***MEETING NOTES***

***SOUTH CAROLINA ELECTRIC & GAS COMPANY***
***SALUDA HYDRO PROJECT RELICENSING***
***Instream Flow/Aquatic Habitat Technical Working Committee***
***Via Conference Call***
***April 10, 2007***

Final CSB 05-22-07

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## ***ATTENDEES:***

Dick Christie, SCDNR
Alan Stuart, Kleinschmidt Associates
Milton Quattlebaum, SCANA Services
Jeni Summerlin, Kleinschmidt Associates
Mike Waddell, Trout Unlimited
Gerrit Jobsis, AR/CCL
Shane Boring, Kleinschmidt Associates
Brandon Kulik, Kleinschmidt Associates
Hal Beard, SCDNR

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## ***ACTION ITEMS***

- Gather and distribute substrate HSC plots and legends from Catawba-Wateree study for brown trout fry/spawning/juveniles to TWC

*Dick Christie / Shane Boring*

- Finalize HSC curves based on TWC input and incorporate as an appendix to the Saluda IFIM Study Plan

*Shane Boring/Brandon Kulik*

## ***NEXT MEETING***

**TBD**

***MEETING NOTES:***

*These notes serve as a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.*

Shane Boring opened the meeting at approximately 9:00 AM. Shane noted that, at the January 22nd meeting of the Instream Flow/Aquatic Habitat Technical Working Committee (TWC), the TWC had agreed upon Habitat Suitability Criteria (HSC) for depth and velocity for several target species (smallmouth bass, brown trout, and rainbow trout adults). Shane added that the purpose of today's meeting would be to finalize the HSC selection process by selecting substrate criteria for these species.

Shane enquired as to whether there was any follow-up discussion regarding the depth/velocity criteria selection process or other TWC housekeeping items in need of attention. Hal Beard noted that, at the previous meeting, there was an action item assigned to determine whether HSC curves were available for gizzard shad in riverine systems. Hal added that, after discussing this issue with colleagues at SCDNR, he did not think this species was as much of a priority as he had once thought.

Dick Christie reminded the group that DNR manages the lower Saluda as a put-grow-take trout fishery, and as such, he and other DNR staffers had requested at previous TWC meetings that the habitat modeling for trout focus on adult lifestages (i.e. not include spawning, juvenile, fry). He added that, while DNR certainly welcomes any improvements to water quality or habitat that might benefit these early-lifestages, flow recommendations resulting from the IFIM process should not come at the detriment of providing quality growing conditions for stocked adult and sub-adult trout. Dick added that, while looking at early lifestages in the modeling might be good to have for informational purposes, these lifestages were not within the DNR's management strategy for the lower Saluda. Mike Waddell noted that Trout Unlimited does not agree with DNR's strategy of managing only for adult lifestages.

The group then turned their attention to the memo prepared by Shane Boring and Brandon Kulik (Attachment A), which summarized potential source HSC for substrate from a number of regional studies. After reviewing the source HSC plots for applicability to the lower Saluda, TWC members agreed on substrate HSC for the following species and lifestages:

| Species | Life Stage | Curve Source | Modifications |
|---|---|---|---|
| brown trout | adult | Deerfield | Change 'Ledge' to 'Irregular Bedrock' and change SI of this category to 1.0 |
| | juvenile | Deerfield | Change 'Ledge' to 'Irregular Bedrock' and change SI of this category to 1.0 |
| | Fry | Deerfield | Change 'Ledge' to 'Irregular Bedrock' |
| | Spawning | Deerfield | |
| rainbow trout | Adult | Deerfield | Change 'Ledge' to 'Irregular Bedrock' and change SI of this category to 1.0; Lower SI for 'Roots, Snags, Undercut banks, Overhead Cover' to 0.2 |
| smallmouth bass | Adult | Deerfield | Change 'Ledge' to 'Irregular Bedrock' |
| | Juvenile | Deerfield | Change 'Ledge' to 'Irregular Bedrock' |
| | YOY | Deerfield | Change 'Ledge' to 'Irregular Bedrock' |
| | spawning | Deerfield | Change 'Ledge' to 'Irregular Bedrock' |

The group was not able to reach consensus on an acceptable substrate HSC for rainbow trout juveniles, fry or spawning due to limited source information (i.e., only the Raleigh et al. "Blue Book" value were presented). Mike Waddell, expressed interest in evaluating the curves used in the Catawba-Wateree IFIM Study before making a final selection for these lifestages. Dick Christie noted that these curves were presented in the Catawba-Wateree Final IFIM Report, but added that the legends needed to interpret the plots were not included. Dick agreed to contact the authors regarding the legends. Shane agreed to distribute the curves to the TWC once all of the information is gathered.

The meeting adjourned at approximately 11:00 AM.

Attachment A

Memo Summarizing Potential Source Habitat Suitability Curves for Substrate for Smallmouth Bass and Rainbow and Brown Trout Lifestages

**MEMORANDUM**

TO: Saluda Hydro: Instream Flow/Aquatic Habitat TWC

FROM: Shane Boring, Brandon Kulik

DATE: March 30, 2007

RE: **INSTREAM FLOW STUDY: HABITAT SUITABILITY CRITERIA**

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On January 22nd, 2007, the Instream Flow/Aquatic Habitat Technical Working Committee (TWC) agreed upon Habitat Suitability Criteria (HSC ) depth and velocity criteria for target species and lifestages (smallmouth bass, brown trout, and rainbow trout adults, juveniles, young-of-year, and spawning). Criteria from various source studies were evaluated based on transferability to the lower Saluda River (Table 1);

Although depth and velocity HSC were adapted for adult, juvenile, fry/young-of-year, and spawning smallmouth bass, as well as brown and rainbow trout (Table 2), the TWC did not time to completely evaluate substrate suitability. The purpose of this memo is to build upon the decisions made at the January 22nd 2007 TWC meeting by summarizing HSC for substrate and embeddedness for rainbow and brown trout, and smallmouth bass.

**Table 1: Summary of Source Studies Evaluated for Depth and Velocity Habitat Suitability Criteria**

| SPECIES | SOURCE | RIVER | ECO-REGION | PHYSIOGRAPHIC REGION |
|---|---|---|---|---|
| Smallmouth bass | Leonard *et al*. (1986) | Upper James (VA) | Mid-Atlantic | Appalachian Ridge and Valley |
| Smallmouth bass | NEP (1990) | Deerfield (MA) | New England | New England Upland |
| Smallmouth bass | Lockhart IFIM study | Broad (SC) | Southeastern | Piedmont |
| Smallmouth bass | Groshens and Orth (1994) | N. Anna and Craig Creek | Southeastern Plains | Appalachian Ridge and Valley and Piedmont |
| Smallmouth bass | Edwards, *et al* (1983) | Generic | | |
| Rainbow trout | KA (2001) | Lackawaxen, (PA) | Mid-Atlantic | Appalachian Plateau |
| Rainbow trout | NEP (1990) | Deerfield (MA) | New England | New England Upland |
| Rainbow trout | Raleigh, *et al* (1986) | Generic "Blue Book" data | | |
| Brown trout | KA (2001) | Lackawaxen, (PA) | Mid-Atlantic | Appalachian Plateau |

| | | | | |
|---|---|---|---|---|
| Brown trout | NEP (1990) | Deerfield (MA) | New England | New England Upland |
| Brown trout | Strakosh, *et al.* 2003 | Farmington (CT) | New England | New England Upland |
| Brown trout | CT DEP | Housatonic (CT) | New England | New England Upland |
| Brown trout | Raleigh, *et al* (1984) | Generic "Blue Book" data | | |

