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by

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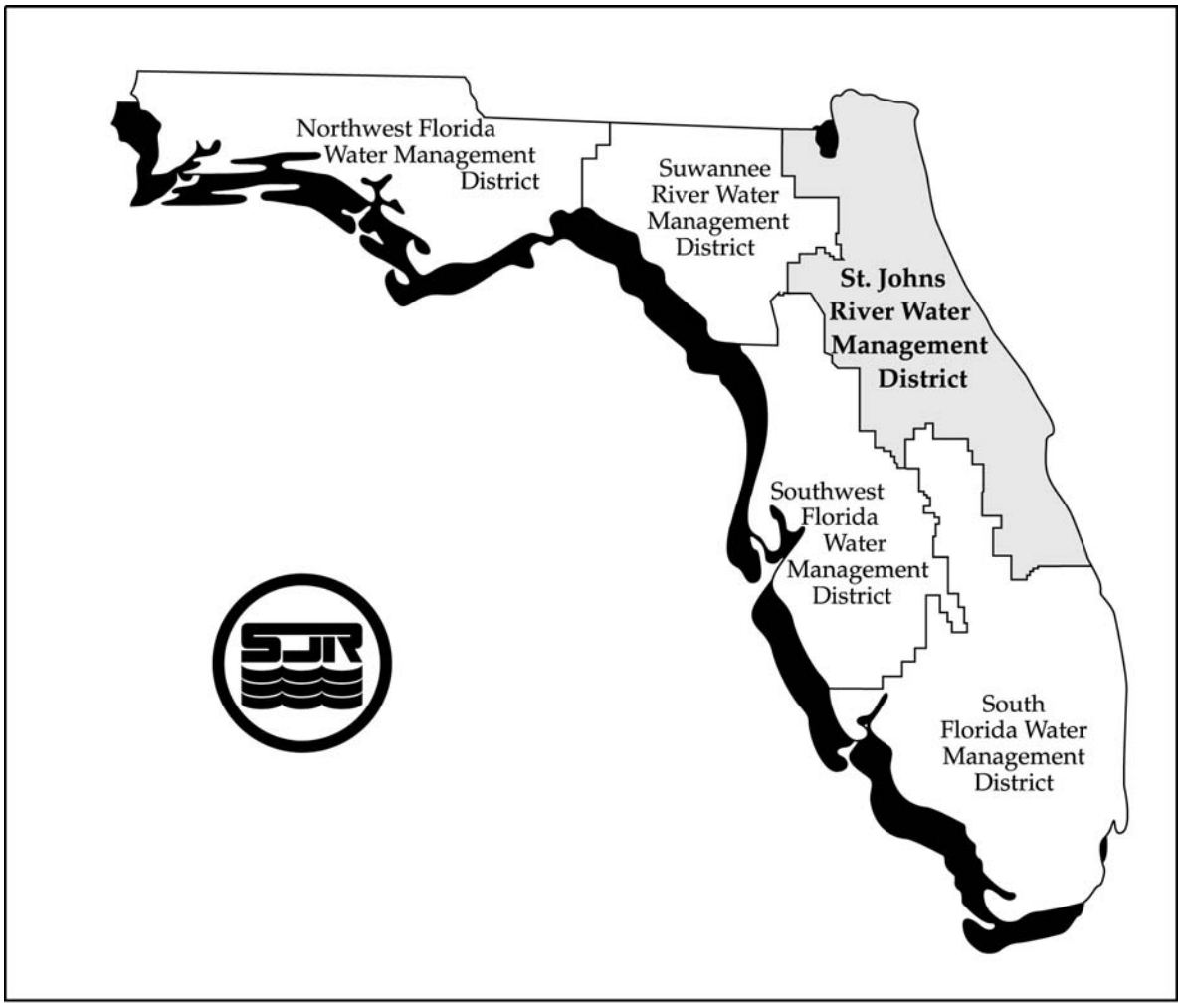
2011



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Evaluation of Discharge Data for Blue Spring, Volusia County, Florida, for the Period 1932–2006

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ABSTRACT

St. Johns River Water Management District (SJRWMD) established minimum flows and levels for Blue Spring, Volusia County, Florida, in 2006 as a minimum flow regime (MFR). SJRWMD evaluated available spring discharge data for Blue Spring for the period of March 1932–June 2006, in support of establishment of the MFR. This evaluation included an exploratory data analysis followed by statistical hypothesis-testing based on the Mann-Whitney U-test and the median test. The evaluation of Blue Spring discharge data for the period of record (1932–2006) was based on 658 discharge measurements. Results indicate that the minimum discharge was 63 cubic feet per second (cfs), the maximum was 218 cfs; the median discharge was 159 cfs; and the mean discharge was 157 cfs. Based on LOESS (locally weighted scatterplot smoothing) statistics, the median spring discharge for the manatee season is 5 cfs higher than the median discharge for the period of record. The Mann-Whitney U-test and the median statistical test indicate that there is a statistically significant difference between the two data sets. Based on LOESS statistics, the median spring discharge for the manatee season is 9 cfs higher than the median discharge for the non-manatee season. The Mann-Whitney U-test and the median statistical test indicate that there is a statistically significant difference between the two data sets. Therefore, discharge from Blue Spring is higher during the manatee season, which extends from November through March, than during non-manatee season of April through October.

