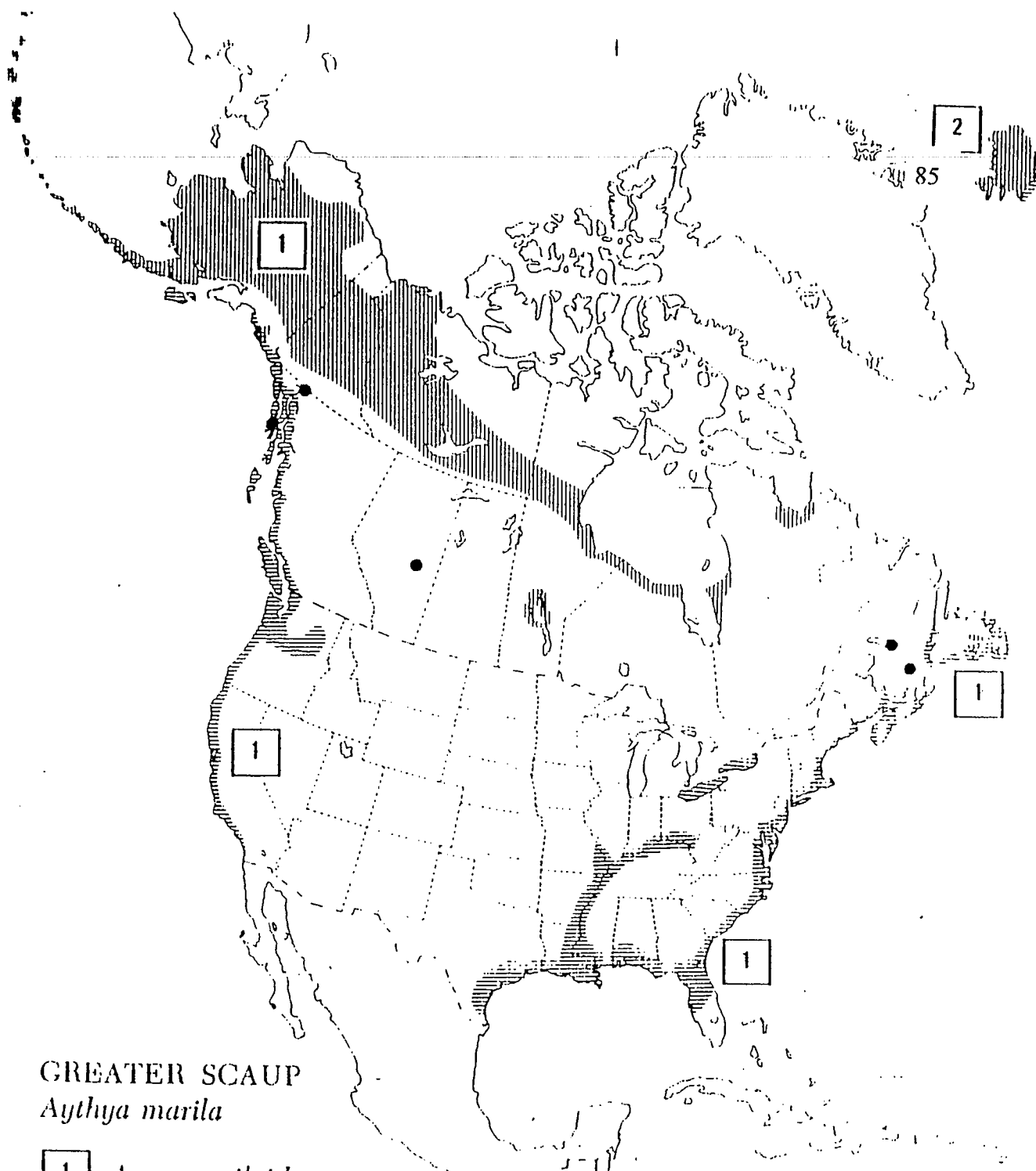
Arrival/Departure Date In Region: 18 October - May 1 (Knight 1994)

Habitat: Salt and brackish coastal bays, estuaries, and less sheltered places (normally along Atlantic coast) (Palmer 1975).

