September 2010 Progress Report

Project Title: True Metabolizable Energy of American Black Ducks Foods

Agreement #: 98210–9-G514

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Duration: 05/29/09 – 9/30/10

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Problem/Issue Statement

Quantifying regional carrying capacity throughout the American black duck (*Anas rubripes*) wintering range is a priority research need identified by the Black Duck Joint Venture (BDJV). Determining carrying capacity requires knowledge of both the types and amounts of different foods available and their nutritional value. Information needs regarding the types and availability of black duck foods along the Atlantic Coast is currently being addressed with ongoing research. However, little information exists regarding the energetic value of these foods.

Justification

American black ducks, a species of international management concern, appear to have increased within the primary breeding range since 1990 (Fig. 1). However, the population size remains 27% below the North American Waterfowl Management Plan (NAWMP 2004) population goal of 640,000. Counter to recent spring survey estimates, the Mid-winter Inventory (MWI) indicates a decline by as much as 60% on traditional wintering areas, with the most substantial losses occurring in the Mississippi and southern Atlantic Flyways. In the Mississippi and Atlantic Flyway, the 2007 mid-winter index was 52% and 14% below the 10-year average, respectively (Fig. 2). Mid-winter counts in both flyways combined currently remain 19% below the 10-year average. There are several possible explanations for this decline, one of which is the loss and/or degradation of non-breeding habitat (Conroy et al. 2002).

Our current understanding of migratory and wintering waterfowl ecology suggests food availability is a key factor limiting waterfowl populations during winter and migration (Haramis et al. 1986, Miller 1986, Conroy et al. 1989, Reinecke et al. 1989, Bergan and Smith 1993, Jeske et al. 1994), and habitat conditions during the non-breeding period may influence survival and subsequent reproductive success (Heitmeyer and Fredrickson 1981, Kaminski and Gluesing 1987, Raveling and Heitmeyer 1989). Determining carrying capacity for any habitat type requires knowledge of both the types and amounts of different foods available and their nutritional value to birds (Miller and Newton 1999, Ballard et al. 2004).

With support from the BDJV, a suite of research studies evaluating the habitat use and food habits of black ducks, and the availability of black duck foods along the Atlantic Coast (New York, New Jersey and Virginia) was recently completed by Ducks Unlimited (DU) and its partners. Esophageal contents from collected birds suggest diets have shifted since the 1980s (Costanzo and Malecki 1989). In addition, food availability data suggests some foods commonly found in the black duck diet in the 1980s are extremely rare (D. M. Cramer, University of Delaware, unpublished report; B. Lewis, Jr., Southern Illinois University, unpublished report; D. Plattner, Southern Illinois University, unpublished data).

Estimates of TME are currently available for 5 species of invertebrates, 1 agricultural food, and the seeds of 5 moist soil plants found in the American black duck

(*Anas rubripes*) diet (Hoffman and Bookhout 1985, Jorde and Owen 1988, Petrie et al. 1998, Sherfy 1999, Checkett et al. 2002, Kaminski et al. 2003, Dugger et al. 2007). This represents a small fraction of the foods eaten by American black ducks. Given the range of values for the few species studied to date, additional work is required to improve our understanding of the foraging landscape for migrating and wintering American black ducks.

Information regarding a food's proximate composition (e.g., fiber content) may provide an indirect measure of metabolizable energy; however, others have found this approach unreliable. Several methods are available for directly estimating metabolizable energy using controlled feeding experiments; however estimates of TME are most accurate (Sibbald 1976, Miller and Reinecke 1984). Unlike estimates of gross energy, the TME method estimates energy available to birds, and TME is preferable over estimates of apparent metabolizable energy because it accounts for fecal and urinary energy of non-food origin. In this study, we propose to estimate TME values for seeds and invertebrates commonly occurring in wetlands along the Atlantic Coast and the black duck diet.

Objectives

The primary objective of this study is to estimate TME values for 6 foods commonly found in wetlands and the black duck diet. These estimates will be combined with food availability, chronology and duration of stay estimates to populate energetic carrying capacity models currently being developed. Ultimately these models will be used to generate science-based habitat objectives during the non-breeding period and target conservation programs along the Atlantic Coast.