INTRODUCTION

The St. Johns River Water Management District (SJRWMD) establishes minimum flows and levels (MFLs) for surface water bodies and aquifers for the purpose of protecting the water resources and ecology of an area from significant harm. In developing MFLs, SJRWMD first evaluates available hydrologic data for the water body or aquifer in question. These hydrologic data are then used with other water resource-related information to establish MFLs.

SJRWMD established MFLs for Blue Spring in Volusia County, Florida, in 2006 as a minimum flow regime (MFR). This paper presents an evaluation of available spring discharge data for Blue Spring from March 1932 to June 2006. Much of the evaluation was completed in support of the development of the established MFR, referenced as Osburn 2001b, 2003b, and 2006b in SJRWMD Special Publication SJ2007-SP17, *Analysis of Blue Spring Discharge Data to Determine a Minimum Flow Regime*, which cites these documents as draft documents. Within this paper, SJRWMD finalizes the draft information contained in previous documents.

METHODS

Available discharge data for Blue Spring (Appendix A) were evaluated by an exploratory data analysis followed by statistical hypothesis testing based on the Mann-Whitney U-test and Mood's median test. The following is a discussion of these techniques.

Exploratory Data Analysis

The exploratory data analysis of the spring discharge data was initiated by a visual inspection of locally weighted scatterplot smoothing (LOESS) graphs (Cleveland 1993). This technique was utilized to produce graphs depicting smoothed spring discharge data over time. The smoothing was performed by selection of a smoothing factor **(f)** and a polynomial fit (λ). The **f** controls the window width over which a smooth is calculated for each data point. Typically, **f** is between 0.25 and 1.0. The polynomial fit (λ) is either a locally linear or a locally quadratic fit. The selection of **f** and λ is determined subjectively according to the purpose for which the smooth is to be utilized (Cleveland 1994). LOESS smoothing is an exploratory technique that can be utilized to: (a) observe any possible patterns in the data, and (b) compare and contrast data with each other (Helsel and Hirsch 1992; Cleveland 1993). To investigate patterns of the spring discharge data, their time series graphs are inspected to observe any differences between the seasons.

Exploratory data analysis also includes the computation of descriptive summary statistics. In this investigation the median, rather than the mean, was utilized as a measure of central tendency of the time series. The median is most appropriate for data sets of time series data which are not normally distributed or that are skewed by highly elevated values. The median is especially robust with respect to anomalous data. If the time series is normally distributed, then the mean and median are equal. If the time series are not normally distributed, as is frequently the case with environmental data and small time series, then the mean and median differ.

Statistical Hypothesis Testing

In hypothesis testing, a null (H_o) and alternative (H_a) hypotheses are stated. Both the Mann-Whitney U-test and median test were used. Both methods formally test for a difference between the medians of two independent samples, using nonparametric approaches. Neither test requires any specific normality assumption concerning the statistical distribution of the investigated time series. With the Mann-Whitney U-test, sample populations should be independent and with similar shape distributions. With the median test, the sample populations should be independent, but need not have similar shape distributions. The Mann-Whitney U-test, also commonly referred to as the Wilcoxon rank-sum test, is the most powerful alternative to the independent samples' t-test. Analyse-it® software for Microsoft Excel was utilized to perform the statistical testing.

Hypotheses tested:

- H_o: There is no difference between the medians of the data set representing the manatee season and the data set representing the non-manatee season.
- H_a: There is a difference between the medians of the data set representing the manatee season and the data set representing the non-manatee season.

The hypotheses were tested, using a 95% confidence level. Under such a condition, H_a is acceptable if the confidence level of the test statistic is equal to or greater than 95%.

DISCHARGE DATA

The discharge data examined for this effort consisted of published U.S. Geological Survey (USGS) discharge measurements

made from March 1932 to June 2006 and discharge measurements made by SJRWMD from February 1983 to February 1996 (Figure 1, Appendix A). These data were modified only by removing duplicate data and by averaging data for days for which different data sets were recorded.