Table 2. Summary of Acceptable HSC Curves as Identified By The TWC

| Species | Life Stage | Parameter | SI Curve Source |
|---|---|---|---|
| brown trout | adult | Depth | Combination: Housatonic (poor cover), Deerfield |
| | adult | Velocity | Lackawaxen, w/modifications |
| brown trout | fry/YOY | Depth | Deerfield |
| | fry/YOY | Velocity | Deerfield |
| brown trout | juvenile | Depth | Combination: Deerfield, Raleigh |
| | juvenile | Velocity | Combination: Lackawaxen, Deerfield |
| brown trout | spawning | Depth | Raleigh |
| | spawning | Velocity | Raleigh w/modifications |
| rainbow trout | adult | Depth | Deerfield |
| | | Velocity | Deerfield (abundant) |
| rainbow trout | fry/YOY | Depth | Raleigh |
| | | Velocity | Raleigh |
| rainbow trout | juvenile | Depth | Lackawaxen |
| | | Velocity | Lackawaxen |
| rainbow trout | spawning | Depth | Raleigh |
| | | Velocity | Raleigh |
| smallmouth bass | adult | Depth | Combination: Groshens & Orth, Bain |
| | | Velocity | Combination: Groshens & Orth, Deerfield (abundant velocity refuge) |
| smallmouth bass | juvenile | Depth | Combination: Bain, Deerfield w/modifications |
| | | Velocity | Deerfield (abundant velocity refuge) |
| smallmouth bass | spawning | Depth | Lockhart |
| | | Velocity | Lockhart |
| smallmouth bass | YOY | Depth | Combination: Groshens & Orth, Bain |
| | | Velocity | Combination: Deerfield, Bain |

## SUBSTRATE CRITERIA OPTIONS

### Brown Trout

We obtained HSC successfully applied in IFIM studies from the Farmington (CT) (Strakosh, et al. 2003), Deerfield (MA) (NEP, 1990), and Housatonic (CT) (CT DEP) rivers, as well as the generalized "Bluebook" criteria (Raleigh, *et al*., 1986) that have been employed in several regional PHABSIM studies. Appendix A contains graphical representations of substrate criteria for juvenile and adult lifestages. For brown trout juveniles and adults, substrates ranging from gravel/pebble to cobble/small boulder were generally found to be the most suitable, along with undercut banks and vegetation for some studies. The degree of substrate embeddedness is also a sub-criterion.

### Rainbow Trout

HSC criteria developed for the Deerfield River (MA) and generalized "Bluebook" criteria (Raleigh, *et al*., 1984) are presented in Appendix B. Although the studies varied in how some substrate sizes were classified, habitat suitability was generally similar between studies, with gravel, cobble and boulder substrates being more suitable than silt, sand and mud. This was particularly true of the early lifestages, i.e. spawning, fry, juvenile. The degree of substrate embeddedness is also a sub-criterion.

### Smallmouth Bass

Substrate HSC criteria developed for the Deerfield River (MA), James (VA) (Leonard, et al., 1986) and generalized "Bluebook" criteria (Edwards, *et al*., 1993) are presented in Appendix C. There is relatively good general agreement among all curves relative to substrate and cover suitability, with large cobble/boulder tending to be optimal, and silt/sand/organics being less suitable.

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Raleigh, R.F., L.D. Zuckerman, and P.C. Nelson. 1986. Habitat suitability index models and instream flow suitability curves: Brown trout, revised. U.S. Fish and Wildl. Serv. FWS/OBS-82(10.124). 65 pp..

Raleigh, R.F., T Hickman, R.C. Solomon and P.C. Nelson. 1984. Habitat suitability information: Rainbow trout. U.S. Fish and Wildl. Serv. FWS/OBS-82/10.60 64 pp.

Strakosh, T.R., R.M. Neumann, and R.A. Jacobsen. 2003. Development and assessment of habitat suitability criteria for adult brown trout in southern New England rivers. Ecology of Freshwater Fish 12:265-274. Blackwell Munksgaards, 2003.

Appendix A
Brown Trout Substrate Habitat Suitability Criteria

**Appendix A, Table 1: Substrate Classification Codes - Raleigh**

| Substrate Codes from Bovee (1982) | | | |
|---|---|---|---|
| **Code** | **Description** | **Size (mm)** | **Size (in)** |
| 1 | plant/detritus/organic material | | |
| 2 | mud/soft clay | | |
| 3 | silt | <0.062 | |
| 4 | sand | 0.062 – 2.0 | |
| 5 | gravel | 2.0 - 64 | |
| 6 | cobble | 64 - 250 | |
| 7 | boulder | 250 – 4000 | |
| 8 | bedrock | solid | |

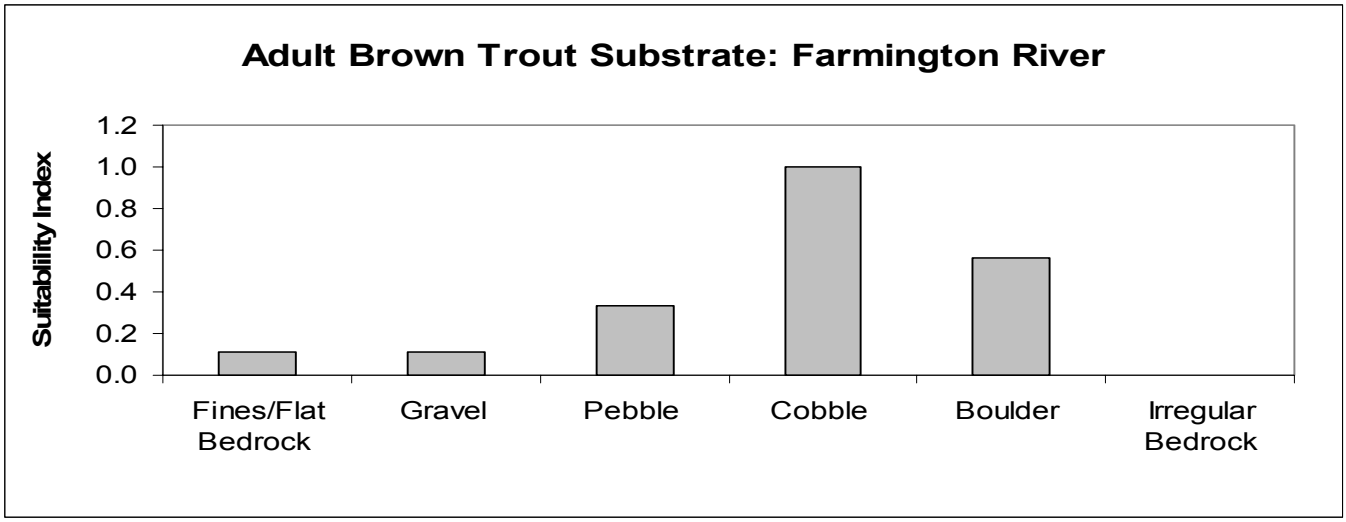
**Appendix A, Table 2: Substrate Classification Codes - Deerfield & Housatonic**

