An Updated Assessment of Manatee Carrying Capacity in the IRL

Presented to the Manatee Forum
by Bob Atkins, President
Citizens for Florida's Waterways (CFFW)

October 2016

Agenda

- Background, Ground Rules and Assumptions
- Analysis of the Impact of Uprooting
- Update on Carrying Capacity and Sustainability in the IRL
- Conclusions and a Proposed Plan of Action

Background

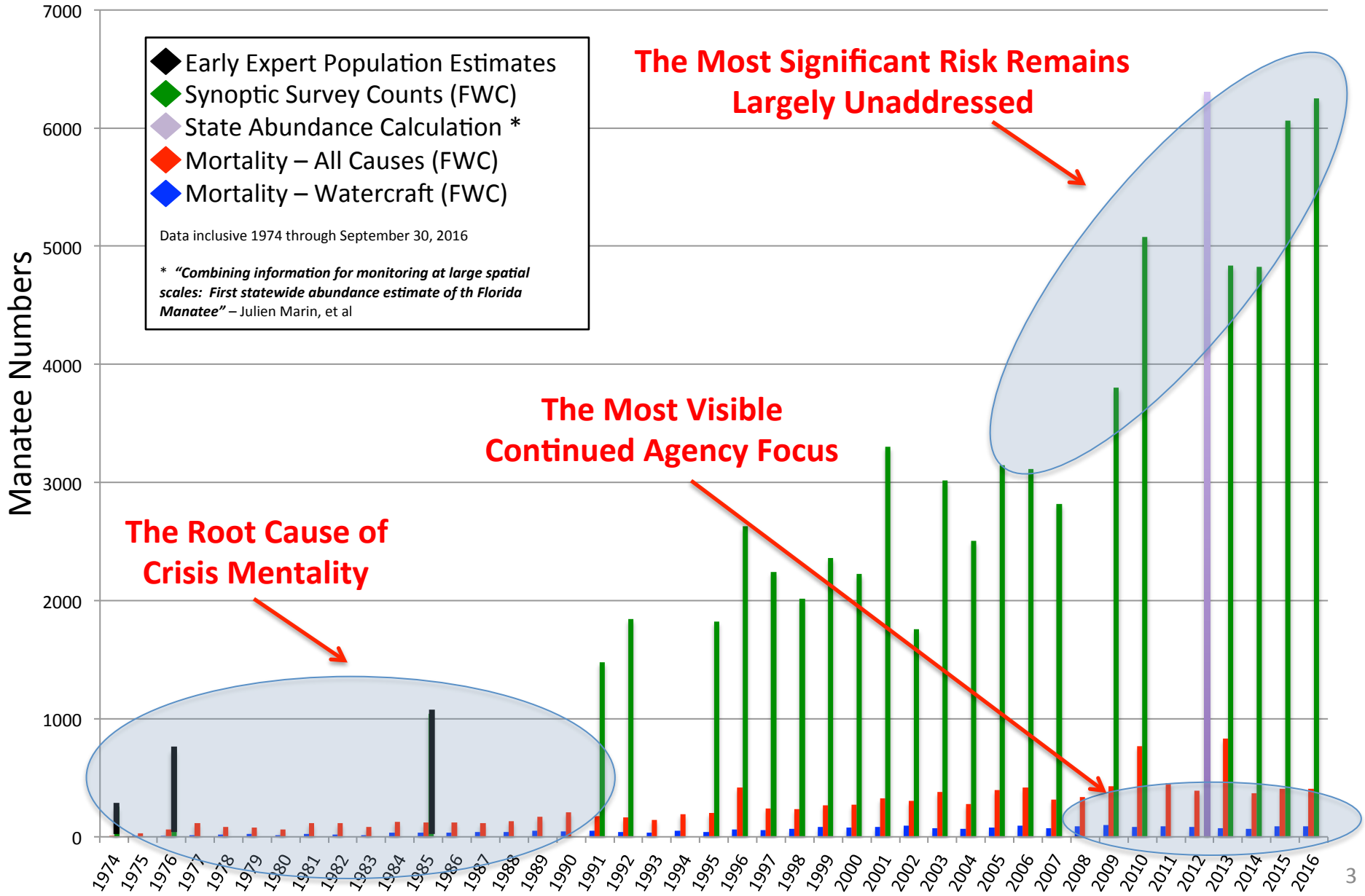
- **Received Constructive Criticism After the May 2014 Discussion on IRL Carrying Capacity**

- **An Important Open Question from my Carrying Capacity Analysis Presented in May 2014**

  What is the Potential Impact of Uprooted/Clear Cut Forage on Carrying Capacity?