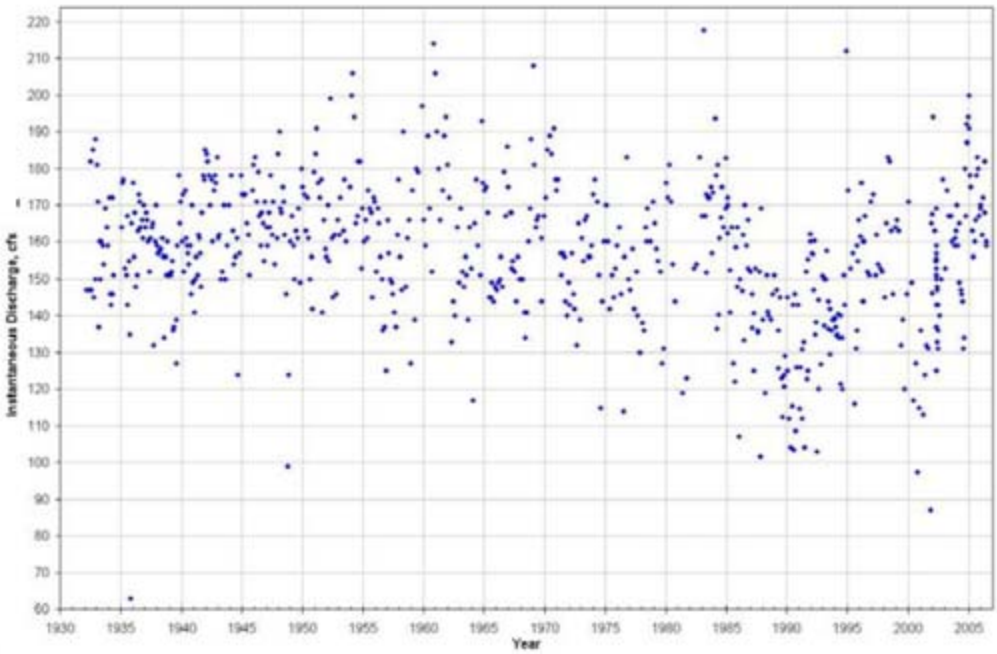

Figure 1. March 1932–June 2006 discharge measurements for Blue Spring, near Orange City, in Volusia County, Fla.

ANALYSIS AND RESULTS

Exploratory Data Analysis

These period-of-record (POR) discharge time series data were divided into two seasons—manatee and non-manatee. The manatee season is the period from November through March. The non-manatee season is the period April through October. The POR, manatee, and non-manatee season minimum, mean, median, and maximum for the spring discharge time series are shown in Table 1. All values have been rounded to the nearest whole number. The median number of yearly measurements is 8 and the maximum is 23. Four years had 5 or fewer measurements per year—notably 1959 (5), 1980 (5), 1981 (2), 1982 (3). The box plots in Figure 2 more clearly show the sample populations' similarities and dissimilarities.

LOESS smoothing of spring discharge data for Blue Spring for the period of 1932–2006 is displayed in Figure 3. In these analyses, LOESS curves are intended for observing changes in spring discharge for POR, manatee season, and non-manatee season data. The LOESS curves for four **f** values (0.05, 0.10, 0.15, and 0.20) were evaluated for the POR data set. An **f** of 0.10 was selected because it appeared to smooth the

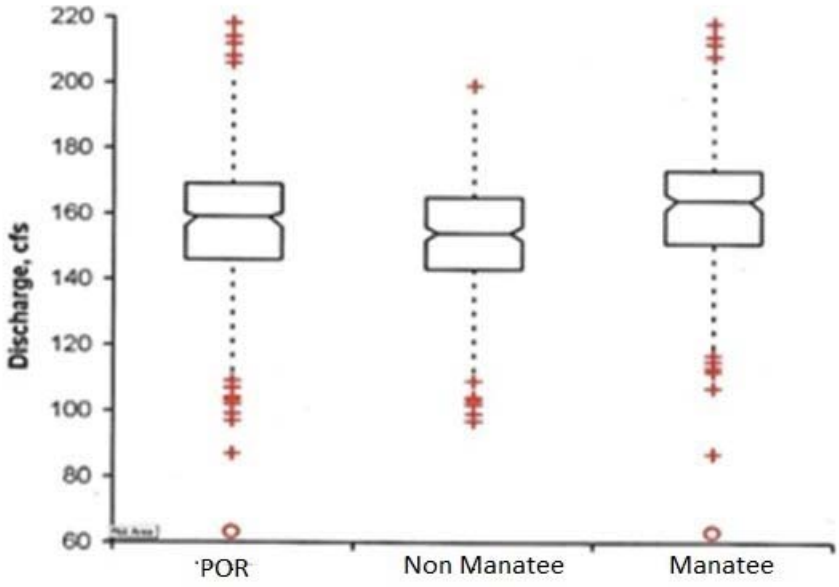

Figure 2. Box plots of period-of-record (POR), non-manatee, and manatee season Blue Spring discharge measurements (notch representing the median value)

Table 1. Statistical summary of Blue Spring discharge measurements

Discharge in cubic feet per second (cfs)							
Season	Period	Minimum	Mean	Median	Maximum	Count	95% CI Median
POR	1932–2006	63	157	159	218	658	156–160
Manatee months	1932–2006	63	162	164	218	256	161–166
Non-manatee months	1932–2006	97	153	154	199	402	152–156

