DISTRIBUTION AND ABUNDANCE OF FLORIDA MANATEES (TRICHECHUS MANATUS LATIROSTRIS) AROUND SELECTED POWER PLANTS FOLLOWING WINTER COLD FRONTS: 2013-2014

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INTRODUCTION

Aerial surveys have been conducted to census and to assess trends in abundance and distribution of Florida manatees (*Trichechus manatus latirostris*) for a number of years (see, for example, Irvine and Campbell, 1978; Rose and McCutcheon, 1980; Patton, 1980; Raymond, 1981; McGehee, 1982; Shane, 1983; 1984; Packard, Frohlich, Reynolds, and Wilcox, 1984; 1989; Kinnaird, 1985; Reynolds and Wilcox, 1985; 1986; 1994; Nabor and Patton, 1989; Garrott et al., 1994; 1995; Ackerman, 1995; Craig et al., 1997; Wright et al., 2002; Craig and Reynolds, 2004; Edwards et al. 2007). Aerial surveys have been an economical means by which to produce a long-term database for the endangered manatee (Reynolds et al., 2012).

Lefebvre et al. (1995) indicated that aerial surveys have been the primary source of information regarding distribution and relative abundance of Florida manatees, and have been important in deriving minimum population estimates for the subspecies. Florida Power & Light Company (FPL) has taken the lead in sponsoring aerial surveys of manatees around selected power plant effluents in Florida for nearly four decades. The current study represents the thirty-seventh consecutive year in which FPL has funded aerial studies, which due to their relatively consistent methodology possess considerable value in terms of long-term assessments of manatee regional abundance, reproduction, and responses to cold weather.

Garrott *et al.* (1995), for example, performed thorough statistical analyses of the data collected between 1983 and 1991 to determine their potential value in assessing manatee population trends. They found that about 50% of the variation in winter counts at FPL plants could be explained using a simple model that considered both short- and long-term temperature data. Using temperature-adjusted counts, the authors stated that the FPL data suggest that the number of manatees using the Fort Myers plant remained stable from 1983-1991, but that the number of manatees using the east coast FPL plants increased over that time frame. Garrott *et
al. (1994) considered the entire FPL-generated database available at that time (from 1977-1992) and reached the same general conclusions. Other studies (e.g., analyses of adult manatee survival by O'Shea and Langtimm [1995] and Langtimm et al. [1998]) however, pointed to an east-coast manatee population that may have declined in the 1990’s. Garrott et al. (1994; 1995) noted, as did Packard et al. (1986) that trends suggested by analyses of local aerial survey databases should be viewed with caution until analyses of other manatee databases corroborate the trends.

After considering and modeling data from several sources, Eberhardt and O'Shea (1995) preliminarily estimated a finite rate of increase for the Atlantic coast population of manatees through 1991 to be 1.01, with a coefficient of variation of 0.12; no such value was calculated for the southwestern part of Florida. The value for the Atlantic coast suggested a stable population through that date. However, as suggested by Marmontel (1993) and Marmontel et al. (1997), Eberhardt and O'Shea (1995) noted that adult survival has had and will continue to have a major influence on the finite rate of increase.

More recently, Craig et al. (1997) also analyzed the 1982-1992 data from the east coast FPL plants, using Bayesian analysis, accompanied by Markov chain Monte Carlo. This approach suggested that the manatee population along Florida's east coast increased at an average annual rate between 2.2% and 16.8% in the 1980’s; in the early 1990’s, however, this population appeared to be stable or even slightly decreasing. Using survey data generated through winter 1997-1998, Craig and Reynolds (2000) conducted preliminary analyses that reaffirmed a leveling off, or perhaps a very slight increase or decline, for the east coast manatee population since the mid-1990s. Their models and analyses provided an independent source of information that generally corroborated trends suggested by adult survival data along the east
coast of Florida. The status of the various sub-populations of manatees in Florida through the 1990s was briefly summarized by the Manatee Population Status Working Group (2001).