Scope & Location

The study was conducted at the Winous Point Marsh Conservancy located near Port Clinton, OH (41°30'N, 84°59'W). Test foods for feeding trials were obtained from either a commercial seed supplier (saltmarsh cordgrass seed) or natural wetlands (widgeon grass vegetation, sea lettuce and animal foods) located on the Atlantic Coast.

Study Design

Feeding trials were conducted using captive American black ducks >5 month of age provided by a local breeder. When not being used in feeding trials birds were confined in an unheated pen, subject to natural temperature and photoperiod, and provided with unlimited access to a commercial game bird ration (crude protein ≥ 20%, crude fat ≥ 3.0%, crude fiber ≤ 5.0%), grit, and fresh water (Petrie et al. 1997). Feeding trials were conducted between September and March following general procedures outlined in Checkett et al. (2002). We will determine TME for saltmarsh cordgrass seeds (S*partina alterniflora*), widgeon grass vegetation (*Ruppia maritima*), sea lettuce (*Ulva spp.*), saltmarsh snails (*Melampus bidentatus*), killifish (*Fundulidae spp.*), fiddler crabs (*Uca spp.*), and grass shrimp (*Palaemonetes spp.*). Test species were selected based on their common occurrence in wetlands and presence in the diet of American black ducks (Costanzo and Malecki 1989; D. M. Cramer, University of Delaware, unpublished report; B. Lewis, Jr., Southern Illinois University, unpublished report; D. Plattner, Southern Illinois University, unpublished report).

Saltmarsh cordgrass seeds were obtained from a commercial seed supplier and widgeon grass vegetation, sea lettuce and animal foods from natural wetlands. Procedures for TME bioassays followed Sibbald (1986). We randomly selected 12 birds (6 male and 6 female) to be fed 7 test foods. Six (3 of each gender) additional birds were randomly selected as controls to provide a measure of endogenous contributions to excreta energy (Sibbald 1986). We used the same 6 control birds for all trials and fed treatment birds the same food for each trial. Feeding trials were separated by a 10-day period to allow birds to recover lost body mass during the previous trial.

Prior to each feeding trial, birds were placed in individual metabolism cages (20 x 20 x 30 cm), provided *ad libitum* water, and fasted for 48 hrs. Following fasting, but prior to feeding, we weighed each bird (± 10 g) then attempted to feed each treatment bird a quantity of food equal to 1% of its body weight (Sibbald 1986). Birds were fed by inserting a clear plastic tube (1.2 x 40 cm) into the esophagus and slowly pouring the food item into the tube using a funnel and pushing the food item down the tube using a wooden dowel. Food items failing to enter the bird's esophagus (e.g., foods clinging to the tube wall) were collected, weighed, and subtracted from each bird's original dose. Birds that regurgitated any portion of a test food following feeding were eliminated from the feeding experiment, thus, for some test foods, more than one trial was required to achieve desired sample sizes. Experimental birds were fed only once during a trial, and all birds were returned to their metabolic chambers following handling. Plastic tubs were placed under each metabolic chamber to capture fecal and urinary material. Excreta was collected from control and experimental cages 48 hrs following feeding.

Following collection of excreta, samples were processed for analysis in a lab. Feathers and grit were removed from each sample; the remaining excreta was oven-dried at 60°C, weighed to the nearest 0.0001 g, and ground with a mortar and pestle. Subsamples of 1.0 g will be oven-dried to a constant mass at 80°C to determine percent moisture. Gross energy (GE_F) of test foods and excreta from fed and fasted birds on duplicate subsamples will be estimated using a Parr adiabatic oxygen bomb calorimeter (30 atmospheres O_2). TME (kcal/g) will be calculated as:

$$TME = ((GE_F \times W_F) - (EE_F - EE_C)) / W_F$$

where GE_F was the gross energy of the food item (kcal/g), W_F was the dry mass fed (g), EE_F was the energy voided as excreta by the experimental bird (kcal/g), and EE_C was the energy voided as excreta by the control bird (kcal/g). The average energy excreted by control birds will be used to estimate EE_C. To account for potentially greater catabolism of body tissue by control birds and avoid overestimating energy derived from non-food origin, TME will be corrected to zero nitrogen balance (TME_N; Parsons et al. 1982, Sibbald and Morse 1982).