POR = period of record
CI = confidence interval

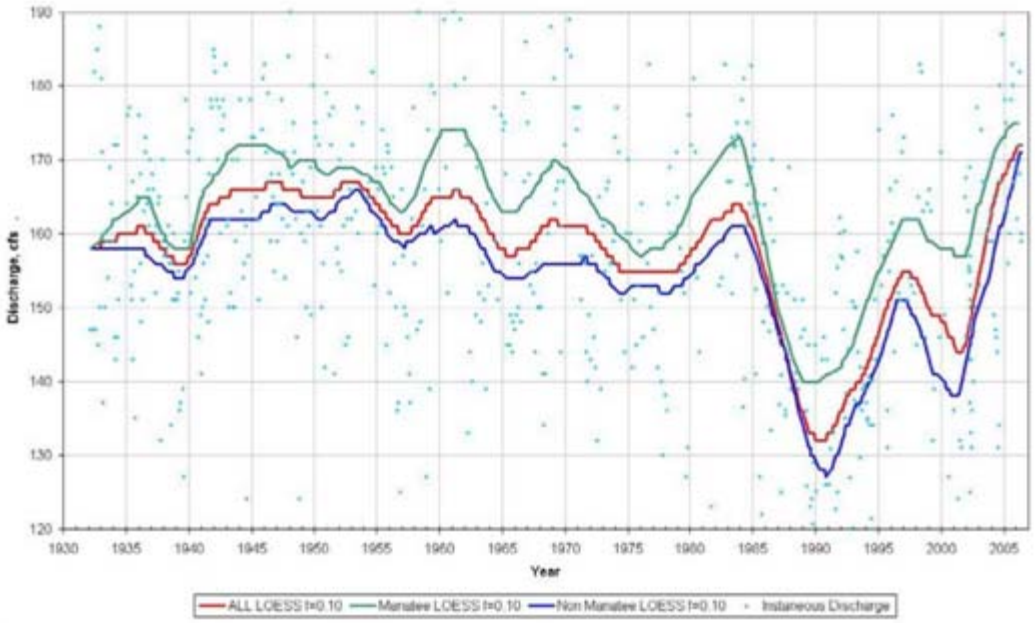

Figure 3. LOESS curves of Blue Spring period-of-record (POR), manatee season, and non-manatee season discharges

data, yet still allowed small annual variations in the data sets to be displayed. Examination of the LOESS smoothing of the residuals, as recommended by Cleveland (1994), indicated that the amount of smoothing for the LOESS curve is reasonably close to a horizontal line, so the amount of smoothing is not too great. The same **f** (0.10) was used on all subsets of the data for LOESS smoothing. A locally quadratic fit was used for λ in all cases.

The LOESS curve of the manatee versus non-manatee sample populations indicates the discharge at Blue Spring is consistently higher during the manatee season. The difference between the manatee season and non-manatee season curves appears to be fairly consistent across the years (Figure 4). The median difference between the LOESS curve for the manatee and non-manatee season is 9 cubic feet per second (cfs). The 95% confidence interval (CI) of the median difference is 8 to 10 cfs utilizing the Mann-Whitney U-test. Figure 4 shows the differences between the manatee season and non-manatee season LOESS curves.

The non-parametric Mann-Whitney U-test and median test were utilized to test for differences in the medians of the data for the manatee and non-manatee seasons. The test statistics are summarized in Table 2. Both tests reject the H_o (null hypothesis)—there is no difference between the populations. In both tests, H_a (alternate hypothesis) is accepted—the sample populations are not equal. By inference, the observed LOESS curve differences in the POR, manatee, and non-manatee season sample populations are statistically significant.

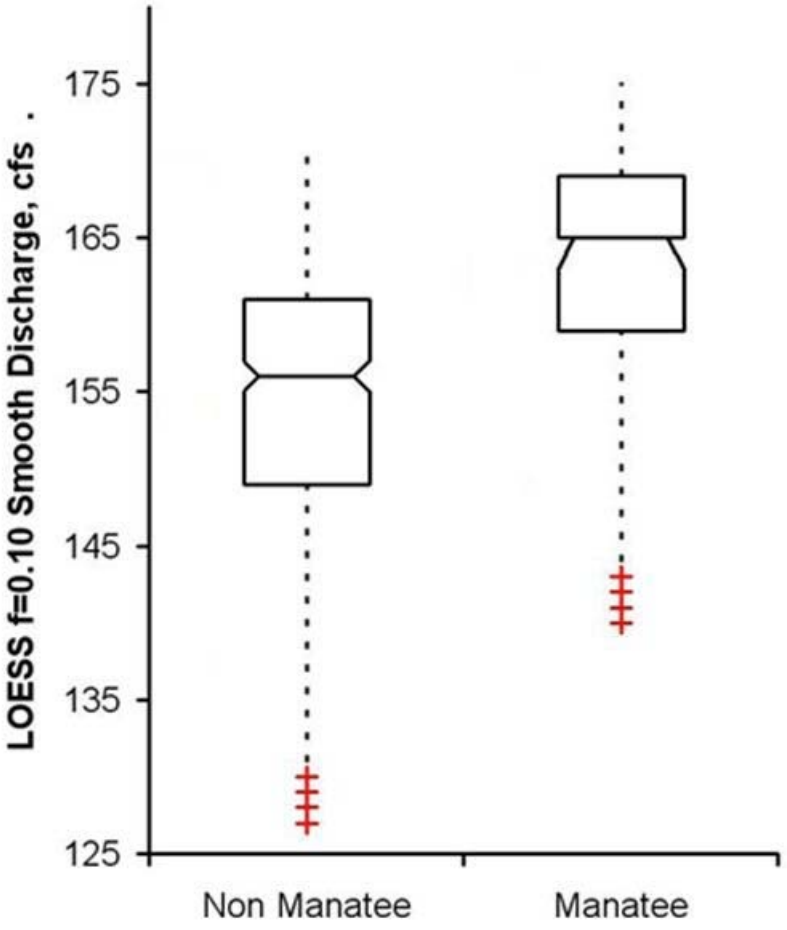

Figure 4. Box plots of the differences between the non-manatee season and manatee season LOESS curves (cfs = cubic feet per second)

CONCLUSIONS

The following conclusions are based on the statistical analysis:

1. Evaluation of Blue Spring discharge data for the period of record (1932–2006) indicates that the minimum discharge was 63 cfs; the maximum was 218 cfs for 658 measurements. The median discharge for this POR was 159 cfs; the mean discharge was 157 cfs.