In April 2002, a Manatee Population Ecology Workshop was held in Gainesville, Florida to update information presented at the 1992 workshop and to assess both the status of manatees in Florida and the status of research efforts there (Lefebvre et al., 2009). As at the 1992 workshop, the FPL-sponsored studies were considered. In particular, Craig and Reynolds (2004) provided an updated Bayesian analysis of trends in counts at the east coast power plants. Their results reconfirmed their impressions that counts had increased through the early 1990s, briefly leveled off, or perhaps slightly decreased, then increased or remained stable after the mid-1990s. The authors provided a plausible estimate (compared to synoptic survey results) of the population size for the east coast manatee populations in 2001 (1607 individuals).

At the same 2002 workshop, a number of other authors reconsidered adult survival estimates for manatees in various regions of Florida. Assessment of adult manatee survival rates indicated that manatees in northwestern Florida and in the upper St. Johns River are doing quite well (Langtimm et al., 2004), and the analyses for manatees along the Atlantic coast suggested that that regional subpopulation may be doing slightly better than originally suggested by Langtimm et al. (1998), but that there was still likely to be a decreasing trend over the past five years. However, recent recalculations (see Langtimm, 2007) have suggested that the mark-recapture analyses may provide revised trend assessments that are more consistent with what Craig and Reynolds (2004) stated. The data for the southwestern subpopulation of manatees are not as strong as for other regions, and depending on the assumptions one makes, that subpopulation is likely to be in the worst shape of the four (Langtimm et al., 2004).
Unpublished analyses of updated photo-identification records suggest that, in fact, the southwestern subpopulation may also be increasing (L. Ward, pers comm.).

Some controversy has developed in light of the differences in population status suggested by analyses of the databases described by Craig and Reynolds (2004), Runge et al. (2007) and Langtimm et al. (2004). The Florida Fish and Wildlife Conservation Commission and the U.S. Fish and Wildlife Service provided funding to promote conversations among the scientists involved (Runge, Langtimm, Craig, and Reynolds) to attempt to determine whether the results of these independent approaches can be reconciled to achieve greater overlap (see Reynolds and Runge 2007). As a result, at the March 2007 conference of the International Biometric Society’s Eastern North American Region in Atlanta, Georgia, these scientists presented updated analyses and interpretations that have led to more comparable results (see Reynolds and Runge, 2007; Craig, 2007; Langtimm, 2007; and Runge et al., 2007). These scientists expected to proceed with integrated analyses of the photo-identification and aerial survey data for the Atlantic coast. In the meantime, Bruce Craig, Chris Fonnesbeck and Reynolds are working to update the Bayesian analyses of the manatee survey data for the east coast FPL plants through at least winter 2010-2011.

Reynolds and Wilcox (1988) noted the many ways in which FPL-generated data have been valuable to biologists and managers. A panel of experts who attended the 2002 workshop indicated that the most rigorous analyses of population trends for manatees were the adult survival estimates. The panelists did not believe that statewide, synoptic aerial surveys are useful in this regard. However, they felt that the analyses by Craig and Reynolds (2004) had the potential to be more useful in reliably demonstrating trends than analysis of synoptic surveys,
although the assumptions made by those authors merited some verification, a caution that echoes that of Garrott et al. (1994; 1995).

In the study reported here, manatees were counted in the winter of 2013-2014. Because much of the winter was extremely mild, count data from the FPL plants were collected only one time: 8 and 10 January 2014. These data are compared to similar data from previous years.
METHODS

With one modification, aerial surveys were conducted using the intensive search method (Packard et al., 1989) as described in detail by Reynolds and Wilcox (1985; 1994) and in various annual reports by Reynolds to FPL since 1982. The one change that is being made is that instead of Reynolds conducting the surveys of Broward County plants, personnel (namely Dr. Pat Quinn and Mr. Ryan Goldman) with the Broward County Marine Resources Section, Natural Resources Planning & Management Division, are providing aerial survey data for Broward County waterways, including the discharge areas for the emerging Port Everglades Energy Center (PEEC) and the inland Ft. Lauderdale Plant (PFL). The Broward surveys are conducted using a helicopter, which permits more thorough and safer surveys of the Ft. Lauderdale area power plants than occurs using single engine aircraft. The Broward County-based surveys are done weekly through each winter, whereas the typical FPL power plant surveys are done as weather conditions dictate.

