## SUMMARY OF ABUNDANCE DATA COLLECTED DURING THE PILOT PHASE OF THE INTEGRATED WATERBIRD MANAGEMENT AND MONITORING PROGRAM (IWMM), 2010 TO 2014

PREPARED FOR:

THE INTEGRATED WATERBIRD MANAGEMENT AND MONITORING PROGRAM U.S. Fish and Wildlife Service, Natural Resource Program Center 1201 Oakridge Drive, Suite 320, Fort Collins, CO 80525 BY: **KEVIN AAGAARD** U.S. Geological Survey, Upper Midwest Environmental Sciences Center 2630 Fanta Reed Road, La Crosse, WI 54603; kaagaard@usgs.gov JAMES E. LYONS U.S. Geological Survey, Patuxent Wildlife Research Center 12100 Beech Forest Road, Laurel, MD 20708; jelyons@usgs.gov **BRIAN LOGES** U.S. Fish and Wildlife Service, Two Rivers NWR HC 82 107 Brussels, IL, 62103; brian\_loges@fws.gov WAYNE THOGMARTIN U.S. Geological Survey, Upper Midwest Environmental Sciences Center 2630 Fanta Reed Road, La Crosse, WI 54603; wthogmartin@usgs.gov

Abstract: This report summarizes the data collected during the pilot phase of the Integrated Waterbird Management and Monitoring (IWMM) Program (2010 to 2014). Data were collected from 729 participating units (wetlands), constituting 165 sites (comprised of some refuges in the U.S. Fish and Wildlife Service (USFWS) National Wildlife Resource System (NWRS), as well as several non-refuges) across USFWS Regions 3, 4 and 5 (Midwest, Southeast, and Northeast, respectively). There were 232 observers who spent a total of 182,219 hours performing 1,145 bird surveys over the five-year period. A total of 107 species of waterbirds were counted across the units. A series of filters were applied to these data to isolate the particular factors of interest: (1) a focus on waterfowl, shorebirds, and wading birds (2) during the non-breeding period (3) for which corresponding surveys of local habitat conditions could be associated. This yielded 131,412 observations. These counts were corrected for effort and converted to bird-use-days (BUDs) to generate basic population trends across regions, to assess community composition (biodiversity), to evaluate the relationship between habitat factors and abundance, and to establish the per-unit waterbird conservation contribution to each Region. This procedure is useful as an appraisal of the utility of the early years of data collection, and to the USFWS as a statement on (and tool to determine) the value of particular refuges in terms of waterbird conservation.

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The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the U.S. Fish and Wildlife Service. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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## Introduction



Figure 1. Spatial distribution of participating IWMM units in USFWS Regions 3 (gray), 4 (red), and 5 (green). Point size  $\neq$  unit area.

The Integrated Waterbird Management and Monitoring (IWMM) Program is a collaboration of management officials, conservation partners, and scientists that provides optimized wetland management practices through monitoring, modeling, and decision support tools. The goal of the IWMM is to identify effective strategies for managing this conservation estate through rigorous, standardized monitoring protocols. To accomplish this goal it is necessary from time to time to review the state of the data produced from the monitoring efforts and evaluate the status of the monitored system (i.e., waterbird populations). This report represents a summary of the pilot phase (the first five years) of monitoring data produced by the IWMM program, and provides the foundation for tools that can be used to analyze the data to correct for sources of error and biases in the monitoring process, provide management-relevant indices of abundance, identify population trends and relationships with local habitat features, and generate a comparative metric of participating units to evaluate the contributions by a unit to a larger region.

The pilot data of the IWMM program were collected during the non-breeding period of the North American waterbird migratory cycle, specifically the portion of this cycle relevant to the United States (i.e., when the birds cross the border with Canada; approximately July to May). There were 729 conservation units that participated in the IWMM from 2010 to 2014 (Figure 1). Surveys were conducted following the procedures outlined in early versions of the IWMM Monitoring Manual, available in the Appendix. In 2015 IWMM made significant revisions to these monitoring methods and adopted a new online database to improve data management.

#### Methods

#### Overview

A seven-step process was used to generate the products of this report (Figure 2):

- (1) Data management: ensures that all data conformed to necessary requirements, including: surveys conducted during the non-breeding period; bird surveys associated with vegetation surveys; observations of species belonging to focal guilds (waterfowl, shorebirds, and waders); and surveys with recorded length (start/end times). Also see Table 1.
- (2) *Effort-correction*: uses survey length as a parameter in a hierarchical over-dispersed Poisson model of observed abundances to account for variability in survey effort.
- (3) *Regional trends*: shows variation in abundance throughout the pilot phase of the IWMM program across seasons and years.
- (4) *Community and guild composition*: community diversity metrics were computed for each unit, grouped by USFWS Region, to assess the degree of difference in habitat use.
- (5) *Calculating bird-use-days* (BUDS; or, duck-use-days, as in Heitmeyer 2010): using the area-under-the-curve method (from Millar et al. 2012); this metric demonstrates habitat use over a season in terms of abundance of individuals and (roughly) length of stay.
- (6) *Relationship between habitat factors and waterbird abundance*: a correlation matrix was created to evaluate the relationships between BUDs (and BUDs scaled for wetland area and area of open water) and each of the habitat factors measured in the surveys.

(7) *Relative value of Regional refuge lands*: the contribution to conservation efforts by each unit was compared to all other units within each Region.



Figure 2. Diagrammatic workflow of summary report procedure.

#### Data management

Data from IWMM bird and vegetation surveys were merged with geospatial data layers containing information on crop lands, wetlands with emergent vegetation, wooded wetlands, grasslands, hay, shore habitat, and open water. These landscape layers were combined with a disturbance-level layer indicating the degree of urban development in an area.

There were three categories of issues associated with the dataset that needed to be accounted for to produce a clean dataset for analysis (Table 1). First, the analyses conducted here focused on USFWS focal guilds: waterfowl, shorebirds, and wading birds. Any species observed in the surveys that belonged to a guild other than one of these three was excluded from the data.

Second, there were data entry errors, primarily with the reported start and end times of the surveys. Because the data were subsequently corrected for effort and this correction requires information on survey length, any data from a survey of 0 length were incompatible with the effort-correction model. Additionally, some start and end times were reported on a 12-hour

timetable while others were reported on a 24-hour timetable; these times needed to be standardized to accurately calculate survey length.

Finally, any surveys conducted in June (which is outside the non-breeding period of most waterbirds) were eliminated from the dataset. All data management was performed in R v. 3.2.2 (R Core Team 2015).

Table 1. Illustrative dataset of the data management process. Gray rows are excluded, bold anditalicized cells mark the cause for exclusion.

Site	Unit	Date	Start	End	Species	Guild	Count
1	А	2010-10-27	4:30:00 AM	6:27:00 AM	LBHE	wader	5
1	В	2010-11-03	5:18:00 AM	11:20:00 AM	MALL	waterfowl	135
2	А	2012-03-14	19:42:00	21:11:00	WODU	waterfowl	140
2	В	2011-11-17	7:05:00 AM	7:05:00 AM	MALL	waterfowl	10000
3	А	2013-02-21	4:42:00 AM	5:29:00 AM	NOSH	waterfowl	33
3	В	2010-06-23	9:15:00 AM	10:51:00 AM	NOPI	waterfowl	2000
4	А	2012-01-04	18:55:00	20:40:00	BUFF	waterfowl	17
4	В	2013-06-17	8:04:00 AM	9:18:00 AM	MALL	waterfowl	92
5	А	2011-04-02	7:12:00 AM	8:26:00 AM	AMOY	shorebird	10
6	А	2011-03-27	16:03:00	18:00:00	ABDU	waterfowl	94
6	В	2012-12-06	10:05:00 AM	1:09:00 PM	REED	wader	1
7	А	2013-03-25	4:00:00 AM	7:30:00 AM	BBPL	shorebird	27
7	В	2013-02-01	5:24:00 AM	9:21:00 AM	SNGO	waterfowl	30000
8	А	2010-12-13	17:05:00	23:07:00	AMCO	rail	1
8	В	2011-04-18	6:17:00 AM	12:11:00 PM	ABDU	waterfowl	41
9	Α	2013-01-09	14:18:00	18:00:00	SNEG	wader	218

## Effort-correction

An effort-correction model was applied to account for possible sources of error and varying effort (in terms of survey length and unit area) in the data collection process. The modeling framework proposed by Link et al. (2008) was employed, in which variation in observations is partitioned into assorted categories to yield an effort-corrected abundance count via an overdispersed hierarchical mixed-effects linear model, in which counts are assumed to follow a Poisson distribution.

The original model is applied to Audubon Christmas Bird Count and Breeding Bird Survey data, and includes effects for strata, circles/routes, observers, year, and effort (which includes survey

length; Link et al. 2008). The analogous categories for the IWMM are USFWS Region, unit, observers, year, and effort. This model is extended here by adding consideration of seasonal effects (both linear and quadratic).

Effort is estimated by using the traditional effort correction (i.e., length of a survey divided by the average length of all surveys in the dataset; 'Effort Correction') as a normally distributed parameter. The global model has the following form:

 $Count \sim Year + Region + Unit + Observer + Seasonal + Seasonal^2 + Effort + Error$ 

The *Effort* component of this model includes two further parameters, B and p, in addition to the traditional effort correction factor, E, and is modeled as

$$Effort = B \times \frac{E^{p-1}}{p}$$

where *B* and *p* are region-specific parameters with normal prior distributions. Link et al. (2008) note that when B = 1, the limit as  $p \rightarrow 0$  of this formulation reduces to the traditional effort correction factor. The flexibility of this approach makes it useable even under conditions of minimal effects of variability in survey effort among participants, as may be expected with a rigorously controlled monitoring protocol such as the IWMM Program.

After the effort-correction was applied to the observed data, the percent deviation (D) of effortcorrected counts from observed counts was calculated for each species. This calculation is:

$$D=\frac{\bar{E}-\bar{X}}{\bar{X}}\times 100\,,$$

where  $\overline{E}$  is the average effort-corrected count and  $\overline{X}$  is the average observed count for each species. This allows for an evaluation of the degree of difference between the corrected and observed counts.

This model was formulated using Stan (v. 2.10.0, Stan Development Team 2015, Carpenter et al. 2016) implemented in R (v. 3.3.1, R Core Team) via the package 'rstan'. Further details of the application of the Link et al. (2008) effort-correction model to IWMM data can be found in Aagaard et al. (*in prep*).

#### **Regional trends**

Basic population trends were created to show the overall trajectory of effort-corrected waterbird abundance across and within years, for each Region (3, 4, and 5) by guild. These trends show the total number of waterbirds counted in each Region, side by side, for the duration of the IWMM Pilot Data period (2010-2014). They are then broken down within year to show seasonal variation in total waterbird abundance throughout each year (non-breeding period only).