Winter Food: Vegetable material makes 46.5% of diet and animal matter 53.5% (Palmer 1975).

Drake Plumage: Side/flank feathers are whiter during fall than Lesser and larger size and weight is apparent. Black heads, necks and chests separated by gray backs from the black rumps and tails (Bellrose 1976).

Hen Plumage: The same, except, have brown heads with single white oval patches around bill (Bellrose 1976).



GREATER SCAUP
Aythya marila

1 *A. m. mariloides*

2 *A. m. marila*

Breeds in these areas
(but mainly in Alaska)

• Breeding record

Breeding and winter

Winter

[The species is widely
distributed in the Palearctic
region.]

(Palmer 1975)

Bufflehead
Bucephala albeola

Population Number: On breeding ground numbers 500,000 in 1960-1964 (Bellrose 1976).

Arrival/Departure Date In Region: Winter resident (Knight 1994)

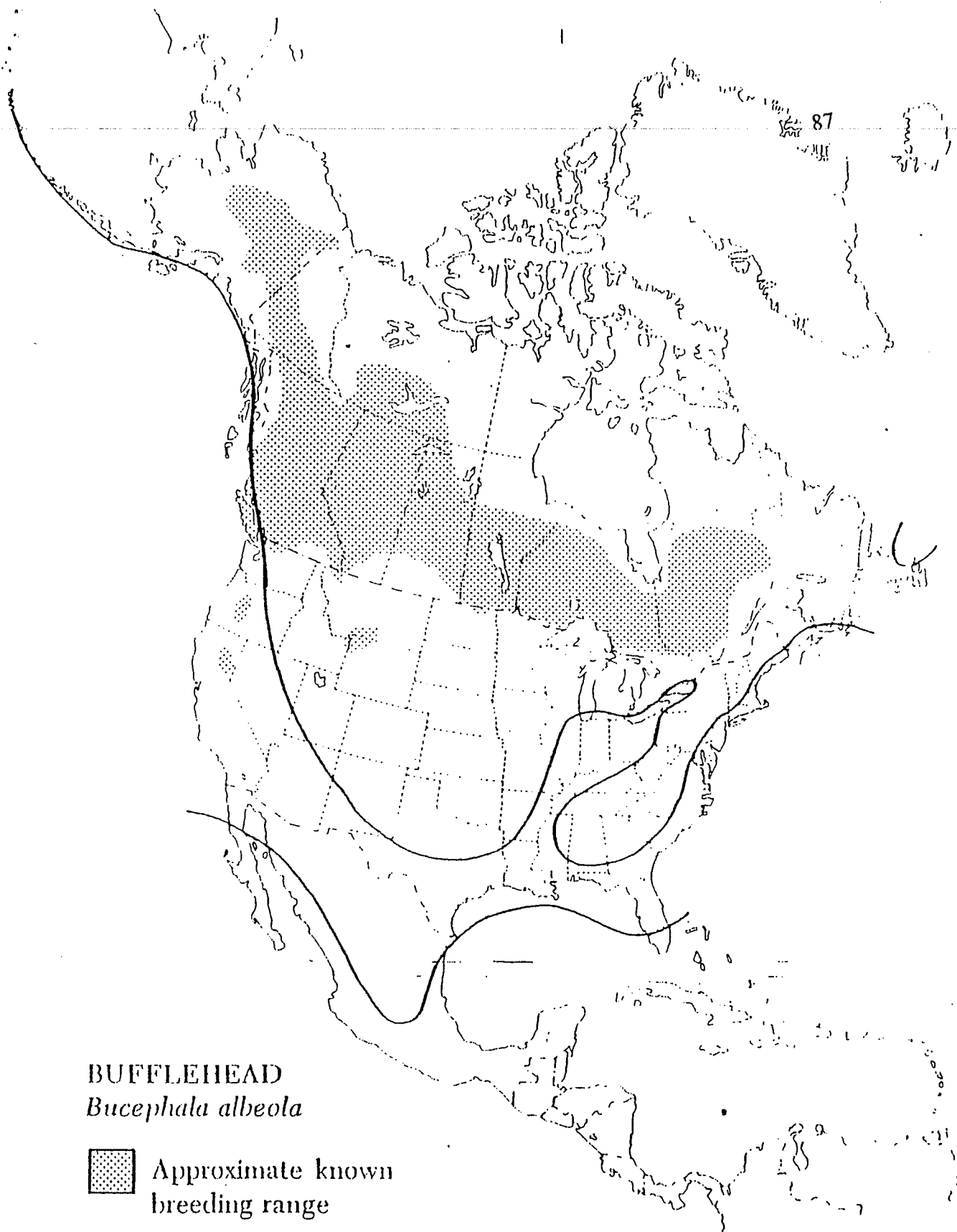
Habitat: Sheltered salt water, some brackish water, freshwater. Spend time distant from shore (shelters not necessary) (Palmer 1976).