- **This Presentation Addresses the Above**

Manatee Management Focus



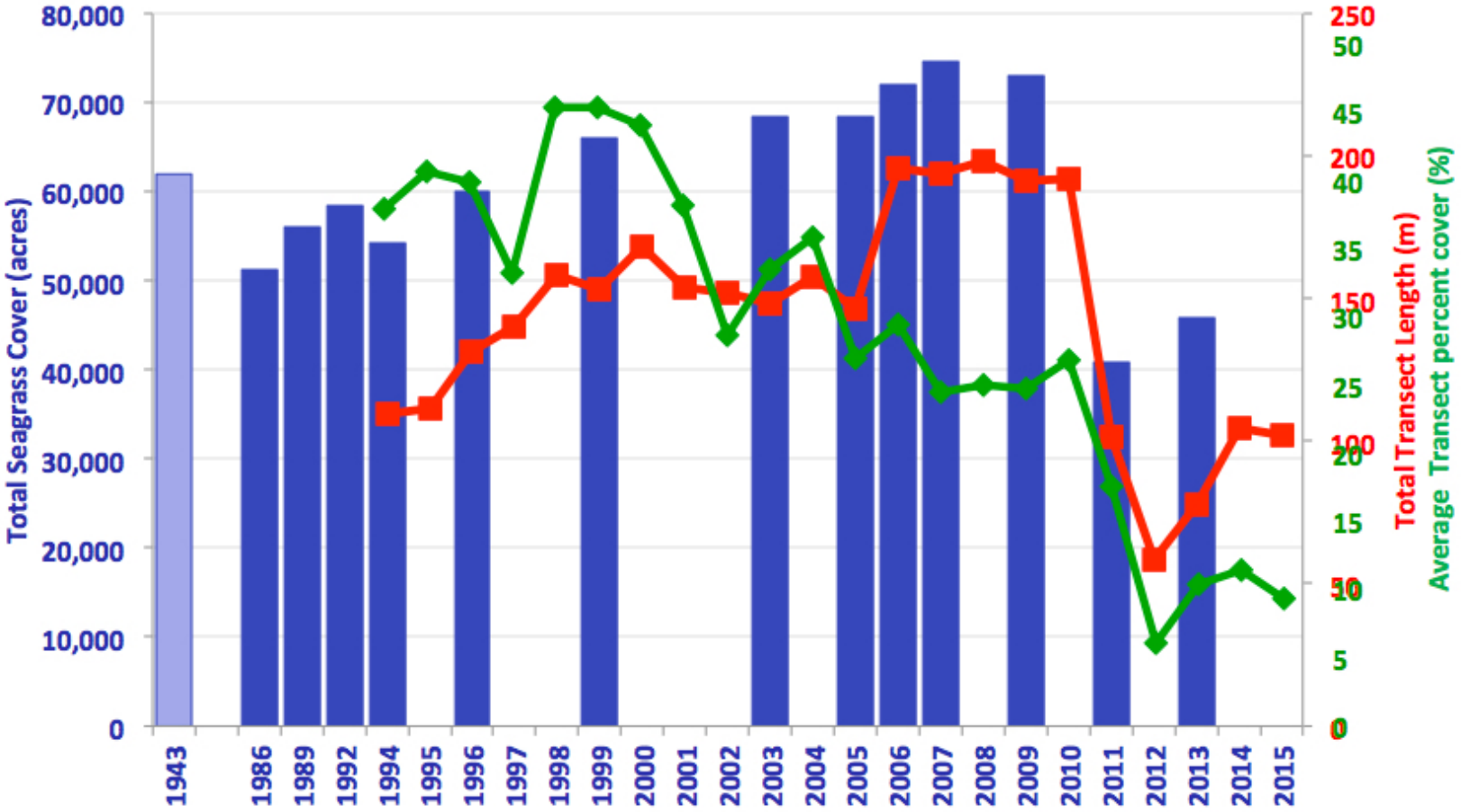
Brevard County Manatee Counts

YEAR	Synoptic Survey	FPL High Count	FPL Count Average
2002	468		
2003	596		
2004	718		
2005	529		
2006	389		
2007	859		
2008			
2009	596	540	393
2010	1087	560	464
2011	640	1464	709
2012		931	559
2013		1792	977
2014	633	**1966**	**1392**
2015	**1670**	1785	1338
2016	1166		

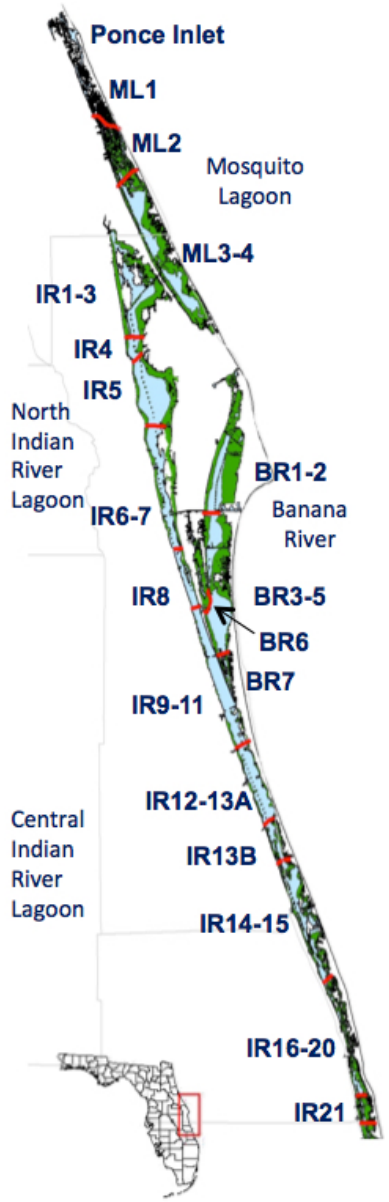
Note: FPL Counts Conducted Bi-weekly (Oct – Mar)

Total seagrass mapped acres, total transect length, and average transect cover

Source: SJRWMD



IRL Seagrass Acreage by Region



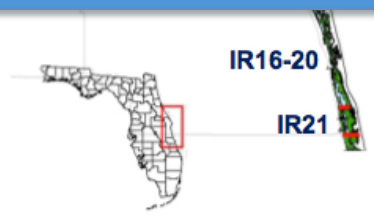
Source: SJRWMD

IRL Sublagoon	IRL Segment	Mapping years 1943	1992	1994	1996	1999	2003	2005	2007	2009	2011	2013	2015	
Mosquito Lagoon	ML1	822	330	192	19	59	67	72	94	73	78	64	67	
	ML2	2,975	2,669	2,400	2,351	2,811	2,737	2,761	2,767	2,690	2,655	2,722	2,792	
	ML3-4 *	14,517	13,332	12,823	13,465	13,345	13,466	13,368	13,970	13,748	14,155	14,125	13,900	≈ 60%
Banana River	BR1-2	6,722	9,828	8,484	9,966	10,483	11,866	11,848	12,187	12,286	2,127	3 ,390	5,440	
	BR3-5	6,476	6,417	5,337	5,317	6,905	6,646	6,651	8,449	8,210	733	1,681	3,422	
	BR6	2,796	1,375	1,142	1,288	2,281	2,531	2,440	2,927	2,863	223	359	400	
	BR7	406	173	78	159	210	221	219	459	443	73	10	5	
North IRL	IR1-3	8,732	9,336	9,909	9,467	8,152	8,437	8,426	8,960	8,555	9,238	8,489	9,270	Brevard Co
	IR4	690	790	581	527	753	757	757	734	717	612	597	628	
	IR5	4,620	4,841	3,859	4,411	5,039	5,329	5,379	5,384	5,333	3,301	3,563	4,525	
	IR6-7	4,979	1,955	1,521	2,986	4,301	4,397	4,384	4,531	4,632	2,086	3,573	3,298	
	IR8	427	213	214	101	517	520	473	487	501	3	17	1	
	IR9-11	2,265	197	89	175	722	769	786	832	834	185	236	7	
Central IRL	IR12-13A	1,017	161	466	831	1,009	1,146	1,128	1 ,270	1,245	71	181	114	
	IR13B	352	347	444	908	834	859	845	1,033	979	157	671	600	
	IR14-15	1,325	2,673	3,267	3,502	3,167	3,307	3,411	3,785	3,644	1,249	1,498	1,886	
	IR16-20	1,727	734	501	910	1,154	1,305	1,331	2,422	2,114	500	791	955	
	IR21	1,322	824	718	1,041	1,370	1,282	1,270	1,386	1,371	877	1,117	1,199	
	TOTAL	62,169	56,196	52,025	57,422	63,111	65,642	65,548	71,676	70,238	38,322	43,084	48,509	

