Summary of Wakulla Springs Wildlife Monitoring Results

January, 1997 through December, 2016

by Bob Thompson

Document revised: May 11, 2017

The abundance of 34 species of animals along the 3-mile river boat tour route in the Wakulla Springs State Park has been monitored for 25 years (monthly by park staff from 1992 through October, 2012 and weekly by volunteers since November, 2012). This annual summary presents 20-year (1997-2016) plots and 20-year and 5-year (2012-2016) abundance trends of wildlife in Attachment 1.

Simple linear regression was applied to the monitoring data to identify abundance trends (Attachment 2), using the following two criteria.

Prob(F) The probability of the F statistic was used to identify statistically significant linear relationships between mean annual abundance and year. Relationships were identified as "significant" if Prob(F)<0.05. This indicates there is a 95% or higher likelihood that the apparent linear relationship actually exists.

Plus/Minus Sign of Slope Slope is 'm' in the regression equation y=mx+b. Trends were identified as follows, based on the sign of the slope and the statistical significance of the linear relationship.

Increasing Abundance if the linear relationship was significant and slope was positive.
Decreasing Abundance if the linear relationship was significant and slope was negative.
No Trend if the linear relationship was not statistically significant (i.e. the slope was not significantly different from zero).

Coefficient of Determination (R^2) The strength of the abundance trend was estimated by the R^2 regression statistic, a measure of the percent of the variation in mean abundance explained by year. Where the linear relationship was statistically significant, three categories of trend strength were defined as follows: Weak: $R^2 < 0.30$; Moderate: $R^2 \geq 0.30$ and $R^2 < 0.70$; and Strong: $R^2 \geq 0.70$

Table 1. Summary of Trends in Wildlife Abundance, based on Regression of Annual Means

20-year (1997-2016) Trends		5-year (2012-2016) Trends	
Decreasing for 12 animals		**Decreased to zero for 6 animals** **(based on 5-year 2012-2016 means)**	
American Alligator	Purple Gallinule	American Widgeon	Limpkin
American Widgeon	Snowy Egret	Blue-winged Teal	Purple Gallinule
Anhinga	Tricolored Heron	Green Heron	Snowy Egret
Blue-winged Teal	Wood Duck	**Decreasing for 2 animals**	
Common Gallinule	Yellow-crowned Night-Heron	American Coot	Manatee
Green Heron		**Increasing for 2 animals**	
Limpkin		American Alligator	Yellow-crowned Night-Heron
Increasing for 3 animals		**No Trend for 14 animals** (as well as the 6 animals identified above that decreased to zero)	
Cattle Egret	Pied-billed Grebe	Anhinga	Hooded Merganser
Hooded Merganser		Cattle Egret	Little Blue Heron
No Trend for 9 animals		Common Gallinule	Osprey
American Coot	Little Blue Heron	Cooter Turtle	Pied-billed Grebe
Cooter Turtle	Manatee	Double-cr. Cormorant	Tricolored Heron
Double-cr. Cormorant	Osprey	Great Blue Heron	White Ibis
Great Blue Heron	White Ibis	Great Egret	Wood Duck
Great Egret			

Note: Of the 34 animals monitored, it was not feasible to identify trends for the following 10 animals because of low abundance: Bald Eagle, Barred Owl, Belted Kingfisher, Black-Crowned Night Heron, Florida Softshell Turtle, Killdeer, Lesser Scaup, Red-Shouldered Hawk, Snake, Spotted Sandpiper.

Monitoring results are sorted in Table 2 from low to high abundance, based on the 2016 annual mean in the eighth column of the table.

Table 2. Abundance of Animals Sorted on the Most Recent (2016) Annual Mean

	15-year Mean	5-year Mean	Annual Means During Recent 5 Years					20-year Trend	5-year Trend
	1997-2011	2012-2016	2012	2013	2014	2015	**2016**	(1997-2016)	(2012-2016)
Limpkin	0	0	0	0	0	0	**0**	**Decreasing**	**5-year Mean=0**
American Widgeon	80	0	0	0	0	0	**0**	**Decreasing**	**5-year Mean=0**
*Blue-Winged Teal	3	0	0	0	0	0	**0**	**Decreasing**	**5-year Mean=0**
Purple Gallinule	1	0	0	1	0	0	**0**	**Decreasing**	**5-year Mean=0**
Green Heron	3	0	1	0	0	1	**0**	**Decreasing**	**5-year Mean=0**
Snowy Egret	2	0	1	1	0	0	**0**	**Decreasing**	**5-year Mean=0**
Osprey	2	1	1	1	1	1	**0**	**No Trend**	**No Trend**
Tri-Colored Heron	2	1	1	1	1	1	**1**	**Decreasing**	**No Trend**
**Cattle Egret	0	10	12	21	16	1	**1**	**Increasing**	**No Trend**
Great Blue Heron	1	1	2	1	2	1	**1**	**No Trend**	**No Trend**
Wood Duck	13	4	4	7	4	4	**2**	**Decreasing**	**No Trend**
Great Egret	3	2	2	1	2	2	**2**	**No Trend**	**No Trend**
*Manatee	3	6	12	8	5	3	**3**	**No Trend**	**Decreasing**
Yellow-cr. Night Heron	3	2	1	2	2	2	**3**	**Decreasing**	**Increasing**
Double-crested Cormorant	2	3	3	2	3	2	**5**	**No Trend**	**No Trend**
Little Blue Heron	5	4	4	4	3	4	**5**	**No Trend**	**No Trend**
*American Coot	48	29	88	40	30	13	**10**	**No Trend**	**Decreasing**
Anhinga	15	12	13	10	12	13	**14**	**Decreasing**	**No Trend**
Cooter Turtle	19	16	15	14	16	20	**16**	**No Trend**	**No Trend**
American Alligator	24	16	14	15	16	16	**17**	**Decreasing**	**Increasing**
Pied-Billed Grebe	12	20	27	20	20	19	**19**	**Increasing**	**No Trend**
*Hooded Merganser	3	12	6	7	13	8	**21**	**Increasing**	**No Trend**
*White Ibis	21	25	25	22	24	23	**30**	**No Trend**	**No Trend**
Common Gallinule	82	37	64	44	33	31	**34**	**Decreasing**	**No Trend**

* Migratory/Seasonal; ** Cattle Egret abundance was extremely low, except during nesting from 2012 to 2014.

Unfortunately, there has been an astonishing decrease in wildlife abundance of four animals (American Alligator, American Widgeon, Common Gallinule, and Wood Duck) over the past 20 years. Although this steep decline in abundance seems to have leveled for the Alligator and possibly leveled during the most recent 3 years for the Common Gallinule, their numbers are much lower than historical levels. Wood Duck abundance continues to decrease. And, except for rare occasional sightings, the Limpkin has all but totally relocated to other aquatic systems in the region.

The appearance of Manatees in the park and their increase in abundance to a peak in 2012 has been amazing. They have had a positive impact on the biological community by grazing on and significantly reducing Hydrilla, an exotic invasive rooted aquatic plant. The subsequent decline in manatee abundance corresponded with the failure of the Hydrilla to recover from grazing during the winter of 2012-2013. That event corresponded to a 75 percent reduction in nitrate loading to the aquifer from the Tallahassee wastewater treatment facilities, beginning in November 2012.

Many thanks to volunteers for spending a portion of their Saturday mornings monitoring wildlife and Bob Deyle for his expert advice and encouragement in the analysis and report writing.

ATTACHMENT 1

PLOTS OF WILDLIFE ABUNDANCE

Important note: Volunteers increased monitoring frequency from monthly to weekly beginning in the fall of 2012. The high density of data points (diamond symbols) on the right side of the 20-year plots is the result of this increase in monitoring frequency.

Legend for plots

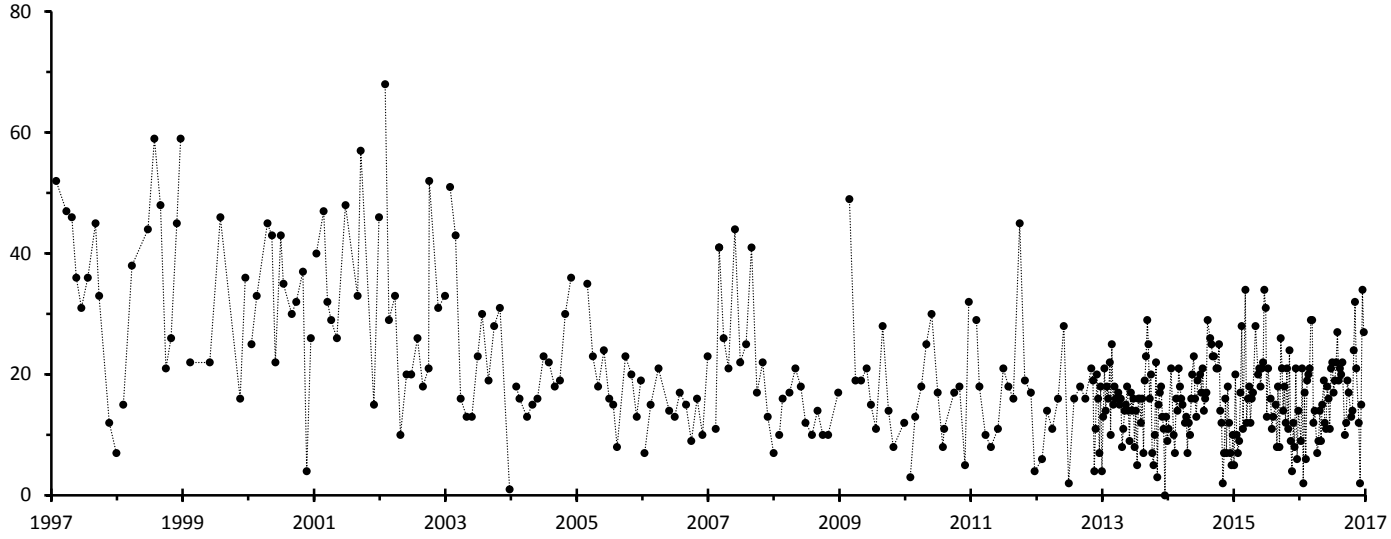
- • Number of animals (data point) observed during monitoring
- ◇ Annual Mean number of animals observed during monitoring
- ..... Line connecting data points and connecting Annual Means
- - - **Decreasing Abundance**: Linear regression line of best fit for the annual mean number of animals over time with a statistically significant negative linear relationship (negative slope).
- - - **Increasing Abundance**: Linear regression line of best fit for the annual mean number of animals over time with a statistically significant positive linear relationship (positive slope).

Regression The following results (three lines of text) are provided in all "Regression of Annual Mean" plots:

1. Prob(F)
2. Slope of the regression equation (y=mx+b), where m is the slope, b is the y intercept, x is the year value on the horizontal axis, and y is the value on the vertical axis for the annual mean number of animals counted on wildlife surveys
3. Coefficient of Determination (R^2)

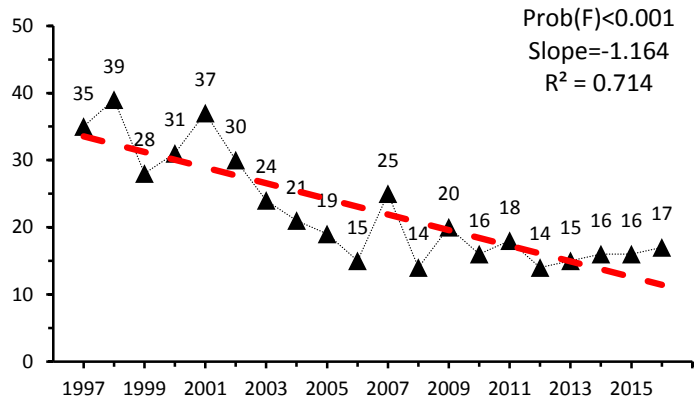
AMERICAN ALLIGATOR

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

Regression of Annual Means

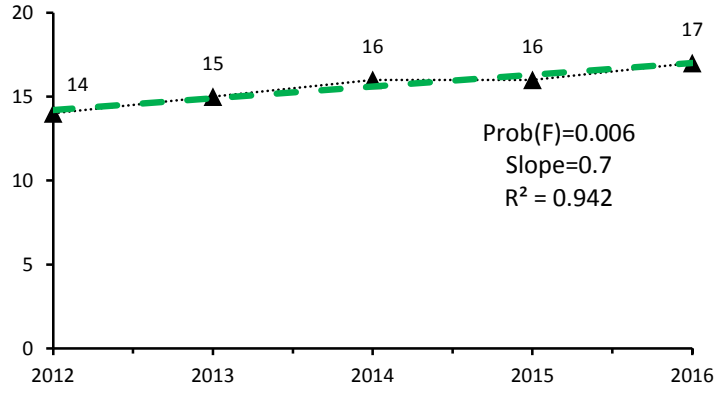


Regression results show a **Decreasing Abundance Trend**. The linear relationship was statistically significant and slope was negative. Trend strength was strong, with 71.4% of the variation in abundance explained by year. Based on slope, mean annual abundance decreased by 1.2 American Alligators per year.

Note that a steep decline in abundance occurred from 2001 to 2006. During this time period, the annual mean number of alligators decreased from 37 to 15 (=22 fewer alligators in six years). Fortunately, abundance has leveled and even increased slightly over the most recent 5 years.

5-year (2012-2016) Abundance Trend

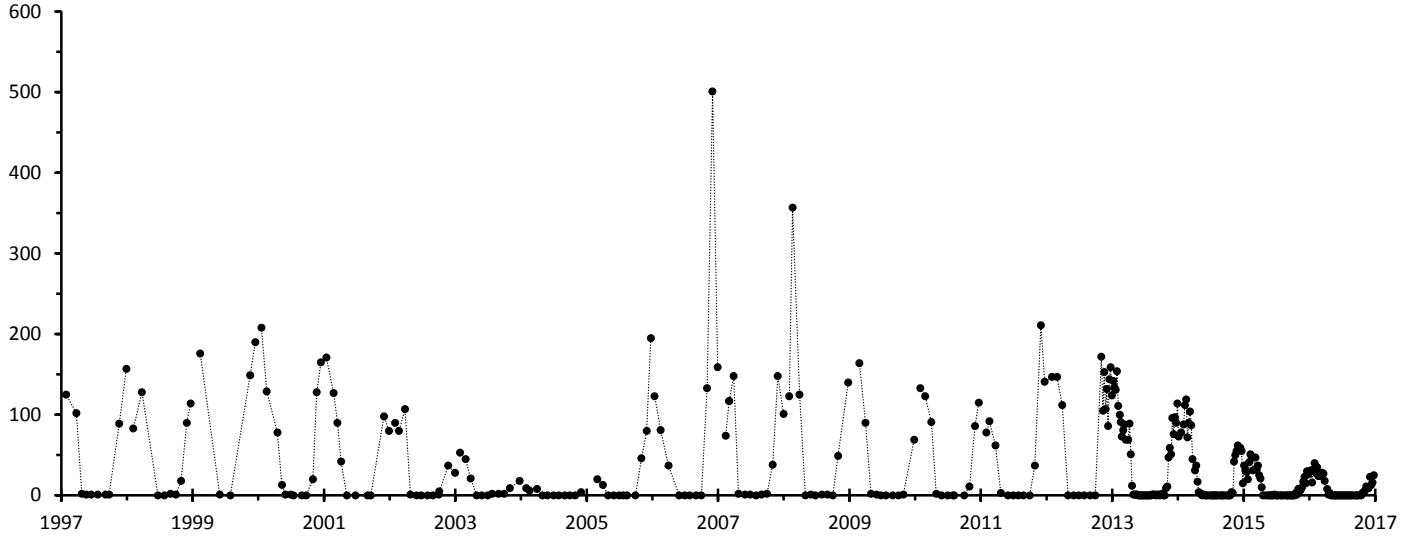
Regression of Annual Means



Regression results show an **Increasing Abundance Trend**. The linear relationship was statistically significant and slope was positive. Trend strength was strong, with 94.2% of the variation in abundance explained by year. Based on slope, abundance increased by 0.7 American Alligators per year.