The nutrient composition for all food items will be estimated using proximate analysis. Percent moisture will be determined by drying samples in a forced air oven at 100°C and percent nitrogen using the Kjeldahl procedure (Association of Official Analytical Chemists 2000). Percent nitrogen will be multiplied by 6.25 to estimate crude protein. Crude fat will be estimated using ether extraction, acid detergent fiber (ADF) and neutral detergent fiber (NDF) by the Ankom A200 filter bag technique, and ash content by heating in a cold furnace until 625°C after 15 hr (Association of Official Analytical Chemists 2000). Crude fiber will be estimated as ADF*0.80. Nitrogen Free Extract will be calculated as (100% − %water − %crude fiber − %ash − %fat − %crude protein). TME_N values will be expressed as a percentage of gross energy [(TME_N /GE_F)*100%] to estimate digestive efficiency.

Because body mass may influence TME results, we will use a single factor analysis of variance (ANOVA; PROC GLM) to compare body mass among months for birds used in feeding trials and for differences in mean treatment-body mass among test foods. We also will use ANOVA to determine whether TME_N values of test foods are influenced by gender. We will determine whether TME_N of the 6 foods differ by fitting a mixed model ANOVA (Littell et al. 1996). Test species will be treated as a fixed effect, and date of feeding trial and individual bird will be classified as random effects. To further examine differences in TME_N between test foods, we will conduct pair-wise multiple comparisons using a Tukey multiple comparison test.

Preliminary Results

We hired two technicians and started them on the project on August 3, 2009. We purchased equipment, supplies and materials for the laboratory, holding pen and metabolic chambers and constructed bird facilities (holding pen, shelter and metabolic chambers). Our local breeder (Earl Tappenden) suffered a pen collapse during winter 2008/2009 and was unable to provide in-kind birds for the study. Therefore, we purchased and picked up 12 American black duck pairs from a breeder in Lakeville, Minnesota (Tacheny Wildlife; Permit #749956) on August 13, 2009. We modified the study design to include both male and female American black ducks (n = 18; 6 treatment and 3 control birds of each gender) to evaluate differences in TME_N values of test foods by gender.

We purchased saltmarsh cordgrass seed from Environmental Concern, Inc.'s wetland plant nursery and widgeon grass vegetation was collected by Maryland Department of Natural Resources staff. We were unable to secure widgeon grass seed from the Maryland Department of Natural Resources due to poor seed production from donor beds. Therefore, we elected to substitute and add grass shrimp and sea lettuce as test foods. Animal foods (fiddler crabs, killifish, saltmarsh snails and grass shrimp) and sea lettuce were collected by New Jersey Division of Fish & Wildlife staff and Michael Castelli, a volunteer. Percent moisture was estimated for each test food.

We conducted practice trials 8/31 – 9/4 and 9/14 – 9/18 to acclimate birds, practice feeding methodology and determine appropriate food volumes to avoid issues with regurgitation (Table 1 & 2). During practice trials, birds were fed varying amounts (0.5 – 1% dry weight of body mass) of saltmarsh cordgrass seed, widgeon grass vegetation, cracked corn, and millet. Regurgitation issues were encountered when individual birds were fed a quantity of saltmarsh cordgrass seed and widgeon grass equivalent to 1% of body mass. Therefore, we attempted to feed each bird approximately 0.5% of its body mass.

Despite our best efforts, we encountered significant regurgitation issues when feeding saltmarsh cordgrass seed and widgeon grass vegetation. Therefore, we conducted 13 feeding trials to achieve desired sample sizes (Table 1 & 2). A total of 159 excreta samples were collected from fed (n = 84) and control birds (n = 75) (Table 3). Food and excreta samples were shipped to the University of Rhode Island for gross energy, nitrogen and proximate analyses. We anticipate receiving laboratory results in early October. Subsequent data analyses and manuscript preparation will occur during the fall and winter 2010/2011.

Information regarding the study and study resources (articles, etc.) are posted on Ducks Unlimited's Great Lakes Atlantic Regional Office Web page at http://www.ducks.org/Conservation/BlackDuckStudy/3410/BlackDuckStudy.html.

Project Status: This project is ongoing. Feeding trials (n = 13) were completed and food and excreta samples (n =174) were shipped to the University of Rhode Island for gross energy, nitrogen and proximate analyses. We anticipate receiving laboratory results in early October. Subsequent data analyses and manuscript preparation will occur during the fall and winter 2010/2011.