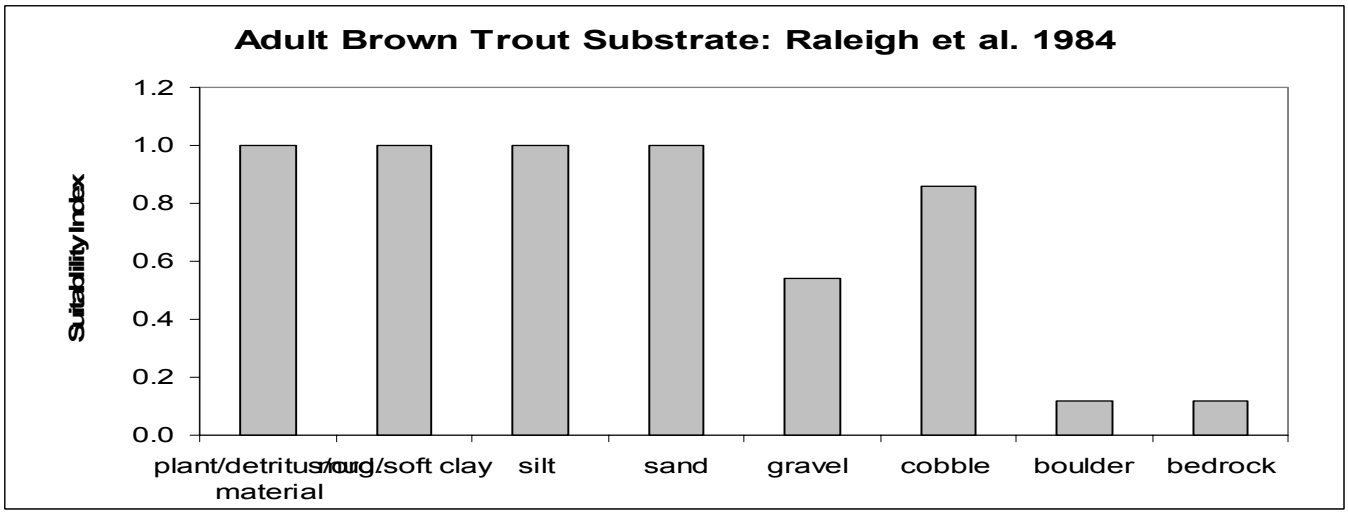
| Code | Description | Size (mm) | Size (in) |
|---|---|---|---|
| 1 | Roots, Snags, Undercut Banks, Overhead Cover | | |
| 2 | Clay | | |
| 3 | Silt | | |
| 4 | Sand | | |
| 5 | Small Gravel | < 5.1 | < 2 |
| 6 | Gravel | 5.1 - 10.2 | 2-4 |
| 7 | Cobel | 10.2 - 25.4 | 4 - 10 |
| 8 | Boulder | 25.4 - 61 | 10 in - 2 ft |
| 9 | Boulder | >61 | > 2 ft |
| 10 | Ledge | | |
| 11 | Detritus, Vegetation | | |

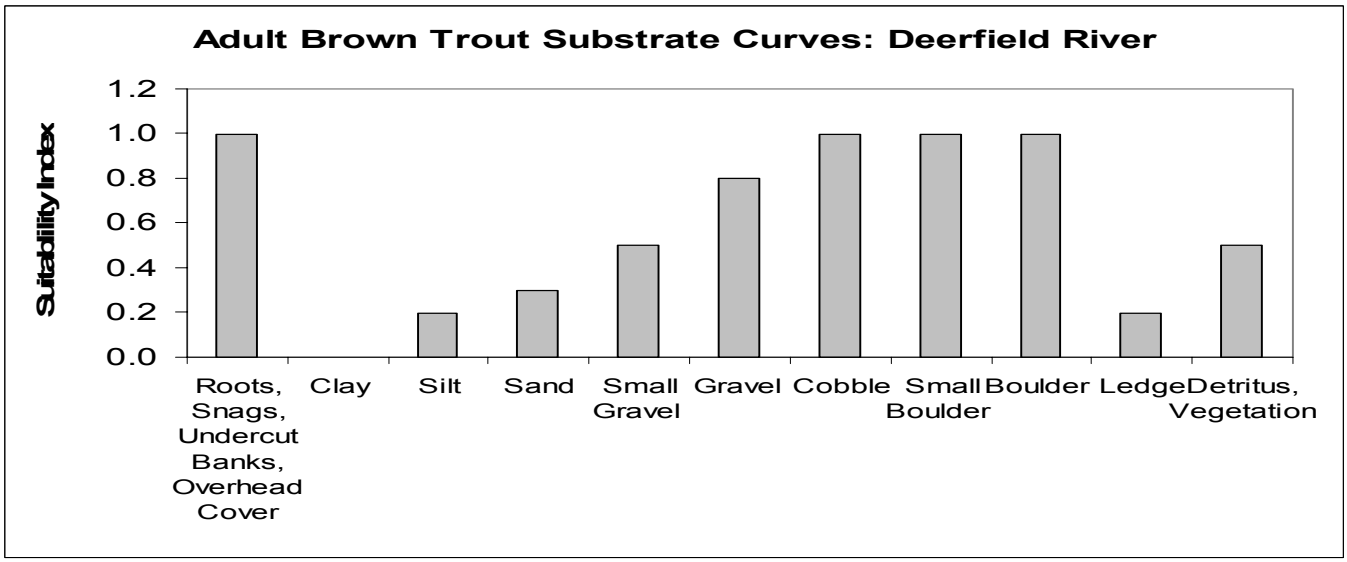
**Appendix A, Table 3: Substrate Classification Codes - Farmington**

| Code | Description | Size (mm) | Size (in) |
|---|---|---|---|
| 1 | Fines/Flat Bedrock | < 2 | < .08 |
| 2 | Gravel | 2 - 16 | 0.08 - 0.63 |
| 3 | Pebble | 16 - 64 | 0.63 - 2.52 |
| 4 | Cobble | 64 - 256 | 2.52 - 10.08 |
| 5 | Boulder | > 256 | > 10.08 |
| 6 | Irregular Bedrock | | |