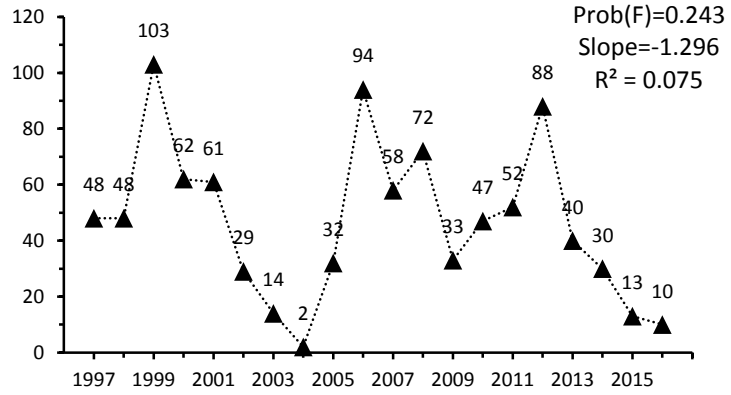
AMERICAN COOT

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

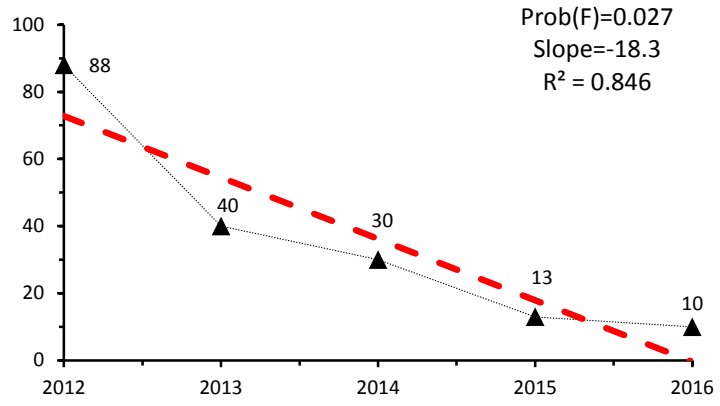
Regression of Annual Means



No Trend Identified Linear regression was not statistically significant.

5-year (2012-2016) Abundance Trend

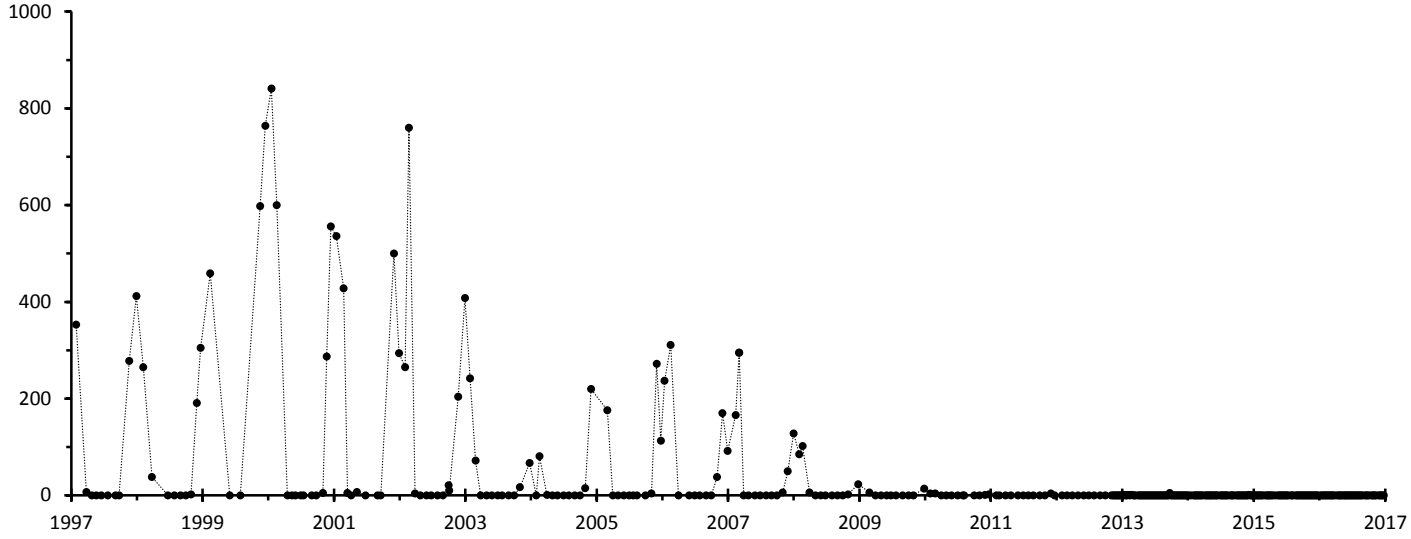
Regression of Annual Means



Regression results show a **Decreasing Abundance Trend**. The linear relationship was statistically significant and slope was negative. Trend strength was strong, with 84.6% of the variation in abundance explained by year. Based on slope, mean annual abundance decreased by 18.3 American Coots per year.

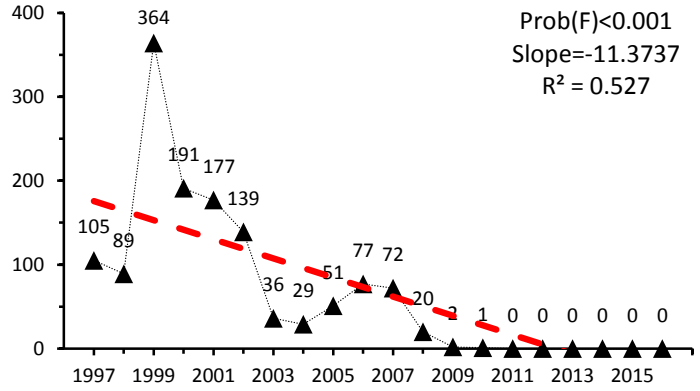
AMERICAN WIDGEON

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

Regression of Annual Means

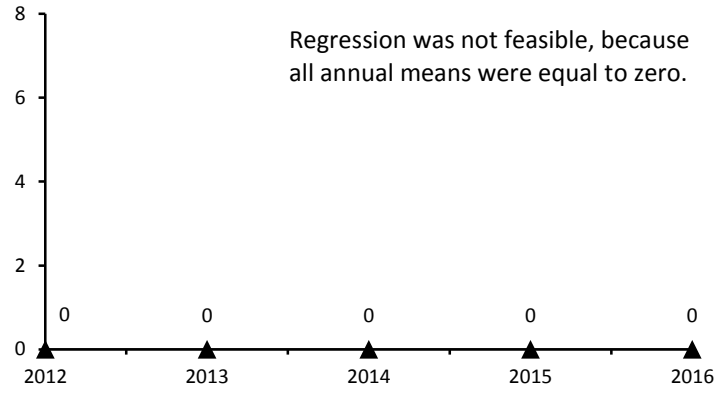


Regression results show a **Decreasing Abundance Trend**. The linear relationship was statistically significant and slope was negative. Trend strength was moderate, with 52.7% of the variation in abundance explained by year. Based on slope, mean annual abundance decreased by 11.4 American Widgeons per year.

Although the annual means from 2011-2016 were zero, American Widgeons are periodically observed in very low numbers.

5-year (2012-2016) Abundance Trend

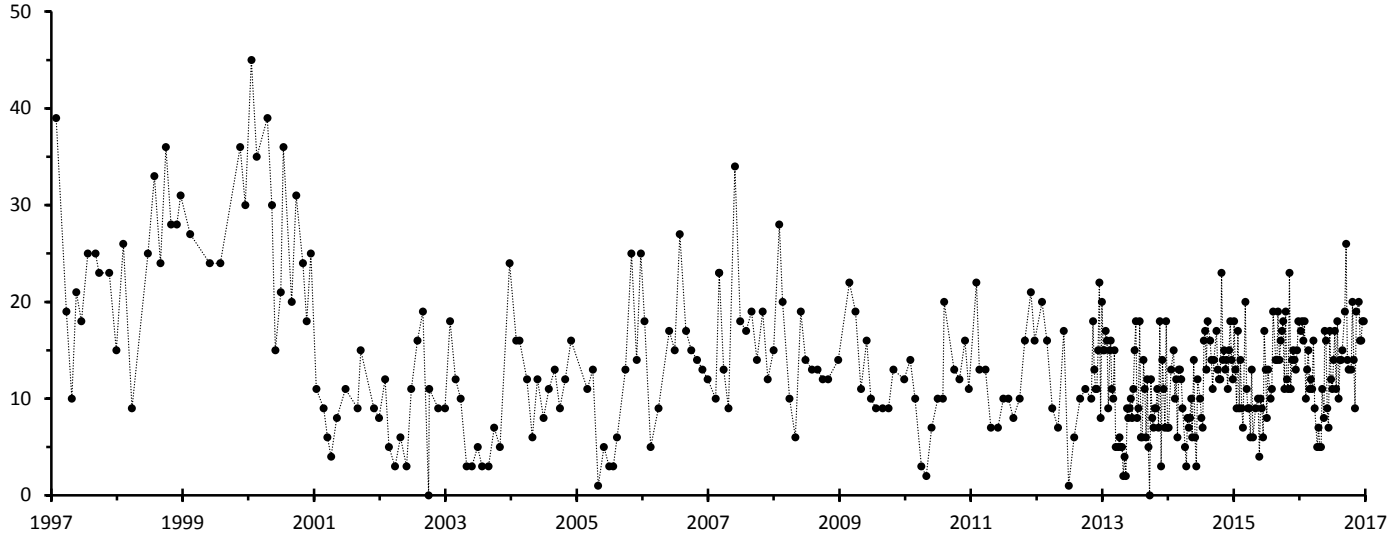
Annual Means



No Trend Identified: **Annual Means Decreased to Zero**

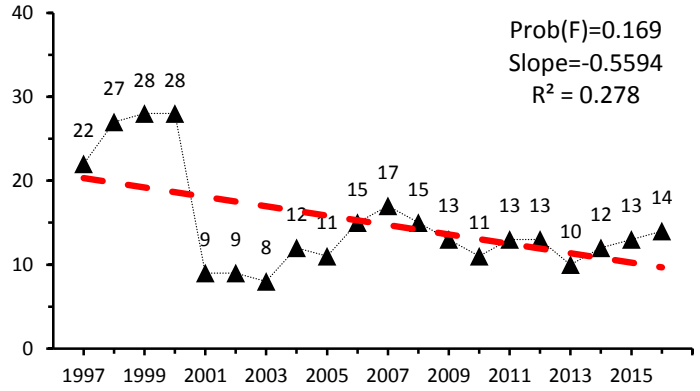
ANHINGA

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

Regression of Annual Means

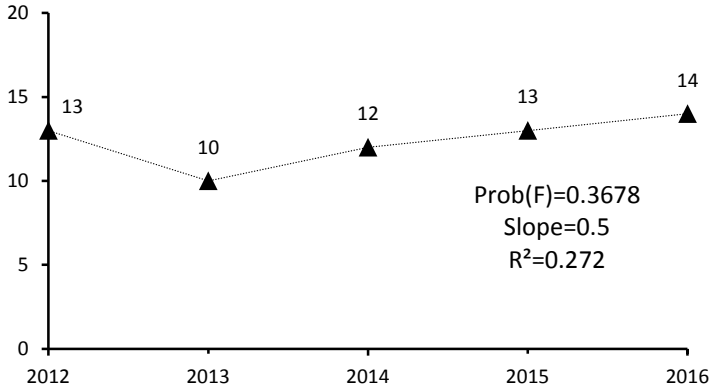


Regression results show a **Decreasing Abundance Trend**. The linear relationship was statistically significant and slope was negative. Trend strength was weak, with 27.8% of the variation in abundance explained by year. Based on slope, man annual abundance decreased by 0.6 Anhingas per year.

Annual means of the first four years (1997-2000) were higher compared to the latter 16 years (2001-2016). The range of annual means were 22 to 28 for the first four years and 9 to 14 for the later 16 years.

5-year (2012-2016) Abundance Trend

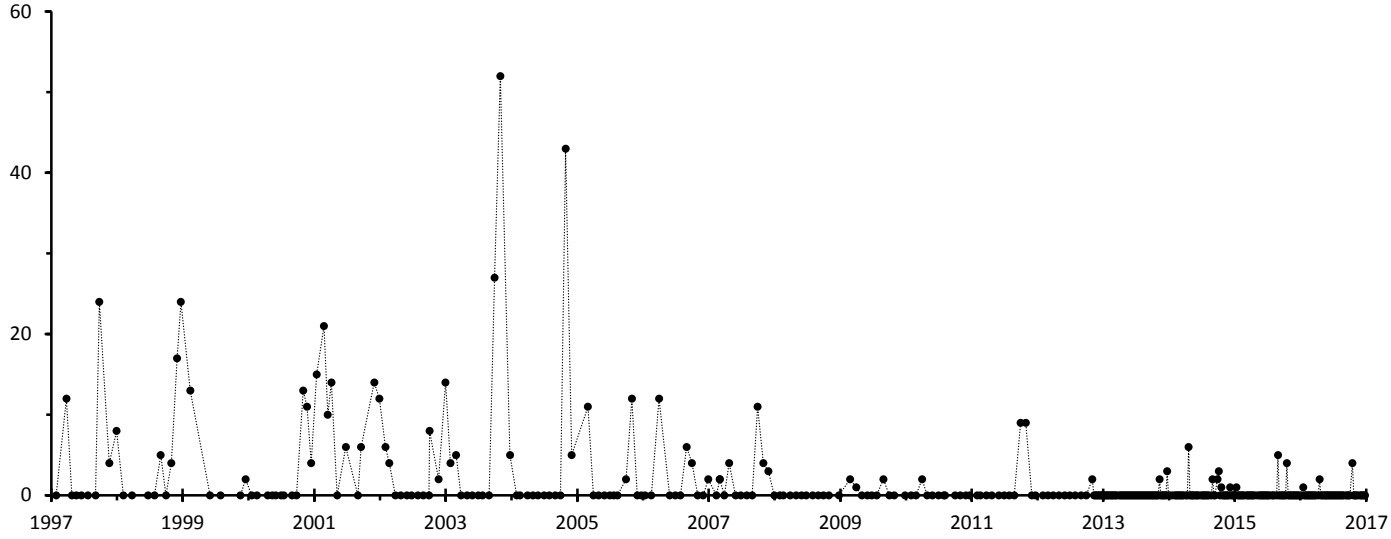
Regression of Annual Means



No Trend Identified Linear regression was not statistically significant.