Winter Food: Primarily small animals (70%-90%). Feed on more crustaceans in sea and insects in fresh water (Palmer 1976).


Flocking Behavior: Appear as pairs and trios. They are less common in flocks of 5-10 and rarely in large flocks. They are among the fastest flying (Bellrose 1976).


Drake Plumage: Single broad white band across wings (visible in flight) and contrast with dark outer wings. It's puffy head has a wedged shaped crown of white and hues of purple and green. Feet are pink flesh color and bill is blue-gray (Bellrose 1976).

Hen Plumage: White specula contrast with dark outer wings. White almond shape behind eye and the rest of the body is gray-black. Both it's bill and feet are blue-gray (Bellrose 1976).



BUFFLEHEAD
Bucephala albeola

 Approximate known
breeding range

 Approximate limits of
winter occurrence

(Palmer 1975)

Hooded Merganser

Lophodytes cucullatus

Population Number: 76,000 pre-breeding population -- 878,000 breeding population of common and red breasted mergansers (Bellrose 1976)

Arrival/Departure Date In Region: 30 September - 3 May (Knight 1994)

Habitat: Prefer wooded streams, ponds, lakes, and rivers (Bellrose 1976).




Winter Food: Divers who consume 96% animal and 4% vegetation (Palmer 1975).

Flocking Behavior: Usually found as singles, pairs, and in flocks of 5-10 individuals. Thin in flight, head low. bill directed forward (Bellrose 1976).