### Community and guild composition

#### Community composition

To assess the community composition of each unit (grouped by USFWS Region), three metrics were computed: species richness (R; the sum of the unique species observed—eqn 1), species diversity (D, the Shannon Diversity Index—the number of individuals belonging to a given species,  $s_i$ , divided by the number of species ( $s_i / R = p_i$ ), then multiplied by the natural logarithm of this proportion, and finally summed together for each area of interest [unit, site, Region], and negated—eqn 2), and species evenness (E; accounting for the number of individuals of each species; the quotient of the diversity and the natural logarithm of the richness—eqn 3).

$$R = \Sigma (unique species) eqn 1$$

$$D = -\sum \frac{s_i}{R} \times \ln\left(\frac{s_i}{R}\right) = -\sum p_i \times \ln(p_i)$$
eqn 2

$$E = \frac{D}{\ln(R)}$$
 eqn 3

All three metrics are presented simultaneously in the resulting output (see Results). Unfortunately, values for these three metrics occurred on scales that varied by an order of magnitude, making it difficult to visualize them concurrently. To compare the performance of units in each Region the metrics were corrected to a common scale by dividing the score for a given metric in a given unit by the maximum value for that score across all units.

#### Guild composition

The composition of the total waterbird community for each unit (by Region) was computed by guild. This value  $(P_i)$  is the number of individuals within each guild  $(N_i)$  divided by the total number of individuals across all three guilds (N), where *i* represents each guild (waterfowl, shorebirds, waders). That is:

$$P_i = \frac{N_i}{N}$$
eqn 4

The scores for each unit were plotted on a ternary diagram (a triangle plot with one axis per guild) with coordinates for a unit equal to the proportion of waterbirds belonging to each guild. Units were color-coded by Region to identify patterns.

To more explicitly reveal the community composition by unit in terms of the same community metrics used at the species level, both Shannon Diversity and Evenness were calculated per guild as well, using equations 1 through 3, with guild,  $g_i$ , instead of species,  $s_i$ .

#### **Calculating BUDs**

Bird-use-day estimates (BUDs) for relevant management units and Regions were calculated using the abundance counts (corrected for effort using the model above). The calculation is based on the area-under-the-curve method outlined in Millar et al. (2012). Essentially, the average count from two surveys, i and j, is calculated and multiplied by the difference in days between the surveys:

$$BUD = \overline{Count_{ij}} \times (day_i - day_i).$$

This value is calculated for every two successive surveys, and the final values are summed to produce the BUD estimate for the season. We further corrected this metric by computing BUDs per hectare (ha) and BUDs per ha of open water.

#### **Relationships between habitat factors and abundance**

Correlations between waterbird abundance (in terms of BUDs) and various habitat features

measured during the bird and vegetation surveys were evaluated. Features included in the correlational evaluation were the percentage of the unit covered by preferred-forage vegetation, annual plants, perennial plants, and the percentage of the unit at which the water depth was in one of six different classes (dry, saturated, 0 to 4 inches, 4 to 12 inches, 12 to 48 inches, and greater than 48 inches). This process was repeated for each guild to identify patterns potentially obscured at the aggregated level.

#### **Relative value of refuge lands**

Finally, the contribution of each unit to the Region within which it resides was calculated to quantify the value of a unit relative to all other IWMM-participating units within the Region (unit contribution index, UCI). This contribution was defined as the sum of the total BUDs, species richness (R), species evenness (E), and species-conservation score (SCS) for each unit, i, divided by the maximum of all units within a Region. This way all four of the components are on the same scale (0 to 1). Thus, the maximum possible UCI is 1 (depending on weighting scheme).

$$UCI = w_1 \left(\frac{BUDs_i}{\max(BUDs_{Reg})}\right) + w_2 \left(\frac{R_i}{\max(R_{Reg})}\right) + w_3 \left(\frac{E_i}{\max(E_{Reg})}\right) + w_4 \left(\frac{SCS_i}{\max(SCS_{Reg})}\right), \quad \text{eqn } 6$$

where  $w_i$  equals 0.25 in the base case but can be adjusted to emphasize abundance, diversity, or conservation concern as desired.

The indexed value of each unique species' IUCN threat level was assigned on a scale from 0 (not listed) to 5 (Critically Endangered). Scores of 1 through 4 correspond to Least Concern, Near Threatened, Vulnerable, and Endangered, respectively. The *SCS* represents the sum of the indexed IUCN Red List (IUCN 2001) threat level for all species represented in a unit, divided by the maximum possible IUCN Red List threat level sum for a unit with that many species. For example, a unit that supports 32 species could have a maximum IUCN Red List threat level sum of 46 (the 32 most threatened species represented in the IWMM data have an indexed threat level status sum of 46). If that unit's realized sum is 35, it has a  $SCS = \frac{35}{46} = \sim 0.76$ . This process was repeated for all units *across* Regions, such that

$$UCI = w_1 \left(\frac{BUDs_i}{\max(BUDs_{Tot})}\right) + w_2 \left(\frac{R_i}{\max(R_{Tot})}\right) + w_3 \left(\frac{E_i}{\max(E_{Tot})}\right) + w_4 \left(\frac{SCS_i}{\max(SCS_{Tot})}\right), \quad \text{eqn 7}$$

Further details of this UCI score formulation are available in Aagaard and Thogmartin (in prep).

#### Results

#### General data trends and observations

There were 166,154 observations from 1,145 bird surveys conducted between 25 January 2010 and 11 July 2014 (Figure 3). There were 3,747 observations from 354 vegetation surveys conducted between 07 August 2010 and 24 June 2013. Merging these observations into a single dataset (i.e., associating all bird surveys with relevant vegetation surveys) resulted in 166,051 observations (Figure 3). Applying the restrictions outlined above produced a final dataset of 131,412 observations (Figure 3).

The 694 units had an average area of 101.17 ha (range = 0.26 to 5,015.71 ha). Bird surveys lasted on average 76.41 minutes (sd = 83.29, se = 0.23, range = 1 to 592). The most represented guild was waterfowl (33,152,968), followed by shorebirds (1,373,636) and wading birds (280,987). The most abundant species in the pilot data was the snow goose (11,572,795). The snow goose and mallard (10,080,638) accounted for 60.73% of all individuals counted, with no other species recorded in excess of 2,210,000.



*Figure 3. Data size as restrictions were applied during data management.* 

#### **Effort-correction**

In general, there was good agreement between observed and effort-corrected counts (Figure 4). The posterior distribution for the parameter *p* included 0, but for *B*, 1 was not included in the posterior distribution, suggesting that for these data, the flexible effort-effect model of Link et al. (2008) was different from the traditional effort correction (mean *B* [and 95% CI] = 0.29 [-0.19, 0.66] and p = 0.47 [-0.82, 5.78]).



Figure 4. Densities of model-corrected and observed counts on the natural log scale.

In evaluating the average percent deviation, the effort-corrected counts tended to be less than the observed counts (Figure 5; mean percent deviance = -6.56, sd = 11.9). This suggests that the general effect of effort is to slightly reduce observed counts; this effect is consistent with the direction of the mean of the posterior means of all of the effort-effects (-0.24). This trend was born out across Regions for all guilds (Figure 5).

The wader guild was the only one to show positive median percent deviation (Figure 5). This is likely a result of the low numbers of wading birds in the record and their general tendency not to flock to the degree that shorebirds and waterfowl do.



Figure 5. Percent deviation for all data and for each guild, separated by Region. A value of -20 means the effort-corrected count is 20% less than the observed count.

## **Regional trends**

Region 3 yielded substantially greater effort-corrected waterbird abundances (mean abundance

per unit) than Regions 4 and 5, which were roughly equivalent over the course of the pilot phase, excepting 2014 (Figure 6). Abundance in Region 3 was particularly high in 2012 and 2013, with a sharp decline in 2014. This is partly explained by increased participation (i.e., more units surveyed) as the pilot phase progressed, and the end of the period of record occurring in the spring of 2014 (thus missing autumn survey results that year). However, even after the number of units participating was accounted for by calculating the mean waterbirds per unit, this drop persisted. It appears that the primary reason for the 2012/2013 surplus was driven by two counts of snow geese at Eagle Pool in Squaw Creek NWR; the first of 1.25 million observed on 17 February 2012, and the second of just over 1 million on 11 February 2013. In fact, the abundance in 2011 can primarily be explained by a large count of 382,534 snow geese at the same unit on 27 December 2011. These birds were not observed as the moved to other Regions due to a lack of participating units in the relevant areas during this time period.

Region 3 represented the overwhelming majority of bird abundance in the observed counts (see Appendix III). Applying the effort-correction model reduced the cumulative estimate for all Regions (Appendix III). The effort-correction model corrects each observation and accounts for error attributable to unit and site effects, but it does not aggregate counts at the Regional level to scale for the number of units and sites per Region. This scaling procedure (Effort-corrected count / Units per Region; and, Effort-corrected count / Sites per Region) allows for "apples to apples" comparisons by showing the estimated effort-corrected abundances per Region if each Region had the same number of units and sites. Applying this scaling correction revealed modest modifications to each Region's estimated total abundance metric, but preserved the same rank order of Regions as was generated after the effort-correction model alone (see Appendix III).

The abundance overall is driven primarily by waterfowl, the most abundant guild in the dataset, and Region 3 supports the greatest proportion of waterfowl.

Seasonal variation in abundance in individual Regions indicates heaviest use of the Regions during the mid-winter period (December to February). Region 4 tends to support the greatest proportion of wading birds out of the three Regions, while Region 5 supports the greatest proportion of shorebirds, and Region 3, again, primarily supports waterfowl.

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Figure 6. Average effort-corrected abundance estimates per unit, by year, for each Region.

## Community and guild composition

## Community composition

Average species richness at the unit level ranged from 1 to 66, with a mean of 26.95 (sd = 12.74). Shannon diversity ranged from 0 to 2.86 (mean =1.78, sd = 0.51) and species evenness ranged from 0 to 1 (mean = 0.56, sd = 0.15).

Region 5 housed the unit that supported the highest species richness (Chincoteague NWR, B South). The unit supporting the greatest diversity was in Region 4 (Altamaha WMA, Butler Island). The unit with the greatest species evenness was from Region 3 (Clarence Cannon NWR, Levee Ditch, MSU7). Region 5 also had the highest unit-median values for species richness (31) and diversity (1.98); Region 4, however, had the highest unit-median value for species evenness (0.63; Figure 7).



Figure 7. Species richness, diversity, and evenness for each unit, grouped by Region.

#### Guild composition

The ternary plot of proportional guild abundance per Region further demonstrates the greater relative abundance of waterfowl than wading birds or shorebirds in all Regions (Figure 8). Also demonstrated in Figure 8 is the general reliance on Region 4 by wading birds and shorebirds. This reinforces the high evenness value demonstrated by Region 4 and depicted in Figure 7.

Region 4 had the greatest median relative species diversity (0.26), while Region 5 had the greatest median relative species evenness (0.28; Figure 9). Median relative guild richness was 1 for all regions (there is a greater likelihood of at least one unit in each Region supporting all three guilds than there is of one unit supporting all observed species). Figure 9 also emphasizes the prevalence in Region 3 of waterfowl, while Regions 4 and 5 tend to support a broader diversity of guilds more evenly.



Figure 8. Ternary diagram showing proportional abundance of each of the three target guilds in at each unit, color coded by Region.



Figure 9. Guild composition (richness, diversity, evenness) at the unit level, by Region.

### **Calculating BUDs**

Applying the BUDs calculation to the effort-corrected estimates yielded BUDs ranging from 0.64 to 28,393,330 (mean = 82,877.51; sd = 732,459.90). When accounting for the area of units and the area of open water at each unit, the area-scaled BUD range was restricted to 0.05 to 397,860.5 BUDs/ha (mean = 2,520.21; sd = 13,245.83) and 0 to 1,473.56 BUDs/ha-open-water (mean = 1.04; sd = 28.35).

