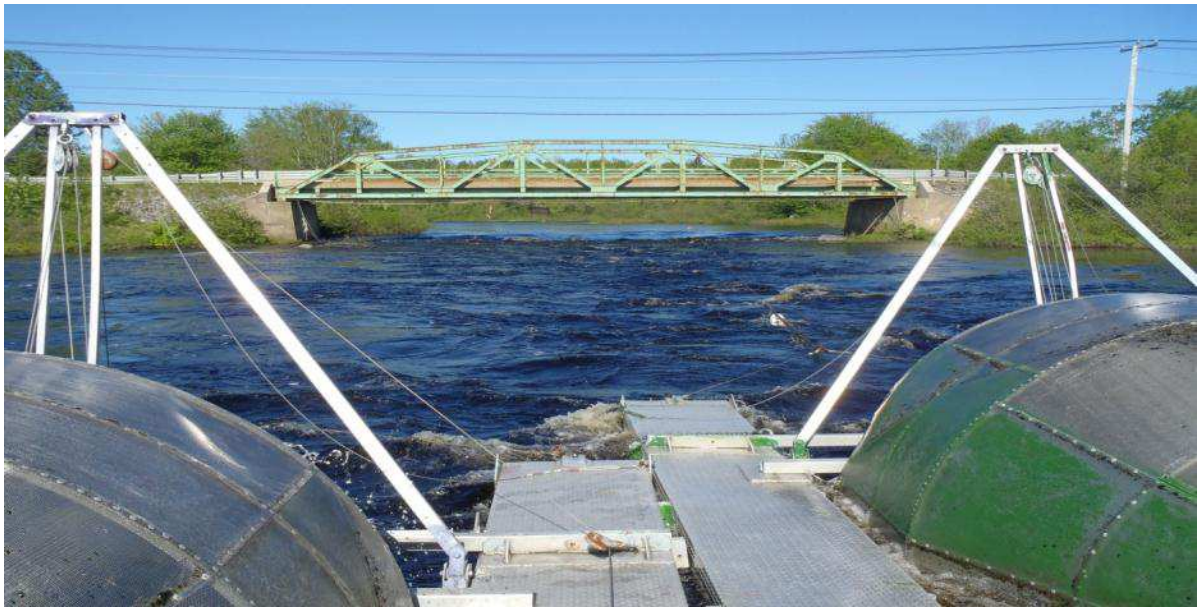
East Machias River
Smolt Population Assessment