The general pattern is as follows: Following passage of severe or prolonged cold weather in Florida, aerial surveys are conducted from a high-winged, Cessna 172 aircraft. Cruising altitude and air speed are 213 m (700 ft) and 167 km/hr (90 kt), respectively; note that the altitude used in recent winters has been slightly higher than that used in many past surveys to provide a slightly greater margin of safety during surveys. During circling of manatee aggregations, slower air speeds and lower altitudes permitted most efficient counting; however, as necessary for safety around the power plant stacks, altitude was sometimes increased to approximately 240 m (800 ft). A Canon EOS10D digital camera (or similar camera) with 6.3 mega pixel resolution and fitted with a 75-300 mm zoom lens with a polarizing filter is used to verify visual counts when manatees occupy clear water.
Winter 2013-2014 was remarkably mild, so only one set of surveys of all power plants was conducted on 8 and 10 January 2014. The survey focused on the five power plants that have been the focus of such work for 37 years (Figure 1): Cape Canaveral Energy Center (CCEC), formerly called the Cape Canaveral Plant (PCC); Riviera Beach Energy Center (RBEC), formerly called the Riviera Plant (PRV); Port Everglades Energy Center (PEEC), formerly called the Port Everglades Plant (PPE); Lauderdale Plant (PFL); and Ft. Myers Plant (PFM). The CCEC and RBEC are both recently modernized, and the PPE was taken offline in January 2013 to allow that facility to undergo a similar transition to become the Port Everglades Energy Center (PEEC).

The Orlando Utilities Commission (OUC) plant, located just north of CCEC, was also surveyed intensively; even though that plant is no longer operating, manatees continue to use the deep channels formerly used for the intake and discharge of water.

As noted, in contrast to other years except for 2011-2012 and 2012-2013, the survey in 2013-2014 was conducted on two separate dates (8 and 10 January 2014) by separate teams of observers. This arrangement takes advantage of winter surveys of Broward County waters being done weekly using helicopters by Dr. Pat Quinn and Ryan Goldman of Broward County’s Marine Resources Section. It is important to note that the change in survey methods, observers, and even aircraft types introduced variables in 2013-2014 that were similar to those used in 2011-2012 and 2012-2013, but different from all other survey years.

In the aftermath of the terrorist attacks of 11 September 2001, low-altitude aerial surveys around power plants became extremely difficult to coordinate and conduct. Prior to every manatee survey conducted every winter since 2001, I notify law enforcement offices, military bases, and air traffic controllers in the areas where I plan to do intensive circling of power plants.
Figure 1. Locations of power plants surveyed and other landmarks on the Florida peninsula

CCEC: Cape Canaveral Energy Center, an FPL plant. Immediately north of the CCEC is an inactive plant formerly owned by the Orlando Utilities Commission (OUC).

RBEC: Riviera Beach Energy Center

PEEC: Port Everglades Energy Center

PFL: Inland Lauderdale Plant.

PFM: Ft. Myers Plant.

HS: Hobe Sound
Figure 1.
In addition, I coordinate my surveys with Jodie Gless of FPL, who notifies corporate security and staff at each FPL plant.

At each power plant, aggregations of manatees were observed until a satisfactory count was obtained or until local air traffic controllers insisted that the circling terminate. Certain data were routinely recorded: total manatees present; total calves (defined as animals less than half the length of a closely-associated animal) present; distribution of animals; behavior, including feeding or direction of travel; weather and water conditions.
RESULTS

Individual Sites

Cape Canaveral Energy Center (CCEC) and Vicinity

Counts for bi-weekly surveys of Brevard County waters for winter 2013-2014 are being provided in a separate annual report to FPL in compliance with the Conditions of Certification for the modernization of CCEC. On 8 January 2014, 150 manatees were counted at CCEC and zero manatees were observed at the currently-retired Orlando Utilities Commission (OUC) Plant. Calves were not counted at CCEC due to the extreme difficulty of counting them among the tightly clustered manatees in the warm-water discharge at the plant.