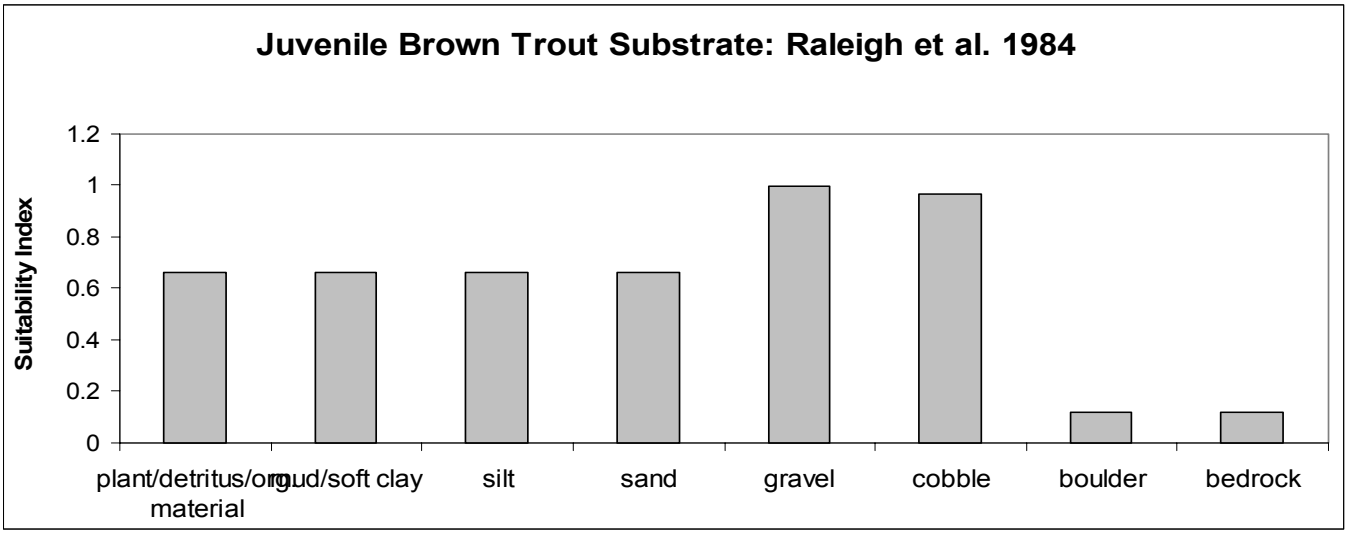
Adult Brown Trout

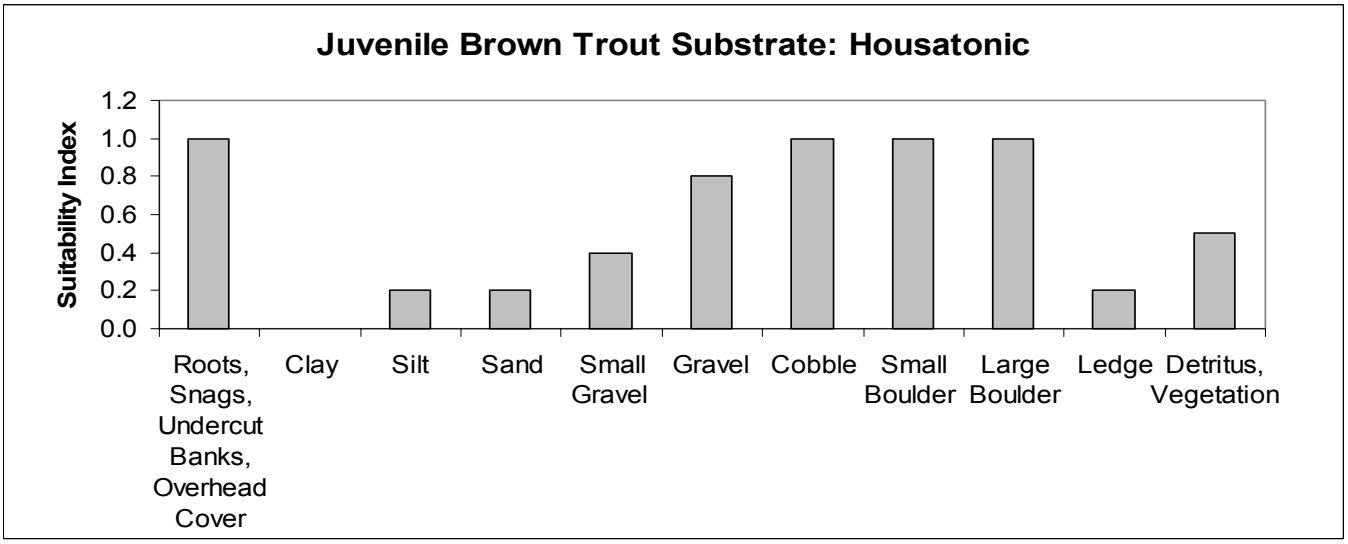


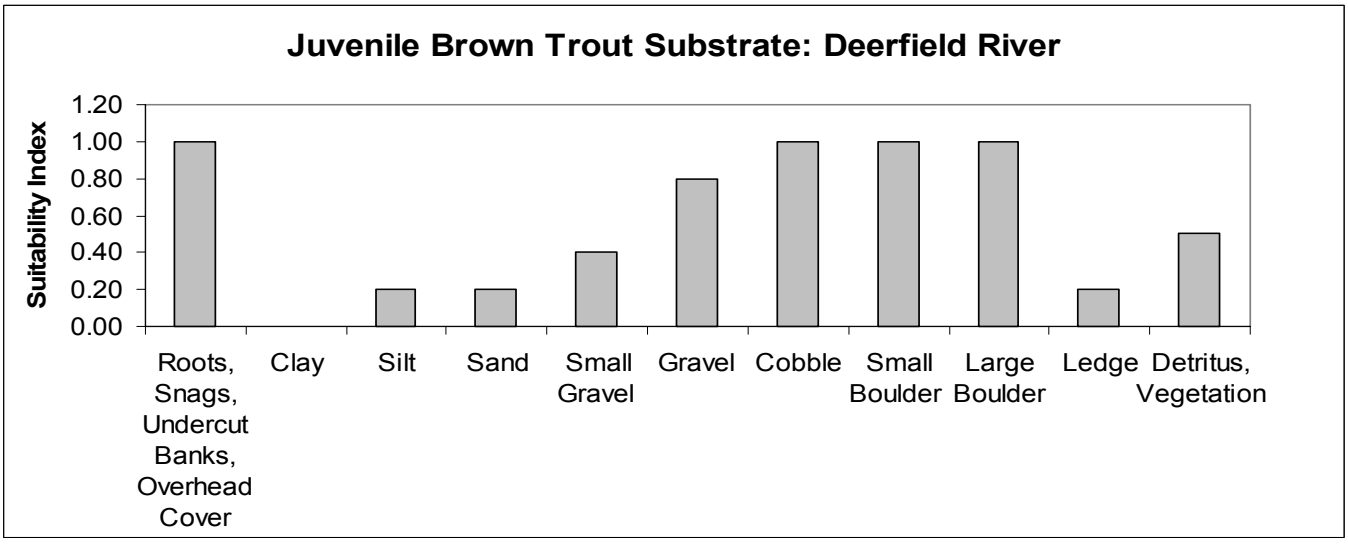



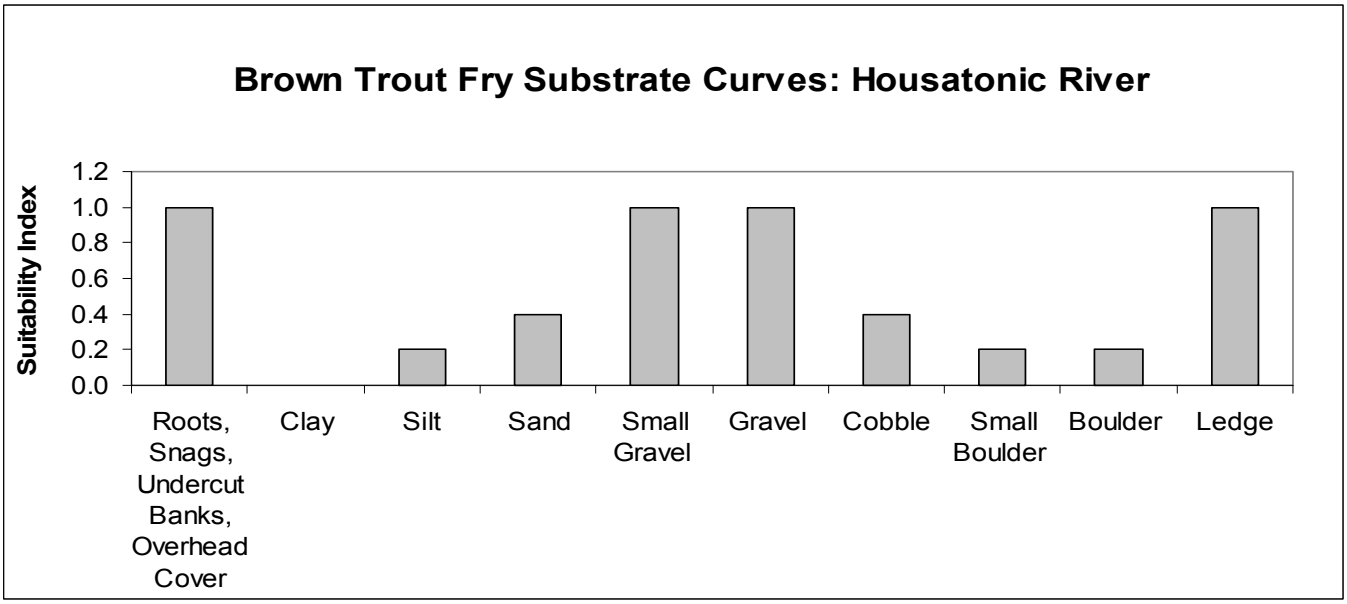
Juvenile Brown Trout