2016

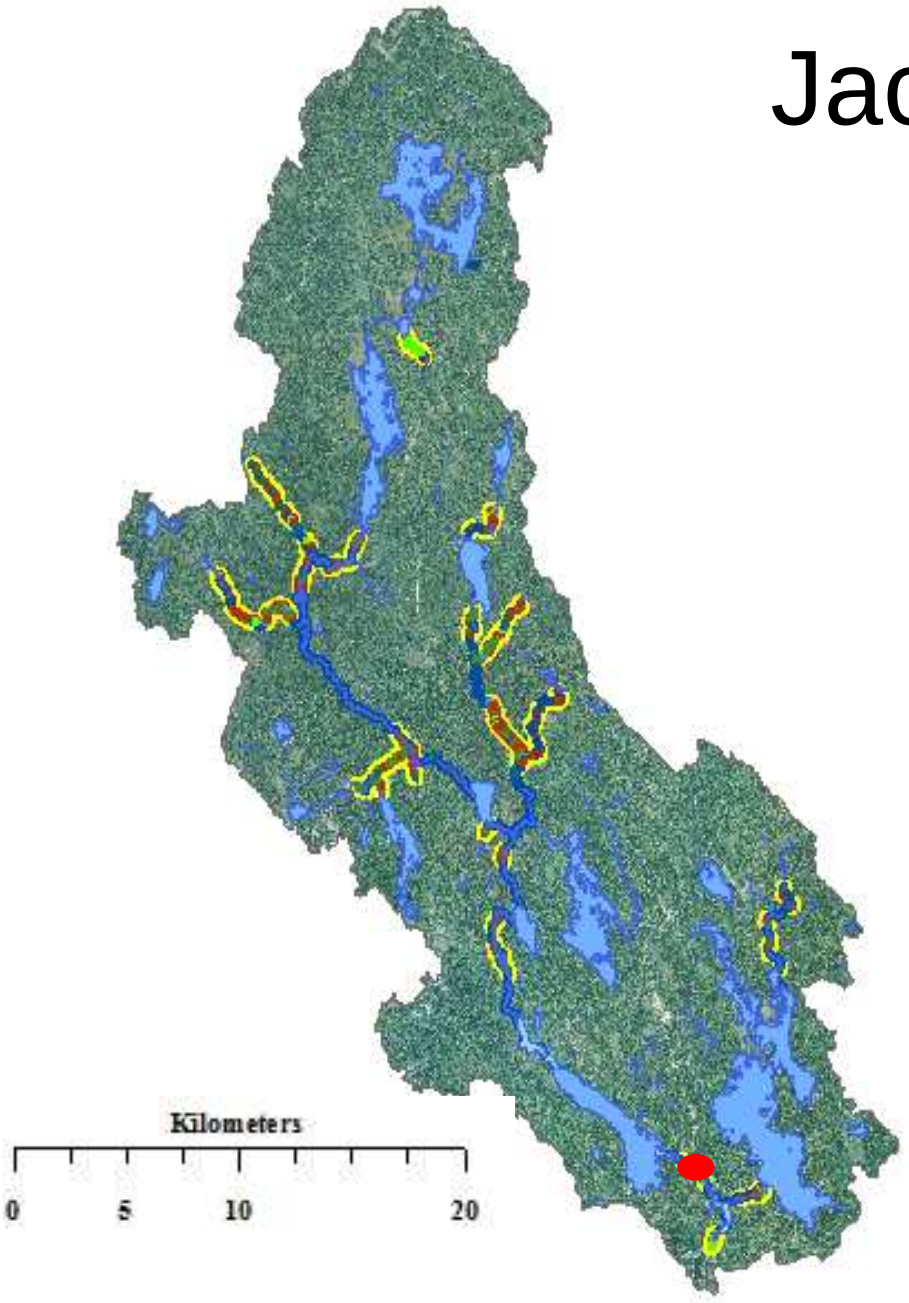
Colby Bruchs, Maine DMR

East Machias River Smolt

- Naturally-reared origin
  - Primarily progeny from fry stocking
    - Creamer Brook
    - Harmon Stream

- Hatchery origin (marked w/ adipose clip)
  - Fall 2011 – pilot stocking – 1,362 parr
  - Fall 2012 – 53,215 @ ~30-45/unit
  - Fall 2013 – 77,568 @ ~30-90/unit
  - **Fall 2014 – 149,815 @~45-120/unit**
  - **Fall 2015 – 192,032 @~45-120/unit**

Jacksonville Bridge RST Site



Deployed 14 April to 7 June

Season Captures

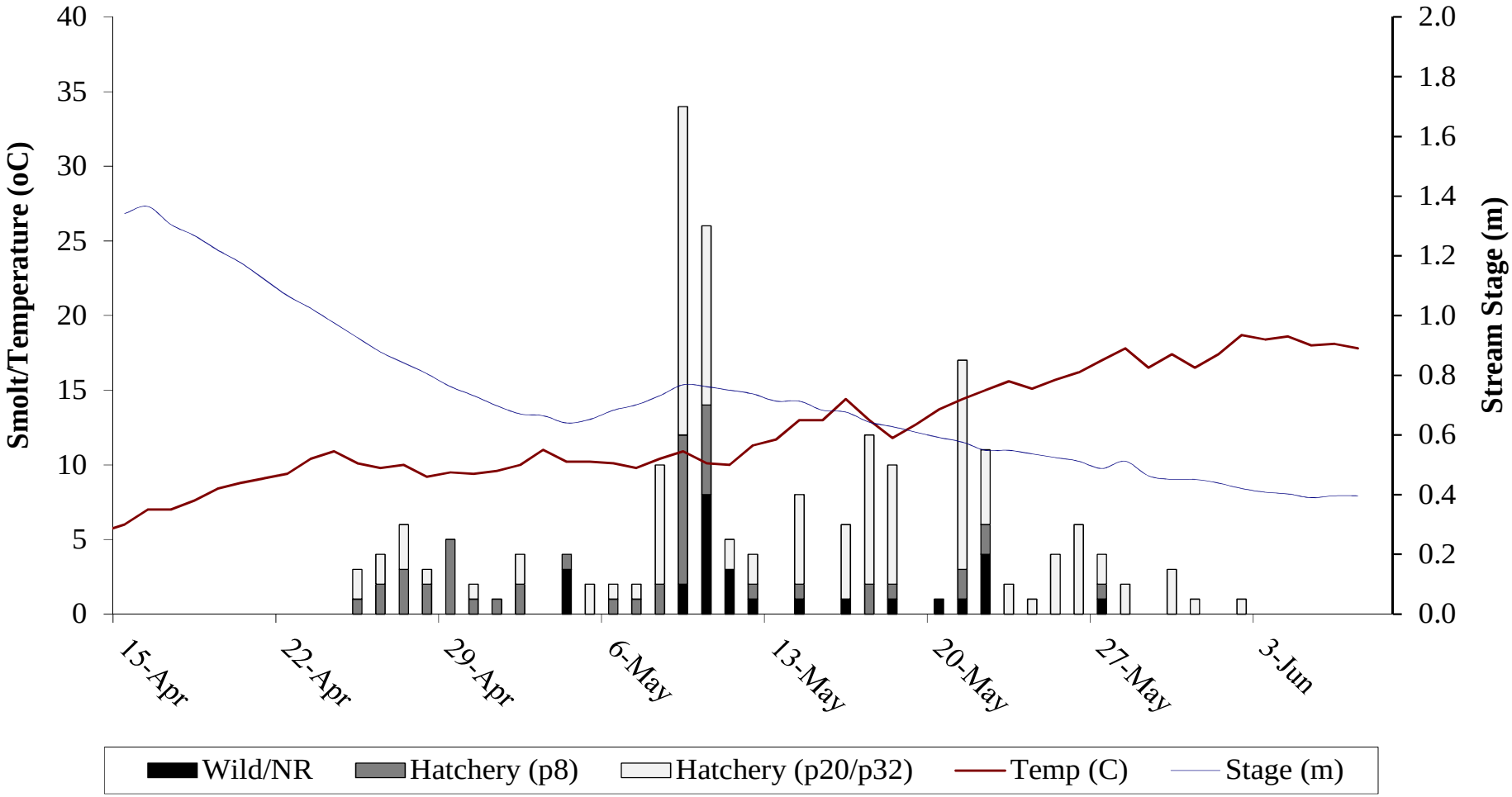


Figure 1. Daily smolt catch (by origin), water temperature (°C), and stream stage (m) at the Route 191/Jacksonville Bridge RST transect, East Machias River, Maine, 2016.