Riviera Beach Energy Center (RBEC) and Vicinity

Counts for bi-weekly surveys of Palm Beach County waters for winter 2013-2014 are being provided in a separate annual report to FPL in compliance with the Conditions of Certification for the modernization of RBEC. The RBEC heating system was run only once (23 January 2014) in winter 2013-2014, due to the lack of cold weather and consequent warm water temperatures; however, the plant itself ran on several occasions as part of system’s testing prior to the commissioning of the plant in late spring, 2014. Twenty six manatees (21 adults and 5 calves) were observed in the vicinity of RBEC (basically Lake Worth Lagoon, including the Port of Palm Beach) during the aerial survey on 8 January. Survey conditions were fair to poor in the vicinity of RBEC. A few animals occupied deep-water slips in the Port of Palm Beach.
Table 1. For the January 8 and 10 surveys of winter 2013-2014, total manatees sighted, survey conditions, and observers are provided.

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SURVEY DATE</th>
<th>ANIMALS SIGHTED</th>
<th>CONDITIONS</th>
<th>OBSERVER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCEC</td>
<td>8 January 14</td>
<td>150</td>
<td>Poor</td>
<td>Reynolds-Mote</td>
</tr>
<tr>
<td>RBEC</td>
<td>8 January 14</td>
<td>26</td>
<td>Fair to poor</td>
<td>Reynolds-Mote</td>
</tr>
<tr>
<td>PEEC</td>
<td>10 January 14</td>
<td>12</td>
<td>Very good to excellent</td>
<td>Quinn-Broward</td>
</tr>
<tr>
<td>PFL</td>
<td>10 January 14</td>
<td>171</td>
<td>Poor to fair</td>
<td>Quinn-Broward</td>
</tr>
<tr>
<td>PFM</td>
<td>8 January 14</td>
<td>321</td>
<td>Fair to good</td>
<td>Reynolds-Mote</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>680</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Broward County Plants: Port Everglades Energy Center (PEEC) and Vicinity & Ft. Lauderdale Plant (PFL) and Vicinity

Counts for weekly surveys of Broward County waters for winter 2013-2014 are being provided in a separate annual report to FPL in compliance with the Conditions of Certification for the modernization of PEEC; those surveys are conducted annually by Dr. Pat Quinn and Ryan Goldman, and the data are generously provided to FPL.

The former PPE (Port Everglades Plant) did not operate in winter 2013-2014, as it was taken off line for modernization at the end of January 2013. Visibility was very good to excellent on 10 January 2014, when 12 manatees were spotted in the discharge canal (Table 1).

At PFL, the count was 171 manatees on 10 January (Table 1). Visibility in the cooling lakes for the plant is generally fair, at best.

Ft. Myers Plant (PFM) and Vicinity

The Ft. Myers Plant produced a count of 321 manatees (295 adults and 26 calves) on 8 January (Table 1). Visibility was fair to good, with the best visibility occurring in the Orange River. Most manatees using the PFM area were observed along the length of the Orange River, downstream from the intersection with the plant’s discharge canal and Manatee Park.

Collective Data

A total of 680 manatees was observed at the five primary FPL plants on 8 and 10 January 2014 (Table 1). Because the survey area, observers, and survey aircraft differed from most past winters, the only relevant data included in Table 2 is the total count of manatees at the five plants.
Table 2. Summary of counts since 2000-2001. Data for earlier years appear in Reynolds 2013 and other annual reports to FPL. "%" reflects the percentage of the total manatees counted that were located at the plants. SE indicates the standard error of the mean. Asterisks indicate relatively mild winters, when neither very intense nor prolonged cold weather occurred. The N/A designation for some years in column 2 (Manatees/Survey) reflects that an average value cannot be calculated with a sample size of one survey. The N/A designation for some years in column 6 (% of Counts at FPL Plants Only) reflects that in recent years, the surveys have been conducted to hasten arrival at the primary mission locations (the plants), which has reduced efficacy of coverage at non-plant areas.