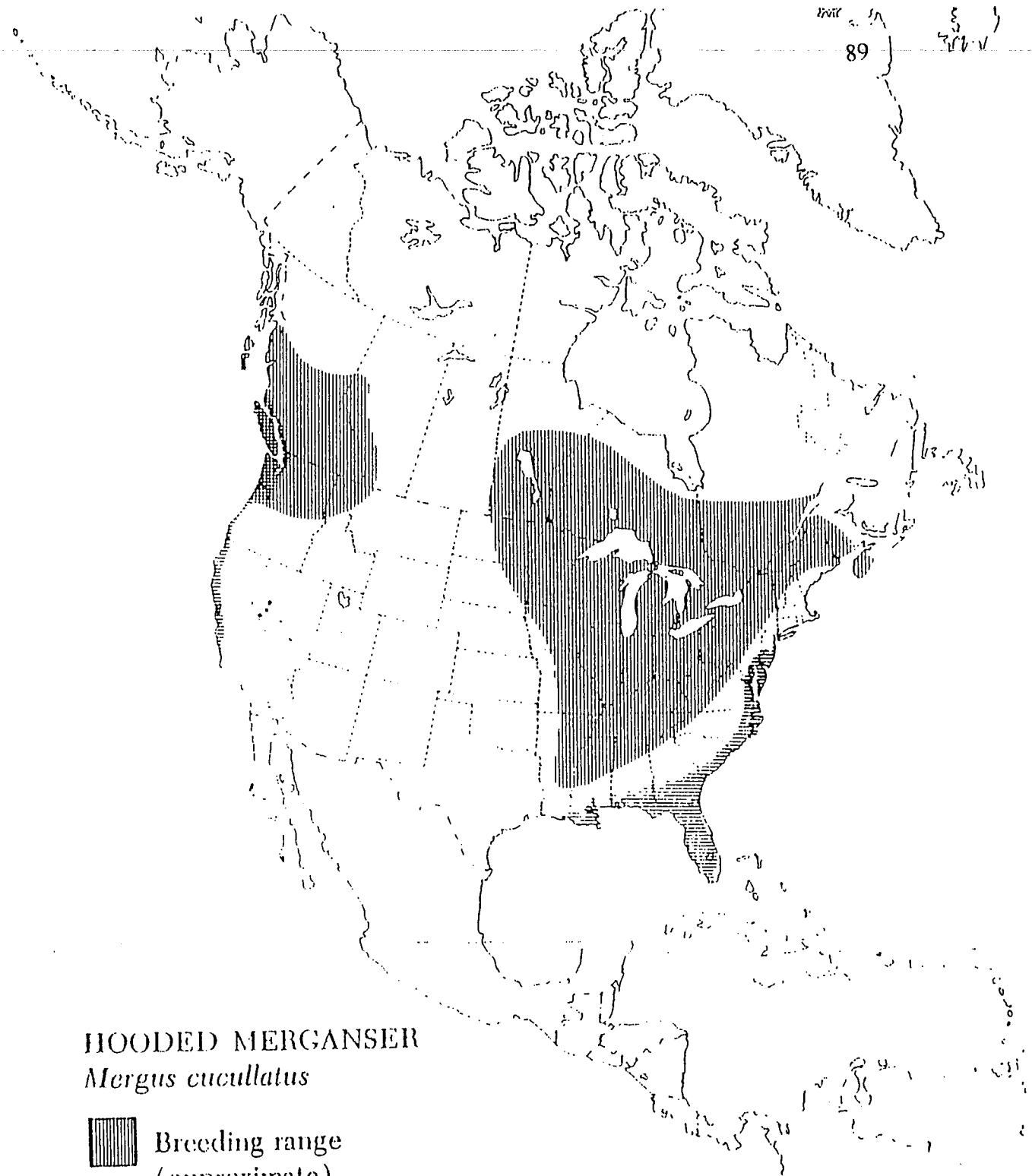
Drake Plumage: Vertical fan-shaped white crest (can be raised) which is bordered in black. White breast with two black bars on each side. White patch on wing, brown flanks, and white belly (Bellrose 1976).

Hen Plumage: Head and neck are gray/brown, reddish brown crest, gray neck, chests, sides and flanks. Brown/black backs, rumps, and tails. Upper bills are black edged with orange and lower bills are yellow (Bellrose 1976).

HOODED MERGANSER
Mergus cucullatus

-  Breeding range
(approximate)
-  Breeding and winter
-  Major wintering areas

(Palmer 1975)



Ruddy Duck

Oxyura jamaicensis

Population Number: 475,000 breeding ground average (Bellrose 1976)

Arrival/Departure Date In Region: 3 October - 20 May (Knight 1994)