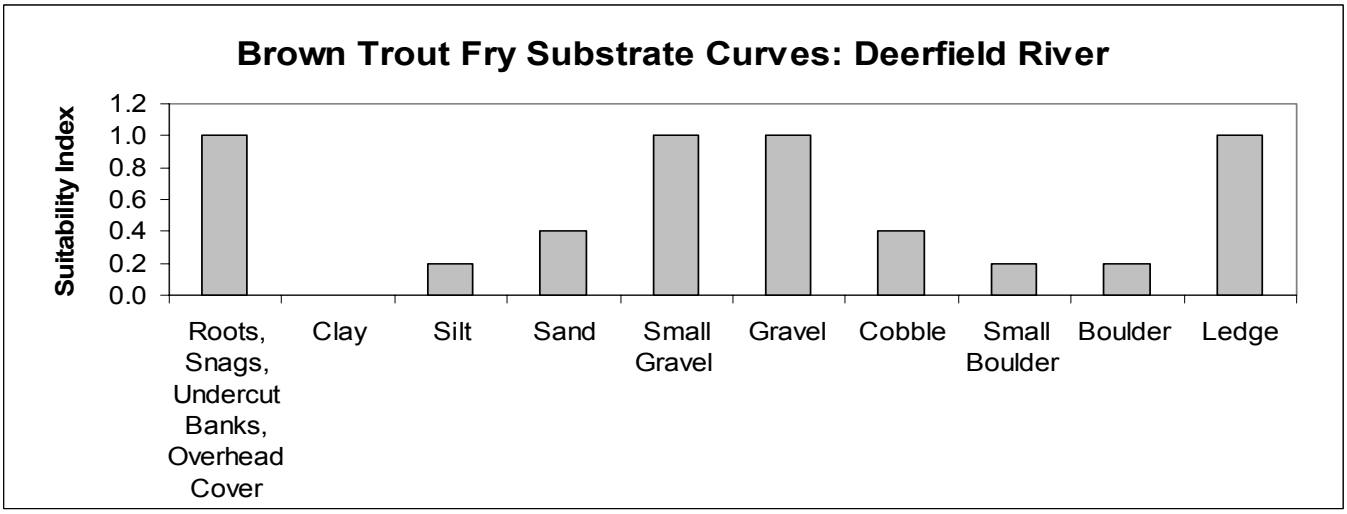


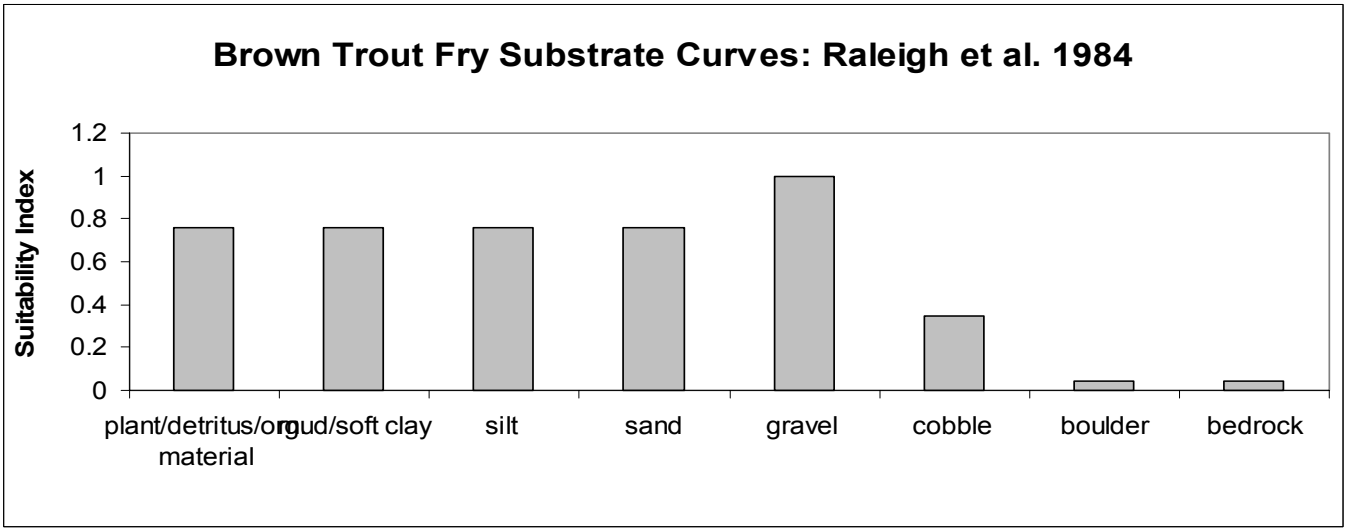



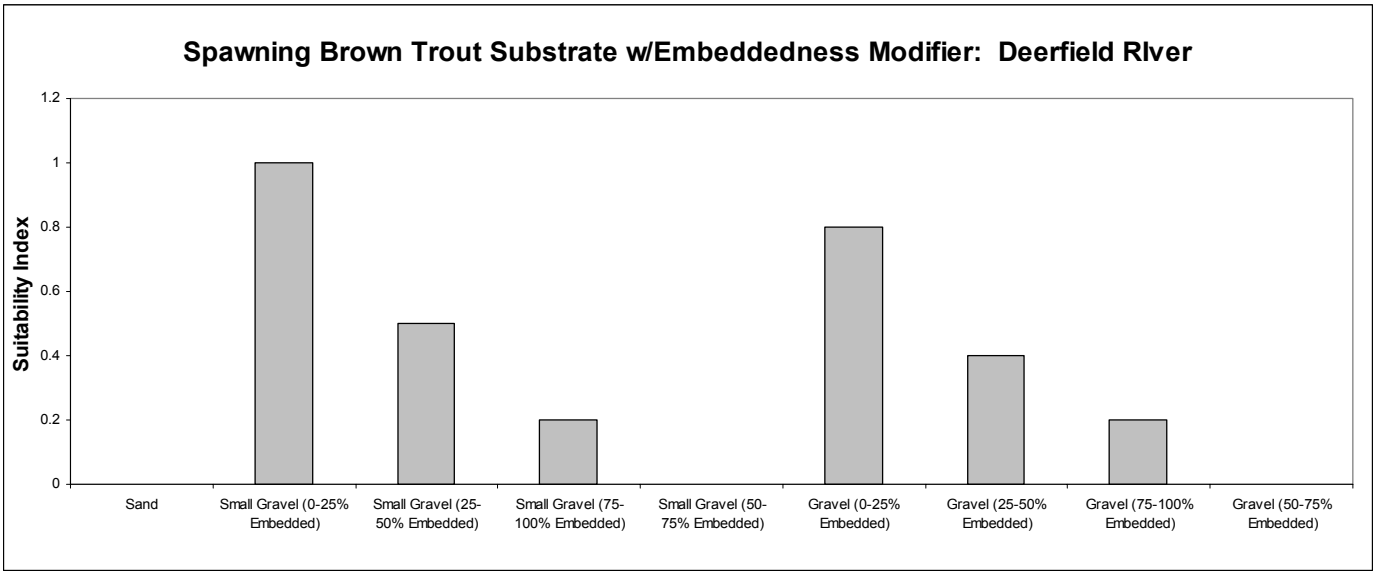
Brown Trout Fry

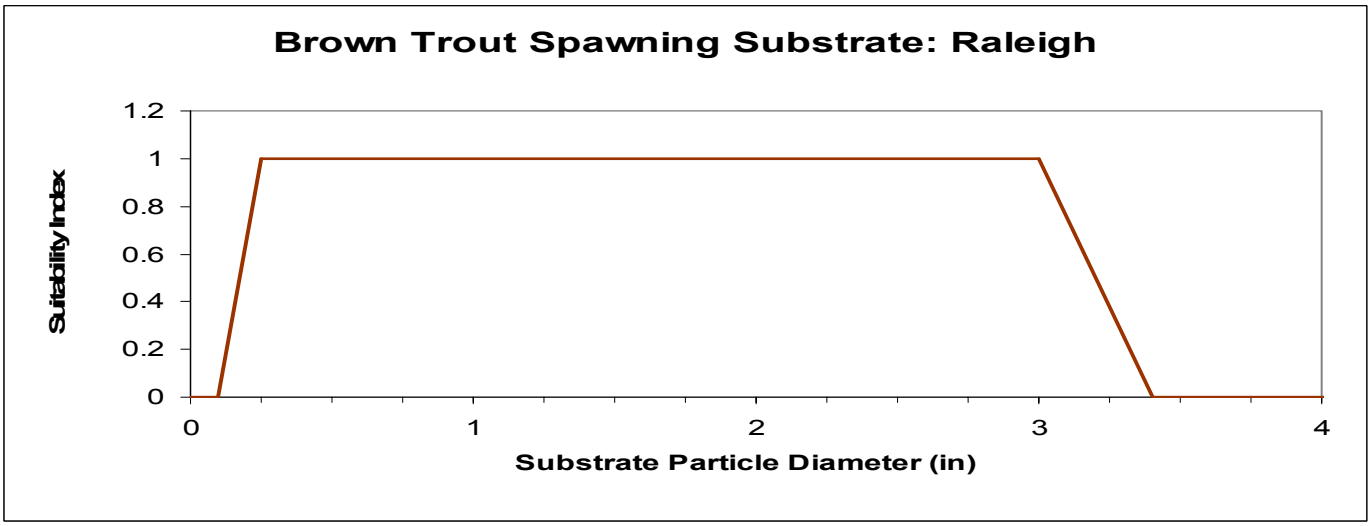


Spawning Brown Trout