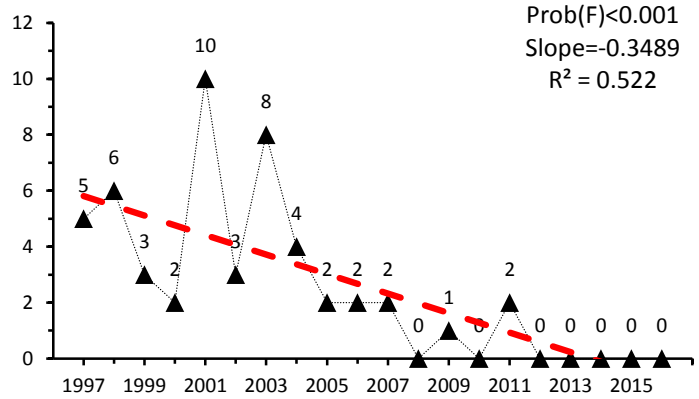
BLUE-WINGED TEAL

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

Regression of Annual Means



Regression results show a **Decreasing Abundance Trend**. The linear relationship was statistically significant and slope was negative. Trend strength was moderate, with 52.2% of the variation in abundance explained by year. Based on slope, mean annual abundance decreased by 0.3 Blue-winged Teal per year.

Although the annual means from 2011-2016 were zero, Blue-winged Teal are periodically observed in very low numbers.

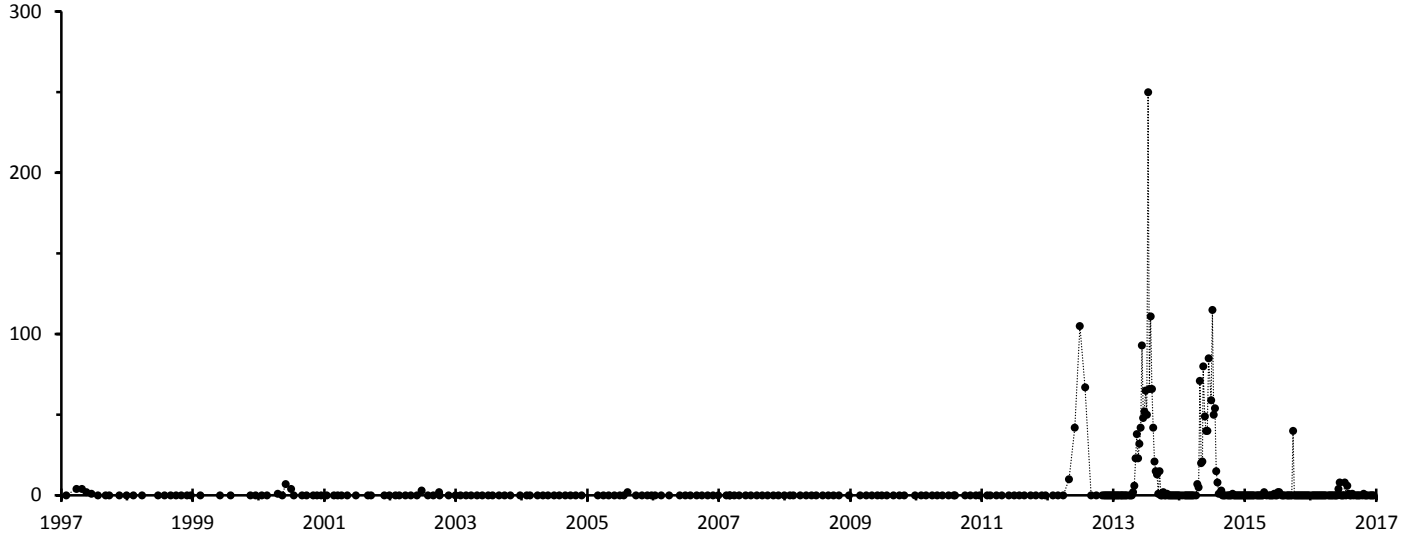
5-year (2012-2016) Abundance Trend

Annual Means

No Trend Identified - **Annual Means Decreased to Zero**

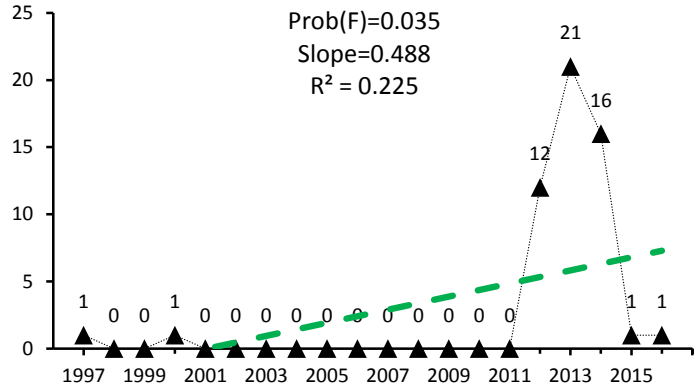
CATTLE EGRET

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

Regression of Annual Means

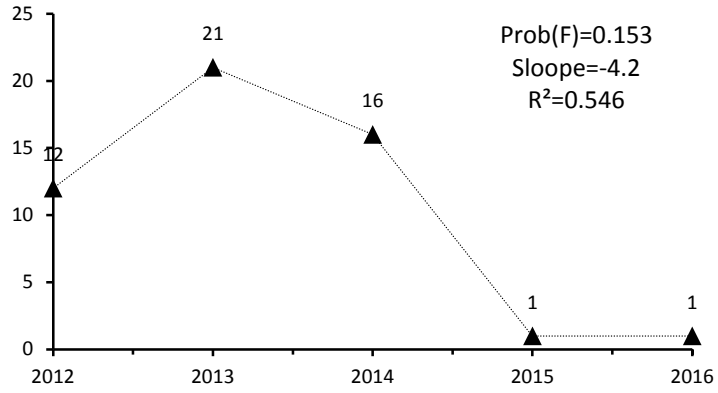


Regression results show an **Increasing Abundance Trend**. The linear relationship was statistically significant and slope was positive. Trend strength was weak, with 22.5% of the variation in abundance explained by year. Based on slope, mean annual abundance increased by 0.5 Cattle Egrets per year.

The increase in Cattle Egret abundance from 2012-2014 was the result of colony nesting on an island in the River.

5-year (2012-2016) Abundance Trend

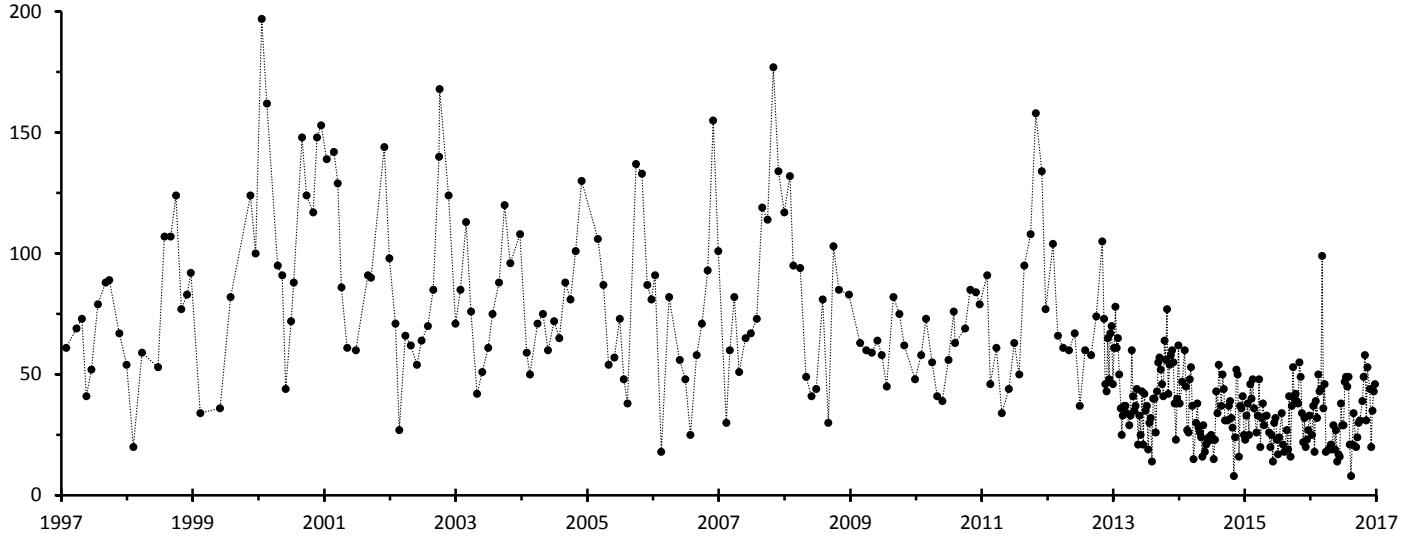
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

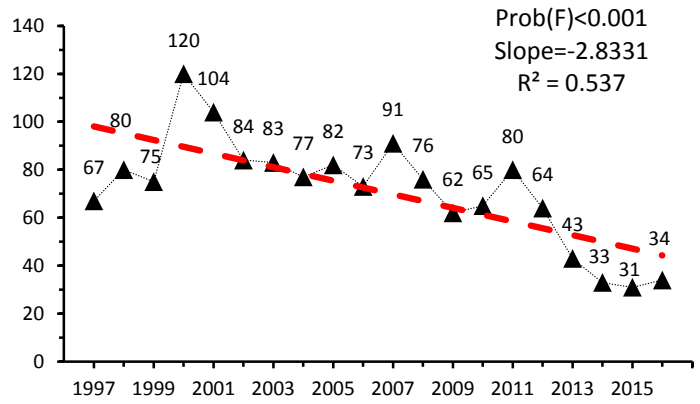
COMMON GALLINULE (COMMON MOORHEN)

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

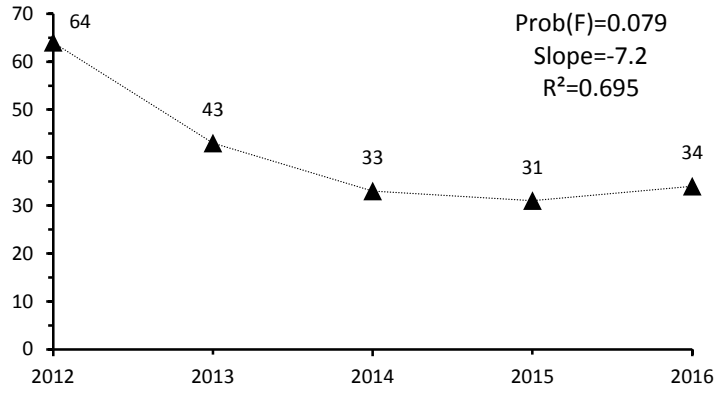
Regression of Annual Means



Regression results show a **Decreasing Abundance Trend**. The linear relationship was statistically significant and slope was negative. Trend strength was moderate, with 53.7% of the variation in abundance explained by year. Based on slope, mean annual abundance decreased by 2.8 Common Gallinules per year.

5-year (2012-2016) Abundance Trend

Regression of Annual Means

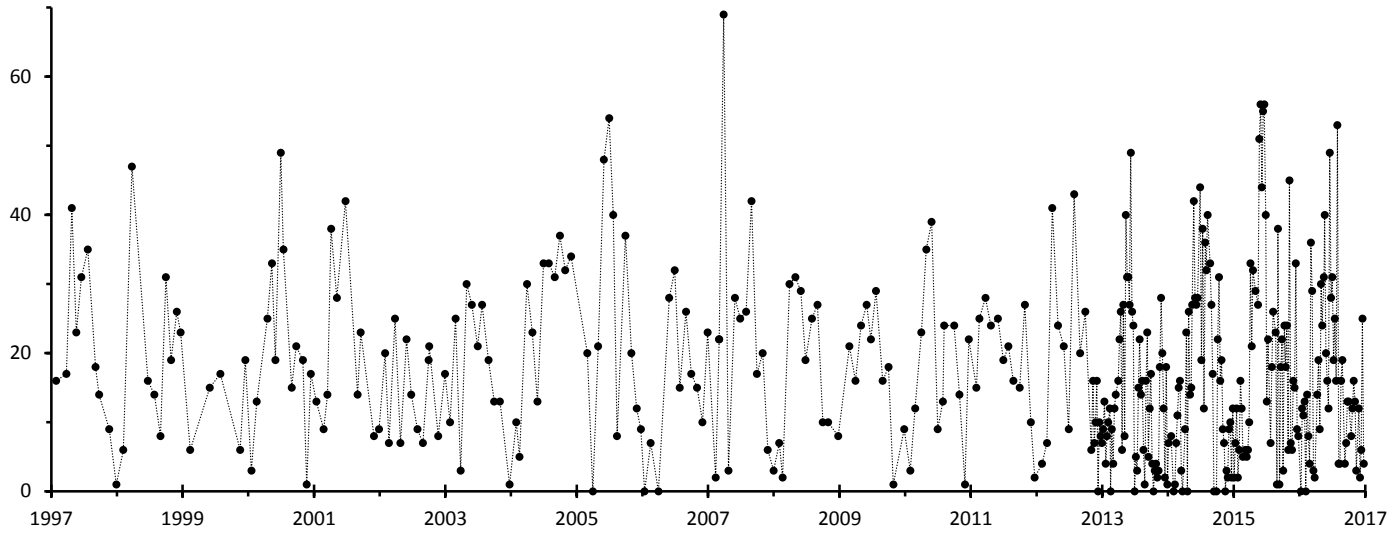


SUMMARY

No Trend Identified The linear relationship was not statistically significant.

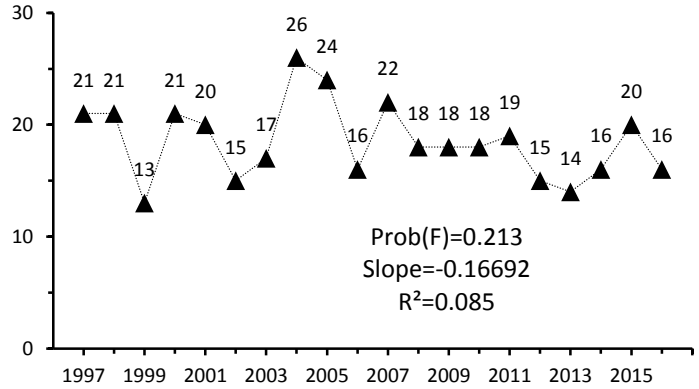
COOTER TURTLE

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

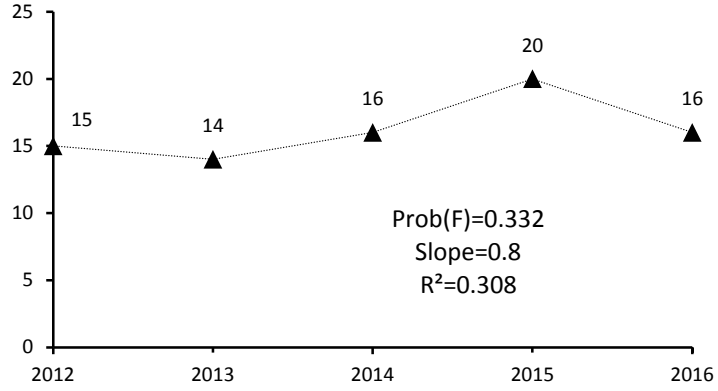
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