2. Based on LOESS statistics, the median spring discharge for the manatee season is 5 cfs higher than the median discharge for the POR. The Mann-Whitney U-test and the median statistical test indicate a statistically significant difference between the two data sets.

Table 2. Summary of statistical test results

Discharge—unsmoothed

Mann-Whitney U-test

Populations Compared	Two-tailed p-value
manatee–non-manatee	<0.0001
manatee–POR	<0.0001

Median test

Populations Compared	Two-tailed p-value
manatee–non-manatee	<0.0001
manatee–POR	<0.0002

Discharge—LOESS f = 0.10 smoothed

Mann-Whitney U-test

Populations Compared	Two-tailed p-value
manatee–non-manatee	<0.0001
manatee–POR	<0.0001

Median test

Populations Compared	Two-tailed p-value
manatee–non-manatee	<0.0001
manatee–POR	<0.0001

POR = period of record

3. Based on LOESS statistics, the median spring discharge for the manatee season is 9 cfs higher than the median discharge for the non-manatee season. The Mann-Whitney U-test and the median statistical test indicate a statistically significant difference between the two data sets. Therefore, discharge from Blue Spring is higher during the manatee season, which extends from November through March, than during the non-manatee season of April through October.

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APPENDIX A

Blue Spring Discharge Data

Date	Discharge	Manatee Season
3/7/1932	147	Yes
6/16/1932	147	No
7/13/1932	182	No
8/1/1932	147	No
9/6/1932	185	No
10/6/1932	145	No
11/21/1932	150	Yes
12/5/1932	188	Yes
1/11/1933	181	Yes
2/8/1933	171	Yes
3/2/1933	137	Yes
4/7/1933	160	No
5/2/1933	150	No
6/2/1933	160	No
7/5/1933	159	No
8/4/1933	154	No
10/2/1933	169	No
11/17/1933	164	Yes
12/13/1933	169	Yes
1/23/1934	172	Yes
2/16/1934	146	Yes
3/15/1934	143	Yes
4/23/1934	172	No
5/8/1934	146	No
6/5/1934	151	No
1/23/1935	164	Yes
2/15/1935	176	Yes
4/2/1935	177	No
5/23/1935	153	No
6/22/1935	151	No
7/12/1935	143	No
8/1/1935	167	No
9/19/1935	155	No
10/3/1935	135	No
11/6/1935	63	Yes
12/4/1935	165	Yes
1/2/1936	176	Yes

Date	Discharge	Manatee Season
2/18/1936	156	Yes
3/10/1936	168	Yes
4/2/1936	148	No
5/7/1936	151	No
6/12/1936	163	No
7/16/1936	173	No
8/6/1936	171	No
9/4/1936	164	No
10/6/1936	166	No
11/3/1936	161	Yes
12/2/1936	170	Yes
1/13/1937	164	Yes
2/11/1937	168	Yes
3/9/1937	166	Yes
4/15/1937	160	No
5/12/1937	152	No
6/4/1937	161	No
7/27/1937	164	No
9/8/1937	165	No
10/5/1937	132	No
11/9/1937	160	Yes
12/6/1937	170	Yes
1/5/1938	159	Yes
2/2/1938	157	Yes
3/2/1938	157	Yes
4/8/1938	158	No
5/18/1938	161	No
6/25/1938	156	No
7/27/1938	134	No
8/26/1938	156	No
10/1/1938	151	No
10/30/1938	160	No
11/22/1938	151	Yes
12/22/1938	151	Yes
1/27/1939	151	Yes
2/15/1939	152	Yes
3/22/1939	155	Yes

Date	Discharge	Manatee Season
4/18/1939	136	No
5/19/1939	137	No
7/20/1939	139	No
8/2/1939	127	No
8/28/1939	159	No
10/6/1939	178	No
11/7/1939	165	Yes
12/5/1939	171	Yes
1/20/1940	160	Yes
2/5/1940	173	Yes
3/4/1940	152	Yes
4/9/1940	174	No
5/8/1940	161	No
6/10/1940	159	No
7/8/1940	157	No
8/5/1940	154	No
9/7/1940	159	No
10/8/1940	146	No
11/12/1940	170	Yes
12/12/1940	149	Yes
1/13/1941	141	Yes
2/10/1941	150	Yes
3/9/1941	156	Yes
4/16/1941	151	No
5/12/1941	162	No
6/10/1941	161	No
7/8/1941	157	No
8/4/1941	148	No
9/2/1941	168	No
10/6/1941	178	No
11/13/1941	177	Yes
12/16/1941	185	Yes
1/13/1942	184	Yes
2/24/1942	182	Yes
3/31/1942	178	Yes
5/5/1942	170	No
6/20/1942	177	No
7/17/1942	160	No
8/25/1942	174	No
10/1/1942	178	No
10/27/1942	176	No