Population Estimates

- Season recaptures → 4 Wild ; 51 Hatchery
- Site recapture efficiency → 26.8%

2016 DARR estimate total smolt production = **1,223 ± 297**

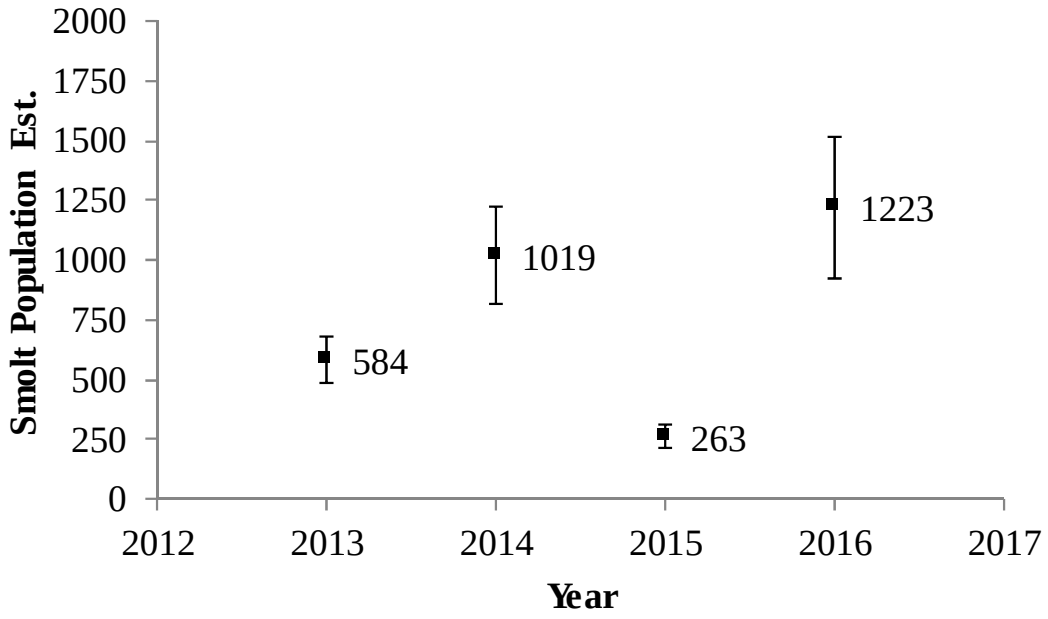


Figure 2. Total smolt population estimates and standard error (DARR 2.02 for program R), East Machias River, Maine, 2013-2016.

Age and Origin

Table 1. Age distribution for wild and hatchery origin Atlantic salmon smolt emigrating from the East Machias River, Maine, 2013-2016. Smolt ages p8, p20, and p32 designate freshwater residency in months for hatchery origin smolt stocked as 0+ parr.

			Smolt Age					
Drainage	Year	Origin	1	2	3	p8	p20	p32
East Machias	2013	W	0.0%	87.5%	12.5%	-	-	-
		H	-	-	-	81.4%	18.6%	-
	2014	W	0.0%	58.3%	41.7%	-	-	-
		H	-	-	-	64.1%	35.0%	0.9%
	2015	W	0.0%	42.9%	57.1%	-	-	-
		H	-	-	-	29.2%	67.7%	3.1%
	2016	W	0.0%	80.8%	19.2%	-	-	-
		H	-	-	-	27.5%	67.1%	5.4%