5-year (2012-2016) Abundance Trend

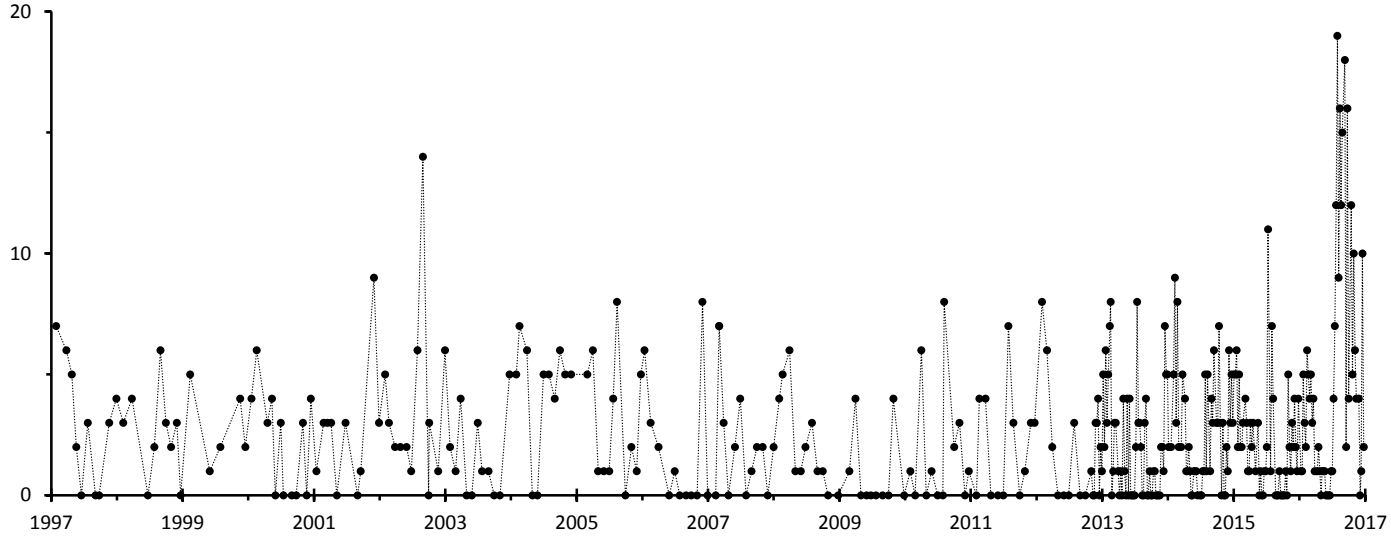
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

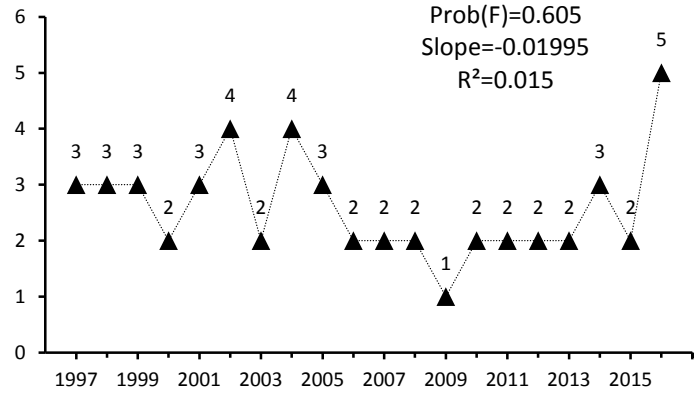
DOUBLE-CRESTED CORMORANT

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

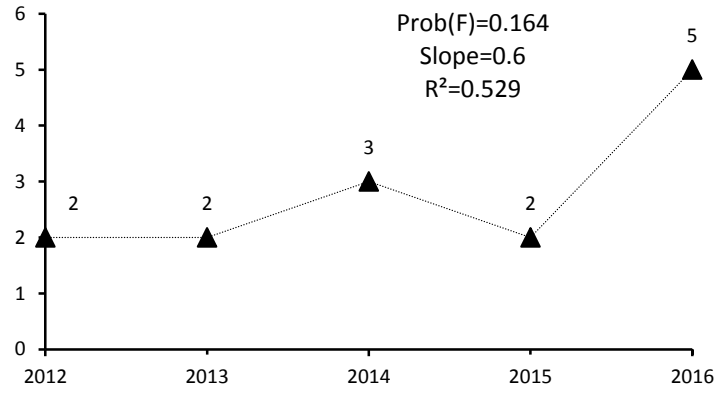
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

5-year (2012-2016) Abundance Trend

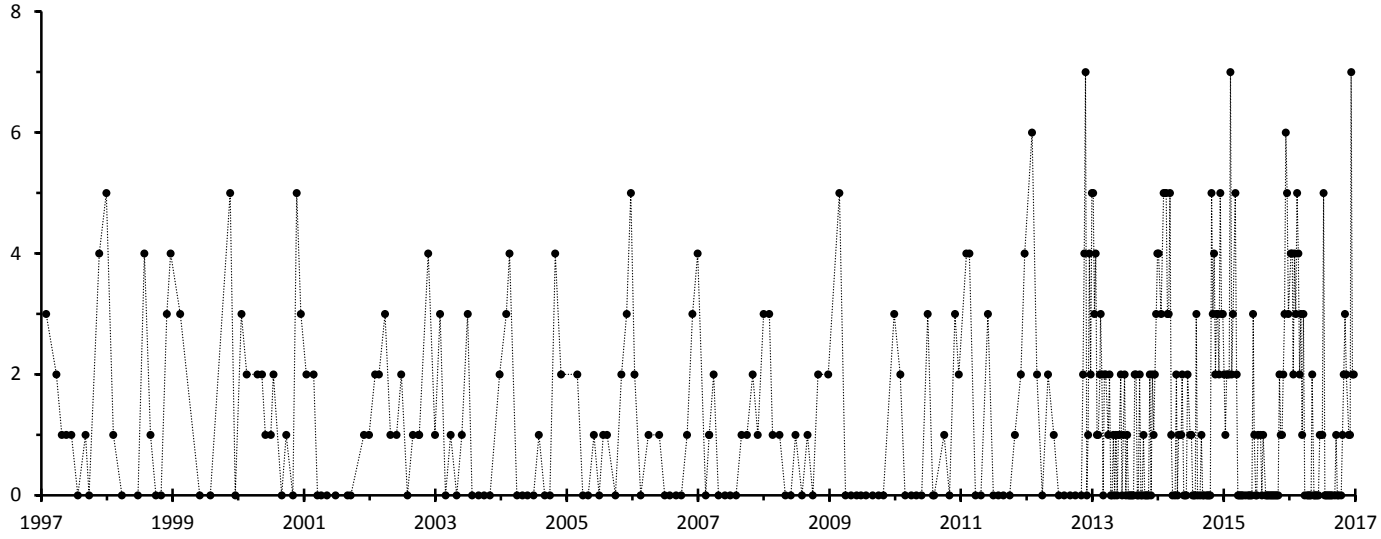
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

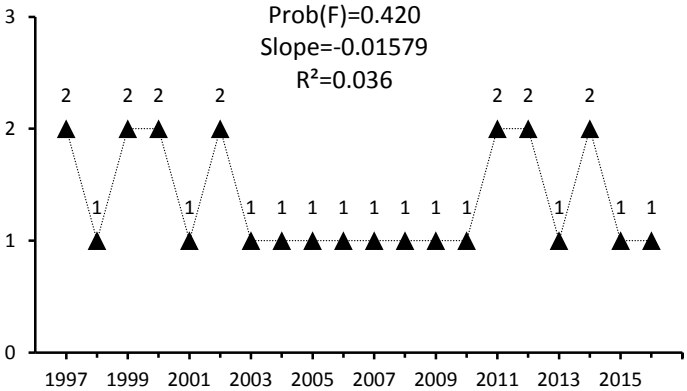
GREAT BLUE HERON

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

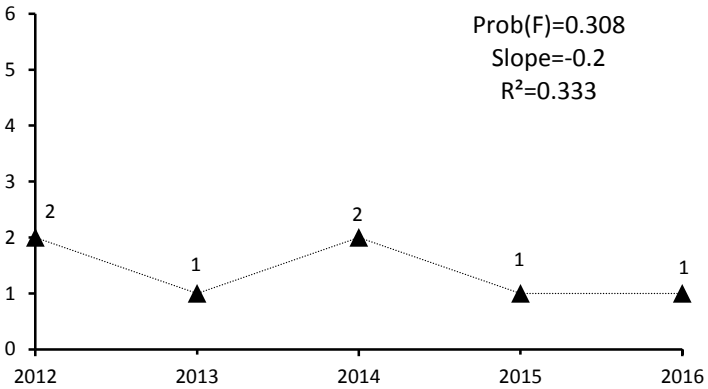
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

5-year (2012-2016) Abundance Trend

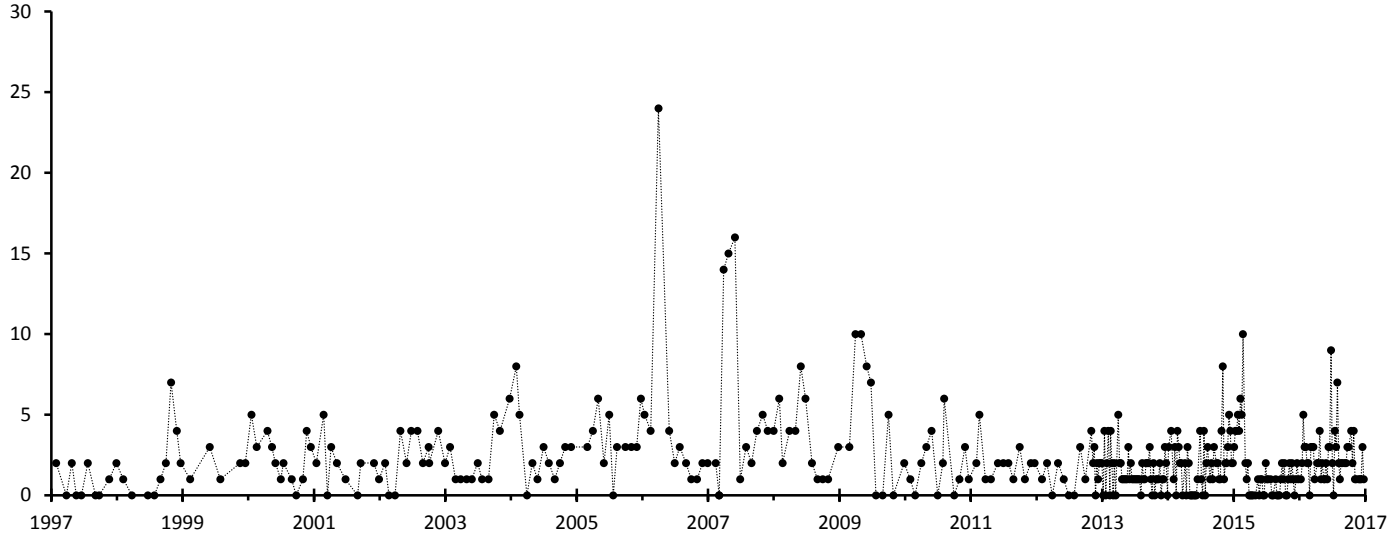
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

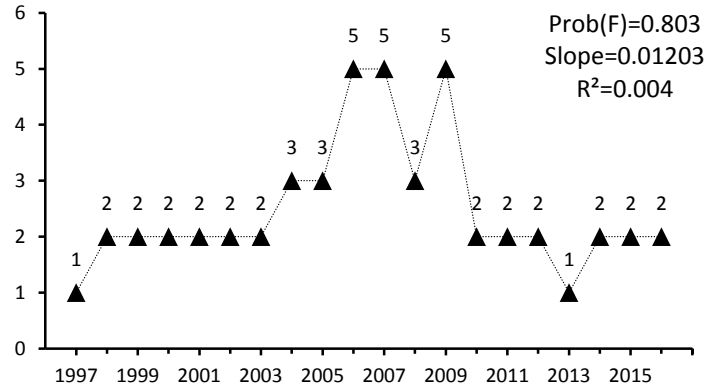
GREAT EGRET

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

Regression of Annual Means

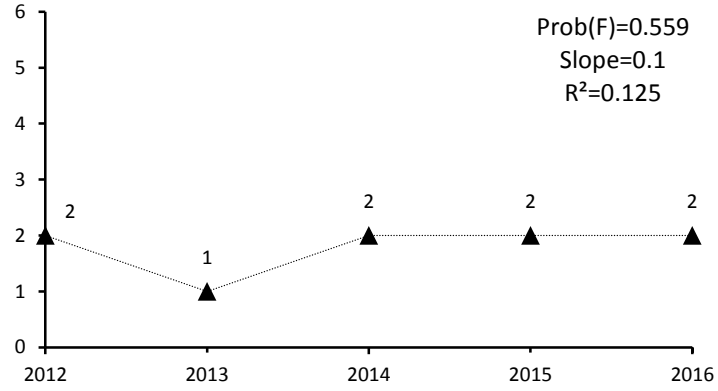


No Trend Identified The linear relationship was not statistically significant.

Periodically Great Egrets nest in small colonies on the islands in the river.

5-year (2012-2016) Abundance Trend

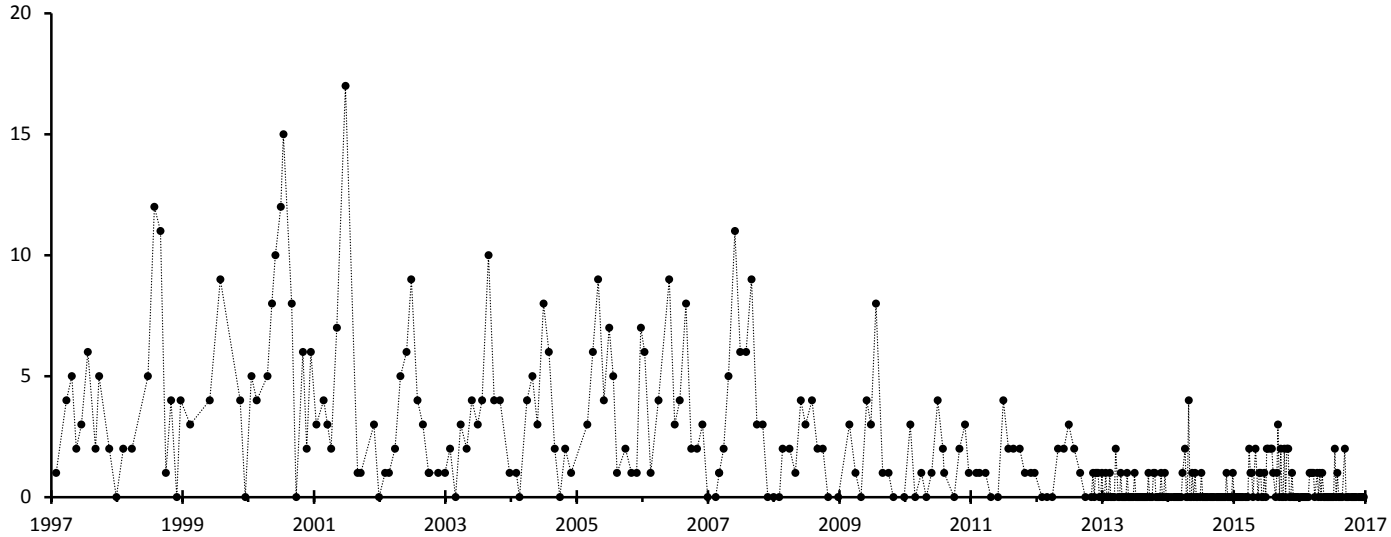
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

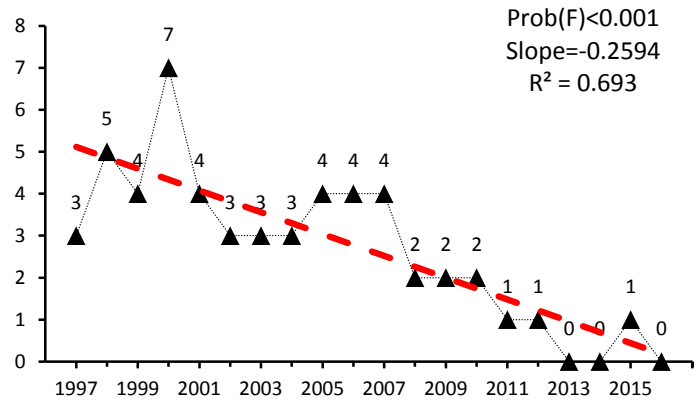
GREEN HERON

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

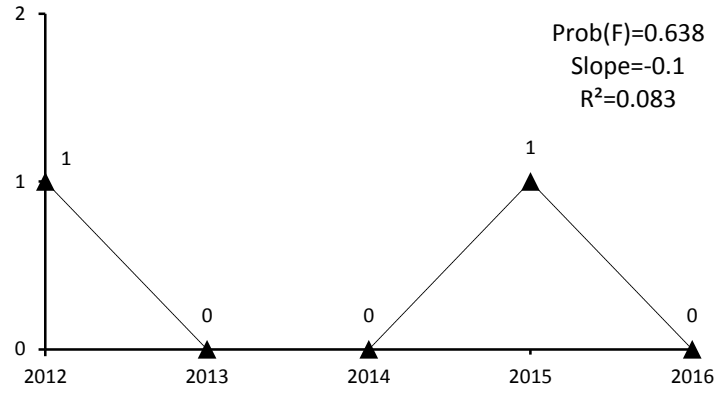
Regression of Annual Means



Regression results show a **Decreasing Abundance Trend**. The linear relationship was statistically significant and slope was negative. Trend strength was moderate, with 69.3% of the variation in abundance explained by year. Based on slope, mean annual abundance decreased by 0.3 Green Herons per year.