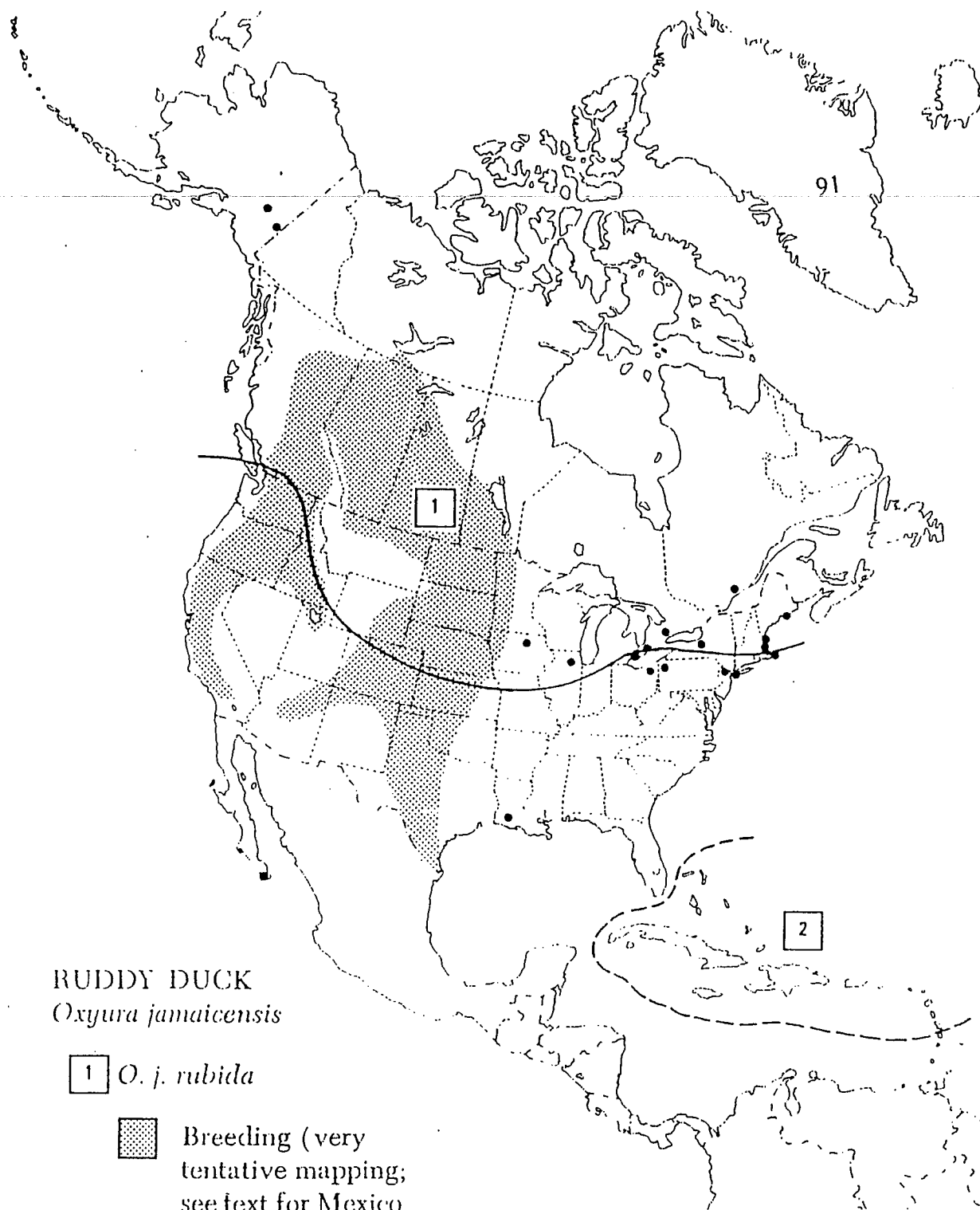
Habitat: Primarily marsh bordered lake and ponds, often at considerable elevations, extensive marshes having at least patches of open water (Palmer 1975).

Winter Food: Divers who consume 72% vegetation and 28% animal matter (Palmer 1975).

Flocking Behavior: Seldom observed in flight, prefer diving to escape danger. Skim over the water in small, compact flocks at high speeds (can not walk on land) (Bellrose 1976).