P20 Smolt Production

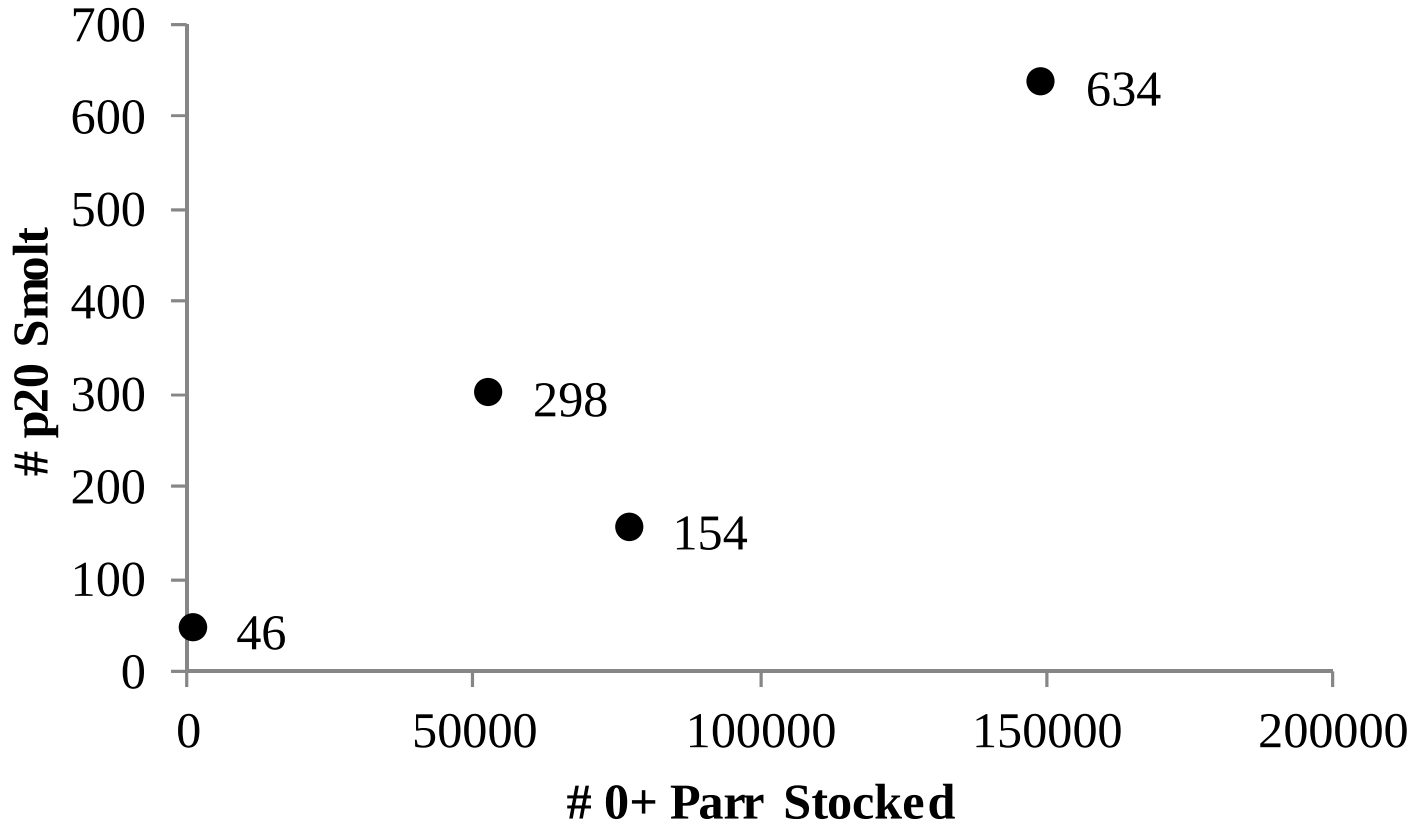


Figure 3. Hatchery-origin p20 smolt (20 months stream residency post-stocking) estimate and number of fall (0+) parr stocked, East Machias River, Maine (2013-2016).

P20 Smolt Production (cont.)