<table>
<thead>
<tr>
<th>Date</th>
<th>Manatees/Survey</th>
<th>Number of Surveys</th>
<th>Counts at FPL Plants Only</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Range</td>
<td>Mean + SE</td>
</tr>
<tr>
<td>2000-01</td>
<td>287-1338</td>
<td>4</td>
<td>215-1331</td>
<td>901±260</td>
</tr>
<tr>
<td>2001-02</td>
<td>833-1260</td>
<td>3</td>
<td>683-1249</td>
<td>924±292</td>
</tr>
<tr>
<td>2002-03</td>
<td>719-1471</td>
<td>5</td>
<td>678-1456</td>
<td>1097±168</td>
</tr>
<tr>
<td>2003-04*</td>
<td>989-1163</td>
<td>2</td>
<td>876-1050</td>
<td>963±87</td>
</tr>
<tr>
<td>2004-05*</td>
<td>446-888</td>
<td>3</td>
<td>422-879</td>
<td>715±147</td>
</tr>
<tr>
<td>2005-06</td>
<td>1088-1176</td>
<td>2</td>
<td>1040-1109</td>
<td>1074±35</td>
</tr>
<tr>
<td>2006-07*</td>
<td>1125-1555</td>
<td>2</td>
<td>1065-1512</td>
<td>1289±224</td>
</tr>
<tr>
<td>2007-08*</td>
<td>N/A</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008-09*</td>
<td>1111-2233</td>
<td>3</td>
<td>1060-2177</td>
<td>1672±400</td>
</tr>
<tr>
<td>2009-2010</td>
<td>1828-2750</td>
<td>2 complete</td>
<td>1793-2710</td>
<td>2252±459</td>
</tr>
<tr>
<td>2010-2011</td>
<td>1721-2055</td>
<td>2</td>
<td>1650-2043</td>
<td>1847±271</td>
</tr>
<tr>
<td>2011-2012*</td>
<td>N/A</td>
<td>1</td>
<td>1200</td>
<td>N/A</td>
</tr>
<tr>
<td>2012-2013*</td>
<td>900-1186</td>
<td>2</td>
<td>900-1186</td>
<td>1043+124</td>
</tr>
<tr>
<td>2013-2014*</td>
<td>N/A</td>
<td>1</td>
<td>680</td>
<td>N/A</td>
</tr>
</tbody>
</table>
DISCUSSION

Winter of 2013-2014 was remarkable for its mildness. The only cold weather occurred in mid-January 2014 and in March 2014. As usual, when a mild winter occurs, the number of surveys required to document manatee use of power plant discharges is low, and the overall counts/survey are also low. This was also the case in 2013-2014.

Another factor that also affected counts at particular plants was that two of the five plants (specifically RBEC and PEEC) are undergoing modernization. This process has led to much less warm water at RBEC than in the past and no warm-water production at PEEC. Thus, these two plants (previously called the Riviera Plant [PRV] and the Port Everglades Plant [PPE]) produced remarkably, but not unexpectedly low counts.

Another unusual feature associated with the 2013-2014 surveys is that the typical methodology was adjusted to take advantage of Broward County’s commitment to conducting weekly surveys of county waterways for manatees into the foreseeable future. Thus, instead of having Reynolds conduct an all day survey of all five FPL power plants of interest on 8 January, he flew only CCEC, RBEC and PFM, whereas Dr. Pat Quinn surveyed PEEC and PFM two days later (see Table 1).

As noted, the results of the surveys were generally what one would expect during a mild winter: a low-moderate total count (680 manatees at the five plants; Table 2) and moderate or even very low counts at most of the individual plants (see Table 3). It is especially interesting that even during the cool-cold weather in mid-January, counts at the active FPL plants (namely CCEC, PFL, and PFM) were moderate, at best.

At CCEC, the count on 8 January was 150 manatees. The highest count ever at CCEC during an FPL power plant survey was 685 manatees (Table 3). However, counts in the
Table 3. Maximum counts of manatees during an individual survey at FPL plants and Hobe Sound during each of the last thirty-seven years. Numbers in red indicate the highest counts ever at particular locations. Note: PCC is now CCEC; PRV is now RBEC; PPE is now PEEC.