Figure 10 depicts BUDs/ha on the natural log-scale, color coded by Region (see Appendix IV for BUDs/ha of open water). Mean BUDs/ha for units by Region were 2,700.42 (Region 3), 835.76 (Region 4), and 3,151.81 (Region 5), with median values of 227.44 (Region 3), 216.43 (Region 4), and 257.42 (Region 5). This demonstrates the skewed nature of the BUDs by unit; many more low BUD values than high.



Figure 10. BUD estimates per area of unit (in hectares), by Region

#### Relationships between habitat factors and abundance

Three BUD metrics were evaluated; raw, scaled by area, and scaled by area of open water. In the aggregate, there were mostly weak relationships among the various habitat factors measured during the surveys and these BUD metrics, but the correlation between BUDs per hectare and water depth corresponding to 12 to 48 inches was the strongest (Figure 11). A regression of BUDs per unit-area with water depth class 5 emphasized this positive relationship (regression coefficient =  $368.5 [\pm 13.08 \text{ SE}]$ , p < 0.001).

This pattern remained when these relationships were evaluated by isolating target guilds (see Appendix V), especially with shorebirds (correlation coefficient = 0.6), suggesting that units that have a high proportion of their area occupied by 12 to 48 inches of water may provide optimal habitat for shorebirds. This is not to say that 12 to 48 inches is optimal for shorebirds, but it may indicate the presence of other conditions that are optimal.



Figure 11. Correlation matrix of habitat factors and shorebird abundance.

## **Relative value of refuge lands**

The unit-specific contribution to migratory waterbirds across Regions ranged from 0.03 to 0.81, with a mean of 0.56 (sd = 0.10) (Fig. 1). When scaled to identify the relative contribution of each unit compared to all units  $\left(\frac{UCI_i}{\Sigma UCI}\right)$ , the mean was 0.0015 (sd = 0.0004), indicating that each IWMM participating unit contributes, on average, 0.15% to the total value represented by all units combined for migratory waterbirds (in terms of species diversity, abundance, and conservation status). The maximum UCI-percent contribution was 0.28%, from Chincoteague



National Wildlife Refuge, Unit B (South), in Region 5.

Figure 12. Relative contribution to waterbird conservation, in terms of species diversity, abundance, and conservation status of each IWMM participating unit, within and across Regions.

The mean ( $\pm$  sd) across-Region UCIs were 0.53 ( $\pm$  0.08, Region 3), 0.55 ( $\pm$  0.07, Region 4), and 0.63 ( $\pm$  0.0.9, Region 5) (Fig. 1). These mean ( $\pm$  sd) values increased when calculating the *within*-Region UCIs for Regions 3 and 4: 0.60 ( $\pm$  0.10, Region 3), 0.64 ( $\pm$  0.10, Region 4), but decreased for Region 5: 0.58 ( $\pm$  0.10).

For a tabular form of the UCI data, including the species composition metrics and BUD estimates used to calculate UCI, see Appendix VI.

## Conclusions

The dataset compiled using the IWMM protocols during the pilot phase of the program is cumulatively large and generally free from many types of easily avoidable error (i.e., data entry errors; only 0.12% of data on focal guilds were excluded for this reason). Other, more pernicious

sources of error persisted in the dataset, but the application of existing techniques to account for them produced corrected data for further analyses (e.g., variable effort in surveys) and put the data into management relevant units (i.e., BUDs). No compelling relationships between habitat factors and waterbird abundance were identified, but this result is not surprising in light of other recent investigations of a similar nature (e.g., Aagaard et al. 2015). The likely cause for the lack of relationships found in this regard relates to habitat variables not measured by the presentlyevaluated protocols: e.g., invertebrate populations which serve as forage material for waterbirds, or agricultural waste in the area surrounding wetlands. Inclusion of these variables in future protocols would help illuminate their potential connections to local waterbird abundance.

Future efforts aimed at evaluating combinations of predictors (e.g., open water + forage availability + sanctuary; season + location) are certainly warranted to further investigate potential relationships. The procedures and analyses employed here serve as a model for future efforts to summarize IWMM Program data as surveys accumulate more information for the database. Periodic reviews of the state of the data are essential for evaluating the effectiveness of monitoring protocols and for assessing adherence to data quality control standards by participating units. Having this review process available in "canned" format will be of use to future reviews.

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## **Appendix I: IUCN Threat Status**

List of threat-status for each species represented in the IWMM data, as determined by the IUCN Red List. Index scores correspond to not listed (0), Least Concern, Near Threatened, Vulnerable, Endangered, Critically Endangered (1 to 5, respectively). Cumulative Sum of IUCN Index represents the running total of IUCN Index scores in decreasing order of species threat level; this is used to calculate the maximum score for a unit. That is, a unit with 15 species could maximally support an IUCN threat level index of 29 (up to American Oystercatcher).

Common Name	IUCN Index
Whooping Crane	4
American Woodcock	3
Long-tailed Duck	3
Black Scoter	2
Buff-breasted Sandpiper	2
Piping Plover	2
Red Knot	2
Reddish Egret	2
Semipalmated Sandpiper	2
Snowy Plover	2
American Avocet	1
American Bittern	1
American Black Duck	1
American Golden-Plover	1
American Oystercatcher	1
American Wigeon	1
Baird's Sandpiper	1
Black-bellied Plover	1
Black-bellied Whistling-Duck	1
Black-crowned Night-Heron	1
Black-necked Stilt	1

Blue-winged Teal	1
Brant	1
Bufflehead	1
Cackling Goose	1
Canada Goose	1
Canvasback	1
Cattle Egret	1
Common Goldeneye	1
Common Merganser	1
Common Snipe	1
Dunlin	1
Eurasian Wigeon	1
Fulvous Whistling-Duck	1
Gadwall	1
Glossy Ibis	1
Godwit	1
Great Blue Heron	1
Great Egret	1
Greater Scaup	1
Greater White-fronted Goose	1
Greater Yellowlegs	1
Green Heron	1
Green-winged Teal	1
Hooded Merganser	1
Killdeer	1
Least Sandpiper	1
Lesser Scaup	1
Lesser Yellowlegs	1
Limpkin	1
Little Blue Heron	1

Long-billed Dowitcher	1
Mallard	1
Marbled Godwit	1
Mottled Duck	1
Mute Swan	1
Northern Pintail	1
Northern Shoveler	1
Pectoral Sandpiper	1
Purple Sandpiper	1
Red-breasted Merganser	1
Redhead	1
Ring-necked Duck	1
Roseate Spoonbill	1
Ross's Goose	1
Ruddy Duck	1
Ruddy Turnstone	1
Sanderling	1
Sandhill Crane	1
Semipalmated Plover	1
Short-billed Dowitcher	1
Snow Goose	1
Snowy Egret	1
Solitary Sandpiper	1
Spotted Sandpiper	1
Stilt Sandpiper	1
Surf Scoter	1
Tricolored Heron	1
Trumpeter Swan	1
Tundra Swan	1
Upland Sandpiper	1

Western Sandpiper	1
Whimbrel	1
White Ibis	1
White-faced Ibis	1
White-rumped Sandpiper	1
White-winged Scoter	1
Willet	1
Wilson's Phalarope	1
Wilson's Plover	1
Wilson's Snipe	1
Wood Duck	1
Wood Stork	1
Yellow-crowned Night-Heron	1



**Appendix II: Effort-correction Supplemental Material** 

Relationship of survey effort metrics with count records. The upper-right plots show the correlation of the metrics in the given column and row; the diagonal plots show the kernel densities for each metric; the bottom-left plots show the scatter plots of the pairs of metrics in a given column and row with simple linear regressions for each Region overlaid.



Appendix III: Regional Trends Supplemental Material

Regional abundance comparisons using observed, effort-corrected, and Site and Unit scaled abundances for US FWS Regions 3, 4, and 5. Site and Unit scaled abundances represent the total effort-corrected abundances per Region divided by the number of sites per Region and units per Region, respectively.



Region 3 seasonal variation in effort-corrected abundance



Region 4 seasonal variation in effort-corrected abundance



Region 5 seasonal variation in effort-corrected abundance



Appendix IV: Calculating BUDs Supplemental Material

BUD estimates per area of open-water on the unit (in hectares), by Region



# Appendix V: Habitat Factors and Abundance Supplemental Material

Correlation matrix of habitat factors and shorebird abundance for waterfowl

![](_page_35_Figure_0.jpeg)

Correlation matrix of habitat factors and shorebird abundance for shorebirds

![](_page_36_Figure_0.jpeg)

Correlation matrix of habitat factors and shorebird abundance for wading birds

Region	Site	BUDs	Richness	Evenness	SCS	Within- Regions	Across- Regions
Region		Debs	Intelliess	Lienness	505	UCI	UCI
Reg3	Horseshoe Duck Club	397873.4	11	0.14	11	0.42	0.37
Reg3	C. Cannon NWR	282235.6	28	0.23	28	0.62	0.54
Reg3	Squaw Creek NWR	152333.0	49	0.13	50	0.74	0.63
Reg3	Paric/Maryland	149692.2	29	0.22	29	0.62	0.54
Reg3	Mtc Club & Ca	134252.7	15	0.02	15	0.42	0.37
Reg3	Limit Club	130733.5	27	0.31	27	0.62	0.54
Reg3	Delair	125939.0	35	0.30	38	0.71	0.61
Reg3	Delair	102365.5	27	0.34	27	0.62	0.55
Reg3	C. Cannon NWR	85244.7	30	0.28	31	0.64	0.56
Reg3	Delair	52480.9	27	0.30	27	0.60	0.53
Reg3	Squaw Creek NWR	45131.6	35	0.42	36	0.70	0.61
Reg3	Squaw Creek NWR	45131.6	35	0.42	36	0.70	0.61
Reg3	Squaw Creek NWR	36448.8	47	0.27	48	0.74	0.64
Reg3	Delair	35281.4	34	0.43	36	0.70	0.62
Reg3	Squaw Creek NWR	25281.6	41	0.37	42	0.72	0.63
Reg3	Bk Leach	25136.1	24	0.39	24	0.59	0.52
Reg3	Bk Leach	25136.1	24	0.39	24	0.59	0.52
Reg3	C. Cannon NWR	22790.9	30	0.34	30	0.62	0.54
Reg3	Squaw Creek NWR	21510.0	38	0.42	39	0.71	0.62
Reg3	Squaw Creek NWR	18851.8	53	0.36	54	0.79	0.68
Reg3	Squaw Creek NWR	17751.8	34	0.49	35	0.70	0.61
Reg3	Squaw Creek NWR	17076.2	38	0.43	39	0.71	0.62
Reg3	Two Rivers NWR	16456.4	18	0.49	18	0.54	0.49
Reg3	C. Cannon NWR	15571.6	23	0.40	24	0.58	0.52
Reg3	Squaw Creek NWR	15571.5	37	0.33	37	0.67	0.58
Reg3	Mtc Club & Ca	15495.4	29	0.38	30	0.63	0.55
Reg3	Two Rivers NWR	15186.1	23	0.51	23	0.60	0.53
Reg3	C. Cannon NWR	14699.4	28	0.47	28	0.63	0.56
Reg3	C. Cannon NWR	13852.0	39	0.49	40	0.73	0.64
Reg3	Blackmore	13844.6	28	0.55	28	0.65	0.58
Reg3	Squaw Creek NWR	13650.1	38	0.39	39	0.70	0.61
Reg3	C. Cannon NWR	13371.9	32	0.51	32	0.67	0.59
Reg3	C. Cannon NWR	12807.3	27	0.47	27	0.62	0.55
Reg3	Mingo	11544.9	11	0.51	11	0.45	0.41
Reg3	Mingo	11348.2	11	0.51	11	0.45	0.41
Reg3	Pool 8 WICA	11301.9	23	0.52	25	0.62	0.55
Reg3	Blackmore	10992.2	26	0.53	26	0.63	0.55