5-year (2012-2016) Abundance Trend

Regression of Annual Means

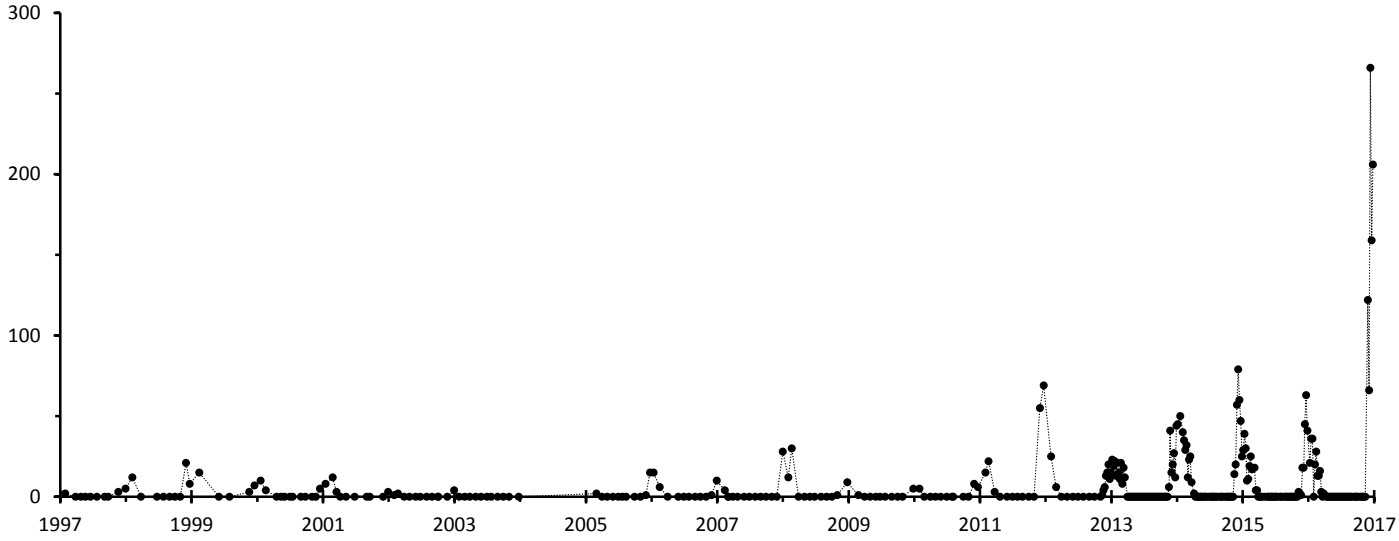


No Trend Identified The linear relationship was not statistically significant.

The number of Green Herons seen in the last 5 years is much lower compared to historical levels.

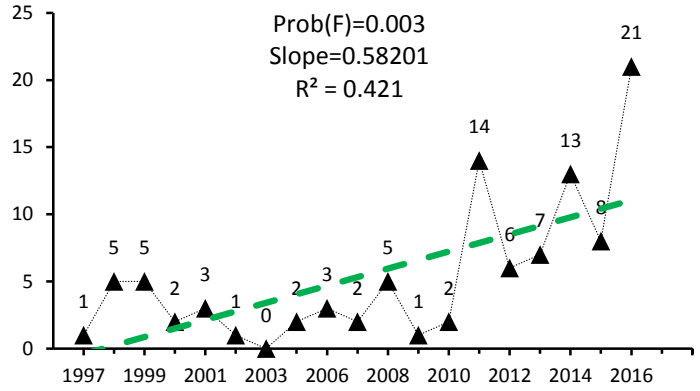
HOODED MERGANSER

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

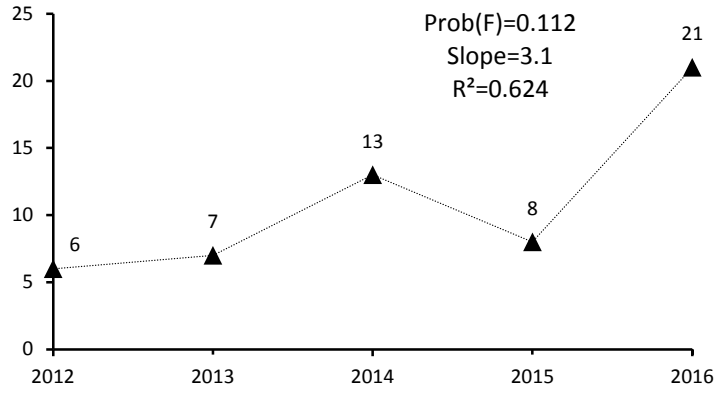
Regression of Annual Means



Regression results show an **Increasing Abundance Trend**. The linear relationship was statistically significant and slope was positive. Trend strength was moderate, with 42.1% of the variation in abundance explained by year. Based on slope, mean annual abundance increased by 0.6 Hooded Mergansers per year.

5-year (2012-2016) Abundance Trend

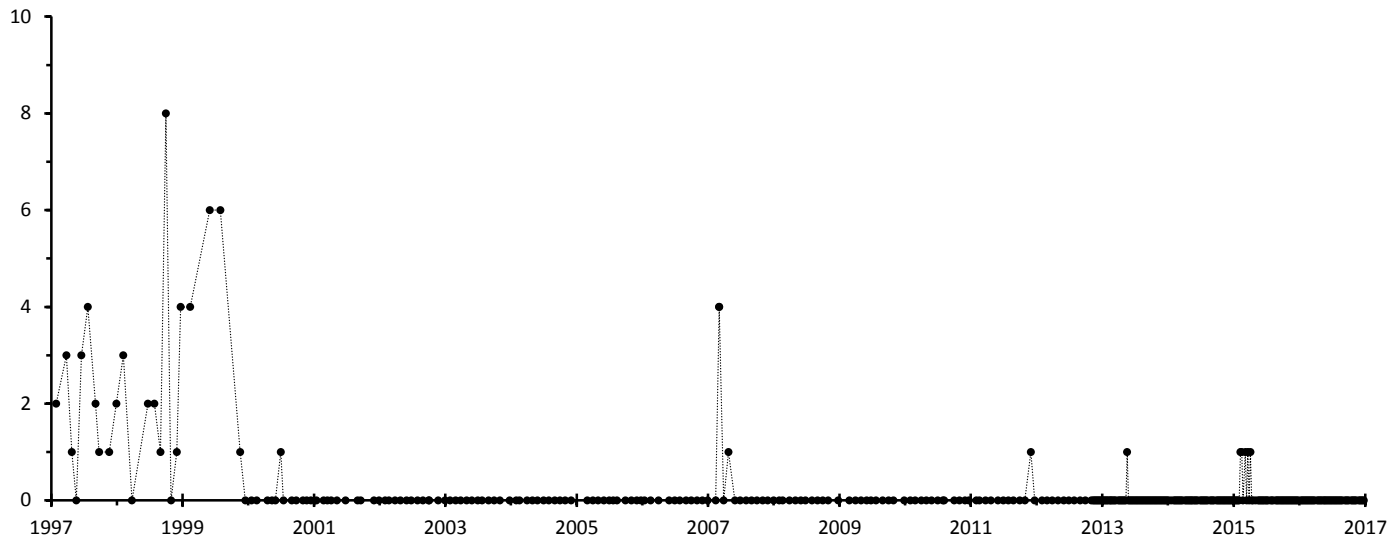
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

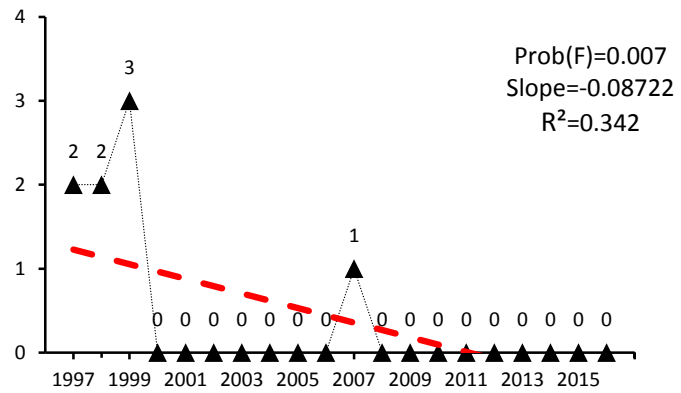
LIMPKIN

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

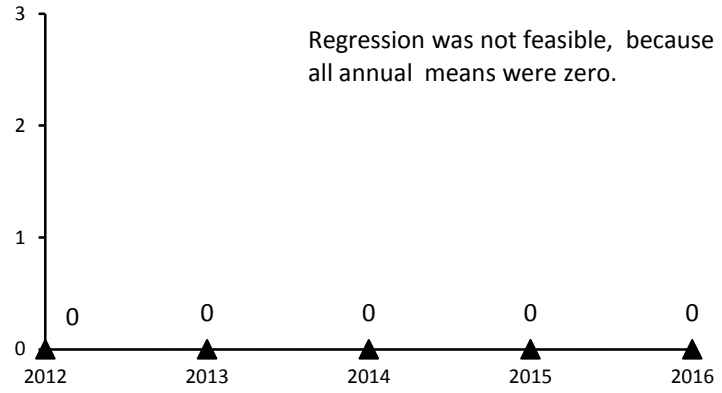
Regression of Annual Means



Regression results show a **Decreasing Abundance Trend**. The linear relationship was statistically significant and slope was negative. Trend strength was moderate, with 34.2% of the variation in mean annual abundance explained by year. Based on slope, abundance decreased by 0.1 Green Herons per year.

5-year (2012-2016) Abundance Trend

Annual Means

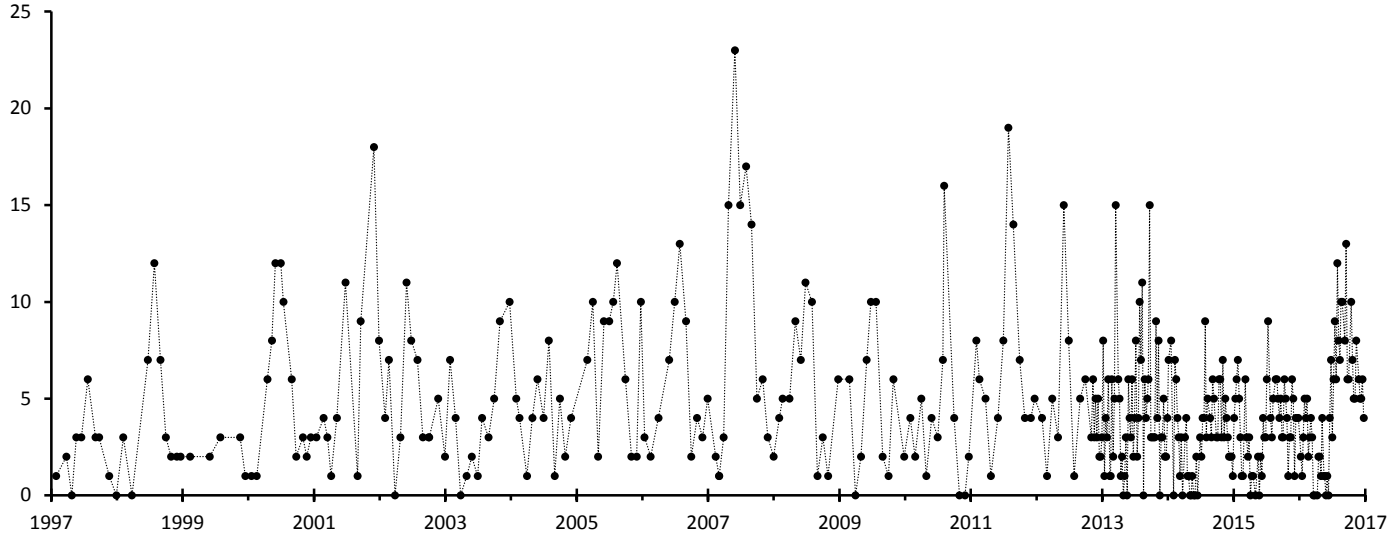


No Trend Identified Annual Means Decreased to Zero

Apple Snails, the preferred food of Limpkins, is no longer present in sufficient numbers to support a permanent population of Limpkin. From time to time, one or two Limpkins are seen feeding on mussels.