IRL Seagrass Within Brevard

Brevard County	IRL Segment	1943	1992	1994	1996	1999	2003	2005	2007	2009	2011	2013	2015
	ML1												
	ML2												
60%	ML3-4	8710	7999	7694	8079	8007	8080	8021	8382	8249	8493	8475	8340
100%	BR1-2	6722	9828	8484	9966	10483	11866	11848	12187	12286	2127	3390	5440
100%	BR3-5	6476	6417	5337	5317	6905	6646	6651	8449	8210	733	1681	3422
100%	BR6	2796	1375	1142	1288	2281	2531	2440	2927	2863	223	359	400
100%	BR7	406	173	78	159	210	221	219	459	443	73	10	5
100%	IR1-3	8732	9336	9909	9467	8152	8437	8426	8960	8555	9238	8489	9270
100%	IR4	690	790	581	527	753	757	757	734	717	612	597	628
100%	IR5	4620	4841	3859	4411	5039	5329	5379	5384	5333	3301	3563	4525
100%	IR6-7	4979	1955	1521	2986	4301	4397	4384	4531	4632	2086	3573	3298
100%	IR8	427	213	214	101	517	520	473	487	501	3	17	1
100%	IR9-11	2265	197	89	175	722	769	786	832	834	185	236	7
100%	IR12-13A	1017	161	466	831	1009	1146	1128	1,270	1245	71	181	114
100%	IR13B	352	347	444	908	834	859	845	1033	979	157	671	600
100%	IR14-15	1325	2673	3267	3502	3167	3307	3411	3785	3644	1249	1498	1886
	IR16-20												
	IR21												
	TOTAL	49517	46305	43085	47717	52380	54865	54768	58150	58491	28551	32740	37936

Brevard has 38,000 of the Remaining 48,000 IRL Seagrass Acres

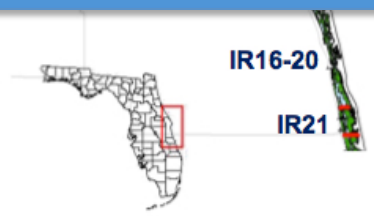


IRL Sublagoon	IRL Segment	1943	1992	1994	1996	1999	2003	2005	2007	2009	2011	2013	2015
IRL	IR14-15	1,325	2,673	3,267	3,502	3,167	3,307	3,411	3,785	3,644	1,249	1,498	1,886
	IR16-20	1,727	734	501	910	1,154	1,305	1,331	2,422	2,114	500	791	955
	IR21	1,322	824	718	1,041	1,370	1,282	1,270	1,386	1,371	877	1,117	1,199
	TOTAL	62,169	56,196	52,025	57,422	63,111	65,642	65,548	71,676	70,238	38,322	43,084	48,509

IRL Seagrass Within 30km of CCEC

		Mapping years											
IRL Sublagoon	IRL Segment	1943	1992	1994	1996	1999	2003	2005	2007	2009	2011	2013	2015
CCEC 30km	IRL Segment	1943	1992	1994	1996	1999	2003	2005	2007	2009	2011	2013	2015
	ML1												
	ML2												
	ML3-4												
100%	BR1-2	6722	9828	8484	9966	10483	11866	11848	12187	12286	2127	3390	5440
100%	BR3-5	6,476	6,417	5,337	5,317	6,905	6,646	6,651	8,449	8,210	733	1,681	3,422
20%	BR6	996	391	304	597	860	879	877	906	926	417	715	660
	BR7												
100%	IR1-3	8,732	9,336	9,909	9,467	8,152	8,437	8,426	8,960	8,555	9,238	8,489	9,270
100%	IR4	690	790	581	527	753	757	757	734	717	612	597	628
100%	IR5	4620	4841	3859	4411	5039	5329	5379	5384	5333	3301	3563	4525
100%	IR6-7	4979	1955	1521	2986	4301	4397	4384	4531	4632	2086	3573	3298
100%	IR8	427	213	214	101	517	520	473	487	501	3	17	1
40.0	IR9-11	906	78.8	35.6	70	288.8	307.6	314.4	332.8	333.6	74	94.4	2.8
	IR12-13A												
	IR13B												
	IR14-15												
	IR16-20												
	IR21												
	TOTAL	34548	33850	30245	33442	37299	39139	39109	41971	41494	18591	22119	27246

About 27,000 Acres Within a Day's Manatee Swim of CCEC



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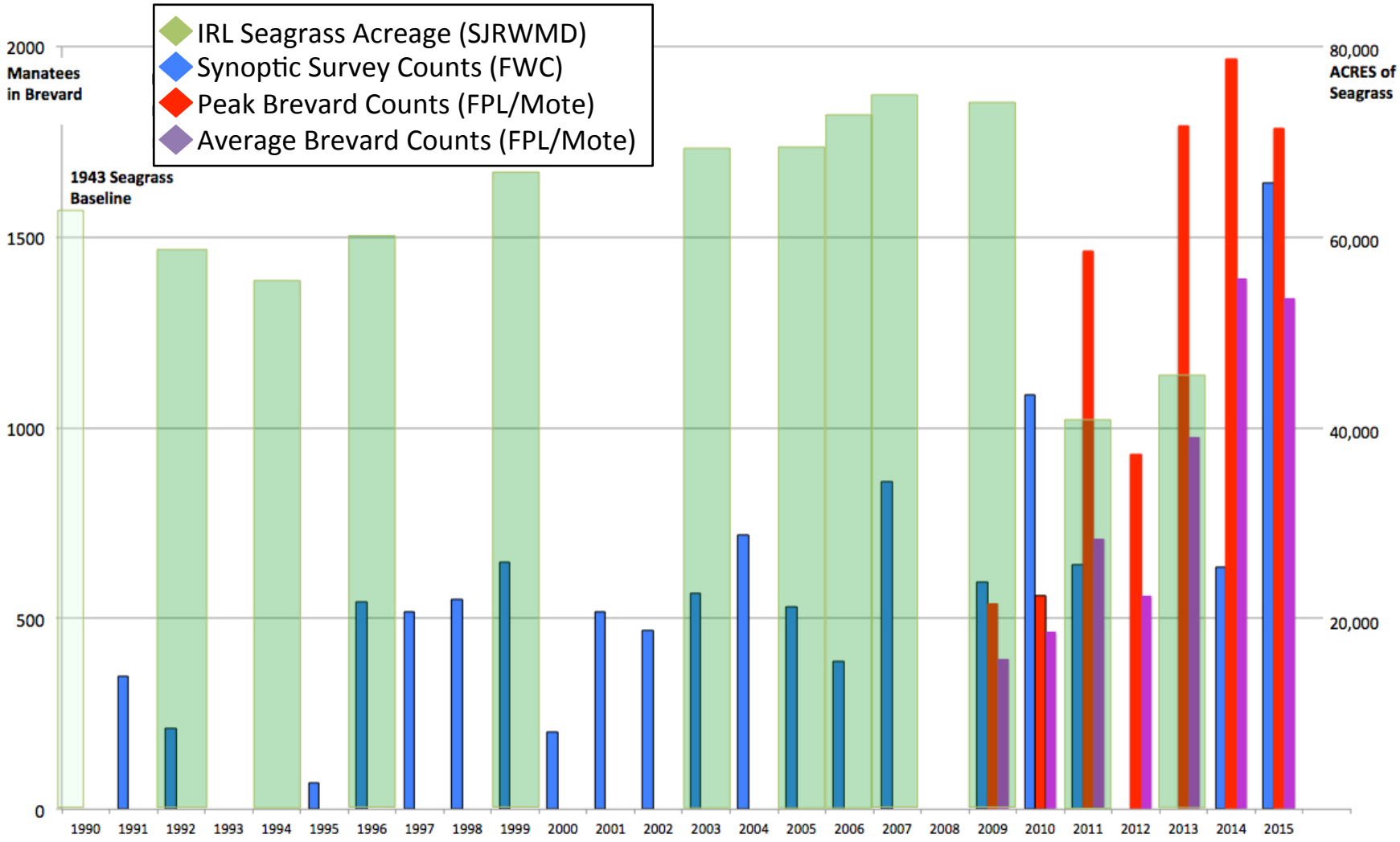
	TOTAL	62,169	56,196	52,025	57,422	63,111	65,642	65,548	71,676	70,238	38,322	43,084	48,509