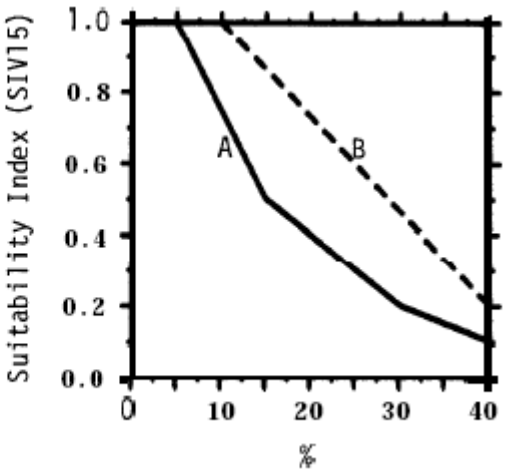



## Brown Trout Spawning: Substrate Embeddedness (Raleigh)

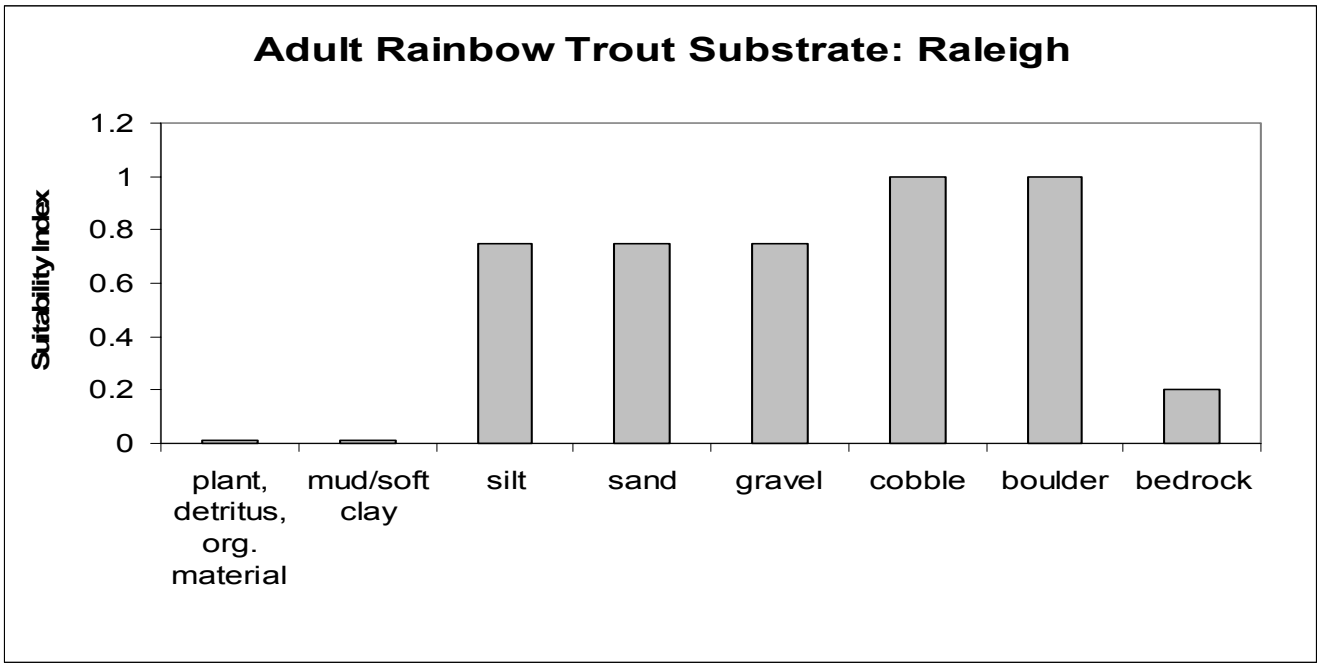
Percent fines (<3 mm) in riffle-run and spawning areas during average summer flows.