Date	Discharge	Manatee Season
12/4/1942	183	Yes
1/17/1943	161	Yes
2/12/1943	162	Yes
3/26/1943	150	Yes
5/10/1943	152	No
6/18/1943	170	No
7/25/1943	150	No
8/26/1943	150	No
10/13/1943	159	No
11/19/1943	170	Yes
2/14/1944	178	Yes
3/22/1944	163	Yes
5/2/1944	154	No
6/6/1944	156	No
7/19/1944	161	No
8/29/1944	124	No
10/11/1944	157	No
11/23/1944	178	Yes
1/3/1945	173	Yes
2/20/1945	173	Yes
4/4/1945	173	No
5/15/1945	165	No
6/28/1945	162	No
8/9/1945	151	No
10/31/1945	174	No
12/12/1945	181	Yes
1/24/1946	183	Yes
3/6/1946	171	Yes
4/24/1946	179	No
5/29/1946	167	No
7/8/1946	159	No
8/15/1946	168	No
9/17/1946	165	No
10/22/1946	155	No
11/26/1946	171	Yes
1/3/1947	164	Yes
2/4/1947	159	Yes
3/10/1947	168	Yes
4/15/1947	164	No
5/19/1947	178	No
6/24/1947	162	No

Date	Discharge	Manatee Season
7/30/1947	171	No
9/8/1947	154	No
11/15/1947	161	Yes
12/22/1947	184	Yes
1/27/1948	190	Yes
3/2/1948	169	Yes
4/7/1948	168	No
5/18/1948	175	No
6/10/1948	171	No
7/15/1948	162	No
8/24/1948	146	No
10/1/1948	160	No
11/10/1948	124	Yes
12/29/1948	160	Yes
2/11/1949	167	Yes
3/24/1949	159	Yes
5/3/1949	150	No
6/15/1949	163	No
7/27/1949	161	No
9/6/1949	169	No
10/19/1949	149	No
11/29/1949	180	Yes
1/11/1950	175	Yes
2/23/1950	173	Yes
4/4/1950	163	No
5/16/1950	172	No
6/28/1950	161	No
8/10/1950	150	No
9/21/1950	156	No
11/2/1950	142	Yes
12/21/1950	179	Yes
1/25/1951	184	Yes
3/8/1951	191	Yes
4/19/1951	176	No
6/1/1951	172	No
7/16/1951	177	No
8/22/1951	141	No
10/12/1951	166	No
11/16/1951	158	Yes
12/20/1951	156	Yes
1/31/1952	170	Yes

Date	Discharge	Manatee Season
3/13/1952	155	Yes
4/29/1952	199	No
6/7/1952	161	No
7/14/1952	145	No
8/29/1952	162	No
10/8/1952	146	No
11/21/1952	166	Yes
1/16/1953	162	Yes
2/10/1953	172	Yes
5/11/1953	163	No
6/25/1953	177	No
8/3/1953	160	No
12/8/1953	175	Yes
1/22/1954	200	Yes
3/1/1954	206	Yes
4/17/1954	194	No
5/26/1954	165	No
7/12/1954	167	No
8/20/1954	182	No
9/29/1954	182	No
11/10/1954	153	Yes
12/21/1954	169	Yes
2/2/1955	160	Yes
3/16/1955	166	Yes
4/27/1955	161	No
6/9/1955	174	No
7/20/1955	169	No
9/1/1955	168	No
10/12/1955	145	No
11/16/1955	172	Yes
12/21/1955	171	Yes
2/2/1956	152	Yes
3/16/1956	169	Yes
4/27/1956	165	No
6/6/1956	156	No
7/20/1956	150	No
8/31/1956	136	No
10/11/1956	137	No
11/29/1956	125	Yes
1/10/1957	166	Yes
2/18/1957	157	Yes

Date	Discharge	Manatee Season
4/4/1957	150	No
5/13/1957	149	No
6/24/1957	146	No
8/7/1957	141	No
9/17/1957	137	No
10/29/1957	162	No
12/12/1957	177	Yes
1/22/1958	156	Yes
3/19/1958	147	Yes
5/14/1958	190	No
7/9/1958	148	No
9/4/1958	161	No
10/28/1958	166	No
12/16/1958	127	Yes
2/10/1959	174	Yes
4/9/1959	139	No
6/4/1959	180	No
7/28/1959	179	No
11/17/1959	197	Yes
1/13/1960	166	Yes
3/2/1960	159	Yes
5/18/1960	189	No
7/12/1960	169	No
9/7/1960	152	No
11/1/1960	214	Yes
12/19/1960	206	Yes
2/13/1961	190	Yes
4/10/1961	180	No
5/29/1961	166	No
7/26/1961	174	No
9/18/1961	189	No
11/14/1961	194	Yes
1/2/1962	181	Yes
2/26/1962	172	Yes
4/23/1962	133	No
6/18/1962	144	No
8/21/1962	140	No
10/11/1962	164	No
11/29/1962	149	Yes
1/25/1963	169	Yes
3/14/1963	152	Yes

Date	Discharge	Manatee Season
5/9/1963	148	No
6/19/1963	156	No
8/1/1963	151	No
9/12/1963	139	No
10/23/1963	164	No
12/10/1963	153	Yes
2/4/1964	117	Yes
3/27/1964	165	Yes
5/21/1964	177	No
7/14/1964	159	No
9/15/1964	151	No
10/28/1964	193	No
12/7/1964	176	Yes
1/18/1965	174	Yes
3/16/1965	175	Yes
4/20/1965	168	No
6/9/1965	145	No
8/4/1965	145	No
9/1/1965	149	No
10/20/1965	144	No
12/1/1965	148	Yes
1/18/1966	147	Yes
3/8/1966	149	Yes
4/19/1966	150	No
5/26/1966	156	No
7/13/1966	148	No
9/8/1966	179	No
10/20/1966	167	No
11/29/1966	186	Yes
1/10/1967	175	Yes
3/7/1967	168	Yes
4/12/1967	153	No
5/9/1967	155	No
6/27/1967	152	No
8/22/1967	144	No
10/1/1967	156	No
11/15/1967	150	Yes
1/4/1968	150	Yes
2/20/1968	150	Yes
4/10/1968	141	No
5/1/1968	134	No