Drake Plumage: White cheek patches beginning in December. Short thick neck, chunky body, and a fan shaped tail of stiff spiny feathers. Their backs, scapulars and rumps are gray-brown. Their breasts and bellies are silver-white, with transverse broken bars of dark gray, the side and flanks more heavily barred. Tails are brown-black and their feet are blue-gray (unusually large feet) (Bellrose 1976).

Hen Plumage: Females are similar, except cheek is crossed by dark line (Peterson 1980).



RUDDY DUCK
Oxyura jamaicensis

1 *O. j. rubida*

■ Breeding (very tentative mapping; see text for Mexico and beyond)

• Breeding record

— Approximate upper limits of winter occurrence; see text for southern limits

2 *O. j. jamaicensis*

Resident on various islands

[Not mapped: 2 subspecies in South America.]

(Palmer 1975)

American Coot
Fulica americana

Arrival/Departure Date In Region: Winter resident (Knight 1994)

Habitat: Ponds, lakes, marshes; in winter park ponds, salt bays, also fields (Peterson 1980).

Plumage: Head and neck are black, white bill, white patch under the tail, lobed feet. Immature are slightly paler with duller bill (Peterson 1980).

Greylag Goose

Anser anser

Arrival/Departure Date In Region: Permanent resident. Introduced domesticated species (Harrison and Greensmith 1993)

Habitat: Rivers, lakes, marshes, and grassland / pastures (Harrison and Greensmith 1993).

Winter Food: Leaves, stems, and roots of plants (Harrison and Greensmith 1993).

Flocking Behavior: Fight is strong and direct. Often travel in V formation. Most local birds appear to be flightless (Harrison and Greensmith 1993).

Plumage: Rippled neck feathers and gray / white body feathers (Harrison and Greensmith 1993).

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A COMPARATIVE STUDY ON AREA WATERFOWL

by Sarah Garrett

Three months ago as I began the new school year at Abingdon High I never dreamed what new experiences were in store for me. As a Junior my schedule included Latin III, English 11, US History, Trig and Analysis, Chorus 11 and 12, Chemistry and last but not least in importance, Advance Placement Biology. I soon learned that in this Advanced Placement Biology course each student would carry out his or her own experimental project. For this project, my teacher, Ms. Bland Craig, required each student to design a project in which he/she would use scientific investigation to arrive at a conclusion.

My initial goal was to define a topic and begin research. I did this through The World Wide Web, Microfiche, and Scientific American. The one topic that interested me most was an article in the Scientific American, written by an Ornithologist. The decision was made to conduct my project on or about birds. Having chosen a general topic everything began to fall in place. It was recommended that I give Mr. Wallace Coffey a call. Mr. Coffey suggested a number of different avenues that I might choose for a specific topic. He also referred me to Mr. Kevin Hamed, Nature Center Coordinator at Steele Creek Park. On talking with Mr. Hamed, we set a date to further discuss my project and the Junior Naturalist program.

After exploring many different possibilities, a specific project was chosen. A comparative study on Steele Creek Park Lake, Bristol, Tennessee, Sullivan County, Middle Brook Lake, City of Bristol, Tennessee and the City of Bristol Virginia, and Clear Creek lake, Washington County, Virginia, would be completed. The main objective would be to determine why area and migrating waterfowl utilize Middle Brook Lake and Clear Creek Lake more often than Steele Creek Park Lake.

After much thought we decided these things would be accomplished:

The project will span over a period of 22 weeks, allowing 1 hour of field work per week for each sight.

The project will measure the different waterfowl and their amounts, under the same weather conditions, on the three area lakes (Winter 97/98). There will be two or more fixed location sights for every lake and the same amount of time will be spent at each.

This project will establish why the lakes are different by examining shape and usage previous to being filled. Information will be gathered on the foods and habitats utilized by waterfowl. The water qualities of each lake will be tested and the perimeters of each lake will be measured, as well as the percentage of shore line accessible to the public. Throughout the study, weather information will be collected on a daily basis.