Project funding sources (US$): 10/01/2009 – 9/30/2010

BDJV	Other U.S. Federal	U.S. non-federal	Canadian federal	Canadian non-federal	Other
$30,000	$0	$38,529	$0	$0	$0

Total cost: $113,997

Total BDJV funds: $30,000

Anticipated Output

The ultimate product of this study will be a peer reviewed publication in the Journal of Wildlife Management, Wildlife Society Bulletin or other comparable scientific journal. Additionally, information regarding the study and study resources (articles, etc.) will be made readily available on DU's Great Lakes Atlantic Regional Office Web page (http://www.ducks.org/Conservation/BlackDuckStudy/3410/BlackDuckStudy.html). The greatest benefit of this work will be the development of energetic carrying capacity models to generate science-based habitat objectives for black duck habitat conservation during the non-breeding period. These products will be made widely available and promoted for use by a diversity of partners to focus their conservation efforts on areas of greatest impact. The BDJV will receive annual and final reports documenting progress on the project.

Management Implications

Although food is not the sole factor determining wetland habitat quality, it is a variable that can be manipulated via management and restoration. TME values of American black duck foods derived from this study and information regarding their abundance in different habitats collected during previous research in New York, New Jersey, and Virginia will be used in conjunction with energetic carrying capacity models to generate science-based habitat objectives for habitat conservation during the non-breeding period in the Atlantic Flyway.

Relationship to Other Projects

This study is directly related to ongoing efforts supported by the BDJV to evaluate habitat carrying capacity, migration chronology, and duration of stay for American black ducks in New Jersey, New York and Virginia. The current project will augment these efforts by providing TME values for previously untested foods commonly found in the black duck diet. In concert this work will lead to the development of bioenergetics models to estimate regional carrying capacity.

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Personnel

Dr. John Coluccy oversees research and planning efforts for Ducks Unlimited's 18-state Great Lakes Atlantic Region. As the Manager of Conservation Planning, John assists with designing, funding and implementing landscape level research with the objective of refining habitat programs within an adaptive management framework. He has experience with a variety of research issues related to wetlands, and breeding, migrating and wintering waterfowl across a broad geographic range including the prairies, Great Lakes, Atlantic Coast, and Gulf Coast. John is a member of the Upper Mississippi River Great Lakes Joint Venture Science Technical Committee and co-chair of the Waterfowl Subcommittee. He is also a member of the Black Duck and Atlantic Coast Joint Venture Science Technical Committees. John has extensive experience with on-the-ground habitat delivery having spent five years directing Ducks Unlimited's conservation programs in Wisconsin, Indiana and southwest Michigan. John received his B.S. in wildlife ecology from the University of Wisconsin in 1985 and his M.S. and Ph.D. in wildlife ecology from the University of Missouri in 1996 and 2001, respectively.

Dr. Tina Yerkes is in charge of landscape level planning and research initiatives for the Great Lakes/Atlantic Region of DU and oversees GIS, communications and habitat delivery programs across the region. She has experience with a variety of research issues related to waterfowl and wetlands: including breeding, wintering, and spring periods. She has mentored and co-advised 10 graduate students to date. She recently completed a large landscape study of breeding mallards in the Great Lakes states that was specifically designed to address uncertainty in habitat conservation program delivery in this area. Current spring and winter focused projects include: Wintering and spring needs of black ducks in New Jersey, New York, and Virginia, The value of urban wetlands for wintering and spring waterfowl in the Meadowlands, New Jersey, and spring needs of dabbling and diving ducks in mid-latitude migration areas of the Great Lakes States.

Schedule

Date	Activity	Actual Accomplishments as of September 2010
July 2009	Hire technicians; purchase materials; construct TME cages	Technicians hired; equipment, materials and supplies purchased
August – September 2009	Collect and/or purchase test foods	Test foods collected and purchased; holding pen and TME chambers constructed; American black ducks purchased and picked up; practice trials conducted
September 2009	Start feeding trials	Commenced feeding trials
December 2009	Complete feeding trials	Feeding trials completed March 2010
September – December 2009	Pick, sieve and dry excreta samples; conduct bomb calorimetry on excreta samples and test foods; conduct proximate analyses of test foods	Excreta samples picked, sieved and dried September 2009 – March 2010; excreta and test food bomb calorimetry ongoing at URI; proximate analyses of test foods ongoing at URI
January – June 2010	Conduct statistical analyses; prepare and submit manuscript	Anticipate completing statistical analyses fall 2010; anticipate preparing and submitting manuscript spring 2011