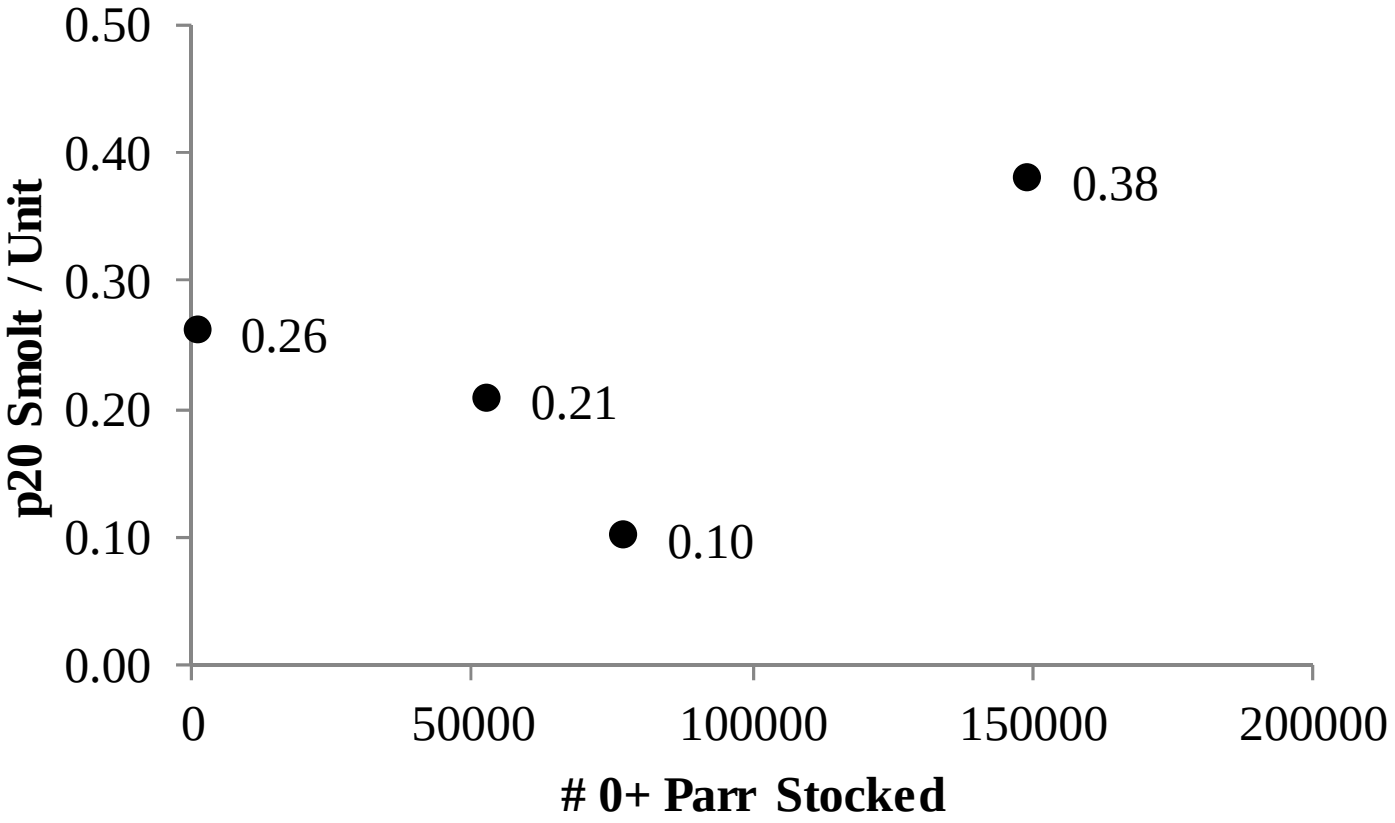


Figure 4. Hatchery-origin p20 smolt (20 months stream residency post-stocking) production rate per unit (100m^2) of supplemented rearing habitat, East Machias River, Maine (2013-2016).

P8 Smolt Production

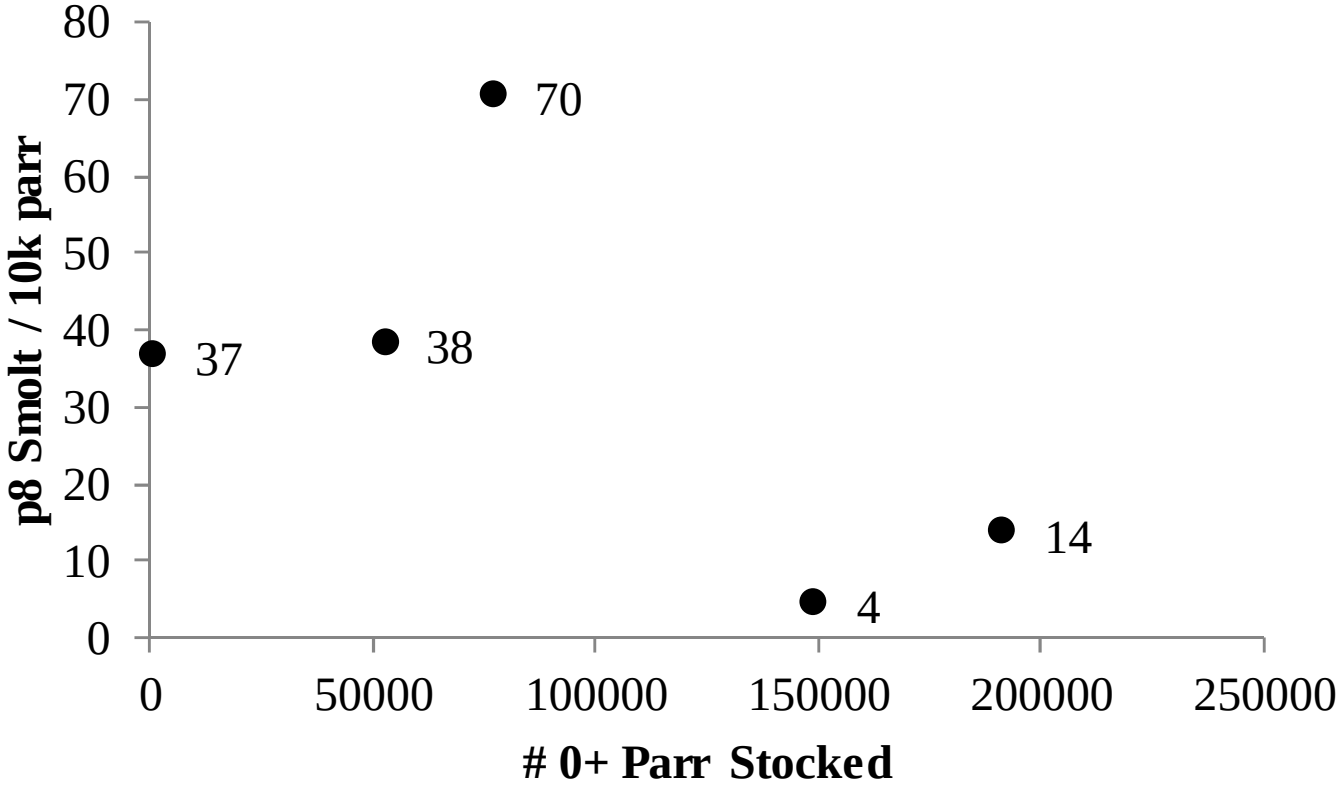
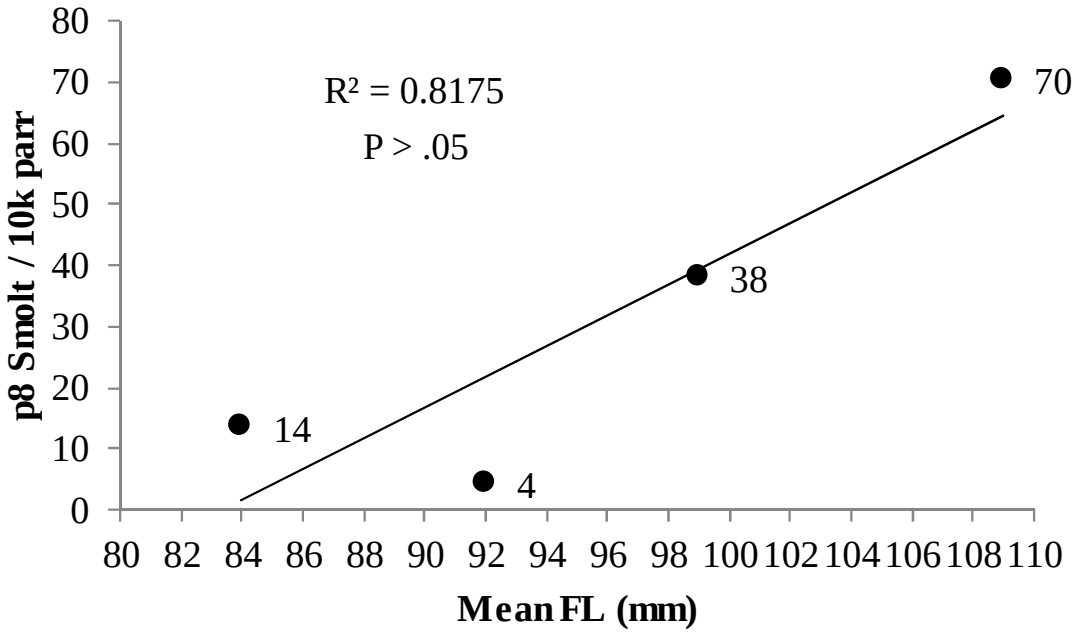