This project will be carried out by myself, Sarah Garrett, with the assistance of Kevin Hamed, Naturalist at Steele Creek Nature Center, Wallace Coffey, Ornithologist, and Tom Laughlin, of the Biology department Emory and Henry College, and under the supervision of Ms. Bland Craig.

I would greatly appreciate any information on previous studies from Middle Brook, Steele Creek, and Clear Creek.

(continued ----->)

From *The Eagle*,
publication of the
Bristol Bird Club,
February 1998
Volume VIII
No. 3

(A Comparative Study on Waterfowl continued)

Also, any birding data from these lakes would be useful if posted over Valley Birds. Throughout the year, I will be posting my results on Valley Birds and the Bristol Bird Club Web page.

Even though I am new to the field, I am greatly enjoying the study of birds along with all the people involved. As a new member to the Bristol Bird Club and Junior Naturalist program, I hope to continue learning and enjoying more about this field.

TENNESSEE ORNITHOLOGICAL SOCIETY

ORGANIZED AT NASHVILLE, TENNESSEE, OCTOBER 1915

FOR THE SCIENTIFIC STUDY OF TENNESSEE BIRDS

PUBLISHERS OF "THE MIGRANT"

A QUARTERLY JOURNAL OF BIRD LIFE

30 April 1998

Ms. Bland Craig
Science Department
Abingdon High School
Abingdon, VA 24211

Dear Ms. Craig:

It is with considerable pride that I recommend for your consideration the study *A comparison of three small lakes in Sullivan County, Tennessee and Washington County, Virginia as habitat for waterbirds during the winter of 1997-1998* by Sarah Ellen Garrett.

Her field studies provide new and important data to our knowledge of the local avifauna. This study will become the baseline data on which future studies will be based. This is research that many local field biologists have talked about during the past decade. Her findings have provided new insight to the winter waterbirds and their ecology.

In addition, this study present a documentation and better understanding of the long-time belief that few waterbirds utilize Steele Creek Lake in winter.

Many in the science community are appreciative for her efforts and impressed with her sincere dedication and devotion to the study.

The Science Department and your faculty leadership of this project does not go without note and admiration from all of us. Thanks for your patience and your help.

Respectfully,



J. Wallace Coffey

Past Editor, *The Migrant*

Journal of the Tennessee Ornithological Society

WINTER WATERFOWL ON BRISTOL LAKES

FREE AND INFORMATIVE SEMINAR

April 30, 1998
7:00 P.M.

Presented by . . .

SARAH GARRETT
Abingdon High School

Steele Creek Park Nature Center • Bristol, Tennessee

**For All Ages,
For All Waterfowl Enthusiasts of Steele Creek Park Lake, Clear
Creek Lake and Middlebrook Lake at Bristol**

This 22-week study discovered new insights about migratory waterbirds which come to Bristol area lakes to spend the winter. Throughout a long, cold, winter Sarah Garrett of Abingdon, VA spent every Saturday inventorying the waterbirds on three area lakes.

Why do some of these lakes have good wintering populations and one apparently attracts few birds? For the first time, a comprehensive look at the winter waterfowl at Steele Creek Park Lake. For the first time the water quality of each impoundment, the weather patterns and human interaction with wild ducks have been studied in the Bristol area.

The research was conducted as a special project for an Advanced Placement Biology Class at Abingdon High School.

About **SARAH GARRETT**

A junior at Abingdon High School, Sarah is an outdoors person who loves field work and conducting her own biological study. She has been active at school in the Latin Club, Fellowship of Christian Athletes and a past member of the track and field team.

Sarah is a member of the Abingdon High School National Honors Society, and has received seven awards for academic achievement. She is a member of the Abingdon High School Falcon Singers and has served her church through Project Crossroads and American Missions.



**If you wish more information, please call
Steele Creek Park Nature Center (423-989-5616)**