IRL Seagrass Acreage & Manatee Numbers

- **Is There a Positive Correlation between Observations of Increased Manatee Presence and Decreased IRL Seagrass?**



Ground Rules and Assumptions

- **Per SJRWMD**
  - IRL Seagrass Acreage as of 2015 Assessment – 48,000 acres
- **Per FWC (Feb 2014)**
  - IRL Seagrass Density: 1466 - 6210 lbs wet mass/acre
    - 1466 – SJRWMD (1996 – 2010) *
    - 6210 - Short, et al (1993)
  - IRL SAV Growth Rate: 0.5% - 4.8% daily
    - 0.5 – 1.0% Winter (Nov-Feb) - Provancha, et al (2012)
    - 4.8% Summer (Mar-Oct) – Virnstein (1982), Near Ft. Pierce
  - Average Manatee Size: 1,000 lbs
  - Typical Manatee Consumption: 4.1 – 9.4% of body weight

** Probably the Most Reliable Value, But pre 2011*
Based on most Recent Observations – Current Density is Probably Lower

Ground Rules and Assumptions (cont)

- **Carrying Capacity is the Limitation of Habitat on Population**
- **A Sustainable Population Can Remain Viable Indefinitely**
- **An Optimum Sustainable Population:**
  - Exceeds the Minimum Population that will Sustain Itself
  - Does not Exceed Carrying Capacity

Ground Rules and Assumptions (concl)

- **We Know Some Amount of Uprooting Occurs During Manatee Foraging**

- **Definitions For the Purposes of This Presentation**
  - *Uprooting* - When no Visible Plant Remains Above the Riverbed – Post Foraging
  - *Regrowth Time* – Number of Years for Uprooted SAV to Become Viable Forage

- **Uprooting and Regrowth Time are Unknown**
  - Assume Both Remain Constant Over Time
    - Conservative Approach

There is an Additional Assumption on Chart 24

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Assessing the Effect of Uprooting

Definitions and Setup

- **Consider Uprooting as a Percentage of Total Forage**

  Let **F** = *Forage Requirement* as Determined (in Acres)

  Let **R** = Uprooting as a *Percentage* (factor) of Forage

- **Regrowth Time will be Represented in Years Based on**
  - Prop Scar Studies (Mosquito Lagoon and FL Keys)
  - Water Management Districts (SJ and SWF) and Other Expert Observations
  - 35 Years of Personal Observations in the IRL

  Let **N** = *Years* for Uprooted Acreage *to Regrow*

- **How Much Acreage is Lost Annually due to Uprooting**

  Define **PL** = Net Annual *Percentage* of Foraged Acreage *Lost*

  Then Actual ***Annual Loss*** is **PL** x **F**

PL = Net Annual Percentage Lost

To Understand the Calculation of PL

- **Suppose R = 20% and N = 2 Years**
  - Each year 20% of the forage acreage would be uprooted
  - The uprooted acreage would grow back in 2 years,
    - ½ would grow back each year
      (rate compounding not calculated for simplicity)
  - Each Year, We Should Observe a **PERCENTAGE NET LOSS**