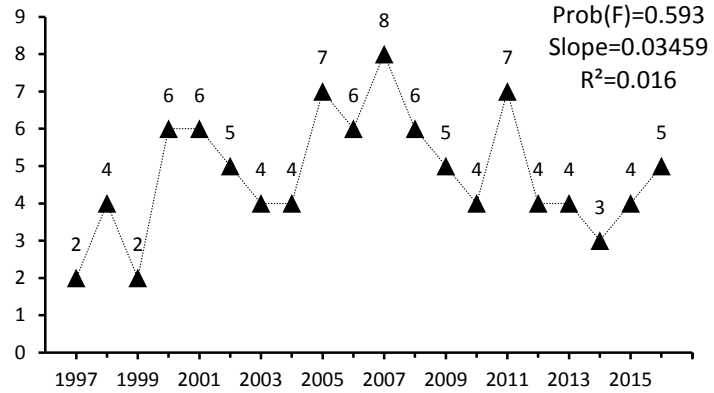
LITTLE BLUE HERON

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

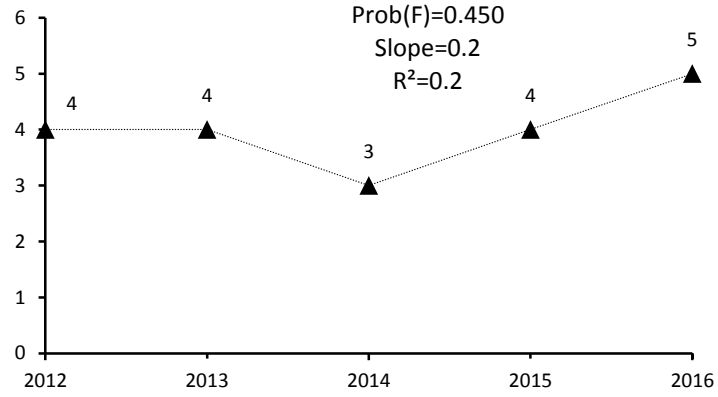
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

5-year (2012-2016) Abundance Trend

Regression of Annual Means

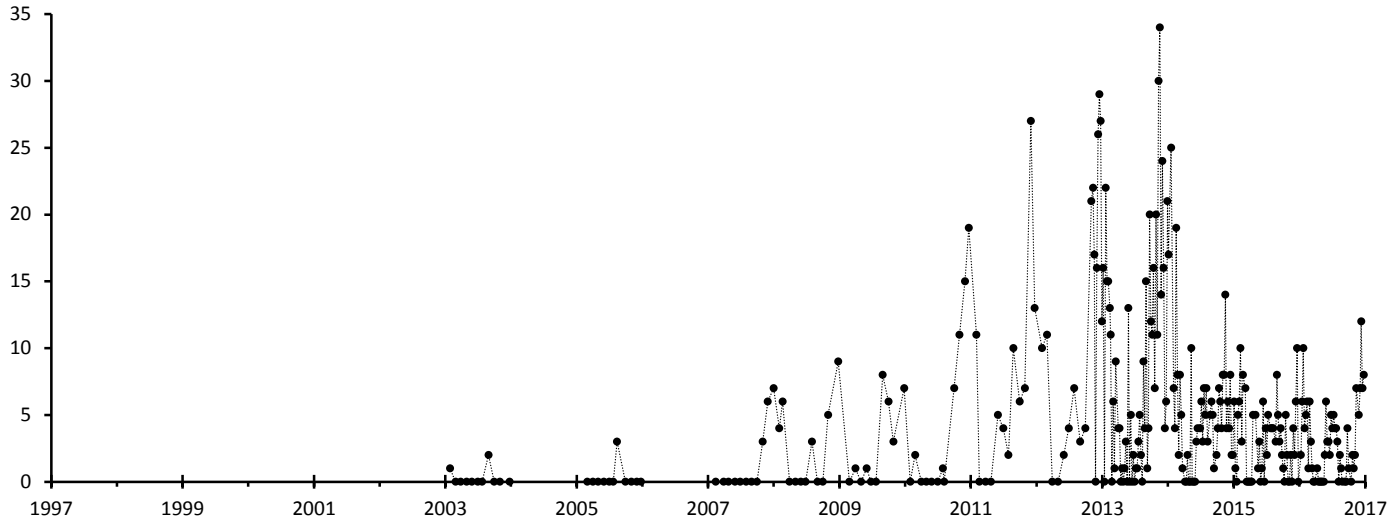


No Trend Identified The linear relationship was not statistically significant.

MANATEE

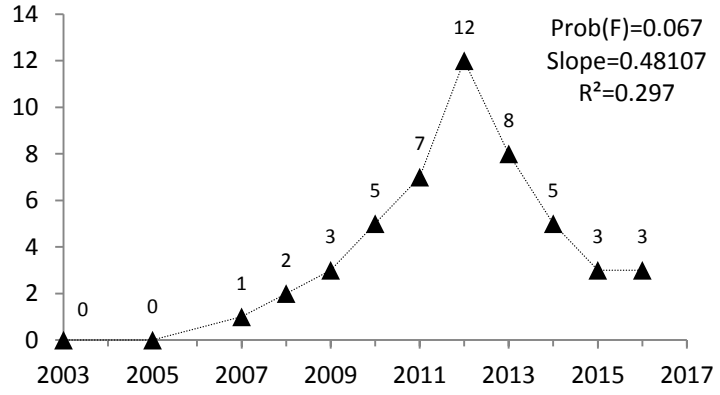
Important Note: Manatees were not monitored during wildlife surveys from 1992-2002, 2004, and 2006

20-year (1997-2016) Plot of Abundance



14-year (2003-2016) Abundance Trend

Regression of Annual Means

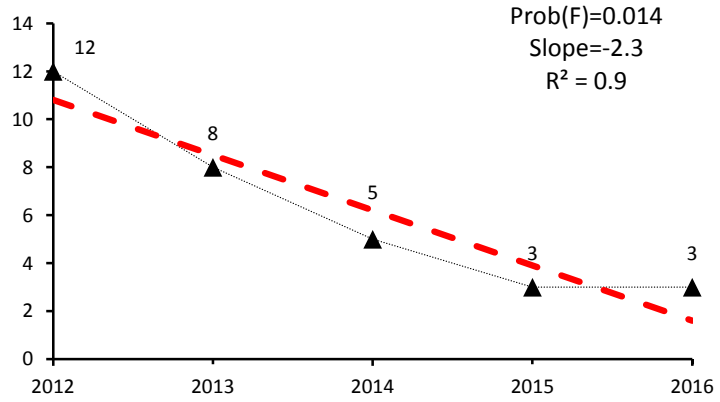


No Trend Identified The linear relationship was not statistically significant.

Manatees abundance increased steadily from 2009 to a maximum in 2012, grazing on rooted submerged aquatic plants and using the spring-fed Wakulla River as a warm water refuge in the winter. The appearance of manatees was remarkable. Manatees achieved biological control of Hydrilla. The subsequent decline in manatee abundance corresponded with the failure of the Hydrilla to recover from gazing during the winter of 2012-2013. That event corresponded to a 75% reduction in nitrate loading from the Tallahassee wasterwater treatment facilities, beginning in November 2012.

5-year (2012-2016) Abundance Trend

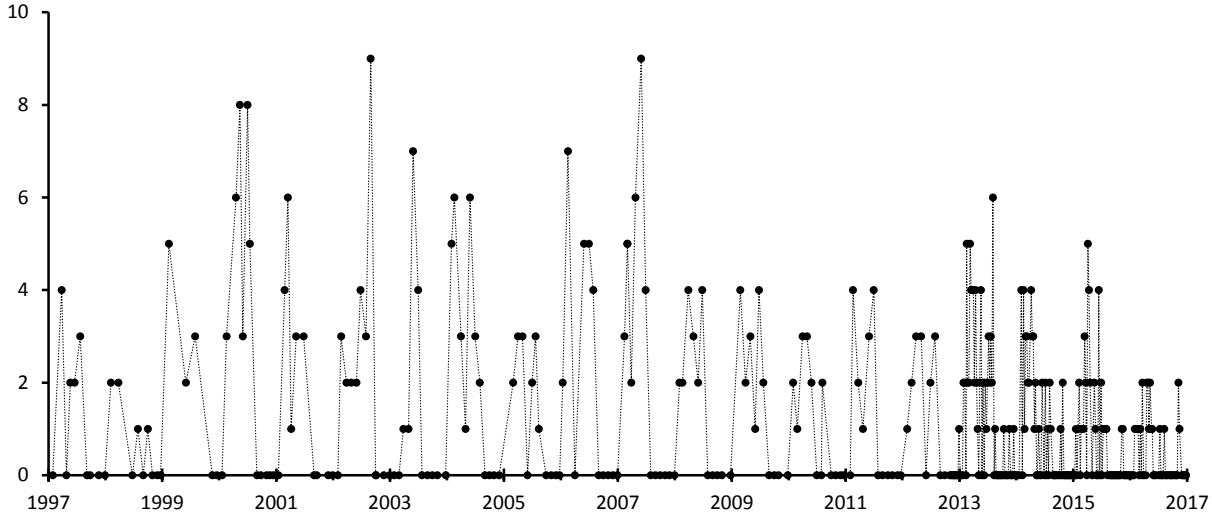
Annual Means



Regression results show a **Decreasing Abundance Trend**. The linear relationship was statistically significant and slope was negative. Trend strength was strong, with 90% of the variation in abundance explained by year. Based on slope, mean annual abundance decreased by 2.3 Manatees per year.

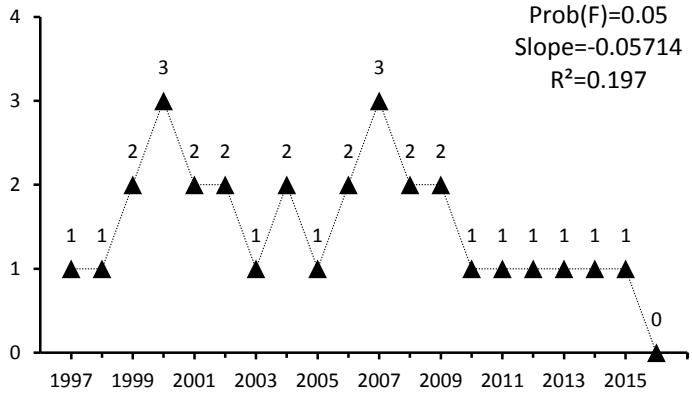
OSPREY

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

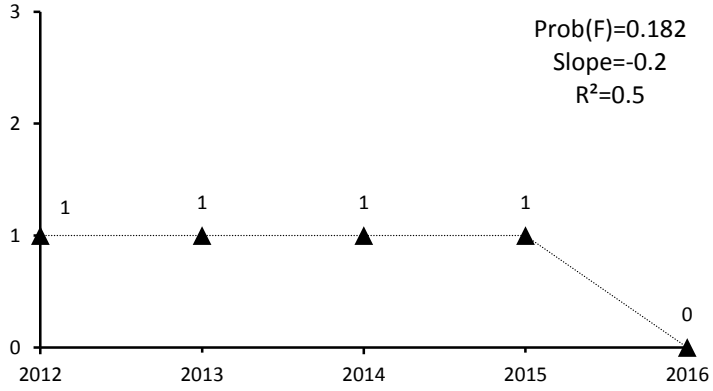
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

5-year (2012-2016) Abundance Trend

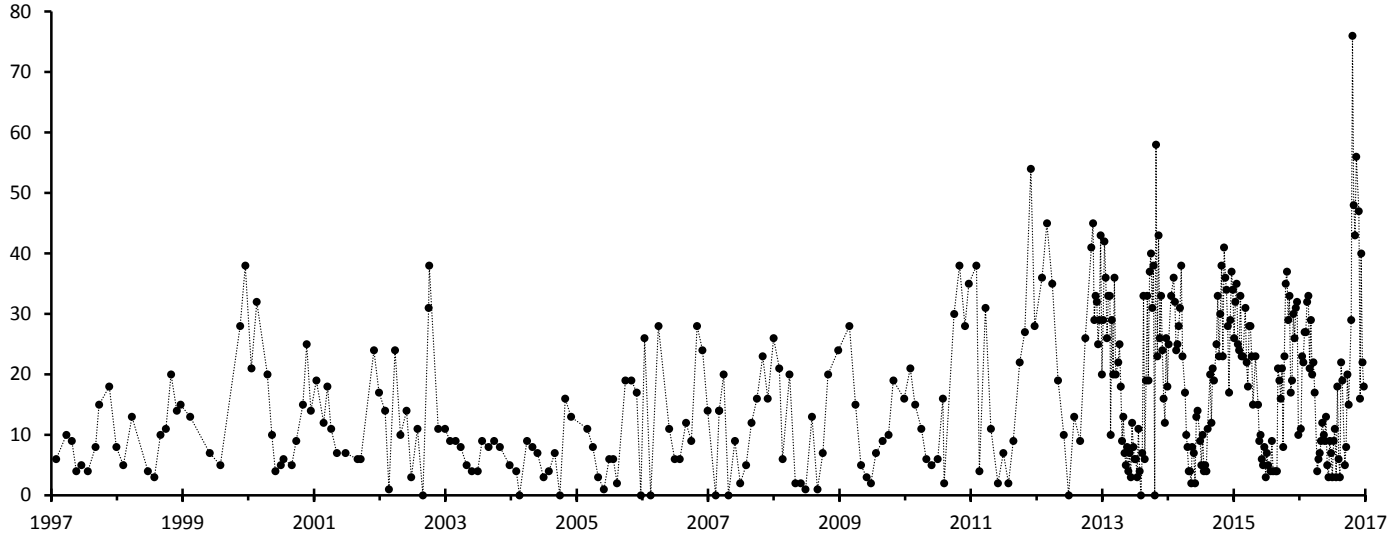
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

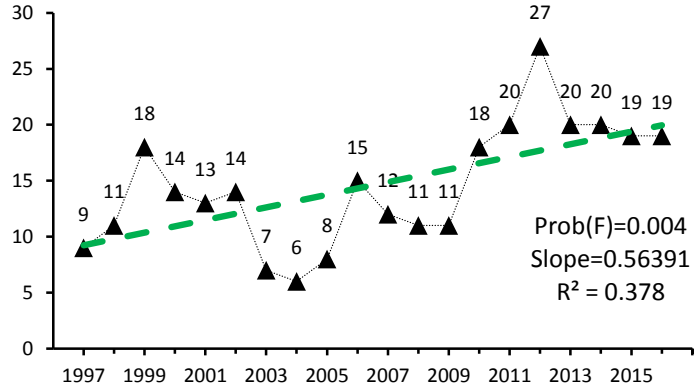
PIED-BILLED GREBE

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

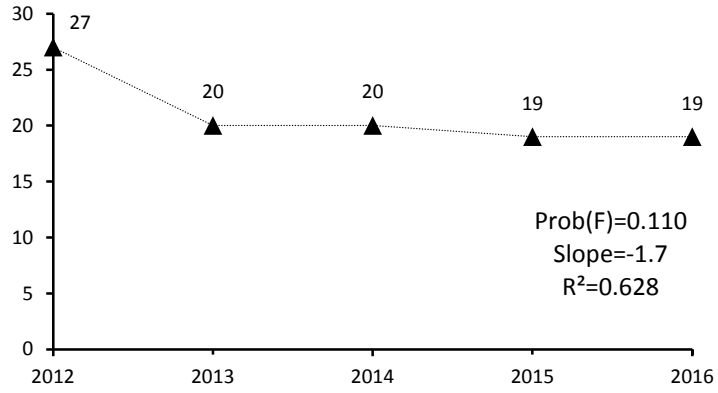
Regression of Annual Means



Regression results show an **Increasing Abundance Trend**. The linear relationship was statistically significant and slope was positive. Trend strength was moderate, with 37.8% of the variation in abundance explained by year. Based on slope, mean annual abundance increased by 0.6 Pied-billed Grebes per year.