Date	Discharge	Manatee Season
6/26/1968	141	No
8/21/1968	160	No
10/3/1968	169	No
11/14/1968	188	Yes
1/7/1969	208	Yes
2/11/1969	181	Yes
3/26/1969	164	Yes
4/30/1969	166	No
6/24/1969	167	No
9/16/1969	144	No
9/30/1969	161	No
11/25/1969	167	Yes
1/13/1970	172	Yes
3/3/1970	185	Yes
5/23/1970	189	No
7/7/1970	184	No
9/15/1970	191	No
11/3/1970	177	Yes
12/17/1970	174	Yes
2/4/1971	177	Yes
4/9/1971	157	No
4/26/1971	151	No
7/8/1971	157	No
8/19/1971	156	No
9/16/1971	144	No
10/20/1971	140	No
12/7/1971	149	Yes
1/20/1972	143	Yes
3/14/1972	157	Yes
5/2/1972	146	No
6/13/1972	142	No
8/8/1972	132	No
10/3/1972	165	No
11/16/1972	139	Yes
1/16/1973	161	Yes
3/14/1973	155	Yes
5/1/1973	166	No
6/12/1973	167	No
7/31/1973	156	No
9/19/1973	156	No
11/13/1973	159	Yes

Date	Discharge	Manatee Season
1/3/1974	173	Yes
2/20/1974	177	Yes
4/22/1974	171	No
4/24/1974	171	No
6/18/1974	151	No
8/19/1974	115	No
10/2/1974	144	No
11/24/1974	160	Yes
1/21/1975	170	Yes
3/18/1975	160	Yes
5/14/1975	142	No
7/8/1975	151	No
9/9/1975	145	No
10/29/1975	153	No
12/17/1975	159	Yes
2/18/1976	164	Yes
4/13/1976	146	No
6/25/1976	114	No
8/3/1976	156	No
10/5/1976	183	No
11/22/1976	150	Yes
1/25/1977	147	Yes
3/22/1977	158	Yes
5/24/1977	142	No
7/20/1977	152	No
9/2/1977	140	No
11/2/1977	130	Yes
1/10/1978	138	Yes
2/28/1978	136	Yes
4/20/1978	164	No
5/30/1978	160	No
6/15/1978	169	No
10/4/1978	160	No
12/7/1978	171	Yes
1/24/1979	165	Yes
3/20/1979	158	Yes
5/15/1979	155	No
7/18/1979	152	No
9/11/1979	127	No
10/29/1979	131	No
12/28/1979	176	Yes

Date	Discharge	Manatee Season
2/22/1980	172	Yes
4/21/1980	181	No
6/12/1980	171	No
8/5/1980	154	No
10/7/1980	144	No
5/20/1981	119	No
9/15/1981	123	No
5/3/1982	153	No
7/20/1982	154	No
10/27/1982	183	No
1/6/1983	167	Yes
2/10/1983	218	Yes
4/14/1983	167	No
5/3/1983	173	No
5/12/1983	152	No
6/21/1983	172	No
7/25/1983	172	No
8/25/1983	172	No
10/7/1983	175	No
10/18/1983	157	No
11/15/1983	173	Yes
1/23/1984	194	Yes
3/9/1984	178	Yes
3/26/1984	136	Yes
4/24/1984	181	No
5/10/1984	140	No
6/15/1984	161	No
7/25/1984	167	No
8/10/1984	175	No
10/3/1984	164	No
12/10/1984	183	Yes
12/12/1984	169	Yes
2/5/1985	170	Yes
2/13/1985	172	Yes
2/18/1985	162	Yes
4/16/1985	141	No
4/17/1985	152	No
6/10/1985	164	No
8/6/1985	127	No
9/27/1985	122	No
10/22/1985	159	No

Date	Discharge	Manatee Season
11/21/1985	148	Yes
12/11/1985	164	Yes
1/16/1986	107	Yes
2/17/1986	150	Yes
4/24/1986	147	No
5/20/1986	162	No
6/30/1986	133	No
7/14/1986	170	No
9/2/1986	159	No
10/14/1986	153	No
10/29/1986	166	No
12/22/1986	152	Yes
2/18/1987	146	Yes
2/19/1987	137	Yes
4/15/1987	125	No
4/23/1987	141	No
6/10/1987	153	No
8/11/1987	136	No
8/25/1987	135	No
9/29/1987	152	No
10/26/1987	102	No
11/24/1987	169	Yes
1/19/1988	139	Yes
3/22/1988	119	Yes
5/9/1988	151	No
6/7/1988	141	No
7/5/1988	140	No
9/1/1988	139	No
10/28/1988	146	No
12/15/1988	151	Yes
2/22/1989	147	Yes
4/18/1989	126	No
4/20/1989	136	No
6/7/1989	145	No
8/2/1989	123	No
8/14/1989	113	No
10/6/1989	124	No
10/17/1989	121	No
11/14/1989	129	Yes
1/11/1990	145	Yes
2/1/1990	125	Yes