    PL = 20% - (1/2)(20%) = (1 – ½) 20%

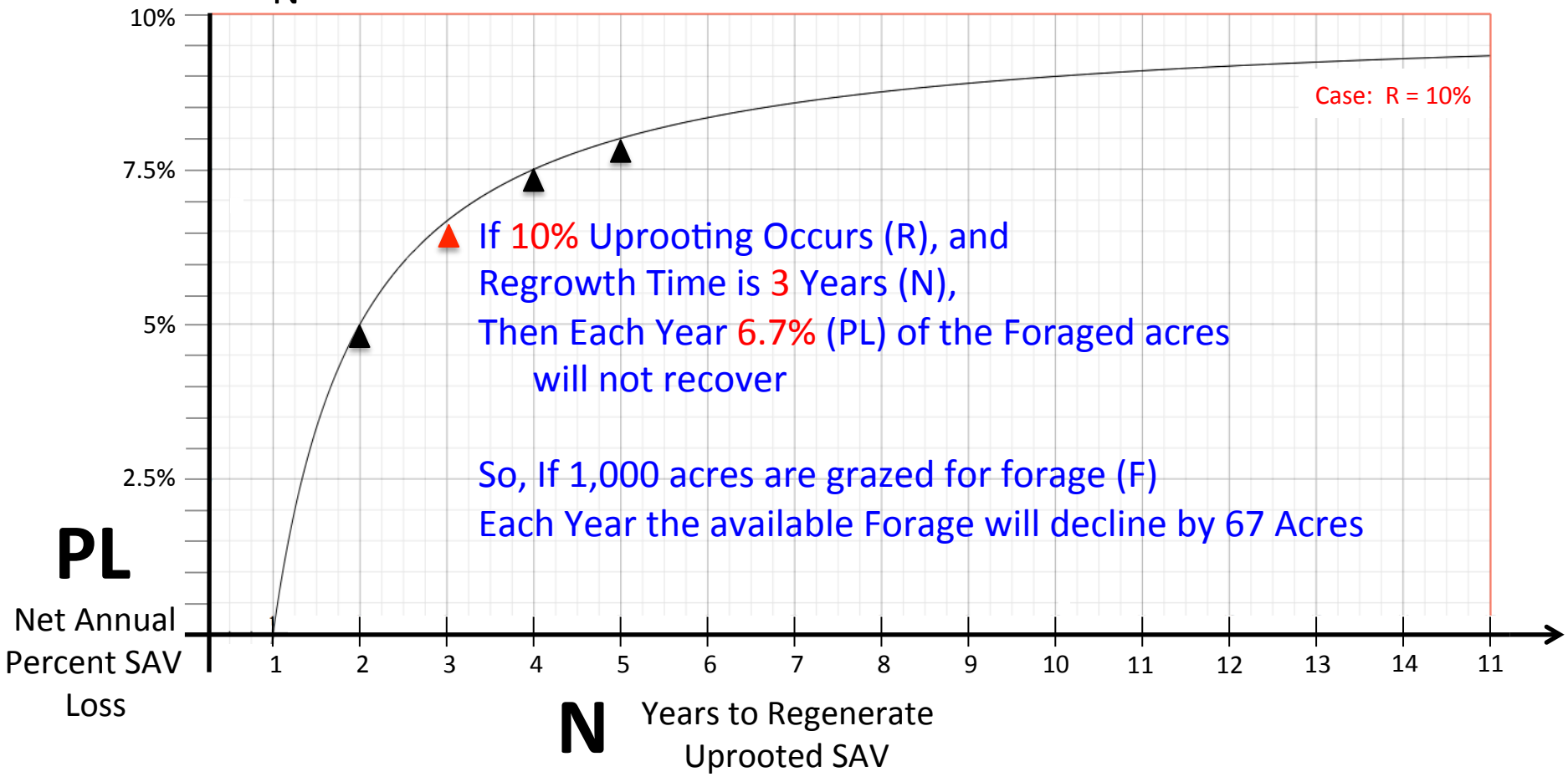
    PL = 10%

- **Specifically We Can Estimate: PL = (1 – 1/N) R**

- **Remember PL is a percentage of F**
  - Actual Annual Loss is **PL** x **F** (in Acres)

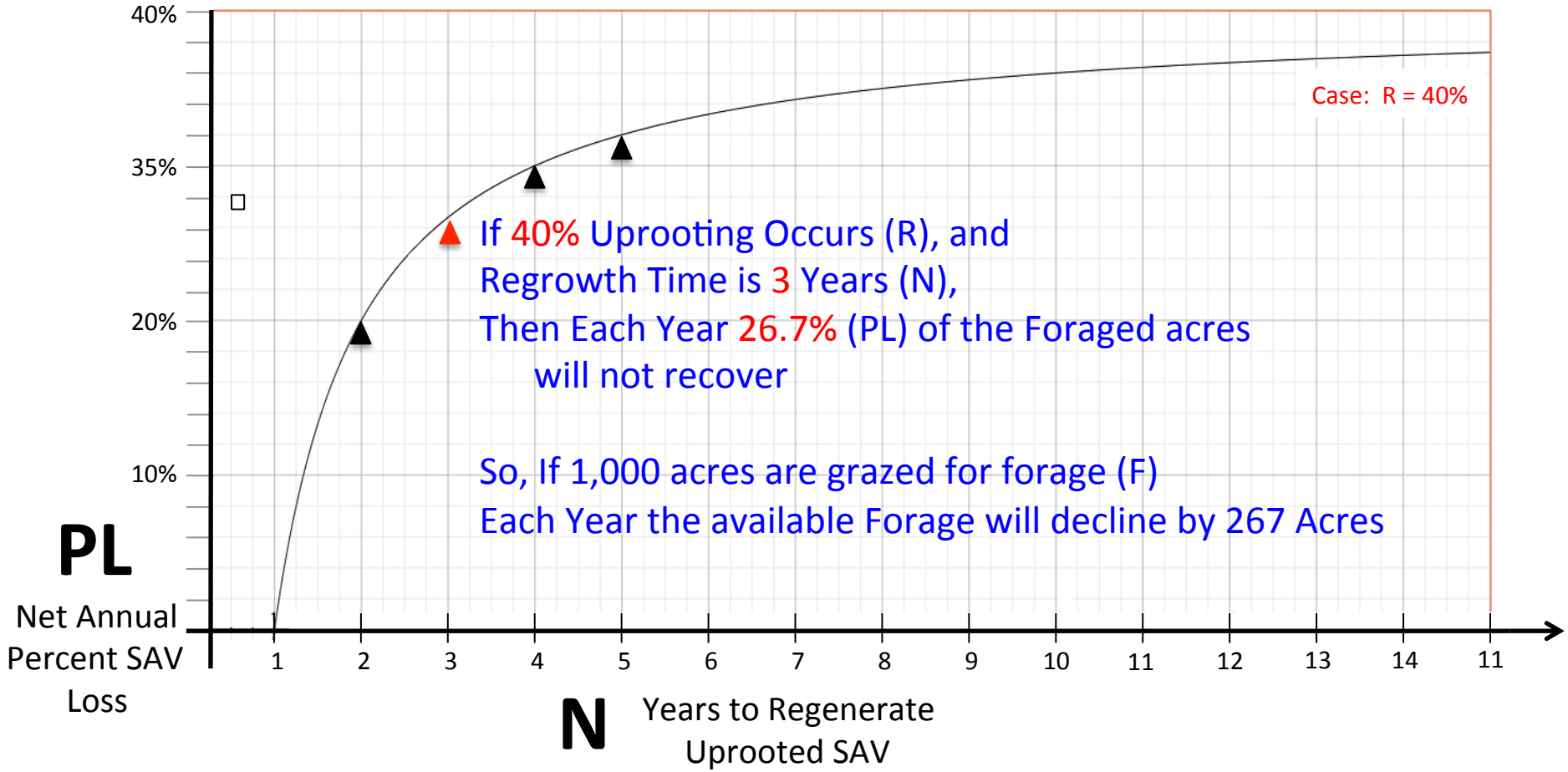
Example 1, R = 10% (Uprooting)