Figure 5. Hatchery-origin p8 smolt (8 months stream residency post-stocking) production rate per 10,000 fall (0+) parr stocked, East Machias River, Maine (2012-2016).

P8 Smolt Production (Cont.)

- Driven by size-at-stocking



Mean size at stocking:

- 2012 – 99mm
- 2013 – 109mm
- 2014 – 92mm
- 2015 – 84mm

Figure 6. Relationship of hatchery-origin p8 smolt (8 months stream residency post-stocking) production rate per 10,000 fall (0+) parr stocked and mean size-at-stocking (FL), East Machias River, Maine (2012-2016).

Hatchery p20 Vital Rates

Table 2. 0+ parr to smolt survival rates based on smolt population estimates, smolt age distribution, and 0+ stocking history for the East Machias, Narraguagus, and Sheepscot Rivers, Maine, 2007-2014.

Lifestage Cohort Year	Drainage	Source	Survival from	Survival to	Number Stocked or Estimated	Number of Survivors	Approx. Months	Period % Survival	Monthly % Survival
Downeast Coastal									
2011	East Machias	Hatchery 0+	0+ parr	Smolt	1,357	46	20	3.4	84.4
2012	East Machias	Hatchery 0+	0+ parr	Smolt	53,012	298	20	0.6	77.2
2013	East Machias	Hatchery 0+	0+ parr	Smolt	77,022	154	20	0.2	73.3
2014	East Machias	Hatchery 0+	0+ parr	Smolt	149,748	634	20	0.4	76.1
2007	Narraguagus	Hatchery 0+	0+ parr	Smolt	15,469	165	20	1.1	79.7
2008	Narraguagus	Hatchery 0+	0+ parr	Smolt	20,990	366	20	1.7	81.7
Merrymeeting Bay									
2009	Sheepscot	Hatchery 0+	0+ parr	Smolt	17,253	933	20	5.4	86.4
2010	Sheepscot	Hatchery 0+	0+ parr	Smolt	13,713	459	20	3.3	84.4
2011	Sheepscot	Hatchery 0+	0+ parr	Smolt	13,357	945	20	7.1	87.6
2012	Sheepscot	Hatchery 0+	0+ parr	Smolt	14,541	188	20	1.3	80.5
2013	Sheepscot	Hatchery 0+	0+ parr	Smolt	12,903	461	20	3.6	84.7
2014	Sheepscot	Hatchery 0+	0+ parr	Smolt	14,406	937	20	6.5	87.2

Cohort Survival

Drainage	0+ Parr Cohort	Parr Stocked	Stocking Density	Smolt Estimate at Age p8	p20	p32	Estimated Total Smolts	% Survival to Smolt
East Machias	2012	53215	45/unit	203	298	7	508	1.0%
	2013	77568	90/unit	546	154	51	751	1.0%
	2014	149815	120/unit	67	634	-	701	0.5%
		Mean		**205**	**362**	**29**	**653**	**0.8%**
Sheepscot	2012	15700	15/unit	1159	188	0	1347	8.6%
	2013	14000	15/unit	1097	461	0	1558	11.1%
	2014	15000	15/unit	594	937	-	1531	10.2%
		Mean		**950**	**529**	**0**	**1479**	**10.0%**