Appendix VI: Habitat Contribution Index Supplemental Material

Reg3	Baldwin Land Co.	10887.6	28	0.51	28	0.64	0.56
Reg3	C. Cannon NWR	10359.3	31	0.51	31	0.66	0.58
Reg3	Squaw Creek NWR	9882.2	38	0.58	39	0.74	0.65
Reg3	Mtc Club & Ca	9625.5	29	0.33	29	0.60	0.52
Reg3	C. Cannon NWR	9474.2	26	0.34	26	0.58	0.50
Reg3	C. Cannon NWR	8065.2	28	0.49	28	0.63	0.55
Reg3	Horseshoe Duck Club	7810.2	27	0.55	28	0.65	0.57
Reg3	Cypress Creek NWR	7047.8	24	0.50	24	0.59	0.52
Reg3	Blackmore	7042.9	25	0.44	25	0.59	0.52
Reg3	Squaw Creek NWR	6813.3	36	0.54	37	0.71	0.62
Reg3	Mingo	6167.5	13	0.46	13	0.46	0.41
Reg3	Mingo	6064.8	12	0.47	12	0.45	0.41
Reg3	Paric/Maryland	6010.9	26	0.50	26	0.61	0.54
Reg3	Mingo	5929.0	10	0.51	10	0.43	0.39
Reg3	Pool 8 WICA	5903.7	27	0.62	27	0.65	0.58
Reg3	Mingo	5857.6	9	0.53	9	0.43	0.39
Reg3	C. Cannon NWR	5715.5	15	0.37	15	0.46	0.41
Reg3	Mingo	5510.3	11	0.55	11	0.45	0.41
Reg3	Mtc Club & Ca	5460.8	19	0.14	19	0.45	0.39
Reg3	Bk Leach	5458.5	22	0.53	22	0.58	0.52
Reg3	Mtc Club & Ca	5324.7	12	0.48	12	0.45	0.41
Reg3	Mtc Club & Ca	5106.1	13	0.30	13	0.42	0.37
Reg3	Mtc Club & Ca	4870.3	13	0.38	13	0.44	0.39
Reg3	Mingo	4804.0	6	0.50	6	0.39	0.35
Reg3	Two Rivers NWR	4697.0	14	0.53	14	0.49	0.44
Reg3	Bk Leach	4382.7	19	0.57	19	0.55	0.50
Reg3	Mingo	4300.7	10	0.48	10	0.42	0.38
Reg3	Delair	4138.8	22	0.60	22	0.59	0.53
Reg3	Mingo	3843.1	21	0.50	23	0.58	0.52
Reg3	Two Rivers NWR	3782.7	15	0.70	15	0.54	0.49
Reg3	Delair	3692.8	21	0.69	21	0.60	0.54
Reg3	Bk Leach	3649.9	27	0.59	27	0.63	0.56
Reg3	Cypress Creek NWR	3648.5	25	0.42	26	0.58	0.51
Reg3	Old Monroe	3526.4	18	0.54	18	0.53	0.48
Reg3	Mtc Club & Ca	3488.4	14	0.59	14	0.50	0.45
Reg3	Horicon NWR	3428.5	21	0.79	21	0.63	0.56
Reg3	Bryant's Creek	3371.0	22	0.45	22	0.55	0.49
Reg3	Mingo	3325.1	11	0.50	11	0.43	0.39
Reg3	Blackmore	3305.0	21	0.53	21	0.56	0.50
Reg3	Squaw Creek NWR	3298.4	35	0.58	38	0.72	0.63
Reg3	Cypress Creek NWR	3292.3	29	0.42	30	0.61	0.54

Reg3	Goose Island	3083.8	23	0.47	23	0.56	0.50
Reg3	Squaw Creek NWR	2995.4	28	0.44	28	0.60	0.53
Reg3	Limit Club	2913.2	17	0.37	17	0.48	0.42
Reg3	Rice Lake NWR	2904.7	18	0.17	18	0.44	0.38
Reg3	Two Rivers NWR	2807.0	12	0.35	12	0.41	0.37
Reg3	Bk Leach	2762.5	26	0.57	26	0.61	0.54
Reg3	Mingo	2759.0	7	0.59	7	0.41	0.38
Reg3	C. Cannon NWR	2743.4	24	0.50	24	0.58	0.51
Reg3	Squaw Creek NWR	2716.4	19	0.43	19	0.51	0.46
Reg3	Mingo	2692.5	9	0.49	9	0.40	0.37
Reg3	Bk Leach	2629.4	18	0.51	18	0.52	0.46
Reg3	Mtc Club & Ca	2613.5	21	0.49	21	0.55	0.49
Reg3	C. Cannon NWR	2603.0	21	0.48	21	0.54	0.48
Reg3	C. Cannon NWR	2408.9	17	0.32	17	0.46	0.41
Reg3	Mingo	2365.5	8	0.55	8	0.41	0.37
Reg3	Foley	2351.7	10	0.64	10	0.45	0.41
Reg3	Old Monroe	2332.0	16	0.60	16	0.52	0.47
Reg3	Foley	2297.1	18	0.62	18	0.55	0.49
Reg3	Horseshoe Duck Club	2286.1	16	0.40	16	0.47	0.42
Reg3	Horseshoe Duck Club	2244.7	18	0.50	18	0.52	0.46
Reg3	Horseshoe Duck Club	2203.2	16	0.54	16	0.50	0.45
Reg3	Bk Leach	2189.7	18	0.53	18	0.52	0.47
Reg3	Horicon NWR	2185.3	32	0.56	35	0.69	0.60
Reg3	Padfield	2125.1	14	0.71	14	0.52	0.47
Reg3	Horseshoe Duck Club	2118.5	13	0.38	13	0.42	0.38
Reg3	Horseshoe Duck Club	2098.4	8	0.07	8	0.29	0.25
Reg3	C. Cannon NWR	2080.8	22	0.21	22	0.48	0.42
Reg3	Bk Leach	2042.4	21	0.60	21	0.57	0.51
Reg3	Foley	1976.6	14	0.56	14	0.48	0.43
Reg3	Mtc Club & Ca	1943.8	10	0.12	10	0.32	0.28
Reg3	C. Cannon NWR	1873.6	7	0.18	7	0.30	0.27
Reg3	Paric/Maryland	1831.5	7	0.09	7	0.28	0.25
Reg3	Mallard Point	1762.7	18	0.25	18	0.45	0.39
Reg3	Two Rivers NWR	1746.7	10	0.82	10	0.49	0.45
Reg3	Two Rivers NWR	1669.5	9	0.33	9	0.36	0.32
Reg3	Horseshoe Duck Club	1594.0	16	0.27	16	0.43	0.38
Reg3	Wilke/Purdy/Timmerman	1504.3	21	0.68	21	0.58	0.52
Reg3	Two Rivers NWR	1492.9	14	0.49	14	0.46	0.41
Reg3	Horicon NWR	1458.6	25	0.70	25	0.63	0.56
Reg3	C. Cannon NWR	1411.5	18	0.75	18	0.57	0.52
Reg3	Shuck WMA	1409.2	9	0.42	9	0.38	0.34

Reg3	Squaw Creek NWR	1407.1	24	0.30	25	0.53	0.46
Reg3	Goose Island	1390.6	17	0.66	17	0.54	0.48
Reg3	Horicon NWR	1287.6	16	0.69	16	0.53	0.48
Reg3	Horicon NWR	1283.6	24	0.62	24	0.60	0.53
Reg3	C. Cannon NWR	1272.3	17	0.47	17	0.49	0.44
Reg3	Horseshoe Duck Club	1260.0	16	0.51	16	0.49	0.43
Reg3	Horicon NWR	1247.9	28	0.76	28	0.67	0.60
Reg3	C. Cannon NWR	1186.8	29	0.76	29	0.67	0.60
Reg3	Horicon NWR	1104.7	14	0.72	14	0.51	0.47
Reg3	Mingo	994.0	9	0.57	9	0.41	0.37
Reg3	Paric/Maryland	954.3	21	0.65	21	0.57	0.51
Reg3	Horseshoe Duck Club	925.7	12	0.48	12	0.42	0.38
Reg3	Paric/Maryland	876.7	6	0.47	6	0.35	0.32
Reg3	Wilts WMA	761.3	18	0.66	18	0.54	0.49
Reg3	UMR NW&FR, Winona	758.8	24	0.64	24	0.59	0.53
Reg3	Cypress Creek NWR	736.4	10	0.78	10	0.46	0.43
Reg3	Mallard Point	731.8	21	0.25	21	0.47	0.41
Reg3	Old Monroe	727.4	13	0.32	13	0.39	0.35
Reg3	Trempealeau NWR	696.1	25	0.74	25	0.63	0.56
Reg3	Horicon NWR	695.5	20	0.70	23	0.61	0.55
Reg3	Wilke/Purdy/Timmerman	686.5	10	0.68	10	0.44	0.40
Reg3	Paric/Maryland	662.3	12	0.30	12	0.37	0.33
Reg3	Artichoke WPA	578.2	9	0.52	9	0.39	0.35
Reg3	Bk Leach	567.3	19	0.67	19	0.55	0.49
Reg3	Jenk	564.8	18	0.63	18	0.53	0.47
Reg3	Baldwin Land Co.	540.7	13	0.73	13	0.49	0.45
Reg3	Paric/Maryland	504.0	18	0.61	18	0.52	0.47
Reg3	Giese WPA	476.6	12	0.58	12	0.44	0.40
Reg3	Horicon NWR	468.7	18	0.57	18	0.51	0.46
Reg3	Padfield	464.8	10	0.72	10	0.44	0.41
Reg3	C. Cannon NWR	463.3	23	0.50	23	0.54	0.48
Reg3	Pepperton WPA	456.7	10	0.71	10	0.44	0.41
Reg3	Mingo	453.9	3	0.33	3	0.26	0.24
Reg3	Mosquito Ranch	447.9	17	0.56	17	0.49	0.44
Reg3	Pepperton WPA	432.4	22	0.69	22	0.58	0.52
Reg3	Long Lake/Edwards WPA	426.3	12	0.65	13	0.47	0.43
Reg3	C. Cannon NWR	417.6	18	0.57	18	0.51	0.45
Reg3	Mingo	414.9	4	0.62	4	0.35	0.33
Reg3	Cypress Creek NWR	409.2	10	0.69	10	0.43	0.40
Reg3	Toqua	403.9	17	0.68	17	0.52	0.47
Reg3	Horseshoe Duck Club	370.7	10	0.65	10	0.42	0.39