$PL = (1-\frac{1}{N})10\%$

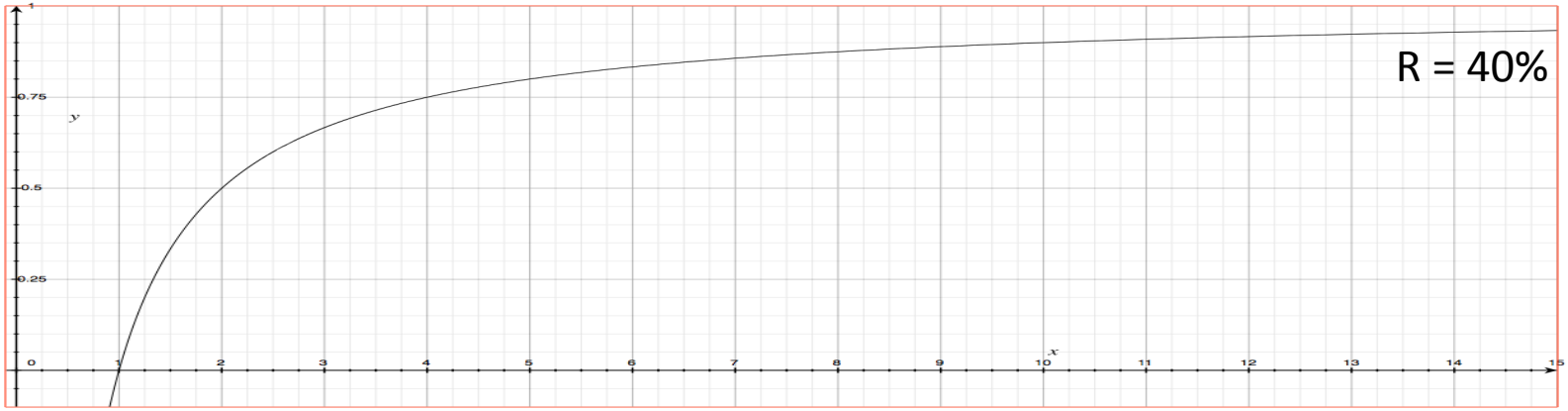


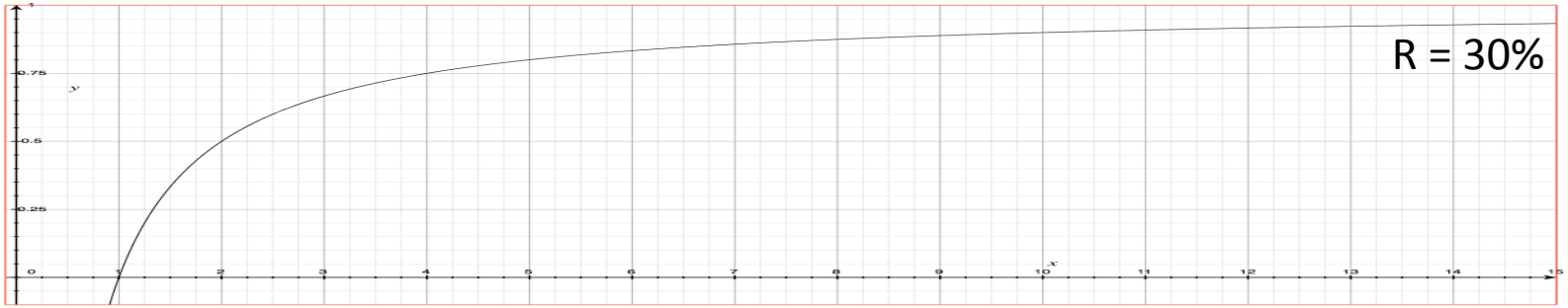
Example 2: R = 40% (Uprooting)

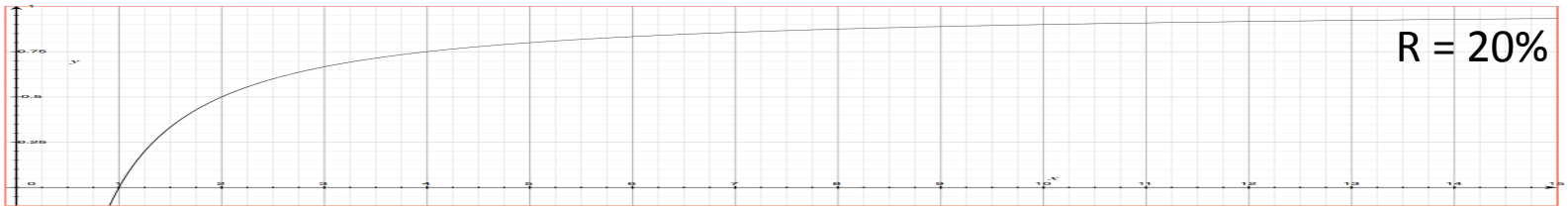
$PL = (1-\frac{1}{N})40\%$

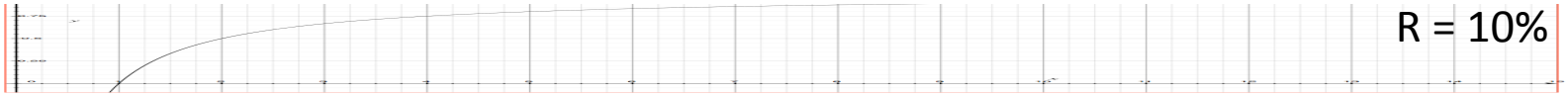


% Uproot Curve Comparison – to scale









The Net Effect of Uprooting

- **The Net Effect of Uprooting is a Continuous Loss of Seagrass Acreage**
  - **As long as Grazing Remains Constant, and**
  - **No Additional "Pasture" is "Created"**
  - **It is CUMULATIVE and PERMANENT**
- **The Pressing Question - How Much?**
  - **The Answer Requires a Better Understanding of**
    - **How Much Uprooting Occurs, and**
    - **How Long Regrowth Requires**
- **Conjectures:**
  - **Uprooting Will Likely Increase as Grazing Pressure Increases**
  - **Exceeding CC Will Result in Observable Over-Grazing and Significant Uprooting**

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Seagrass Productivity in the IRL

- **IRL Seagrass Density**
  - **1466** – 6210 lbs wet mass/ACRE
- **IRL Productivity - Summer Months (Apr – Sept) – 240 days**
  - Seagrass Growth
    - 4.8% / day
  - Total Production per Acre of Seagrass
    - **1466** lbs/acre + (240 days x 0.048/day x 1446 lbs/Acre) ≈ **18,400 lbs / Acre ***
    - 6210 lbs/acre + (240 days x 0.048/day x 6210 lbs/Acre) ≈ **77,700 lbs / Acre**
- **IRL Productivity - Winter Months (Oct – Mar) – 120 days**
  - Seagrass Growth
    - 0.5% / day to 1.0% / day
  - Total Production per Acre of Seagrass
    - **1466**lbs/acre + (120 days x 0.005/day x 1466lbs/Acre) ≈ **2,300 lbs / Acre ***
    - **1466**lbs/acre + (120 days x 0.01/day x 1466lbs/Acre) ≈ **3,200 lbs / Acre ***
    - 6210 lbs/acre + (120 days x 0.01/day x 6210 lbs/Acre) ≈ **13,700 lbs / Acre**