Total Smolt Production

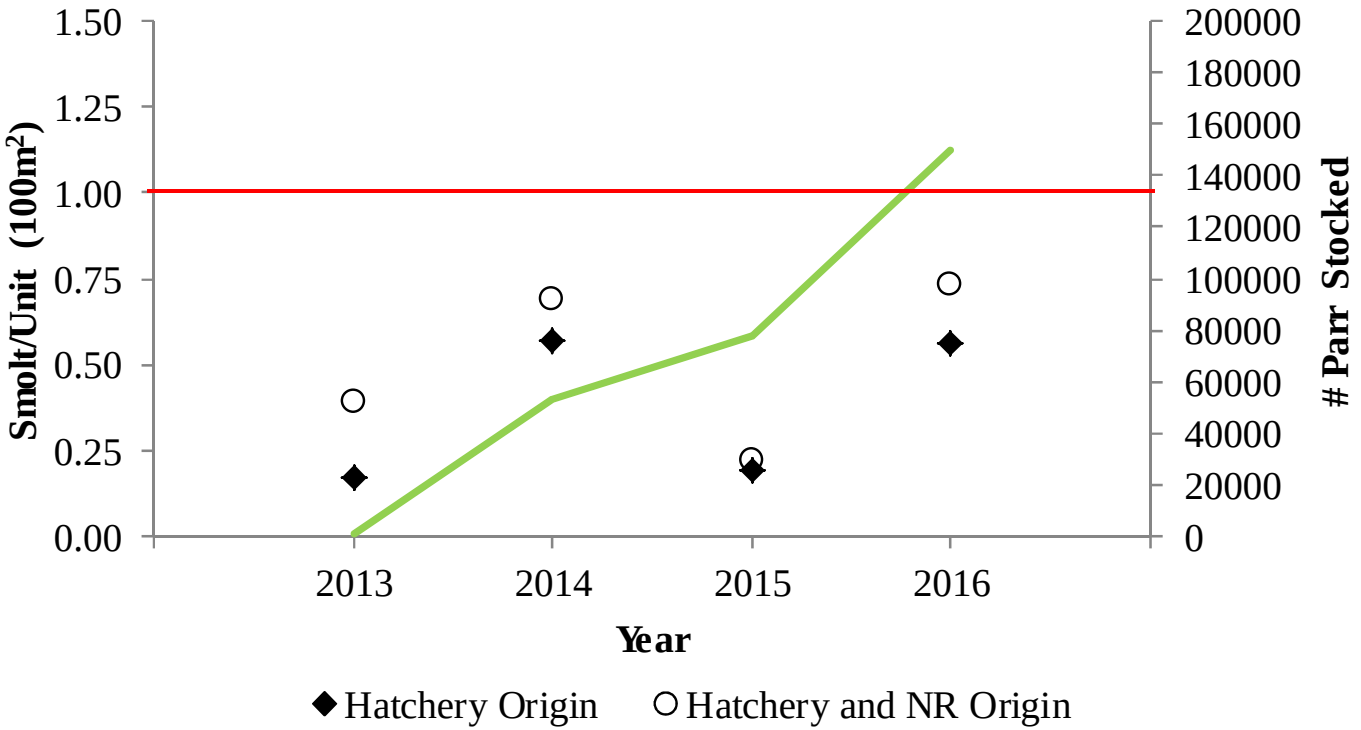


Figure 7. Smolt production rate per unit (100m^2) of supplemented rearing habitat, East Machias River, Maine (2013-2016).

Management Implications

- Increased cohort observed in 2016
- Similar stock enhancement strategy produced low abundance in previous year
  - No change in stocking densities and locations
  - Environmentally driven
- Low survival rates persist
  - Mainsteam reaches have poor survival
  - Exclude from analysis → survival only improves 0.1%...
  - Indicates loss occurring optimal habitat

Management Implications

- Near-term options
  - Reduced stocking densities may improve survival increasing p20/p32 emigrants
  - Reduced stocking densities will likely decrease p8 production

- Long-term options
  - Improve rearing habitat

Management Implications

- Total Freshwater Production
  - East Machias focus (current/near-term)
    - All rearing habitat can be utilized (2281 units)
    - Total smolt production maximized
  - Downeast SHRU focus (potential)
    - Vacant rearing habitat
    - Total smolt production limited

      BUT improved immediately if supplemented
    - Example – Machias River
      - ~8,000 rearing units → 3,900 units vacant
      - Production potential → 741 – 2,223 smolts annually
        - » @ observed EM – H smolt production rates


QUESTIONS?

Assessment Moving Forward

- Dramatic decline in smolt production driven by:
  - (1) a one-year environmental anomaly resulting in poor overwinter survival

    → smolt production rebounds significantly in spring 2016)
  - (2) smaller size at stocking

    → (1+ parr abundance remains high in fall 2015 and p20 smolt abundance increases significantly in 2016)
  - or (3) stocking rates exceeded carrying capacity

    → (reduced 1+ parr abundance and continued poor survival to smolt)

Adaptive Management of Stocking

- Based on objective results obtained during fall 2015 electrofishing and spring 2016 smolt trapping