Reg3	North Ottawa Refuge	364.0	31	0.50	31	0.61	0.53
Reg3	Paric/Maryland	354.6	11	0.65	11	0.43	0.40
Reg3	Swift-Kube WMA	353.8	7	0.67	7	0.40	0.37
Reg3	Mtc Club & Ca	345.0	18	0.65	18	0.52	0.47
Reg3	Wente WPA	338.8	19	0.73	19	0.56	0.50
Reg3	Horicon NWR	332.8	19	0.63	19	0.53	0.47
Reg3	Winfield	330.8	12	0.65	12	0.45	0.41
Reg3	Chokio WPA	329.7	16	0.63	16	0.50	0.45
Reg3	Mingo	317.2	3	0.76	3	0.36	0.34
Reg3	Bk Leach	314.0	13	0.38	13	0.40	0.35
Reg3	Pepperton WPA	307.9	13	0.66	13	0.47	0.42
Reg3	Kensington WMA	303.2	10	0.75	10	0.44	0.41
Reg3	Kensington WMA	303.2	10	0.75	10	0.44	0.41
Reg3	Paric/Maryland	298.5	16	0.64	16	0.50	0.45
Reg3	Squaw Creek NWR	283.4	11	0.72	11	0.45	0.41
Reg3	Sherstad Slough WPA	279.3	23	0.71	23	0.59	0.52
Reg3	Delair	277.7	19	0.73	20	0.56	0.51
Reg3	Wilke/Purdy/Timmerman	272.1	14	0.46	15	0.44	0.39
Reg3	Pepperton WPA	261.1	7	0.62	7	0.38	0.35
Reg3	Cypress Creek NWR	256.1	18	0.70	18	0.53	0.48
Reg3	Mtc Club & Ca	236.4	12	0.60	12	0.43	0.39
Reg3	Mingo	235.9	5	0.46	5	0.32	0.29
Reg3	Bk Leach	227.3	16	0.60	16	0.48	0.43
Reg3	Nelson Lake WPA	226.6	9	0.38	9	0.34	0.30
Reg3	Mingo	216.8	8	0.57	8	0.38	0.35
Reg3	Loen WPA	214.2	3	0.37	3	0.26	0.24
Reg3	Malinmor	197.1	12	0.30	12	0.35	0.32
Reg3	Long Lake/Edwards WPA	195.6	14	0.80	14	0.51	0.46
Reg3	Pepperton WPA	191.6	10	0.50	10	0.37	0.34
Reg3	Swift-Kube WMA	183.0	15	0.56	15	0.46	0.41
Reg3	Robinhood	180.9	20	0.76	20	0.56	0.51
Reg3	Giese WPA	178.4	17	0.78	18	0.55	0.50
Reg3	Mingo	171.3	2	0.67	2	0.32	0.30
Reg3	Two Rivers NWR	166.6	3	0.60	3	0.31	0.29
Reg3	Wilke/Purdy/Timmerman	166.0	11	0.46	11	0.38	0.34
Reg3	Rice Lake NWR	160.8	10	0.61	10	0.40	0.37
Reg3	Seidl	150.9	18	0.48	18	0.47	0.42
Reg3	Mosquito Ranch	149.5	22	0.73	22	0.57	0.51
Reg3	Mtc Club & Ca	145.8	2	0.00	2	0.15	0.13
Reg3	Toqua	144.9	11	0.66	11	0.42	0.39
Reg3	Winfield	137.5	11	0.57	11	0.40	0.37

Reg3	Cypress Creek NWR	125.2	9	0.32	9	0.31	0.28
Reg3	Paric/Maryland	117.8	12	0.56	12	0.41	0.37
Reg3	Long Lake/Edwards WPA	116.4	10	0.62	10	0.40	0.36
Reg3	Seney NWR	105.8	10	0.30	10	0.31	0.28
Reg3	Swift-Kube WMA	100.5	20	0.79	21	0.57	0.52
Reg3	Seney NWR	98.2	9	0.35	9	0.32	0.29
Reg3	Barry Lake	95.3	17	0.82	17	0.53	0.49
Reg3	Paric/Maryland	91.1	8	0.15	8	0.26	0.23
Reg3	Smith WPA	90.4	11	0.74	11	0.44	0.40
Reg3	Red Rock Lake WMA	90.1	12	0.63	12	0.42	0.39
Reg3	Barry Lake	88.5	12	0.78	12	0.46	0.42
Reg3	Karsky	87.1	12	0.64	12	0.42	0.39
Reg3	Delair	79.4	4	0.51	4	0.29	0.27
Reg3	Moen WPA	68.7	8	0.80	8	0.41	0.39
Reg3	Long Lake/Edwards WPA	56.7	4	0.21	4	0.21	0.19
Reg3	Horseshoe Duck Club	56.7	9	0.76	9	0.41	0.38
Reg3	Olson WPA	55.2	7	0.83	7	0.41	0.38
Reg3	Foley	53.9	14	0.73	14	0.47	0.43
Reg3	Paric/Maryland	52.2	10	0.65	10	0.39	0.36
Reg3	Long Lake/Edwards WPA	50.7	5	0.66	5	0.34	0.32
Reg3	Towner WMA	50.2	7	0.75	7	0.39	0.36
Reg3	Stewart WPA	45.3	6	0.71	6	0.37	0.34
Reg3	Lane	44.5	12	0.74	12	0.44	0.40
Reg3	Bergerud WMA	41.4	9	0.86	9	0.43	0.40
Reg3	Seney NWR	41.1	10	0.54	10	0.36	0.33
Reg3	Mud Lake/Erlandson WMA	40.2	13	0.52	13	0.40	0.36
Reg3	Seney NWR	38.9	4	0.56	4	0.30	0.28
Reg3	Marple WMA	36.8	10	0.80	10	0.42	0.39
Reg3	Levee Ditch	36.1	3	1.00	3	0.39	0.37
Reg3	Seney NWR	34.5	6	0.67	6	0.35	0.33
Reg3	Wiley WPA	33.0	7	0.88	7	0.41	0.39
Reg3	Long Lake/Edwards WPA	29.7	2	0.86	2	0.34	0.32
Reg3	Red Rock Lake WMA	26.9	14	0.77	14	0.47	0.43
Reg3	Karsky	24.5	9	0.77	9	0.40	0.37
Reg3	Seney NWR	22.8	6	0.24	6	0.24	0.21
Reg3	Wilke/Purdy/Timmerman	19.8	8	0.26	8	0.26	0.23
Reg3	Boehnke	19.7	10	0.75	10	0.40	0.37
Reg3	Loen WPA	19.3	3	0.55	3	0.26	0.25
Reg3	Rice Lake NWR	19.2	4	0.68	4	0.31	0.30
Reg3	Horseshoe Duck Club	18.5	5	0.38	5	0.26	0.24
Reg3	Bergerud WMA	18.0	9	0.69	9	0.38	0.35

Reg3	Horseshoe Duck Club	17.9	6	0.53	6	0.31	0.28
Reg3	Old Monroe	17.3	5	0.75	5	0.35	0.33
Reg3	Levee Ditch	17.2	5	0.66	5	0.33	0.30
Reg3	Walden WPA	16.7	2	0.41	2	0.22	0.20
Reg3	Seney NWR	16.6	8	0.65	8	0.35	0.33
Reg3	Seney NWR	15.6	8	0.50	8	0.32	0.29
Reg3	Long Lake/Edwards WPA	14.0	3	0.59	3	0.27	0.26
Reg3	Pelican Creek WMA	13.7	7	0.77	7	0.37	0.35
Reg3	Hutchinson WPA	13.6	6	0.77	6	0.36	0.34
Reg3	Shuck WMA	13.5	5	0.56	5	0.30	0.28
Reg3	Seney NWR	12.6	5	0.55	5	0.29	0.27
Reg3	Seney NWR	12.0	6	0.44	6	0.28	0.26
Reg3	Winfield	9.6	5	0.00	5	0.15	0.13
Reg3	Old Monroe	8.1	5	0.66	5	0.31	0.29
Reg3	Levee Ditch	8.1	2	0.00	2	0.10	0.09
Reg3	Limit Club	6.4	3	0.63	3	0.27	0.25
Reg3	Marple WMA	6.2	5	0.65	5	0.31	0.29
Reg3	Mtc Club & Ca	5.2	2	0.00	2	0.09	0.08
Reg3	Pelican Creek WMA	4.8	7	0.76	7	0.35	0.33
Reg3	Wiley WPA	4.8	5	0.76	5	0.33	0.31
Reg3	Foley	3.6	4	0.53	4	0.25	0.24
Reg3	Rice Lake NWR	2.7	3	0.00	3	0.10	0.08
Reg3	Wall WPA	0.5	1	0.00	1	0.04	0.03
Reg3	Paric/Maryland	0.3	4	0.00	4	0.08	0.07
Reg3	Pomme De Terre Lake	0.0	3	0.58	3	0.18	0.17
Reg4	Pocosin Lakes NWR	37681.0	15	0.53	15	0.59	0.48
Reg4	Lake Mattamuskeet	31427.8	32	0.54	32	0.76	0.61
Reg4	Harris Neck NWR	21026.0	20	0.66	20	0.66	0.55
Reg4	Lake Mattamuskeet	20764.6	33	0.45	33	0.73	0.59
Reg4	Lake Mattamuskeet	18666.7	30	0.56	30	0.73	0.60
Reg4	Harris Neck NWR	17368.0	23	0.77	23	0.72	0.60
Reg4	Lake Mattamuskeet	15580.4	26	0.45	26	0.66	0.54
Reg4	Lake Mattamuskeet	15241.8	35	0.48	35	0.75	0.60
Reg4	Bear Island	14586.2	31	0.77	31	0.79	0.65
Reg4	Grand Cote NWR	13815.4	8	0.59	8	0.48	0.41
Reg4	Bear Island	13086.1	24	0.78	24	0.72	0.60
Reg4	Harris Neck NWR	12552.0	20	0.46	20	0.60	0.49
Reg4	Futch Game Land	12014.7	28	0.57	28	0.70	0.58
Reg4	Bear Island	11017.0	29	0.82	30	0.79	0.66
Reg4	Harris Neck NWR	9931.1	25	0.60	25	0.68	0.56
Reg4	Futch Game Land	9805.8	21	0.61	21	0.64	0.53