Date	Discharge	Manatee Season
3/12/1990	112	Yes
5/4/1990	104	No
6/6/1990	115	No
7/9/1990	143	No
7/31/1990	103	No
8/28/1990	146	No
10/1/1990	109	No
10/16/1990	126	No
12/10/1990	143	Yes
1/22/1991	115	Yes
2/11/1991	126	Yes
4/2/1991	131	No
4/8/1991	112	No
5/23/1991	133	No
6/12/1991	104	No
8/9/1991	152	No
8/26/1991	123	No
10/1/1991	155	No
10/9/1991	125	No
12/10/1991	160	Yes
12/16/1991	162	Yes
1/24/1992	157	Yes
2/20/1992	157	Yes
3/17/1992	147	Yes
4/9/1992	160	No
5/7/1992	135	No
6/8/1992	138	No
7/2/1992	103	No
8/19/1992	144	No
8/27/1992	120	No
10/21/1992	127	No
12/14/1992	151	Yes
2/3/1993	137	Yes
2/8/1993	150	Yes
4/9/1993	150	No
4/21/1993	158	No
6/2/1993	144	No
6/8/1993	137	No
7/23/1993	142	No
8/3/1993	130	No
9/17/1993	136	No

Date	Discharge	Manatee Season
10/14/1993	139	No
11/23/1993	139	Yes
12/16/1993	140	Yes
1/19/1994	137	Yes
2/16/1994	135	Yes
3/4/1994	135	Yes
4/12/1994	141	No
5/6/1994	134	No
6/14/1994	121	No
6/24/1994	140	No
8/17/1994	134	No
8/18/1994	120	No
9/30/1994	151	No
10/31/1994	143	No
12/6/1994	212	Yes
2/1/1995	174	Yes
4/12/1995	153	No
6/13/1995	157	No
8/4/1995	116	No
10/2/1995	131	No
10/13/1995	136	No
10/31/1995	159	No
12/1/1995	155	Yes
12/8/1995	166	Yes
2/9/1996	161	Yes
2/28/1996	176	Yes
4/22/1996	144	No
4/24/1996	160	No
5/2/1996	160	No
6/14/1996	167	No
8/13/1996	152	No
10/4/1996	151	No
12/3/1996	171	Yes
1/27/1997	173	Yes
4/22/1997	151	No
5/23/1997	162	No
7/11/1997	154	No
9/8/1997	153	No
10/31/1997	152	No
1/12/1998	145	Yes
3/3/1998	165	Yes

Date	Discharge	Manatee Season
4/23/1998	183	No
6/16/1998	182	No
8/7/1998	163	No
9/28/1998	146	No
12/4/1998	164	Yes
1/22/1999	166	Yes
3/18/1999	163	Yes
5/18/1999	132	No
7/7/1999	139	No
9/1/1999	120	No
11/15/1999	146	Yes
1/11/2000	171	Yes
4/18/2000	149	No
6/8/2000	117	No
8/15/2000	127	No
9/28/2000	97	No
11/16/2000	115	Yes
1/24/2001	136	Yes
3/19/2001	113	Yes
5/17/2001	124	No
7/17/2001	132	No
9/4/2001	131	No
11/14/2001	87	Yes
11/27/2001	165	Yes
12/18/2001	168	Yes
12/18/2001	146	Yes
1/28/2002	194	Yes
3/15/2002	163	Yes
4/15/2002	155	No
4/16/2002	156	No
4/17/2002	150	No
4/18/2002	157	No
4/19/2002	155	No
4/20/2002	169	No
4/21/2002	159	No
4/22/2002	153	No
4/23/2002	137	No
4/24/2002	151	No
5/1/2002	125	No
5/8/2002	143	No
5/15/2002	148	No

Date	Discharge	Manatee Season
5/22/2002	147	No
5/29/2002	133	No
6/5/2002	143	No
6/12/2002	131	No
6/19/2002	136	No
8/8/2002	140	No
9/24/2002	150	No
11/21/2002	177	Yes
1/16/2003	153	Yes
3/13/2003	174	Yes
5/8/2003	167	No
7/10/2003	167	No
8/18/2003	160	No
10/23/2003	159	No
11/25/2003	161	Yes
12/22/2003	163	Yes
1/14/2004	170	Yes
2/12/2004	159	Yes
3/10/2004	165	Yes
3/27/2004	149	Yes
5/6/2004	147	No
6/3/2004	146	No
6/29/2004	144	No
7/29/2004	131	No
8/24/2004	134	No
9/21/2004	180	No
10/5/2004	167	No
10/19/2004	192	No
11/2/2004	187	Yes
11/16/2004	187	Yes
12/14/2004	194	Yes
1/4/2005	200	Yes
1/11/2005	191	Yes
1/31/2005	178	Yes
2/22/2005	175	Yes
4/19/2005	163	No
5/16/2005	156	No
7/1/2005	160	No
7/27/2005	166	No
8/17/2005	178	No
9/6/2005	183	No

Date	Discharge	Manatee Season
10/4/2005	180	No
11/7/2005	167	Yes
12/13/2005	170	Yes
1/3/2006	169	Yes
2/7/2006	162	Yes
3/2/2006	172	Yes
4/24/2006	182	No
5/2/2006	168	No
6/6/2006	159	No
6/7/2006	160	No