- <u>If smolt production/survival continues to decline…</u>

  → No further increase/potential reduction in stocking density

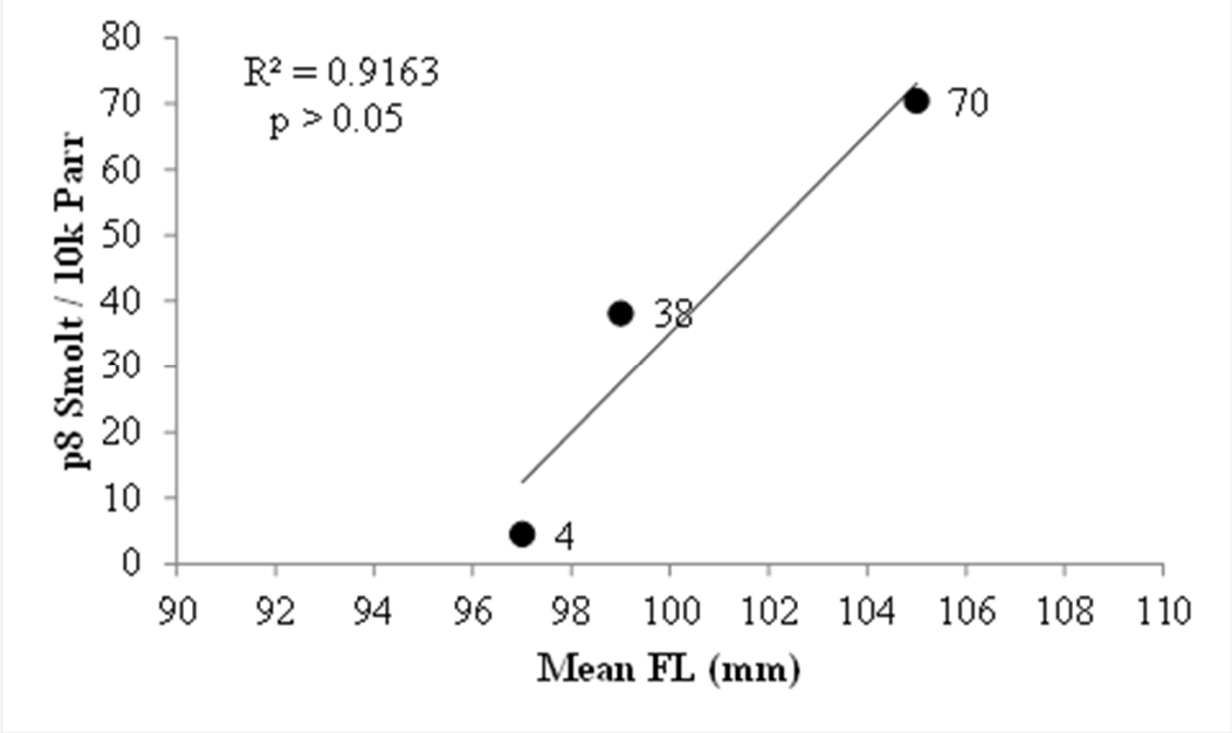
  → Surplus parr = Alternative stocking location in other Downeast SHRU river(s)?

  → Surplus eggs = Available for planting in other rivers?

- <u>If smolt production/survival improves…</u>

  → Continue to increase densities to max. targets

Size at Stocking (SAS)



Mean size at stocking:

- 2013 – 99mm
- 2014 – 105mm
- 2015 – 97mm

- Currently positive (non-significant) correlation between SAS and p8/10k parr stocked
- … No sig. diff. in mean size between 4/10k and 38/10k cohorts
- Overwinter mortality?

Density-Dependent Mortality?

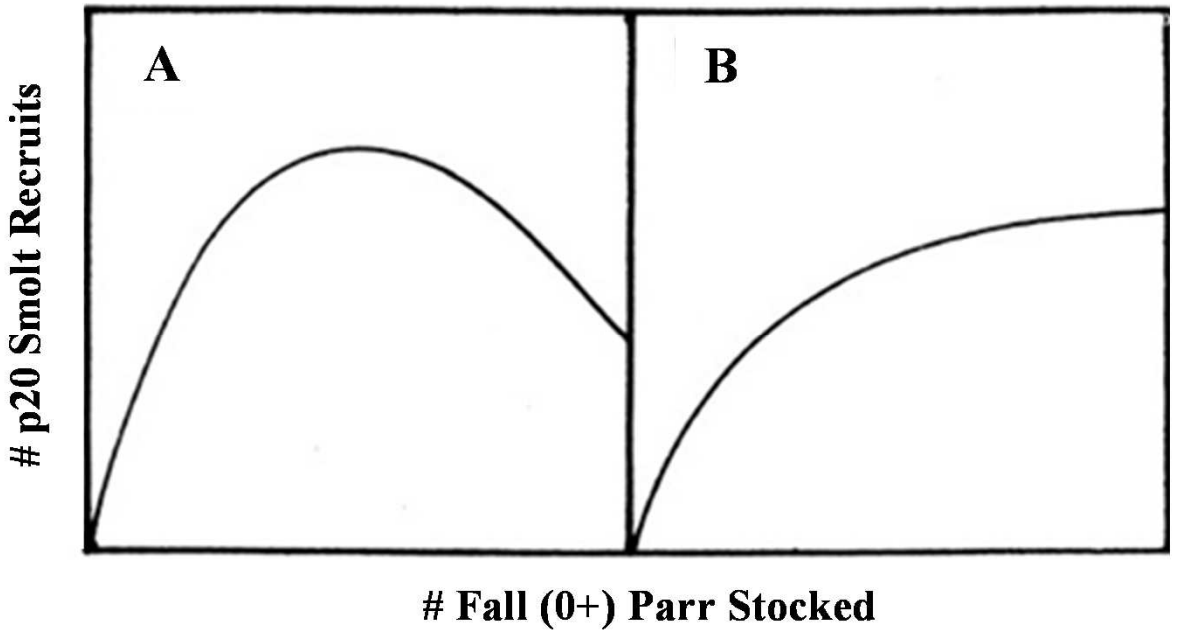


Figure 9. Density-dependent stock-recruit curves describing smolt recruitment; (a) Ricker (1954) and (b) Beverton – Holt (1957).