Reg4	Futch Game Land	9586.0	17	0.67	17	0.61	0.51
Reg4	Lake Mattamuskeet	8457.1	35	0.54	36	0.76	0.62
Reg4	Lake Mattamuskeet	7811.3	32	0.55	32	0.72	0.59
Reg4	Futch Game Land	7780.8	23	0.70	23	0.68	0.57
Reg4	Bear Island	7458.7	27	0.77	27	0.73	0.62
Reg4	Bear Island	6767.4	25	0.79	25	0.72	0.61
Reg4	Harris Neck NWR	6674.5	21	0.68	21	0.65	0.55
Reg4	Bear Island	6231.0	25	0.75	25	0.70	0.59
Reg4	Futch Game Land	5958.0	24	0.67	24	0.67	0.57
Reg4	Futch Game Land	5799.1	23	0.51	23	0.62	0.52
Reg4	Bear Island	5453.9	25	0.73	25	0.70	0.59
Reg4	Futch Game Land	4950.9	29	0.64	30	0.71	0.60
Reg4	Futch Game Land	4923.0	21	0.60	21	0.61	0.52
Reg4	Pocosin Lakes NWR	4919.1	16	0.57	16	0.55	0.47
Reg4	Mackay Island NWR	4594.6	17	0.55	17	0.55	0.47
Reg4	Savannah NWR	4470.7	16	0.67	16	0.57	0.49
Reg4	Lake Mattamuskeet	4232.0	24	0.58	24	0.64	0.54
Reg4	Bear Island	4175.6	24	0.77	24	0.69	0.59
Reg4	Futch Game Land	4159.6	29	0.55	30	0.69	0.58
Reg4	Futch Game Land	3731.0	22	0.60	22	0.62	0.53
Reg4	Lake Mattamuskeet	3403.5	33	0.58	33	0.71	0.60
Reg4	Bear Island	3145.6	33	0.72	33	0.75	0.63
Reg4	Nemours Plantation	2784.7	25	0.63	25	0.65	0.55
Reg4	Pocosin Lakes NWR	2621.4	13	0.67	13	0.52	0.46
Reg4	Merritt Island NWR	2608.4	31	0.62	32	0.71	0.60
Reg4	Nemours Plantation	2568.2	29	0.65	31	0.71	0.60
Reg4	Grand Cote NWR	2473.5	9	0.53	9	0.43	0.38
Reg4	Grand Cote NWR	2405.4	6	0.69	6	0.43	0.39
Reg4	Pocosin Lakes NWR	2230.8	10	0.63	10	0.46	0.41
Reg4	Futch Game Land	2196.6	23	0.58	23	0.61	0.52
Reg4	Mackay Island NWR	2158.0	26	0.67	26	0.66	0.57
Reg4	Goose Creek	2129.2	19	0.48	19	0.54	0.46
Reg4	Merritt Island NWR	2077.4	32	0.44	33	0.66	0.56
Reg4	Savannah NWR	2030.0	18	0.62	18	0.56	0.49
Reg4	Ace Basic NWR	2003.3	17	0.84	17	0.61	0.53
Reg4	Savannah NWR	1949.5	21	0.11	21	0.46	0.39
Reg4	Futch Game Land	1892.9	23	0.53	23	0.59	0.51
Reg4	Lake Mattamuskeet	1778.9	18	0.73	18	0.59	0.52
Reg4	Lake Mattamuskeet	1761.3	24	0.63	24	0.62	0.54
Reg4	Lake Mattamuskeet	1761.0	28	0.58	28	0.65	0.56
Reg4	Nemours Plantation	1739.2	17	0.75	17	0.58	0.51

Reg4	Merritt Island NWR	1672.4	32	0.48	33	0.67	0.56
Reg4	Futch Game Land	1601.0	21	0.59	21	0.58	0.50
Reg4	Altamaha WMA	1574.2	31	0.63	31	0.69	0.59
Reg4	Savannah NWR	1565.3	15	0.72	15	0.54	0.48
Reg4	Emeralda Marsh	1523.9	33	0.45	33	0.66	0.55
Reg4	Mackay Island NWR	1375.1	23	0.58	23	0.60	0.52
Reg4	Donelly WMA	1348.9	10	0.63	10	0.44	0.40
Reg4	Mattamuskeet Ventures	1321.8	21	0.56	21	0.57	0.49
Reg4	Ace Basic NWR	1275.0	20	0.72	20	0.60	0.53
Reg4	Merritt Island NWR	1186.2	25	0.67	26	0.64	0.56
Reg4	Mackay Island NWR	1144.8	16	0.57	16	0.51	0.45
Reg4	Savannah NWR	1141.7	26	0.55	26	0.61	0.53
Reg4	Savannah NWR	1121.8	19	0.56	19	0.54	0.47
Reg4	Pocosin Lakes NWR	1077.4	15	0.55	15	0.49	0.43
Reg4	Gateway Savannah	1046.1	12	0.38	12	0.40	0.36
Reg4	Little Big Econ SF	986.2	34	0.71	36	0.74	0.63
Reg4	Elba Island	970.1	12	0.56	12	0.44	0.40
Reg4	Goose Creek	966.8	11	0.40	11	0.39	0.35
Reg4	Merritt Island NWR	882.6	19	0.26	20	0.47	0.41
Reg4	Mattamuskeet Ventures	858.8	17	0.43	17	0.47	0.42
Reg4	Savannah NWR	839.3	15	0.72	15	0.52	0.47
Reg4	Savannah NWR	824.6	11	0.42	11	0.39	0.35
Reg4	Elba Island	806.6	25	0.79	25	0.65	0.57
Reg4	Apopka	782.0	43	0.52	48	0.77	0.65
Reg4	Ace Basic NWR	762.0	21	0.81	21	0.62	0.55
Reg4	Roanoke Island	747.8	25	0.74	26	0.65	0.57
Reg4	Lake Jesup Ca	739.3	26	0.59	26	0.61	0.53
Reg4	Merritt Island NWR	732.2	33	0.44	36	0.66	0.56
Reg4	Gull Rock	707.9	24	0.50	24	0.56	0.49
Reg4	Ace Basic NWR	661.8	20	0.87	20	0.62	0.55
Reg4	Goose Creek	642.2	16	0.61	16	0.50	0.45
Reg4	Mattamuskeet Ventures	627.5	22	0.71	23	0.61	0.54
Reg4	Merritt Island NWR	599.6	24	0.47	25	0.56	0.49
Reg4	Savannah NWR	593.4	21	0.62	21	0.56	0.50
Reg4	Altamaha WMA	586.3	15	0.70	15	0.51	0.46
Reg4	Mattamuskeet Ventures	578.7	17	0.69	17	0.53	0.48
Reg4	Lake Jesup Ca	547.5	27	0.37	27	0.55	0.48
Reg4	Pocosin Lakes NWR	529.5	6	0.75	6	0.41	0.39
Reg4	Lake Mayer	516.4	19	0.41	19	0.48	0.43
Reg4	Mackay Island NWR	502.5	19	0.73	19	0.56	0.51
Reg4	Savannah NWR	454.2	21	0.76	21	0.59	0.53

Reg4	Emeralda Marsh	443.8	28	0.40	28	0.56	0.49
Reg4	Merritt Island NWR	436.8	20	0.55	22	0.55	0.49
Reg4	Lake Woodruff NWR	409.6	19	0.68	19	0.54	0.49
Reg4	Lower Roanoke River	398.5	21	0.66	22	0.57	0.51
Reg4	Savannah NWR	390.9	13	0.34	13	0.38	0.35
Reg4	Merritt Island NWR	362.3	32	0.72	34	0.70	0.61
Reg4	Mattamuskeet Ventures	360.5	14	0.51	14	0.43	0.40
Reg4	Lake Woodruff NWR	355.5	22	0.59	24	0.57	0.51
Reg4	Mattamuskeet Ventures	335.2	13	0.78	13	0.49	0.45
Reg4	Apopka	314.9	39	0.65	41	0.73	0.63
Reg4	Ace Basic NWR	309.3	7	0.52	7	0.34	0.33
Reg4	Lake Woodruff NWR	307.5	14	0.69	14	0.47	0.44
Reg4	Altamaha WMA	306.1	37	0.79	37	0.73	0.64
Reg4	Little Big Econ SF	299.0	26	0.76	26	0.63	0.56
Reg4	Savannah NWR	287.1	23	0.62	23	0.56	0.50
Reg4	Merritt Island NWR	262.4	27	0.58	29	0.61	0.54
Reg4	Apopka	233.7	28	0.62	28	0.60	0.54
Reg4	Merritt Island NWR	224.9	33	0.65	34	0.66	0.58
Reg4	Lake Woodruff NWR	215.9	24	0.69	24	0.58	0.52
Reg4	Emeralda Marsh	198.1	29	0.53	29	0.58	0.52
Reg4	Mackay Island NWR	190.8	14	0.67	14	0.46	0.43
Reg4	Donelly WMA	188.5	23	0.66	23	0.56	0.51
Reg4	Swim Lake	149.3	16	0.82	18	0.54	0.51
Reg4	Merritt Island NWR	143.3	13	0.61	14	0.43	0.41
Reg4	Bear Island	133.9	10	0.50	10	0.34	0.34
Reg4	Merritt Island NWR	127.9	34	0.72	35	0.67	0.60
Reg4	Ace Basic NWR	120.6	23	0.71	23	0.56	0.51
Reg4	Savannah NWR	114.5	8	0.91	8	0.43	0.42
Reg4	Turnbridge Plantation	110.5	10	0.68	10	0.38	0.38
Reg4	Donelly WMA	105.5	18	0.84	18	0.53	0.50
Reg4	Ford Plantation	103.7	14	0.62	14	0.43	0.41
Reg4	Bear Island	99.2	25	0.54	25	0.53	0.48
Reg4	Donelly WMA	98.8	22	0.78	22	0.56	0.52
Reg4	Lake Woodruff NWR	84.0	13	0.66	13	0.42	0.40
Reg4	Mattamuskeet Ventures	82.2	12	0.65	12	0.40	0.39
Reg4	Merritt Island NWR	71.5	31	0.77	32	0.64	0.59
Reg4	Turnbridge Plantation	69.1	2	0.35	2	0.18	0.21
Reg4	Turnbridge Plantation	66.6	10	0.50	10	0.32	0.32
Reg4	Emeralda Marsh	64.1	18	0.73	18	0.49	0.47
Reg4	Ace Basic NWR	55.2	17	0.76	17	0.48	0.46
Reg4	Mattamuskeet Ventures	55.2	13	0.68	13	0.41	0.40

Reg4	Apopka	53.3	32	0.31	32	0.51	0.46
Reg4	Farles Prairie And Lake	50.3	7	0.77	7	0.35	0.37
Reg4	Lantern Acres	49.5	6	0.73	6	0.33	0.35
Reg4	Long Pond	47.0	9	0.66	9	0.34	0.35
0	Titusville High Rise						
Reg4	Bridge	44.6	20	0.70	20	0.49	0.47
Reg4	Lantern Acres	44.4	7	0.48	7	0.27	0.29
Reg4	Emeralda Marsh	38.1	20	0.76	20	0.51	0.49
Reg4	Ace Basic NWR	38.0	11	0.40	11	0.29	0.30
Reg4	Merritt Island NWR	34.7	23	0.72	24	0.53	0.51
Reg4	Lower Roanoke River	32.4	1	0.00	1	0.04	0.09
Reg4	Grand Cote NWR	28.4	5	0.91	5	0.35	0.37
Reg4	Grand Cote NWR	22.4	10	0.68	10	0.34	0.35
Reg4	Merritt Island NWR	20.7	25	0.58	26	0.50	0.48
Reg4	Donelly WMA	19.8	19	0.77	19	0.48	0.47
Reg4	Apopka	14.7	8	0.05	8	0.14	0.18
Reg4	Savannah NWR	9.5	11	0.83	11	0.37	0.39
Reg4	Farles Prairie And Lake	7.3	6	0.95	6	0.33	0.37
Reg5	Patuxent Research Refuge	2247819.8	30	0.54	31	0.65	0.67
Reg5	Patuxent Research Refuge	2247819.8	30	0.54	31	0.65	0.67
Reg5	Patuxent Research Refuge	2247819.8	30	0.54	31	0.65	0.67
Reg5	Patuxent Research Refuge	2247819.8	30	0.54	31	0.65	0.67
Reg5	Patuxent Research Refuge	2247819.8	30	0.54	31	0.65	0.67
Reg5	Patuxent Research Refuge	2247819.8	30	0.54	31	0.65	0.67
Reg5	Patuxent Research Refuge	2247819.8	30	0.54	31	0.65	0.67
8-	Prime Hook NWR,						
Reg5	Milton. De	437783.9	48	0.38	50	0.68	0.71
Reg5	Patuxent Research Refuge	222350.7	33	0.32	36	0.58	0.62
Reg5	Patuxent Research Refuge	222350.7	33	0.32	36	0.58	0.62
Reg5	Patuxent Research Refuge	222350.7	33	0.32	36	0.58	0.62
Reg5	Patuxent Research Refuge	222350.7	33	0.32	36	0.58	0.62
	Prime Hook NWR,						
Reg5	Milton. De	155211.0	53	0.57	58	0.76	0.79
Reg5	Patuxent Research Refuge	121891.7	28	0.50	28	0.56	0.59
Reg5	Patuxent Research Refuge	121891.7	28	0.50	28	0.56	0.59
Reg5	Patuxent Research Refuge	121891.7	28	0.50	28	0.56	0.59
Reg5	Patuxent Research Refuge	121891.7	28	0.50	28	0.56	0.59
D .	Prime Hook NWR,	101500.0	20	0.46	4.1	0.60	0.66
Keg5	Prime Hook NW/P	101532.3	39	0.46	41	0.63	0.66
Reg5	Milton. De	60560.0	50	0.47	53	0.69	0.72
1050	Prime Hook NWR,	00200.0	50	0.77	55	0.07	0.12
Reg5	Milton. De	39870.3	42	0.47	43	0.62	0.66