Budget

Budget (US $)	**BDJV**	**DU**	**WRF**	**WPMC**	**ET**	**Total**
Category						
Personnel						
PI ($16,800/month × 3 months)	$0	*$28,400*	$22,000	$0	$0	$50,400
Technicians ($2,000/month × 6 months × 2)	$12,000	$0	$12,000	$0	$0	$24,000
Technician Housing & Bird/Lab Facilities	$0	$0	$0	*$19,000*	$0	$19,000
Transportation (vehicles and fuel)	$0	*$10,000*	$0	$0	$0	$10,000
Laboratory Analysis	$18,000	$0	$29,000	$0	$0	$47,000
Materials/Equipment	$0	$0	$12,000	$0	$0	$12,000
Commercial Waterfowl Feed ($50/bag × 30)	$0	$1,500	$0	$0	$0	$1,500
Straw Bedding ($5/bail × 26)	$0	$130	$0	$0	$0	$130
American black ducks ($45/bird × 20)	$0	$0	$0	$0	*$900*	$900
Publications	$0	$2,000	$0	$0	$0	$2,000
Communications	$0	$3,000	$0	$0	$0	$3,000
Total by Funding Source	$30,000	$45,030	$75,000	$19,000	$900	$169,930
Ratio of Cash-Matching Contributions to BDJV Request	2.72:1					
Ratio of In-Kind Matching Contributions to BDJV Request	1.94:1					

BDJV = Black Duck Joint Venture; DU = Ducks Unlimited; WRF = Waterfowl Research Foundation; WPMC = Winous Point Marsh Conservancy, ET = Earl Tappenden

Table 1. Trial, feeding schedule and cage assignments for male American black ducks.

		Male #								
Trial #	**Date**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Practice	8/31 – 9/4									
Break	9/5 – 9/13									
Practice	9/14 – 9/18									
Break	9/19 – 9/27									
1	9/28 – 10/2	WGV-13	WGV-17	WGV-4	WGV-3	WGV-11	WGV-8	C-5	C-2	C-12
Break	10/3 – 10/11									
2	10/12 – 10/16	SMCG-3	SMCG-2	SMCG-18	SMCG-5	SMCG-16	SMCG-12	C-1	C-11	C-13
Break	10/17 – 10/25									
3	10/26 – 10/30	SMS-5	SMS-15	SMS-13	SMS-17	SMS-4	SMS-18	C-16	C-8	C-11
Break	10/31 – 11/8									
4	11/9 – 11/13	KF-8	KF-1	KF-7	KF-16	KF-17	KF-2	C-3	C-9	C-10
Break	11/14 – 11/22									
5	11/23 – 11/27	GS-12	GS-8	GS-17	GS-5	GS-15	GS-7	C-4	C-6	C-9
Break	11/28 – 12/6									
6	12/7 – 12/11	FC-18	FC-13	FC-10	FC-14	FC-6	FC-15	C-7	C-1	C-9
Break	12/12 – 12/20									
7	12/21 – 12/25	WGV-13	WGV-17	WGV-4	WGV-3	WGV-11	WGV-8	C-5	C-2	C-12
Break	12/26 – 1/3									
8	1/4 – 1/8	WGV-13	WGV-17	WGV-4	WGV-3	WGV-11	WGV-8	C-5	C-2	C-12
Break	1/9 – 1/17									
9	1/18 – 1/22	SMCG-3	SMCG-2	SMCG-18	SMCG-5	SMCG-16	SMCG-12	C-1	C-11	C-13
Break	1/23 – 1/31									
10	2/1 – 1/5	FC-3	WGV-2	FC-18	WGV-5	FC-16	WGV-12	C-1	C-11	C-13
Break	2/6 – 2/14									
11	2/15 – 2/19	SMCG-3	SMCG-2	SMCG-18	SMCG-5	SMCG-16	SMCG-12	C-1	C-11	C-13
Break	2/20 – 2/28									

12	3/1 – 3/5	SMCG-3	SMCG-2	SMCG-18	SMCG-5	SMCG-16	SMCG-12	C-1	C-11	C-13
Break	3/6 – 3/14									
13	3/15 – 3/19	ULVA-2	ULVA-5	ULVA-9	ULVA-11	ULVA-18	ULVA-4	C-8	C-12	C-6
Break	3/20 – 3/28									

WGV = widgeon grass vegetation; SMCG = saltmarsh cordgrass seeds; SMS = saltmarsh snail; KF = killifish; GS = grass shrimp; FC = fiddler crab; ULVA = sea lettuce; C = control

Table 2. Trial, feeding schedule and cage assignments for female American black ducks.