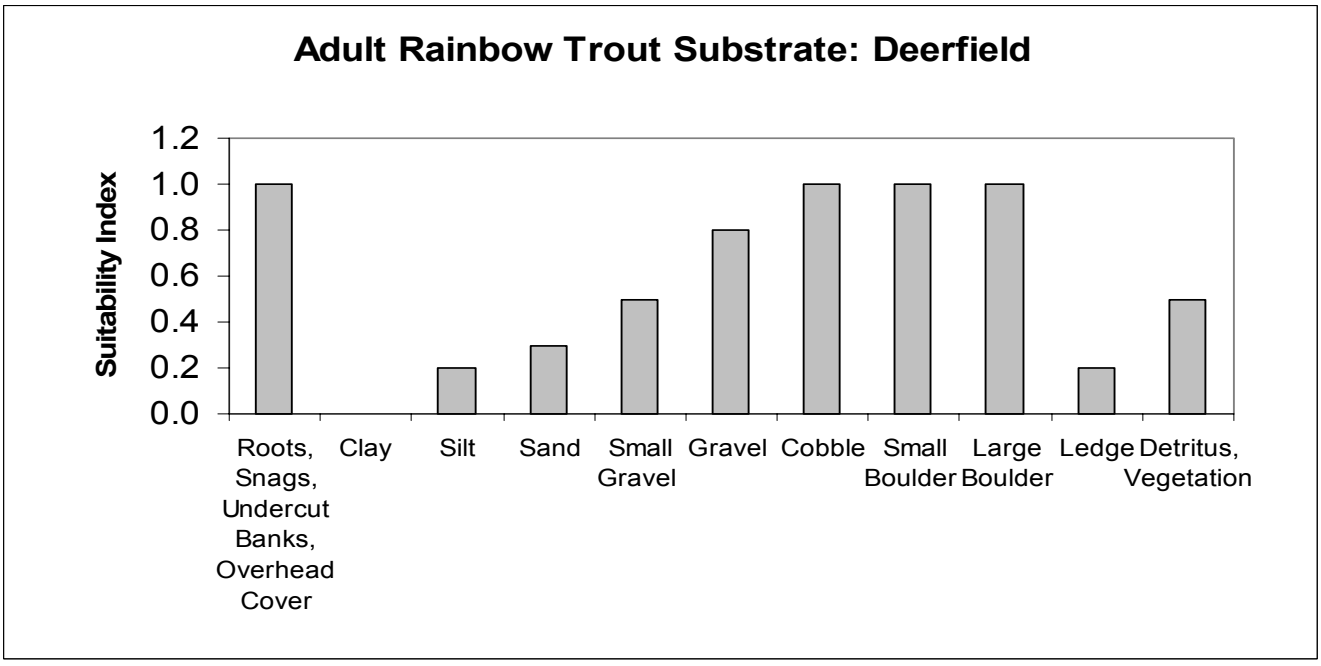
A = spawning
B = riffle-run



Appendix B
Rainbow Trout Substrate Habitat Suitability Criteria

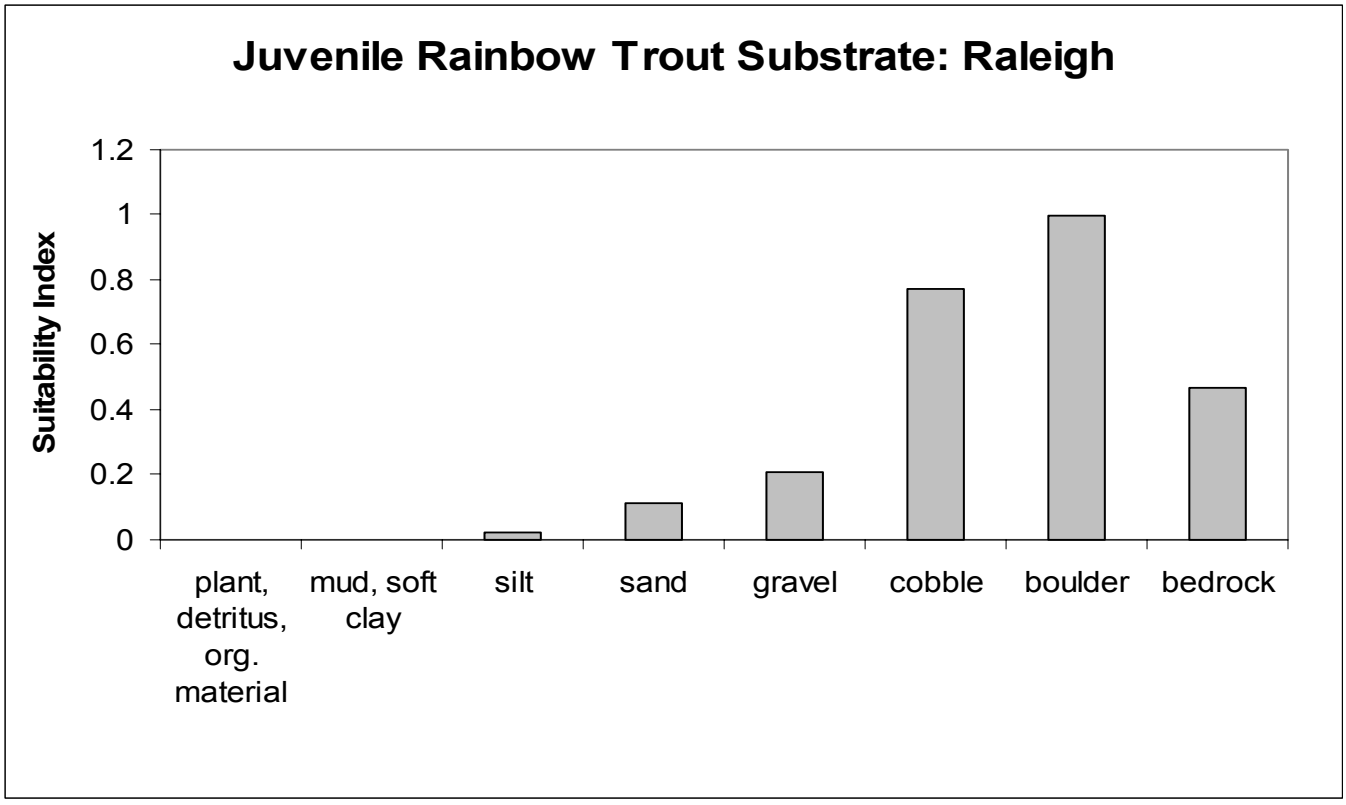
Adult Rainbow Trout[1]



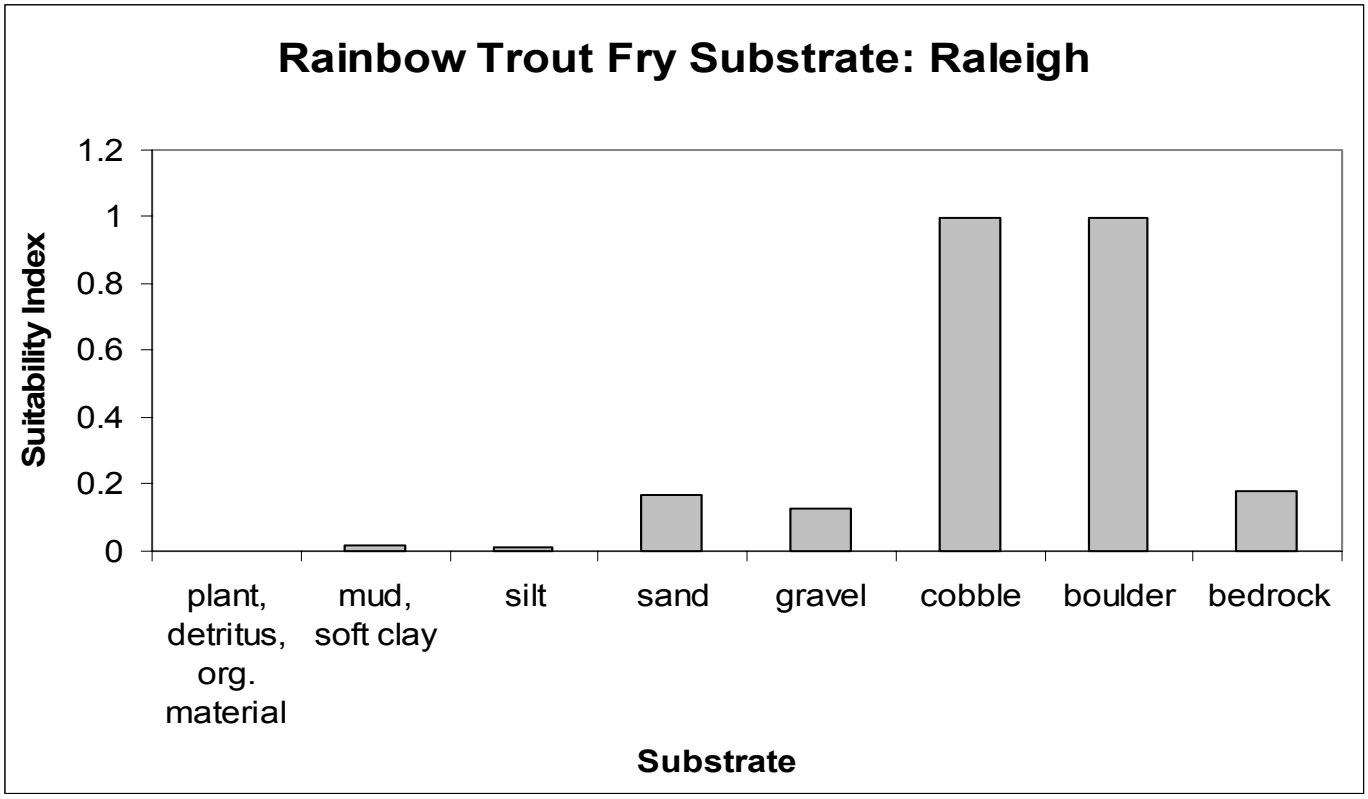




[1] See Appendix A for substrate codes and descriptions.