Reg5	Montezuma NWR	33169.1	58	0.38	63	0.70	0.74
Reg5	E.B. Forsythe NWR	29187.0	44	0.71	45	0.70	0.73
Reg5	Bombay Hook NWR	26449.2	40	0.59	41	0.64	0.68
Reg5	Easterneck NWR	22767.6	4	0.10	4	0.19	0.25
	End Of West Creek Dock						
Reg5	Road	21126.9	22	0.54	25	0.52	0.57
Reg5	Cape May Point State Park	20253.6	30	0.60	31	0.58	0.62
Reg5	Back Bay NWR	16802.9	44	0.62	45	0.66	0.70
Reg5	Montezuma NWR	16684.9	35	0.38	36	0.54	0.59
Reg5	Great Swamp NWR	15431.4	19	0.57	19	0.47	0.51
Reg5	Montezuma NWR	11671.2	44	0.47	45	0.61	0.66
Reg5	Cape May Point State Park	11343.4	34	0.68	35	0.61	0.65
Reg5	Easterneck NWR	10101.8	16	0.56	16	0.42	0.48
	Private Land (Located In Town Of South Bulter						
Reg5	NY)	9718.9	27	0.52	29	0.53	0.58
Reg5	Montezuma NWR	9569.5	33	0.41	34	0.53	0.58
8	Rutgers Marine Field						
Reg5	Station	8894.9	32	0.58	37	0.60	0.65
Reg5	Back Bay NWR	8823.8	51	0.73	53	0.72	0.76
Reg5	Cape May NWR	8401.1	18	0.48	24	0.49	0.54
Reg5	Back Bay NWR	8088.5	45	0.66	46	0.66	0.70
Reg5	Easterneck NWR	7921.2	7	0.48	7	0.31	0.37
Reg5	Parker River NWR	7883.5	41	0.67	42	0.64	0.69
Reg5	Cape May NWR	7529.5	15	0.48	21	0.47	0.52
Reg5	Cape May NWR	7418.8	14	0.55	20	0.48	0.53
Reg5	Chincoteague NWR	7416.0	66	0.57	73	0.77	0.81
Reg5	Easterneck NWR	7228.7	19	0.58	20	0.47	0.52
Reg5	Chincoteague NWR	7110.0	55	0.49	59	0.68	0.73
Reg5	Iroquois NWR	6971.1	45	0.46	46	0.60	0.65
Reg5	Parker River NWR	6157.1	46	0.62	48	0.66	0.70
De a5	Montezuma Wildlife	6105 4	24	0.49	24	0.46	0.52
Reg5	Management Area	0105.4 5021.0	24	0.48	24	0.40	0.52
Reg5		5951.9	32	0.50	20 20	0.55	0.60
Reg5	Wallkill River NWR	5761.7	<u> </u>	0.57	38	0.58	0.63
Reg5	Back Bay NWK	5/01.7	41	0.57	42	0.01	0.00
Reg5	Hackensack Meadowlands	5035.0	<u> </u>	0.63	28	0.54	0.59
Reg5	Chincoteague NWK	5535.5	54 24	0.60	25	0.69	0.74
Reg5	INIONTEZUMA INWK	5400 6	34	0.62	33	0.58	0.63
Reg5		5499.6	14	0.4/	10	0.40	0.45
Reg5	Wallkill Kiver NWK	5209.4	25 42	0.54	 	0.49	0.54
Keg5	Back Bay NWK	5398.4	42	0.66	43	0.64	0.68
Keg5	Back Bay NWR	5330.3	42	0.60	43	0.62	0.67

Reg5	Chincoteague NWR	5293.1	46	0.64	47	0.65	0.70
Reg5	Cape Henlopen State Park	5290.7	45	0.52	47	0.62	0.67
Reg5	Wallkill River NWR	4962.3	44	0.50	46	0.61	0.66
Reg5	Iroquois NWR	4960.0	44	0.17	47	0.52	0.58
Reg5	Lake Lilv	4948.9	31	0.58	31	0.54	0.59
8	Montezuma Wildlife						
Reg5	Management Area	4752.1	26	0.55	26	0.49	0.55
Reg5	Easterneck NWR	4732.2	3	0.29	3	0.19	0.26
Reg5	Wallkill River NWR	4721.9	27	0.38	27	0.45	0.51
Reg5	Easterneck NWR	4660.6	13	0.53	13	0.37	0.43
Reg5	E.B. Forsythe NWR	4573.1	31	0.60	31	0.54	0.59
Reg5	Shark River Inlet	4418.5	41	0.45	42	0.57	0.62
Reg5	Bombay Hook NWR	4391.2	37	0.57	38	0.58	0.63
_	Montezuma Wildlife						
Reg5	Management Area	4388.4	27	0.43	27	0.46	0.52
Reg5	Great Meadows	4365.3	35	0.30	36	0.49	0.55
Reg5	Uscg Loran Support Unit	4287.4	12	0.60	17	0.45	0.51
Reg5	Maurice River	4100.4	46	0.41	50	0.60	0.66
Dog5	The Migratory Bird	1038.0	37	0.65	40	0.62	0.66
Reg5	Hackensack Maadowlands	4038.9	27	0.05	23	0.02	0.00
Reg5	Montorume NW/D	2020.2	15	0.00	46	0.50	0.55
Regs	Montezuma Wildlife	3929.3	45	0.44	40	0.39	0.04
Reg5	Management Area	3884.7	25	0.59	25	0.49	0.55
Reg5	Uscg Loran Support Unit	3836.9	12	0.56	17	0.44	0.49
Reg5	Cape May NWR	3809.0	39	0.65	42	0.63	0.67
Reg5	Chincoteague NWR	3744.2	47	0.68	51	0.68	0.73
	Montezuma Wildlife						
Reg5	Management Area	3680.8	25	0.46	25	0.46	0.51
Reg5	E.B. Forsythe NWR	3485.1	52	0.58	55	0.67	0.72
Reg5	E.B. Forsythe NWR	3283.8	48	0.57	49	0.63	0.68
Reg5	Wallkill River NWR	3223.5	28	0.54	28	0.50	0.55
Reg5	Princess Anne WMA	3171.6	14	0.66	14	0.41	0.47
Reg5	E.B. Forsythe NWR	3155.7	54	0.55	56	0.66	0.71
Reg5	Montezuma NWR	3102.6	32	0.60	32	0.54	0.59
Reg5	E.B. Forsythe NWR	3072.3	50	0.57	52	0.65	0.70
Reg5	Assawoman Wildlife Area	3030.4	26	0.76	26	0.54	0.59
Reg5	Cattus Island Park	2986.5	12	0.66	12	0.39	0.44
Reg5	E.B. Forsythe NWR	2898.6	45	0.58	46	0.62	0.67
Reg5	Uscg Loran Support Unit	2838.2	16	0.55	22	0.48	0.53
	Montezuma Wildlife	<b>2</b> 0 <b>2</b> 0 <b>-</b>		0.54		0.55	0
Reg5	Management Area	2820.7	27	0.64	27	0.52	0.57
Reg5	Iroquois NWR	2742.7	40	0.44	43	0.56	0.62

Reg5	Chincoteague NWR	2702.8	29	0.65	30	0.54	0.59
Reg5	Stone Harbor Point	2529.2	36	0.52	42	0.59	0.64
	Montezuma Wildlife						
Reg5	Management Area	2514.3	13	0.63	13	0.39	0.45
Reg5	Level Ponds	2465.4	21	0.20	22	0.35	0.42
Reg5	Wallkill River NWR	2456.6	26	0.49	27	0.47	0.53
Reg5	Easterneck NWR	2455.2	9	0.17	9	0.21	0.29
Reg5	E.B. Forsythe NWR	2448.5	59	0.66	60	0.71	0.76
Reg5	Iroquois NWR	2416.7	22	0.59	22	0.46	0.52
	Montezuma Wildlife						
Reg5	Management Area	2371.6	22	0.70	22	0.49	0.54
Reg5	Great Meadows	2363.2	31	0.35	34	0.49	0.55
Reg5	Hackensack Meadow lands	2304.8	34	0.65	35	0.57	0.62
Dog5	Montezuma Wildlife	2278 0	22	0.61	22	0.46	0.52
Keg5	Montezuma Wildlife	2278.0		0.01	22	0.40	0.32
Reg5	Management Area	2267.5	20	0.71	20	0.48	0.53
	Montezuma Wildlife						
Reg5	Management Area	2215.2	22	0.55	22	0.45	0.51
Reg5	Cedar Bonnet Island	2101.6	25	0.82	25	0.55	0.60
Reg5	Chincoteague NWR	2024.1	52	0.72	56	0.70	0.75
Reg5	Back Bay NWR	2004.5	39	0.68	40	0.61	0.66
Reg5	Montezuma NWR	1979.5	43	0.60	44	0.61	0.66
Reg5	E.B. Forsythe NWR	1958.5	13	0.74	13	0.41	0.47
Reg5	Iroquois NWR	1939.6	34	0.62	35	0.56	0.61
Reg5	Assawoman Wildlife Area	1931.0	31	0.66	32	0.55	0.60
Reg5	Stafford Avenue	1876.2	21	0.79	22	0.51	0.57
	Montezuma Wildlife						
Reg5	Management Area	1854.4	23	0.55	23	0.45	0.51
Reg5	Mannington	1815.7	37	0.53	38	0.55	0.61
Reg5	Bombay Hook NWR	1785.6	28	0.59	29	0.51	0.57
Reg5	Princess Anne WMA	1784.6	12	0.55	12	0.34	0.41
D5	Montezuma Wildlife	1760 5	22	0.00	22	0.49	0.54
Keg5	Management Area Montezuma Wildlife	1/60.5	23	0.00	23	0.48	0.54
Reg5	Management Area	1723.0	26	0.63	27	0.51	0.56
	Montezuma Wildlife						
Reg5	Management Area	1713.8	21	0.47	21	0.41	0.47
Reg5	Margate	1706.8	30	0.76	31	0.57	0.62
Reg5	E.B. Forsythe NWR	1693.7	43	0.52	44	0.58	0.64
Reg5	E.B. Forsythe NWR	1668.0	51	0.54	54	0.64	0.69
Reg5	E.B. Forsythe NWR	1667.8	17	0.78	18	0.48	0.53
	Montezuma Wildlife						
Reg5	Management Area	1623.3	10	0.83	10	0.40	0.45