		Female #								
Trial #	**Date**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Practice	8/31 – 9/4									
Break	9/5 – 9/13									
Practice	9/14 – 9/18									
Break	9/19 – 9/27									
1	9/28 – 10/2	WGV-7	WGV-9	WGV-14	WGV-18	WGV-15	WGV-16	C-10	C-1	C-6
Break	10/3 – 10/11									
2	10/12 – 10/16	SMCG-8	SMCG-14	SMCG-7	SMCG-10	SMCG-4	SMCG-6	C-15	C-17	C-9
Break	10/17 – 10/25									
3	10/26 – 10/30	SMS-9	SMS-1	SMS-10	SMS-6	SMS-3	SMS-14	C-7	C-2	C-12
Break	10/31 – 11/8									
4	11/9 – 11/13	KF-11	KF-12	KF-18	KF-15	KF-13	KF-5	C-6	C-14	C-4
Break	11/14 – 11/22									
5	11/23 – 11/27	GS-11	GS-14	GS-1	GS-2	GS-16	GS-10	C-13	C-3	C-18
Break	11/28 – 12/6									
6	12/7 – 12/11	FC-4	FC-16	FC-17	FC-11	FC-5	FC-8	C-2	C-3	C-12
Break	12/12 – 12/20									
7	12/21 – 12/25	WGV-7	WGV-9	WGV-14	WGV-18	WGV-15	WGV-16	C-10	C-1	C-6
Break	12/26 – 1/3									
8	1/4 – 1/8	WGV-7	WGV-9	WGV-14	WGV-18	WGV-15	WGV-16	C-10	C-1	C-6
Break	1/9 – 1/17									
9	1/18 – 1/22	SMCG-8	SMCG-14	SMCG-7	SMCG-10	SMCG-4	SMCG-6	C-15	C-17	C-9
Break	1/23 – 1/31									
10	2/1 – 1/5	SMCG-8	SMCG-14	SMCG-7	SMCG-10	SMCG-4	SMCG-6	C-15	C-17	C-9
Break	2/6 – 2/14									
11	2/15 – 2/19	SMCG-8	SMCG-14	SMCG-7	SMCG-10	SMCG-4	SMCG-6	C-15	C-17	C-9
Break	2/20 – 2/28									

12	3/1 – 3/5	SMCG-8	SMCG-14	SMCG-7	SMCG-10	SMCG-4	SMCG-6	C-15	C-17	C-9
Break	3/6 – 3/14									
13	3/15 – 3/19	ULVA-16	ULVA-13	ULVA-15	ULVA-14	ULVA-1	ULVA-10	C-3	C-7	C-17
Break	3/20 – 3/28									

WGV = widgeon grass vegetation; SMCG = saltmarsh cordgrass seeds; SMS = saltmarsh snail; KF = killifish; GS = grass shrimp; FC = fiddler crab; ULVA = sea lettuce; C = control

Table 3. Excreta samples collected for test foods fed to captive male and female American black ducks at Winous Point Marsh Conservancy, Ohio, USA, September, 2009 – March, 2010.

Test species	**Male (*n*)**	**Female (*n*)**	**Total (*n*)**
Saltmarsh cordgrass seed	5	5	10
Widgeon grass vegetation	6	7	13
Sea lettuce	6	6	12
Saltmarsh snail	6	6	12
Grass shrimp	6	6	12
Fiddler crab	7	6	13
Killifish	6	6	12
Total	42	42	84