* *Probably the Most Reliable Values*

Typical Manatee SAV Consumption (lbs)

- **Typical Average Manatee**
  - 1,000 lbs

- **Manatee Seagrass Consumption – Winter Season**
  - 4.1% – 9.4 % body weight / day
  - (41 to 94 lbs seagrass / day)
  - x (120 days) ≈ **4,900 to 11,300 lbs / manatee / winter**

- **Manatee Seagrass Consumption – Summer Season**
  - 4.1% – 9.4 % body weight / day
  - (41 to 94 lbs seagrass / day)
  - x (240 days) ≈ **9,800 to 22,600 lbs / manatee / summer**

- **Annual Consumption**
  - ≈ **14,800 to 33,840 lbs** seagrass / manatee / year

Seasonal IRL Seagrass Impact (R = 0%)

- **Manatee Seagrass Consumption – Winter (Nov – Feb)**
  - **≈ 4,900 to 11,300 lbs / manatee**
  - **≈ 2,300 to 3,200 lbs / Acre (Full Productivity)**
  - **The Total Production of ≈ 1.5 to 4.9 acres is consumed by each manatee**
- **Manatee Seagrass Consumption – Summer (Mar – Oct)**
  - **≈ 9,800 to 22,600 lbs / manatee / summer**
  - **≈ 18,400 to 77,700 lbs / Acre**
  - **≈ 0.5 to 1.2 acres / manatee**
- **Winter Requirements Determine Carrying Capacity**
  - Least Available Forage
    - Shorter Time Frame
    - Slower Growth Rate
  - Most Manatees Present

Winter Forage Requirement

Winter Minimum Manatee Forage Requirement

- **Winter Season IRL (Oct – Mar)**
  - **Total Productivity of 1.5 to 4.9 acres Consumed / Manatee**
  - **Based on the FPL Counts Between 1500 and 2000 Manatees in Brevard County**
  - **The Wintering Herd Requires the Equivalent of the Total Production of 2250 and 9800 Acres Of Seagrass**

How Many Acres – Really?

How many Actual Acres SAV are Required to:

- Supply the Equivalent Total Production of 1 Acre?
- And Still Remain Sustainable?

Isn't TWO the Minimum Reasonable Answer?

- All the Other Creatures Need Some SAV Too
- We Have to Maintain Some Filtering Function for the Health of the Habitat

ASSUME It Takes 2 Acres to Sustain the Equivalent of the Total Production of 1 Acre

- This Doubles the Previously Calculated Acreage Requirement for Winter between
- 4,600 and 19,600 acres for the 1,500 – 2,000 Manatees
- Equivalently, 3.1 to 9.8 Acres SAV per Manatee

Re-Calculating CC with Uprooting

- **IRL Carrying Capacity with Zero Uprooting**
  - 3.1 to 9.8 Acres per Manatee
- **What is the Additional Impact of Uprooting?**
  - As an Example, Assume 5% Uprooting and 3 year Regrowth
  - Percent Annual Net Loss is (1 – 1/3) 5% = 3.3 %
  - Actual Annual Net Loss would be between
    3.3%(3.1) up to 3.3%(9.8) Acres Per Manatee
    0.10 to 0.32 Acres Per Manatee LOST Each Year
- **Carrying Capacity Recalculated for R=5%, N=3**
  - This Decreases the Carrying Capacity
  - A Minimum of 3.2 to 10.1 Acres per Manatee
  - Realistically the Impact is Greater
  - And, Increased Uprooting or Longer Regrowth Yields Less Capacity

CC – Including Uprooting Impacts

- **The Actual Annual Loss of Forage is determined by:**
  - Total Acreage Required for Forage (F)
  - by Uprooting Percentage (R) and
  - Years to Regrow (N)

  Actual Annual Loss is **PL** * **F** ,
  where **PL** =(1-1/**N**)***R**

- **So in the IRL case above where 4,500 < F < 19,600**
  If we assume 5% Uprooting with 3 Year Recovery we can Expect an Annual Reduction of
  - **Between 3.3%(4,500) and 3.3%(19,600) Acres Each Year**
  - **A Net Loss Between 150 and 650 Acres SAV each Winter**
  - **Remember, this is annual and cumulative -**
  - **Based on these values and current population and forage Expect 750 to 3,200 acre reduction over 5 years**

Data and Analysis Summary

- **The Observed Brevard / IRL Winter Herd Continues to Grow**
- **The IRL SAV Acreage has Slightly Increased But Density has Declined**
  - This Reduces Productivity/Acre and Potentially the Total Available Forage
- **The IRL Continues to be impacted by "Significant Annual" Algal Blooms**
  - No reason to believe we will exceed 75,000 acres in the IRL
- **Based on the Conservative Baseline Data, Current Conditions and Very Conservative Analysis**
  - Between 11% and 51% of the Total Brevard Forage (38,000 Acres) are Required For Winter Forage
- **Uprooting has a Negative - Yet Undocumented Long Term Impact**
- **Manatee Migration is a Survival Instinct**
  - Probably More Driven by Long-Term Impacts to Forage Than Temperature

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Observations

- **We Urgently Need a Clear Understanding of Local Area Carrying Capacity and Optimum Sustainability for the IRL**

- **We MAY Still have Quantifiable Margin for Capacity in the IRL.**
  - We need to Pro-Actively Manage to Preserve that Margin

- **Doing Nothing and Hoping for the Best is NOT Pro-Active Management**
  - Based on Trends Observed Over the Long Term we are Extremely Likely to See a Significant Detrimental Impact to the IRL Seagrass and / or the East Coast Manatee Population

- **We Must Redefine Our "More is Better" Manatee Management Approach and Redirect our Efforts Toward Management of a Stable and Growing Population**

Outdated Management Approach

Manatee Management is Still Governed by Decades Old *Assumptions* – These are the Fabric of Our History – But NOT Facts

- ***The Manatee is an Endangered Species***
  - Depleted and in danger of extinction
  - The basis for "More is Better" Approach (Over Influence of legal over science - ESA, MMPA, etc)
- ***Boat Mortality is the Greatest Threat to the Manatee Species***
  - " … watercraft-related mortality had the greatest impact on population growth" – Manatee Management Plan
- ***Slow Boat Speed is our Best Hope of Saving the Manatee Species***
  - "… Reductions in boating activity and speed is essential to safeguard the manatee population" – Marmontel, 1997

Insufficient Attention has been Focused on Carrying Capacity and/ or Optimum Population

- **These Quantifiable Measures were Repeatedly Requested at Public Hearings over 30 Years ago**
- **The Observed Population has Continued to Grow at an Explosive Rate**
  - Far Faster than was Assumed; Far Faster than the Basis for Current Management Actions

After All these Years, Manatee Carrying Capacity Remains . . . ?