<table>
<thead>
<tr>
<th>Survey Yr.</th>
<th>PCC/RE</th>
<th>HS</th>
<th>PRV</th>
<th>PPE</th>
<th>PFL</th>
<th>PFM</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977-78</td>
<td>125</td>
<td>56</td>
<td>68</td>
<td>114</td>
<td>36</td>
<td>271</td>
<td>Rose and McCutcheon (1980)</td>
</tr>
<tr>
<td>1979-80</td>
<td>116</td>
<td>38</td>
<td>108</td>
<td>86</td>
<td>36</td>
<td>142</td>
<td>Rose and McCutcheon (1980)</td>
</tr>
<tr>
<td>1982-83</td>
<td>15</td>
<td>19</td>
<td>98</td>
<td>56</td>
<td>16</td>
<td>85</td>
<td>Reynolds (1983)</td>
</tr>
<tr>
<td>1984-85</td>
<td>34</td>
<td>67</td>
<td>231</td>
<td>234</td>
<td>29</td>
<td>338</td>
<td>Reynolds (1985)</td>
</tr>
<tr>
<td>1985-86</td>
<td>17</td>
<td>28</td>
<td>272</td>
<td>185</td>
<td>30</td>
<td>248</td>
<td>Reynolds (1986)</td>
</tr>
<tr>
<td>1989-90</td>
<td>66</td>
<td>15</td>
<td>266</td>
<td>227</td>
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<td>1990-91</td>
<td>152</td>
<td>13</td>
<td>202</td>
<td>75</td>
<td>8</td>
<td>188</td>
<td>Reynolds (1991)</td>
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<td>1992-93</td>
<td>273</td>
<td>23</td>
<td>90</td>
<td>70</td>
<td>0</td>
<td>123</td>
<td>Reynolds (1993)</td>
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<td>1996-97</td>
<td>210</td>
<td>6</td>
<td>177</td>
<td>60</td>
<td>35</td>
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<td>Reynolds (1997)</td>
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<td>1998-99</td>
<td>319</td>
<td>12</td>
<td>64</td>
<td>60</td>
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<td>2000-01</td>
<td>301</td>
<td>33</td>
<td>409</td>
<td>290</td>
<td>143</td>
<td>421</td>
<td>Reynolds (2001)</td>
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<td>2002-03</td>
<td>419</td>
<td>26</td>
<td>479</td>
<td>265</td>
<td>173</td>
<td>343</td>
<td>Reynolds (2003)</td>
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<tr>
<td>2004-05</td>
<td>86</td>
<td>14</td>
<td>403</td>
<td>278</td>
<td>82</td>
<td>215</td>
<td>Reynolds (2005)</td>
</tr>
<tr>
<td>Year</td>
<td>Val. 1</td>
<td>Val. 2</td>
<td>Val. 3</td>
<td>Val. 4</td>
<td>Val. 5</td>
<td>Val. 6</td>
<td>Notes</td>
</tr>
<tr>
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<td>2008-09</td>
<td>540</td>
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<td>581</td>
<td>201</td>
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<td>905</td>
<td>Reynolds (2010)</td>
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<td>301</td>
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<td>554</td>
<td>391</td>
<td>335</td>
<td>754</td>
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<td>333</td>
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<td>220</td>
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<td>320</td>
<td>287</td>
<td>Reynolds (2012)</td>
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<tr>
<td>2012-2013</td>
<td>685</td>
<td>NA</td>
<td>31</td>
<td>2</td>
<td>83</td>
<td>672</td>
<td>Reynolds (2013)</td>
</tr>
<tr>
<td>2013-2014</td>
<td>150</td>
<td>19</td>
<td>26</td>
<td>12</td>
<td>171</td>
<td>321</td>
<td>This report</td>
</tr>
</tbody>
</table>
neighborhood of 1,000 manatees have been recorded there, but the highest counts typically occur in the “shoulder” periods in early winter and late winter, when the most animals are migrating through the area. Such was certainly the case in winter 2013-2014, as 1,966 manatees were observed in Brevard County waters, with 500 at CCEC, during relatively mild weather on 18 February 2014 (Scolardi and Reynolds, unpublished).