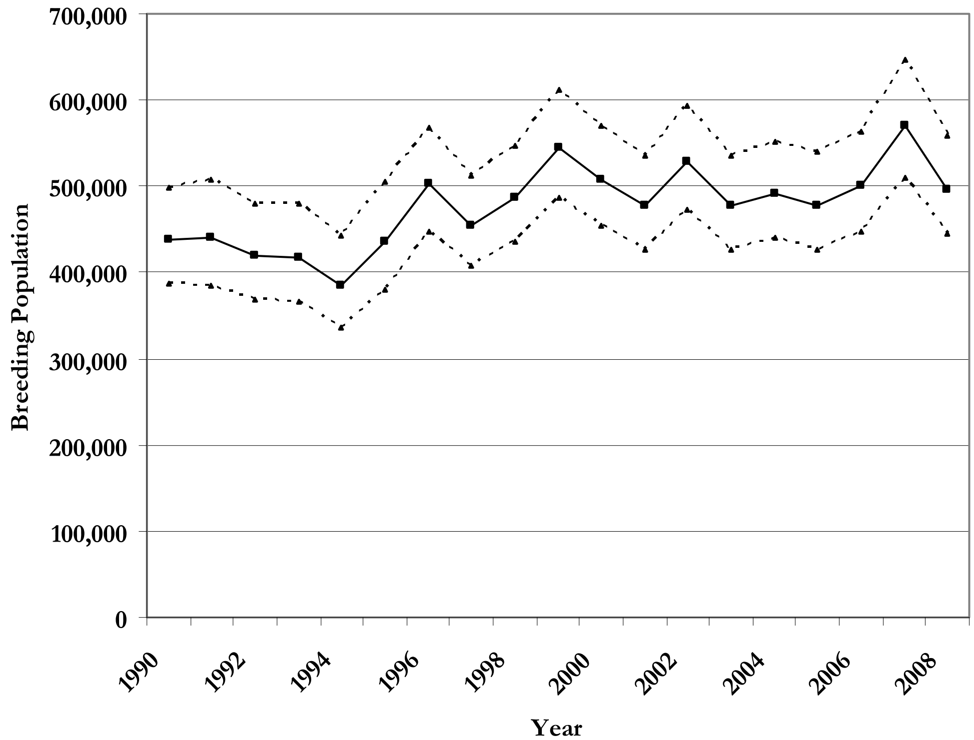

Figure 1. Breeding population estimate and 90% confidence intervals for American black ducks in the eastern survey area, 1990–2008.

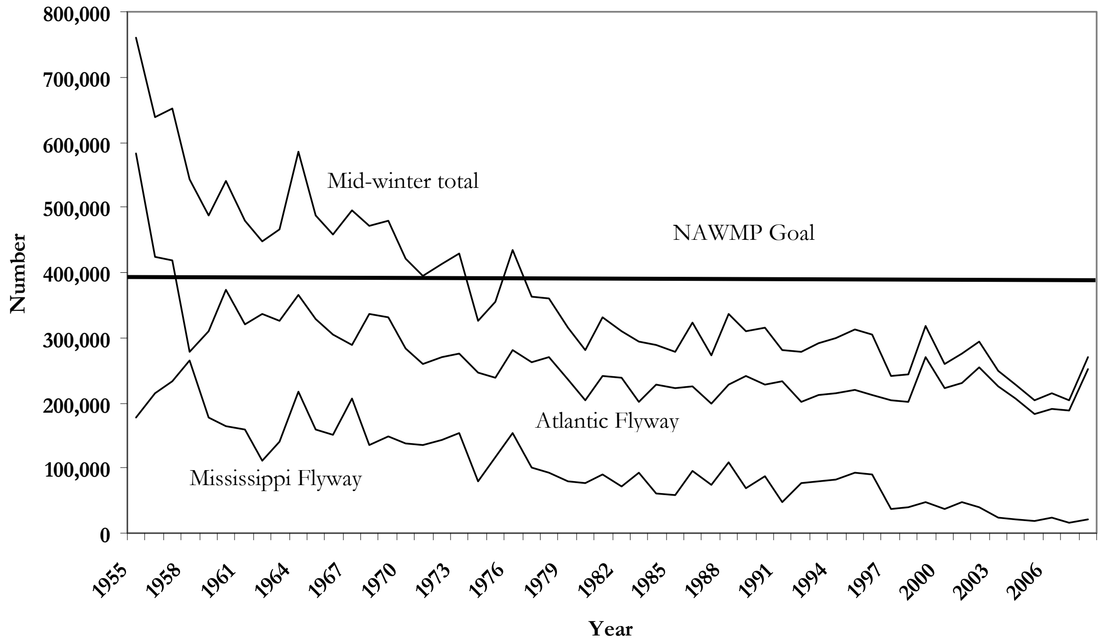

Figure 2. Number of American black ducks counted during the Mid-winter Inventory, 1955–2008.