Problem Description – Root Cause

HUMAN IMPACT

- **We Have Engineered an East Coast Manatee Distribution That Jeopardizes Nature's Ability to Maintain Equilibrium**

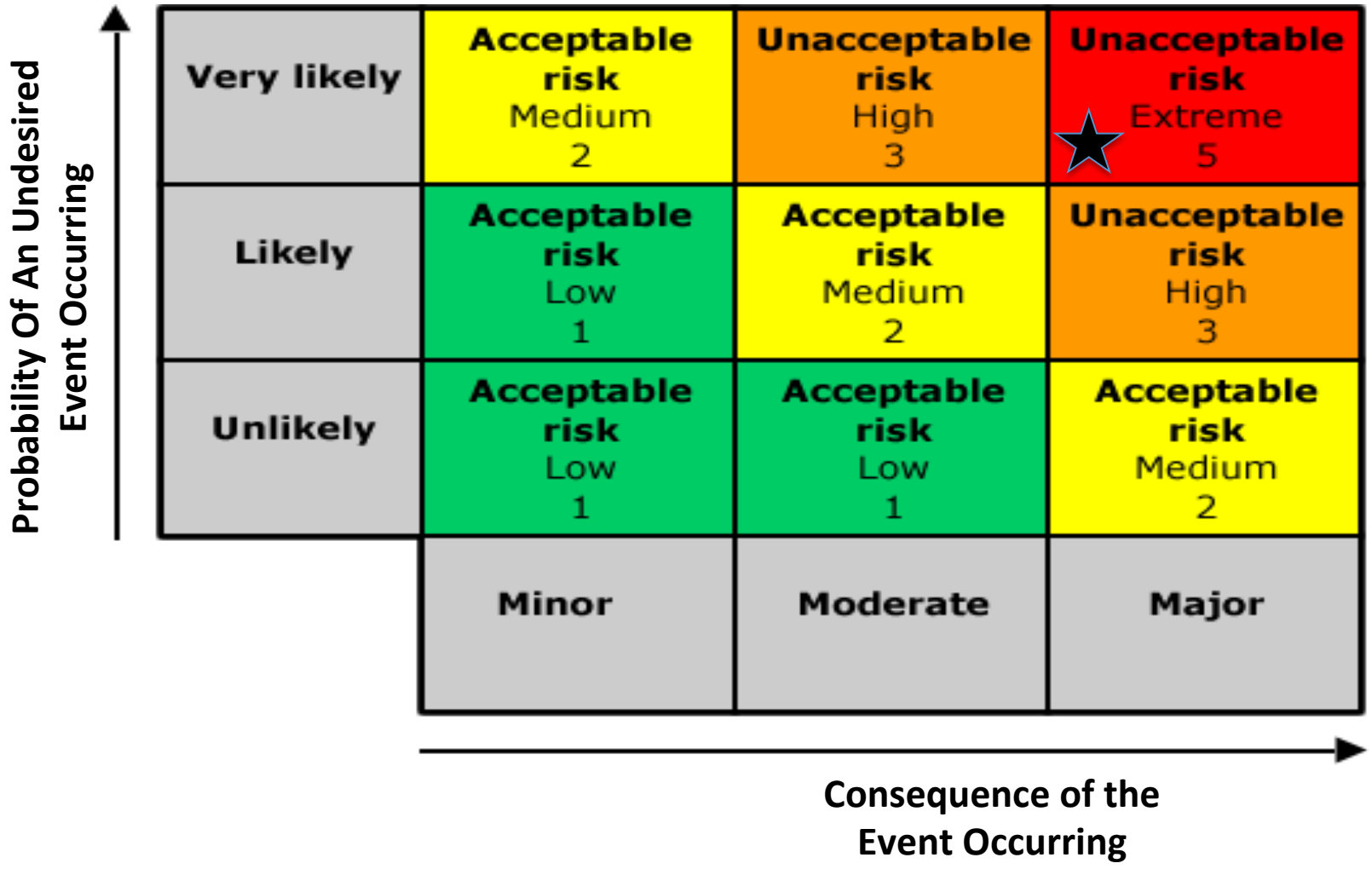
- **We Created and Encouraged the Artificial Warm Water Outflow(s)**
  - Caused the Rapid Localized Seasonal Manatee Population Growth
  - Year-Round Population Numbers not Known

- **We Created the High Nutrient Loads (P & N) in the IRL**
  - Caused Muck, Algal Blooms Resulting in Significant Loss of Seagrass

- **These Trends are In Direct Conflict and Must be Addressed**
  - The Consequence is an Unacceptable Impact to the IRL, the Manatee or Both

Unacceptable Risk Must Be Mitigated

Actions are Required to Reduce the Probability that Population and Seagrass Trends Continue



Mitigation Plan – Seagrass Loss

- **The Multi-Level Government and Citizen IRL COUNCIL has Already Taken the Lead on this Element of the Problem**

Mitigation Plan – Local Population Mgmnt

We Created the Problem – We Can Fix It

- **Action – Eliminate the Impediments to Pro-Active Manatee Management**
  - ESA – Reclassify the Manatee to "Recovered"
  - MMPA – Re-Evaluate Allowable Take Based on "Recovered"
  - Amend/Repeal any Restrictive Legislation
  - Revise Governing Plans
  - Organizational Objections Must be Addressed
    - In Fact – All Organizations MUST Assist in Reshaping Public Opinion

- **Action – Develop and Implement a Pro-Active Manatee Intervention Plan**
  - Respond, Rescue, or Relocate
  - Monitor Potential Overcrowding at Warm Water Site
  - Actively Search for Cold Stressed or Distressed Manatees in the Surrounding Areas

Mitigation Plan – Local Population Mgmnt

- **Action – Impose and Enforce State or Federal Regulations for Immediate Reductions and Timely Elimination of the Artificial Warm Water Outflow**
  - Provide "Cover" for the Operators in the Face of Negative Public Opinion

- **Action . . .**

. . . .Discussion