At PFL, the count of 171 on 10 January, was actually the 5th highest count recorded at the plant by Quinn and Goldman in 2013-2014 (pers. comm.). The highest counts (of 300 manatees and 537 manatees) occurred on 16 and 24 January 2014, respectively; in a not-surprising pattern for this plant, the survey of 10 January documented an influx of manatees in response to cool-cold weather, but that influx continued past the 10 January survey date for at least two weeks. By 4 February, the count was back down to 187 manatees (Quinn and Goldman, pers. comm.).

Finally, at PFM, the count of 321 manatees on 8 January represents about 1/3 of the manatees observed during the peak count ever at that plant (905 manatees; Table 3). Clearly, large numbers of manatees in southwestern Florida were not motivated due to cold weather to seek refuge at the PFM. In addition to the low-moderate count, a striking feature of the PFM survey involved the large number of manatees using the former boat basin, now slated to become a large marina, along the Orange River.

Calves were not counted at the plants as Reynolds has historically done. Thus, it is not possible to compare calf abundance in 2013-2014 with that of previous years.

At this point, of the five FPL plants on which manatees rely most, three (CCEC, PFM and PFL) have been modernized and continue to attract moderate numbers of manatees. Two others (RBEC and PEEC) are undergoing construction and modernization and provide interim warm-water refugia using massive, electric, hot water heaters as needed in winter for manatees.
RBEC will be fully operational well before winter 2014-2015. Thus, with the exception of PEEC, this coming winter, each of the discussed FPL plants will be at least as capable as ever of providing warm-water refuge for manatees in winter for years or decades to come.
RECOMMENDATIONS

Continuation of the FPL-sponsored surveys provides an opportunity to maintain one of the few long-term databases that permits analyses of trends in manatee numbers (e.g., see Garrott et al., 1994; 1995; Craig et al., 1997; Craig and Reynolds, 2004). Recent and ongoing analyses of the data have contributed to our understanding of trends and population size along the Atlantic coast (Craig and Reynolds, 2004). I strongly recommend the continuation of these cost-effective surveys, as well as timely analysis of the data they generate. However, I also recommend splitting the surveys between groups as was done in 2013-2014. Having Broward County staff conduct surveys of PEEC and PFL and with Reynolds surveying the other plants, this ensures that surveys will be done more effectively (due to shorter survey days) and more safely (due to use of a helicopter, rather than a single engine airplane for the Broward plants) than in the past.

Concerns continue to be expressed regarding the fate of manatees when warm-water discharges associated with power production ultimately disappear. This issue is the focus of the Warm-Water Task Force, a working group established to advise and promote certain objectives of the Florida Manatee Recovery Plan (U.S. Fish and Wildlife Service, 2001). The problem is especially worrisome at CCEC, where cold winter weather often causes ambient water temperatures to reach lethal levels for manatees. FPL needs to continue to work closely with the responsible federal and state agencies, as well as other concerned groups, to foster the development of plans to safeguard the well-being of manatees into the future.

The long-term, FPL-sponsored surveys provide important information regarding manatee numbers and trends, as well as responses to temporary loss of warm-water or changes in warm-water sources. Development of appropriate mitigation options (see Laist and Reynolds, 2005;
Laist et al., 2013) depends on the presence of such data, underscoring the importance of continuing the surveys for the foreseeable future.
SUMMARY

In the mild winter of 2013-2014, one coordinated aerial survey effort was conducted to count manatees using warm-water discharges associated with FPL power plants. The surveys were flown on 8 January for CCEC, RBEC, and PFM (Reynolds, Mote Marine Laboratory) and on 10 January for PEEC and PFL (Quinn, Broward County Marine Resources Section). Counts were low-moderate at CCEC, PFL, and PFM, and low at the two plants undergoing modernization, namely RBEC and PEEC. The total count was only 680 manatees.
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LITERATURE CITED


Reynolds, J.E., III. 1992. Distribution and Abundance of the West Indian Manatee *Trichechus manatus* Around Selected Florida Power Plants Following Winter Cold Fronts: 1990-


Reynolds, J.E., III. 1998. Distribution and abundance of Florida manatees (*Trichechus


Reynolds, J.E., III and J.R. Wilcox. 1985. Abundance of West Indian Manatees *Trichechus*


Shane, S.H. 1983. Abundance, distribution and movements of manatees (*Trichechus manatus*)