5-year (2012-2016) Abundance Trend

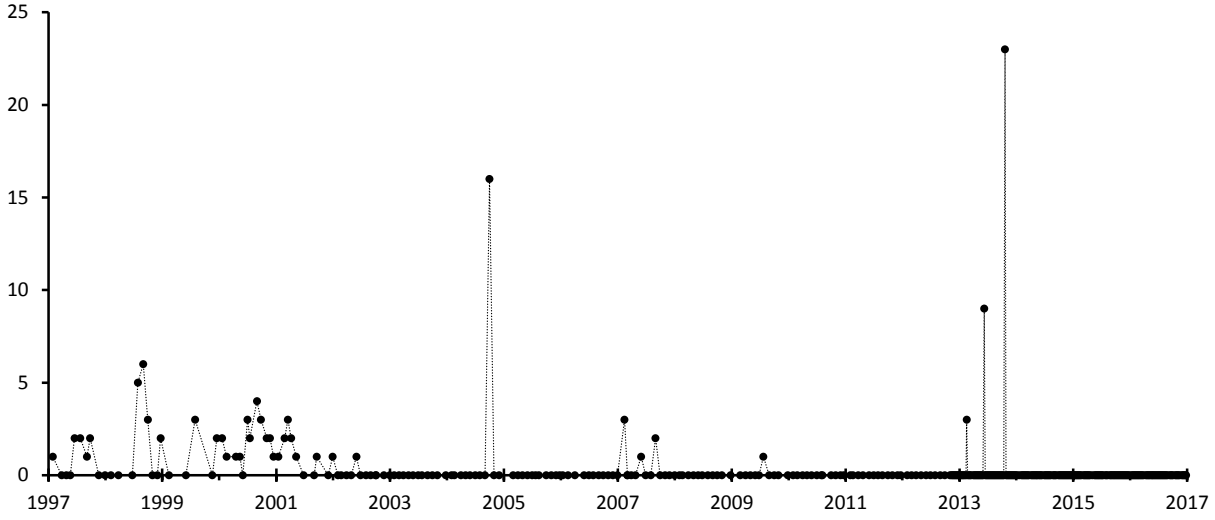
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

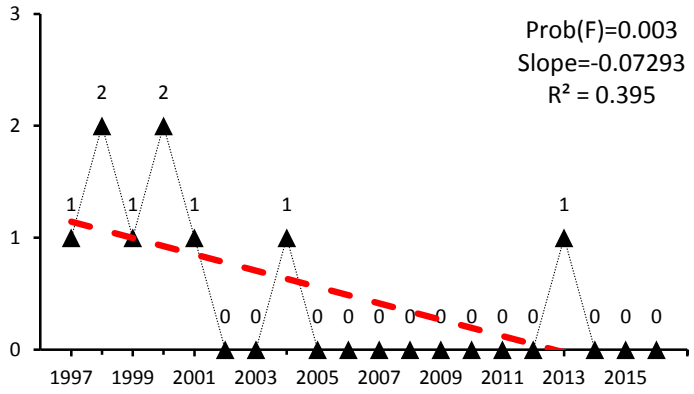
PURPLE GALLINULE

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

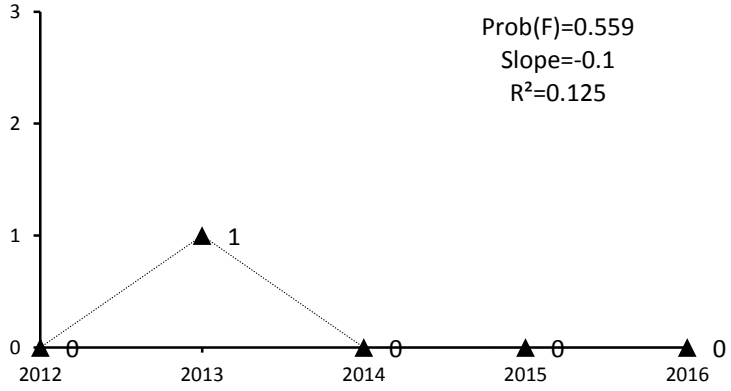
Regression of Annual Means



Regression results show a **Decreasing Abundance Trend**. The linear relationship was statistically significant and slope was negative. Trend strength was moderate, with 39.5% of the variation in abundance explained by year. Based on slope, mean annual abundance decreased by 0.1 Purple Gallinules per year.

5-year (2012-2016) Abundance Trend

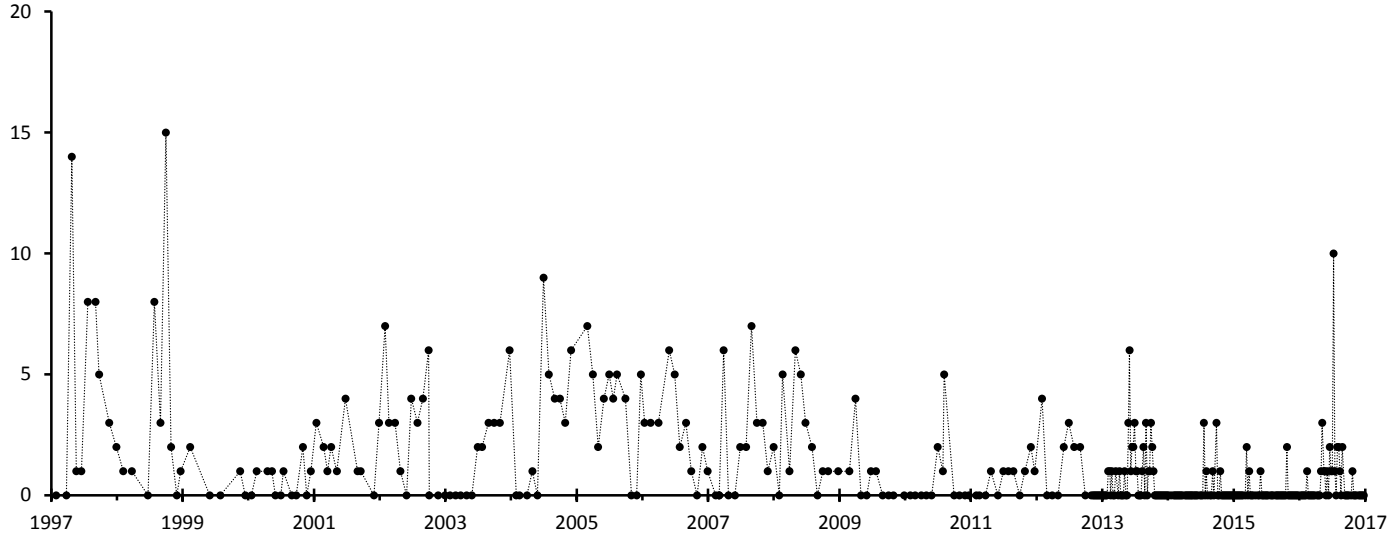
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

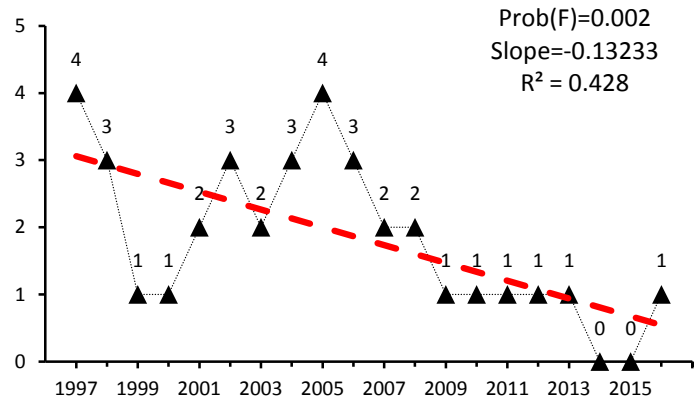
SNOWY EGRET

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

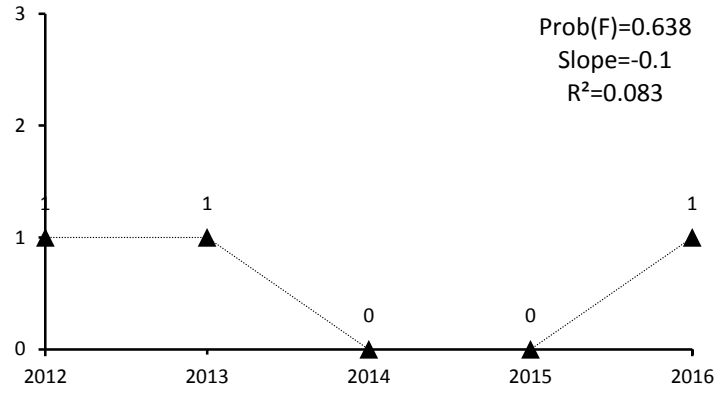
Regression of Annual Means



Regression results show a **Decreasing Abundance Trend**. The linear relationship was statistically significant and slope was negative. Trend strength was moderate, with 42.8% of the variation in abundance explained by year. Based on slope, mean annual abundance decreased by 0.1 Snowy Egrets per year.

5-year (2012-2016) Abundance Trend

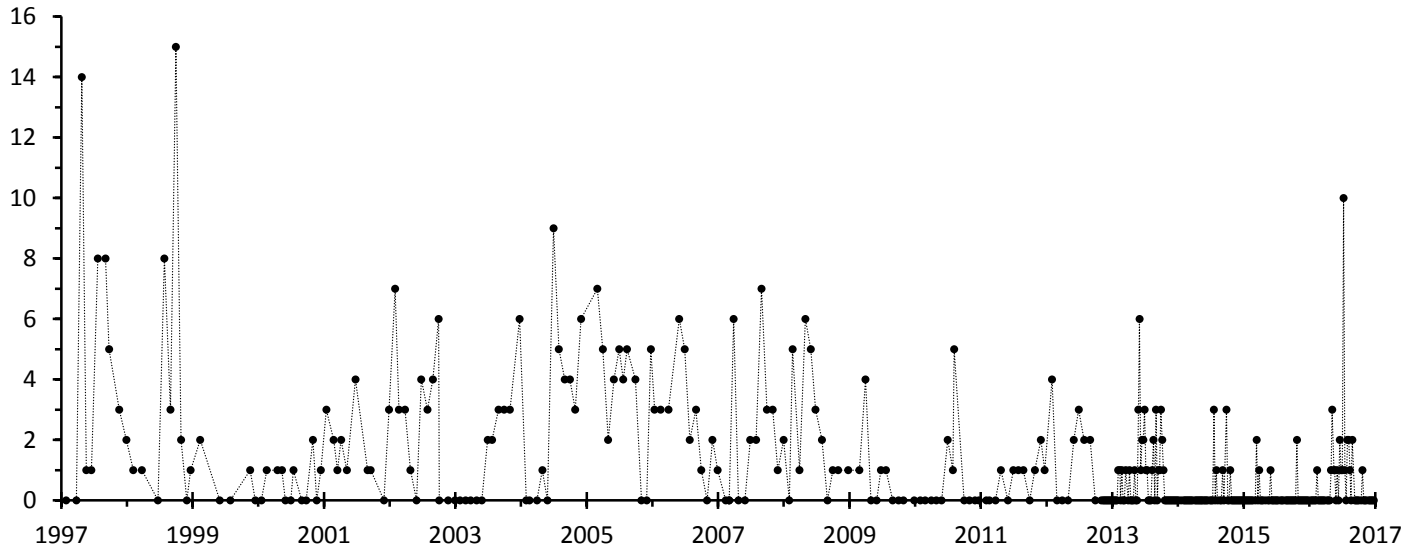
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

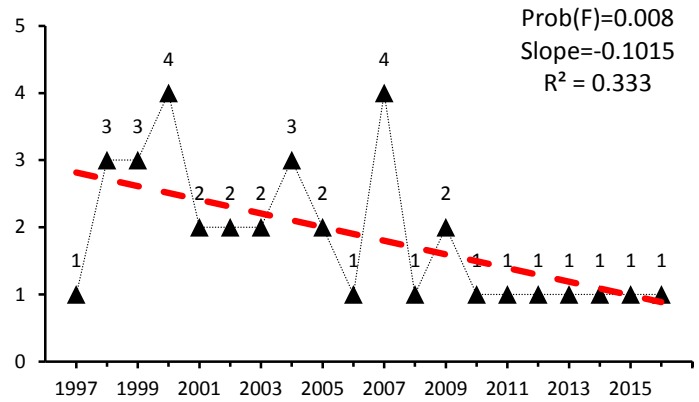
TRICOLORED HERON

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

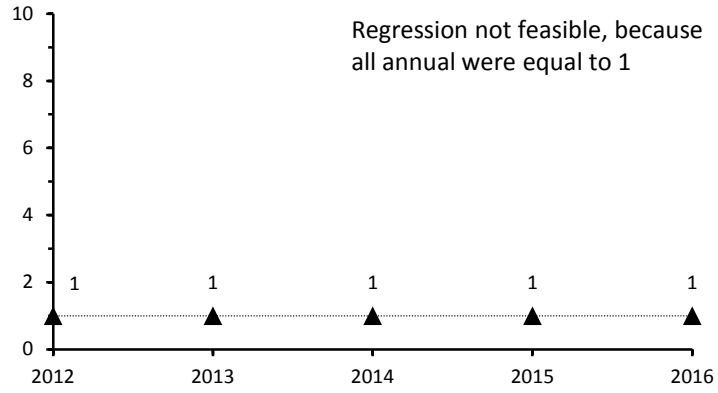
Regression of Annual Means



Regression results show a **Decreasing Abundance Trend**. The linear relationship was statistically significant and slope was negative. Trend strength was moderate, with 33.3% of the variation in abundance explained by year. Based on slope, mean annual abundance decreased by 0.1 Tricolored Herons per year.

5-year (2012-2016) Abundance Trend

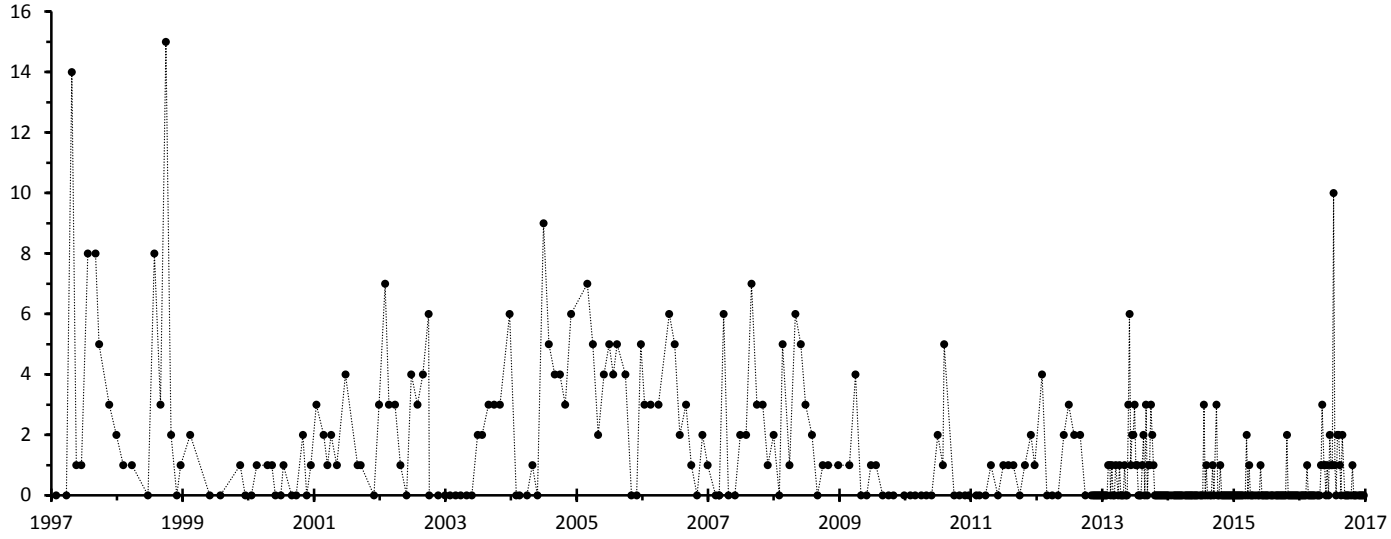
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