	Montezuma Wildlife						
Reg5	Management Area	1520.8	19	0.53	19	0.41	0.47
Reg5	Chincoteague NWR	1501.4	21	0.30	24	0.40	0.46
	Erie NWR Sugar Lake						
Reg5	Division	1489.3	5	0.55	5	0.27	0.34
Dog5	Montezuma Wildlife	1487.0	20	0.62	20	0.51	0.56
Reg5	Coder Dur Dook Dood	1467.0	10	0.02	20	0.31	0.50
Reg5		1432.0	19	0.78	20	0.49	0.55
Reg5	WallKill River NWR	1442.7	31	0.54	32	0.51	0.57
Reg5	Montezunia wildine Management Area	1332.7	29	0.50	29	0.48	0.54
inego	Montezuma Wildlife	1552.7		0.50	2)	0.40	0.54
Reg5	Management Area	1304.1	25	0.64	25	0.49	0.55
	Montezuma Wildlife						
Reg5	Management Area	1298.2	32	0.63	32	0.53	0.59
Reg5	Parker River NWR	1295.2	39	0.60	40	0.58	0.63
Reg5	Chincoteague NWR	1284.1	49	0.57	52	0.63	0.69
Reg5	Forked River Game Farm	1270.8	17	0.64	17	0.42	0.48
	Montezuma Wildlife						
Reg5	Management Area	1238.3	20	0.64	20	0.44	0.50
Reg5	Easterneck NWR	1236.4	11	0.30	11	0.25	0.33
Reg5	Great Swamp NWR	1230.4	16	0.62	16	0.40	0.46
Reg5	Chincoteague NWR	1229.5	37	0.55	41	0.57	0.63
<b>D</b>	Montezuma Wildlife	1010.0	2.5	0.00	07	0.50	0.57
Reg5	Management Area	1219.9	26	0.69	27	0.52	0.57
Reg5	Sunset Beach	1210.2	22	0.47	26	0.46	0.52
Reg5	Cedar Bonnet Island	1193.1	16	0.68	16	0.42	0.48
Deg5	Montezuma Wildlife	1172 0	20	0.66	20	0.52	0.59
Reg5		11/3.2	20	0.00	29	0.32	0.58
Reg5		1100.7	21	0.56	22	0.44	0.50
Reg5	Cedar Run Bog	1137.4	19	0.53	19	0.40	0.47
Reg5	Hackensack Meadowlands	1118./	21	0.60	28	0.50	0.56
Reg5	Great Swamp NWR	1078.1	13	0.72	13	0.40	0.46
Reg5	Montezuma NWR	1054.1	39	0.41	40	0.52	0.58
Reg5	Hackensack Meadowlands	1053.5	13	0.66	13	0.38	0.44
Reg5	Tuckahoe WMA	999.4	25	0.68	26	0.50	0.56
Reg5	Montezuma NWR	999.0	11	0.22	11	0.23	0.31
Reg5	Hog Island WMA	989.2	15	0.31	15	0.30	0.37
Reg5	Sandy Hook	984.8	29	0.40	34	0.49	0.55
	Montezuma Wildlife	0.50 5		0.00		0.15	0.50
Reg5	Management Area	979.5	22	0.68	22	0.47	0.53
Rog5	Niontezuma Wildlife	052 7	12	0 80	12	0.41	0.47
Rego Deg5	Gladas Wildlife Defuse	952.7	25	0.57	27	0.41	0.47
Reg5	Dades whulle Keluge	009.1 910-2	12	0.37	5/ 12	0.34	0.00
keg5	Parkenown Dock Koad	819.2	13	0.75	13	0.39	0.45

Reg5	Back Bay NWR	750.3	18	0.62	18	0.41	0.47
	Private Land (Located In						
D. 5	Town Of Montezuma,	741.0	10	0.70	10	0.44	0.50
Reg5		741.8	19	0.70	19	0.44	0.50
Reg5	Wallkill River NWR	736.5	31	0.60	32	0.52	0.58
Reg5	Management Area	734.3	22	0.68	22	0.46	0.52
	Erie NWR Sugar Lake	10110		0.00		0110	0.02
Reg5	Division	730.6	9	0.27	9	0.21	0.29
Reg5	Absecon	712.9	27	0.69	28	0.51	0.57
Reg5	At&T	693.1	15	0.67	15	0.39	0.46
Reg5	Easterneck NWR	684.9	11	0.62	11	0.33	0.40
Reg5	Back Bay NWR	681.4	36	0.63	36	0.55	0.61
Reg5	Assawoman Wildlife Area	670.7	19	0.63	19	0.42	0.48
Reg5	Wallkill River NWR	638.8	18	0.64	18	0.41	0.48
Reg5	Tuckahoe WMA	632.8	30	0.66	31	0.52	0.58
Reg5	Oxbow Lake	595.3	15	0.40	15	0.32	0.39
Reg5	Lakeshore Marshes WMA	582.7	23	0.65	23	0.46	0.52
	Erie NWR Sugar Lake	<b>F</b> 60 <b>A</b>	_	0.55	_	0.00	0.05
Reg5	Division	569.2	5	0.66	5	0.29	0.35
Reg5	Nummy Island	562.9	39	0.55	43	0.57	0.63
Reg5	Back Bay NWR	560.9	30	0.51	30	0.47	0.53
Reg5	Division	550 5	5	0 59	5	0.26	0 34
Reg5	Easterneck NWR	546.1	10	0.52	10	0.29	0.36
Reg5	E.B. Forsythe NWR	539.0	20	0.48	21	0.39	0.46
nege	Erie NWR Sugar Lake	00010	20	0110		0.07	0110
Reg5	Division	533.7	6	0.45	6	0.23	0.31
Reg5	Back Bay NWR	533.1	34	0.56	35	0.52	0.58
Reg5	Tuckahoe WMA	529.6	33	0.70	34	0.55	0.61
Reg5	Hog Island WMA	514.4	7	0.35	7	0.22	0.29
Reg5	Hackensack Meadowlands	507.3	27	0.72	28	0.52	0.57
	Erie NWR Seneca	100.0	15		1.5	0.40	0.50
Reg5	Division	493.0	17	0.77	17	0.43	0.50
Reg5	Hog Island WMA	484.2	16	0.28	16	0.29	0.37
Reg5	Reedy Creek	460.9	12	0.83	12	0.40	0.46
Reg5	Stafford Avenue	459.1	16	0.79	17	0.44	0.50
Reg5	Hog Island WMA	454.2	14	0.63	14	0.36	0.43
Reg5	Hog Island WMA	452.0	4	0.46	4	0.21	0.29
Reg5	Princess Anne WMA	420.8	7	0.63	7	0.29	0.36
Reg5	Easterneck NWR	419.5	14	0.58	14	0.35	0.42
Reg5	Stafford Avenue	418.8	20	0.89	21	0.50	0.56
Reg5	Montezuma NWR	410.6	24	0.62	24	0.45	0.51
Reg5	Hackensack Meadowlands	410.3	16	0.74	16	0.41	0.48

Reg5	Level Ponds	402.3	15	0.34	16	0.31	0.38
Reg5	Princess Anne WMA	397.3	6	0.71	6	0.30	0.37
Reg5	Chincoteague NWR	391.2	17	0.69	17	0.41	0.47
Reg5	Chincoteague NWR	375.4	17	0.59	17	0.38	0.45
Reg5	E.B. Forsythe NWR	371.9	10	0.38	10	0.24	0.32
Reg5	Princess Anne WMA	369.7	8	0.68	8	0.31	0.38
Reg5	E.B. Forsythe NWR	365.7	10	0.68	10	0.32	0.39
Reg5	Chincoteague NWR	363.3	11	0.73	11	0.35	0.42
Reg5	Sandy Hook	361.0	26	0.41	28	0.42	0.50
Reg5	Montezuma Wildlife Management Area	357.3	10	0.68	10	0.32	0.39
Reg5	Tuckahoe WMA	327.7	32	0.71	35	0.56	0.62
Reg5	Erie NWK Sugar Lake	327 5	8	0.40	8	0.23	0.31
Reg5	Fasterneck NWR	327.5	13	0.58	13	0.23	0.31
Reg5	Chincoteague NWR	322.8	60	0.60	66	0.69	0.74
	Bayshore Waterfront Park,	01210		0.00	00	0.03	
Reg5	Port Monmouth	317.5	18	0.51	18	0.36	0.44
Reg5	E.B. Forsythe NWR	317.1	13	0.42	13	0.28	0.36
Reg5	Hog Island WMA	314.7	17	0.51	17	0.35	0.43
Reg5	E.B. Forsythe NWR	298.9	8	0.69	8	0.31	0.38
Reg5	Chesapeake Bay Envrionmental Center	297.8	21	0.68	21	0.44	0.50
Reg5	At&T	291.9	11	0.69	11	0.34	0.41
Reg5	Easterneck NWR	288.9	9	0.49	9	0.26	0.34
Reg5	Hog Island WMA	281.8	11	0.59	11	0.31	0.38
Reg5	Erie NWR Sugar Lake Division	278.3	10	0.62	10	0.30	0.38
Reg5	Montezuma Wildlife Management Area	276.6	19	0.64	19	0.41	0.47
Reg5	Delaware Seashore State Park	275.5	30	0.64	33	0.52	0.58
Reg5	Montezuma NWR	267.6	11	0.66	11	0.33	0.40
	Erie NWR Sugar Lake						
Reg5	Division	266.8	8	0.54	8	0.27	0.34
Reg5	Tuckahoe WMA	262.1	19	0.83	20	0.47	0.53
Reg5	Division	254.5	3	0.35	3	0.15	0.24
Reg5	Chesapeake Bay Envrionmental Center	251.2	6	0.62	6	0.27	0.34
Reg5	Sandy Hook	245.0	20	0.55	22	0.41	0.48
Reg5	Hackensack Meadowlands	242.0	29	0.64	29	0.48	0.55
Reg5	Montezuma NWR	223.2	21	0.71	21	0.44	0.51
Reg5	Erie NWR Sugar Lake Division	214.2	7	0.55	7	0.26	0.33

Reg5	Hilliard Blvd.	211.6	6	0.73	6	0.30	0.37
	Delaware Seashore State						
Reg5	Park	211.4	25	0.50	27	0.43	0.50
	Montezuma Wildlife						
Reg5	Management Area	203.1	18	0.65	18	0.39	0.46
Reg5	Back Bay NWR	194.0	13	0.62	14	0.35	0.42
Reg5	Level Ponds	184.3	5	0.52	5	0.22	0.30