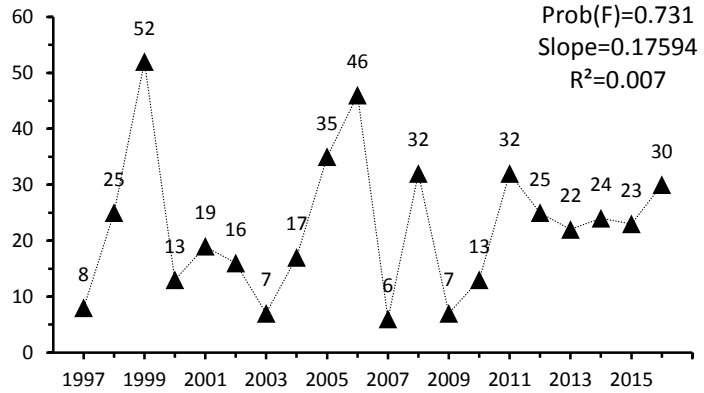
WHITE IBIS

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

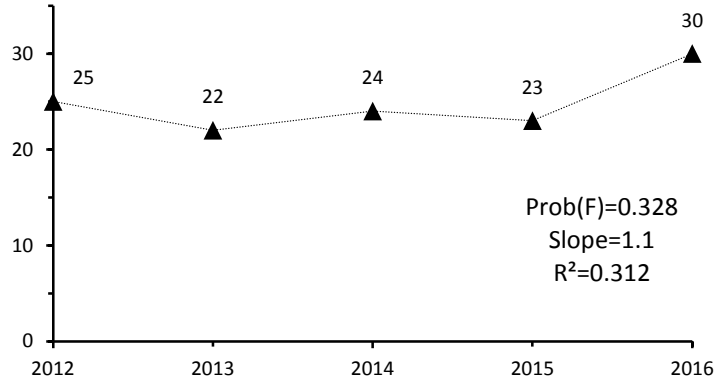
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

5-year (2012-2016) Abundance Trend

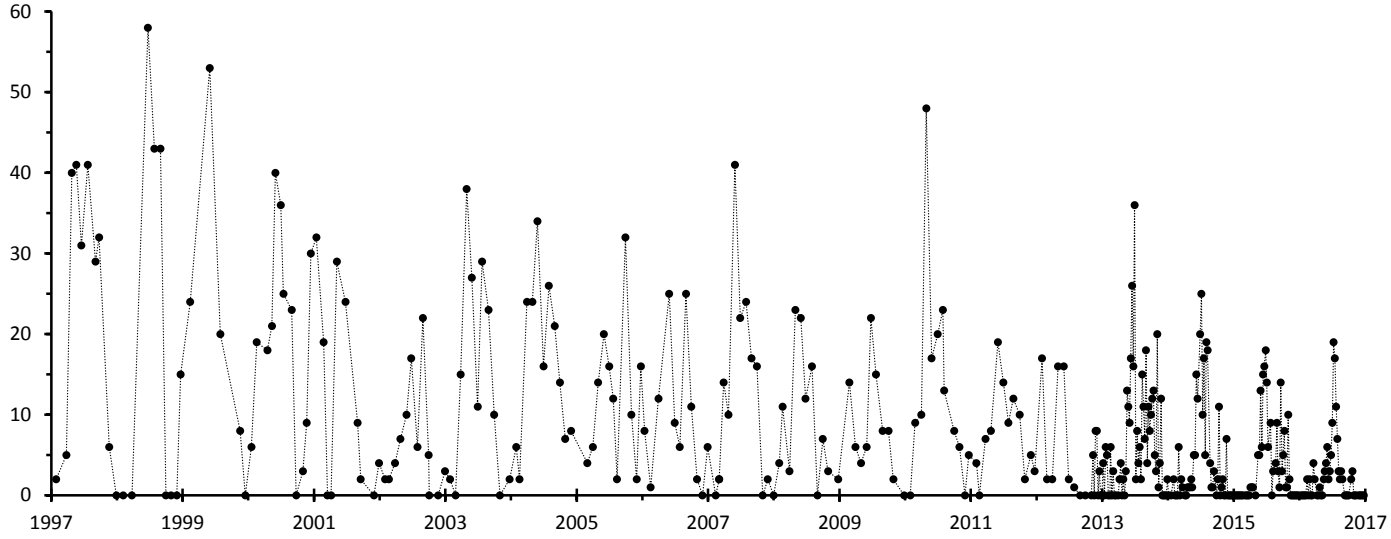
Regression of Annual Means



No Trend Identified The linear relationship was not statistically significant.

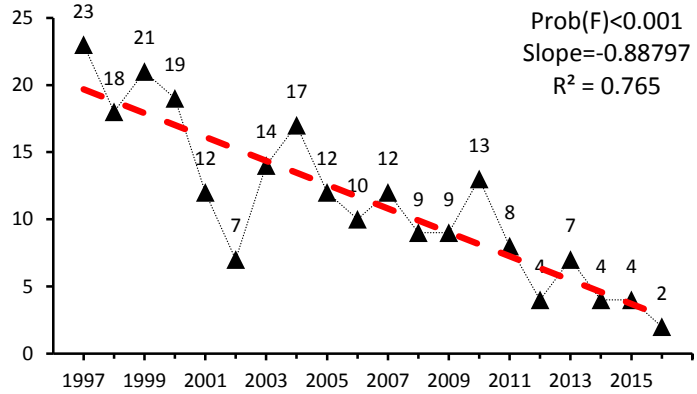
WOOD DUCK

20-year (1997-2016) Plot of Abundance



20-year (1997-2016) Abundance Trend

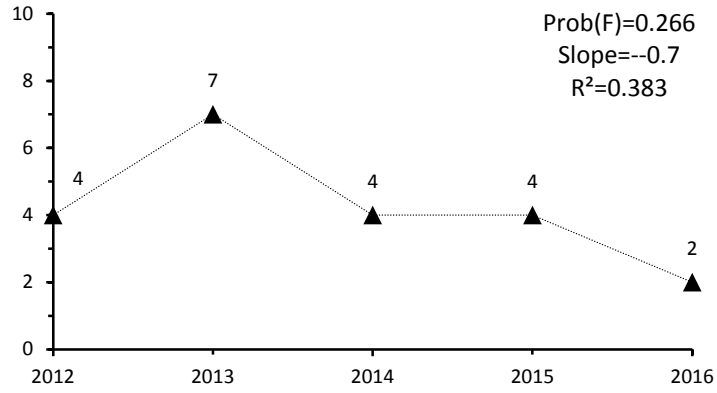
Regression of Annual Means



Regression results show a **Decreasing Abundance Trend**. The linear relationship was statistically significant and slope was negative. Trend strength was strong, with 76.5% of the variation in abundance explained by year. Based on slope, mean annual abundance decreased by 0.9 Wood Ducks per year.

5-year (2012-2016) Abundance Trend

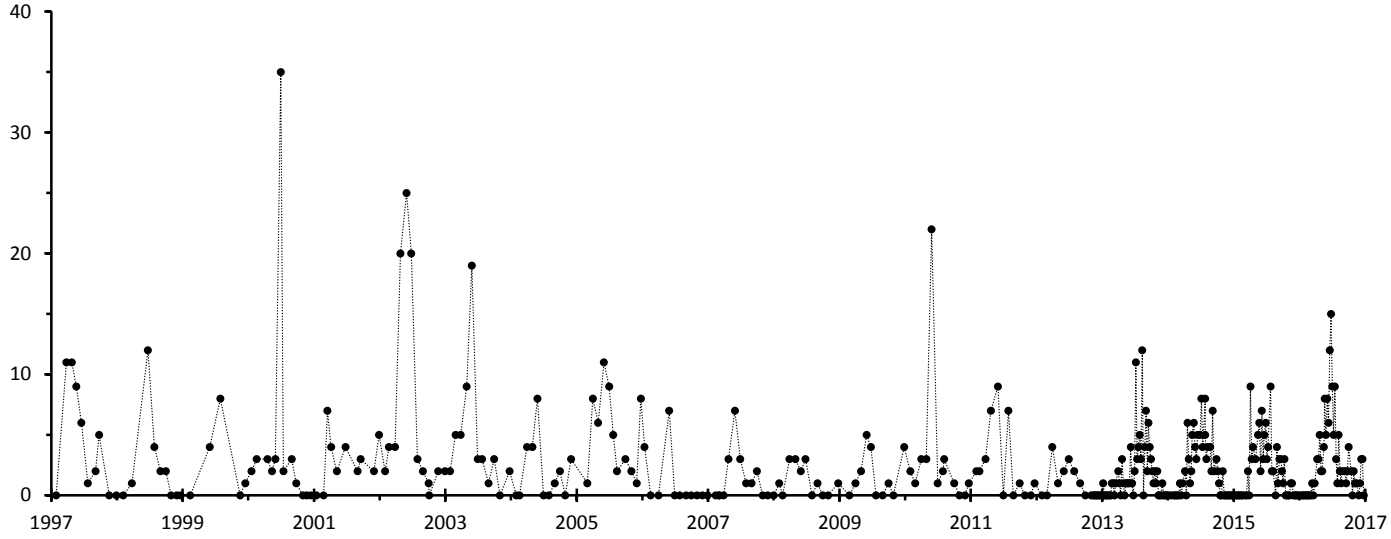
Regression of Annual Means



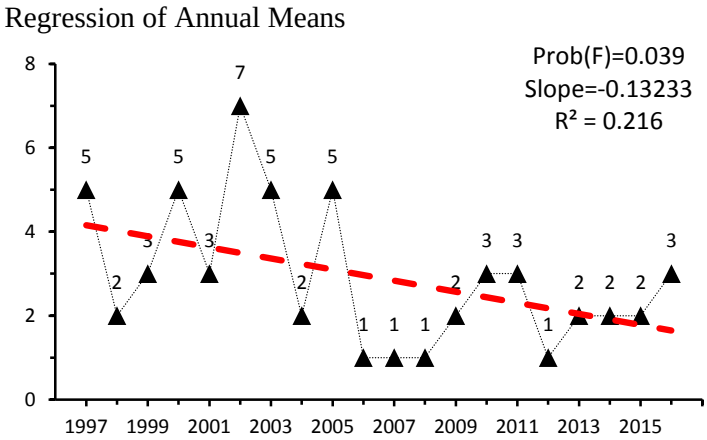
No Trend Identified The linear relationship was not statistically significant.

YELLOW-CROWNED NIGHT-HERON

20-year (1997-2016) Plot of Abundance

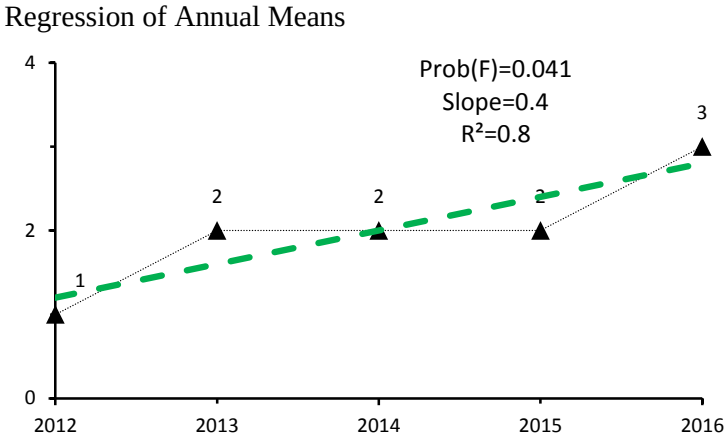


20-year (1997-2016) Abundance Trend



Regression results show a **Decreasing Abundance Trend**. The linear relationship was statistically significant and slope was negative. Trend strength was weak, with 21.6% of the variation in abundance explained by year. Based on slope, mean annual abundance decreased by 0.1 Yellow-crowned Night-Herons per year.

5-year (2012-2016) Abundance Trend



Regression results show an **Increasing Abundance Trend**. The linear relationship was statistically significant and slope was positive. Trend strength was strong, with 80% of the variation in abundance explained by year. Based on slope, mean annual abundance increased by 0.4 Yellow-crowned Night-Herons per year.

ATTACHMENT 2
Regression Results of Annual Means Used to Identify Trends

The following presents in an abbreviated format the three criteria for identifying abundance trends on page 1.

- Prob(F) Statistically significant linear relationship was identified by Prob(F)<0.05
- Plus/Minus Sign of Slope Abundance trends were identified as follows, based on Prob(F) and the sign of the slope of the regression line

  Increasing The linear relationship was statistically significant and slope was positive
  Decreasing The linear relationship was statistically significant and slope was negative
  No Trend The linear relationship was not statistically significant

Results

	20 year (1997-2016)				5 year (2012-2016)			
Animal	Prob(F)	Slope	R^2	Trend	Prob(F)	Slope	R^2	Trend
American Alligator	<0.001	-1.16391	0.714	**Decreasing**	0.006	0.7	0.942	**Increasing**
American Coot	0.243	-1.29624	0.075	**No Trend**	0.027	-18.3	0.846	**Decreasing**
American Widgeon	<0.001	-11.37368	0.527	**Decreasing**	---	---	---	**Means=0**
Anhinga	0.0169	-0.55940	0.278	**Decreasing**	0.368	0.5	0.272	**No Trend**
Blue-winged Teal	<0.001	-0.34887	0.522	**Decreasing**	---	---	---	**Means=0**
Cattle Egret	0.035	0.48797	0.225	**Increasing**	0.153	-4.2	0.546	**No Trend**
Common Gallinule	<0.001	-2.83308	0.537	**Decreasing**	0.079	-7.2	0.695	**No Trend**
Cooter Turtle	0.213	0.16692	0.085	**No Trend**	0.332	0.8	0.308	**No Trend**
Double-cr. Cormorant	0.605	-0.01955	0.015	**No Trend**	0.164	0.6	0.529	**No Trend**
Great Blue Heron	0.420	-0.01579	0.036	**No Trend**	0.308	-0.2	0.333	**No Trend**
Great Egret	0.803	0.01203	0.004	**No Trend**	0.559	0.1	0.125	**No Trend**
Green Heron	<0.001	-0.25940	0.693	**Decreasing**	0.638	-0.1	0.083	**No Trend**
Hooded Merganser	0.003	0.58201	0.421	**Increasing**	0.112	3.1	0.624	**No Trend**
Limpkin	0.007	-0.08722	0.342	**Decreasing**	---	---	---	**Means=0**
Little Blue Heron	0.593	0.03459	0.016	**No Trend**	0.450	0.2	0.2	**No Trend**
Osprey	0.050	-0.05714	0.197	**No Trend**	0.182	-0.2	0.5	**No Trend**
Pied-billed Grebe	0.004	0.56391	0.378	**Increasing**	0.110	-1.7	0.628	**No Trend**
Purple Gallinule	0.003	-0.07293	0.395	**Decreasing**	0.559	-0.1	0.125	**No Trend**
Snowy Egret	0.002	-0.13233	0.428	**Decreasing**	0.638	-0.1	0.083	**No Trend**
Tricolored Heron	0.008	-0.10150	0.333	**Decreasing**	---	---	---	**Means=1**
White Ibis	0.731	0.17594	0.007	**No Trend**	0.328	1.1	0.312	**No Trend**
Wood Duck	<0.001	-0.88797	0.765	**Decreasing**	0.266	-0.7	0.383	**No Trend**
Yellow-cr. Night-Heron	0.039	-0.13233	0.216	**Decreasing**	0.041	0.4	0.8	**Increasing**

Manatees were not monitored during wildlife surveys until 2003; hence the long-term time interval in the table below was identified as 14 years instead of 20 years.

	14 year (2003-2016)				5 year (2012-2016)			
Animal	Prob(F)	Slope	R^2	Trend	Prob(F)	Slope	R^2	Trend
Manatee	0.067	0.48107	0.297	**No Trend**	0.014	-2.3	0.90	**Decreasing**