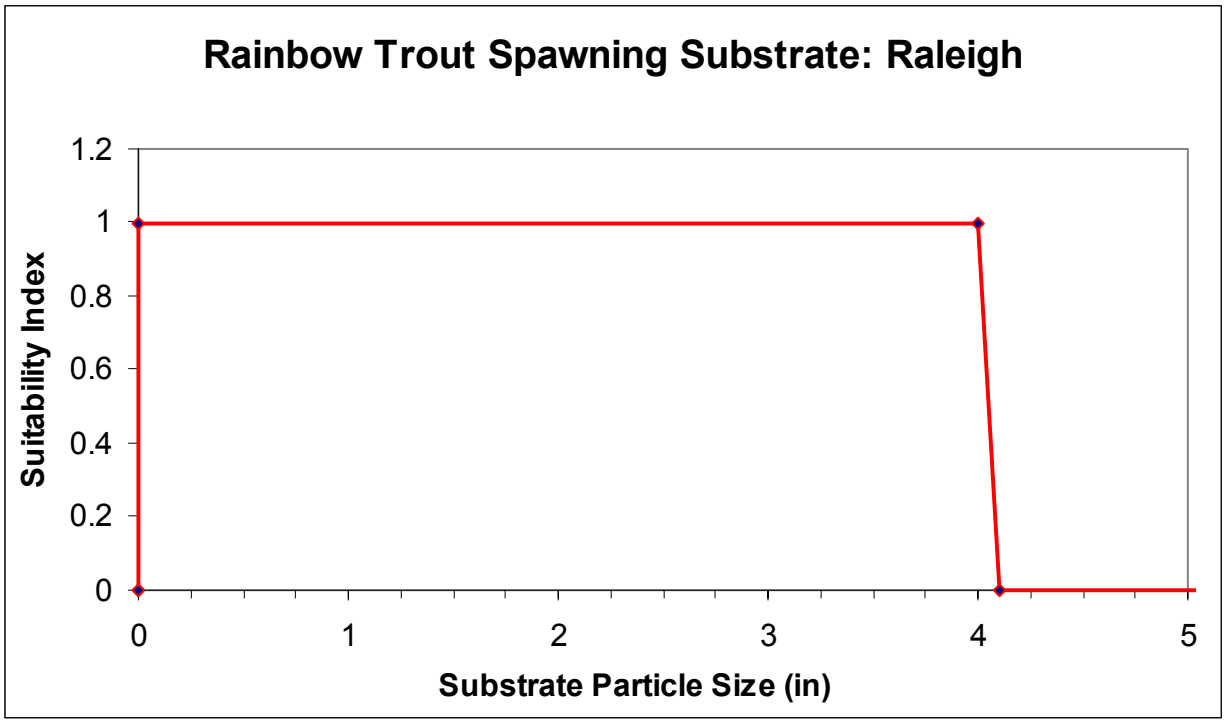
Juvenile Rainbow Trout

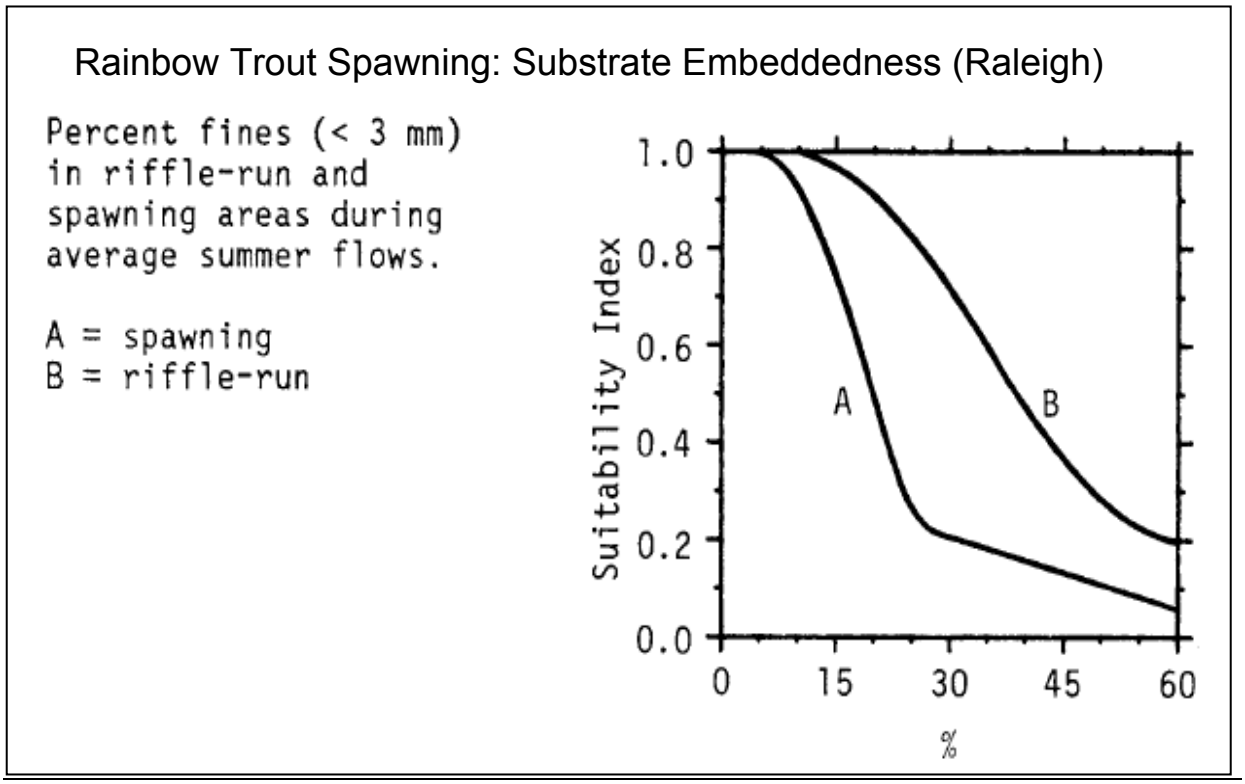


Rainbow Trout Fry



Rainbow Trout Spawning



Appendix C
Smallmouth Bass Substrate Habitat Suitability Criteria

**Appendix C, Table 1: Substrate Classification Codes - Bain**

| Code | Description | Size (mm) | Size (in) |
|---|---|---|---|
| | Silt | | |
| | Sand | | |
| | Gravel | 4-75 | < 3 in. diam, |
| | Rubble | 75-300 | 3-12 in. diam. |
| | Boulder | 300-600 | 1-3 ft. diam. |
| | Bedrock | | |

**Appendix C, Table 2: Substrate Classification Codes - Deerfield**

| Code | Description | Size (mm) | Size (in) |
|---|---|---|---|
| 1 | Roots, Snags, Undercut Banks, Overhead Cover | | |
| 2 | Clay | | |
| 3 | Silt | | |
| 4 | Sand | | |
| 5 | Small Gravel | < 5.1 | < 2 |
| 6 | Gravel | 5.1 - 10.2 | 2-4 |
| 7 | Cobel | 10.2 - 25.4 | 4 - 10 |
| 8 | Boulder | 25.4 - 61 | 10 in - 2 ft |
| 9 | Boulder | >61 | > 2 ft |
| 10 | Ledge | | |
| 11 | Detritus, Vegetation | | |

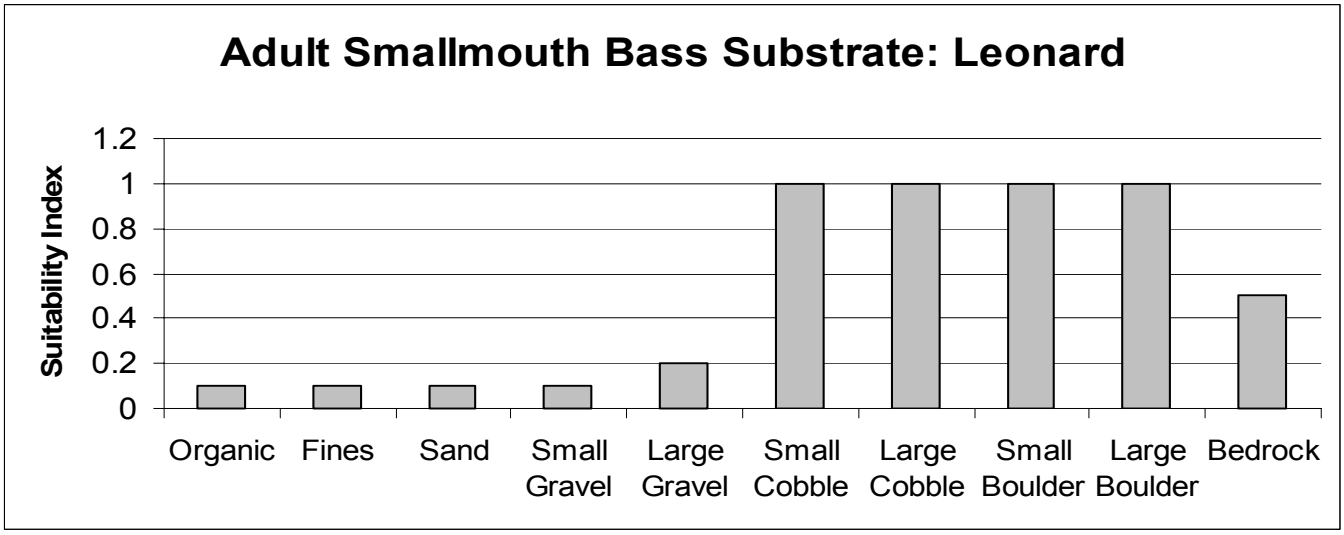
**Appendix C, Table 3: Substrate Classification Codes - Leonard**

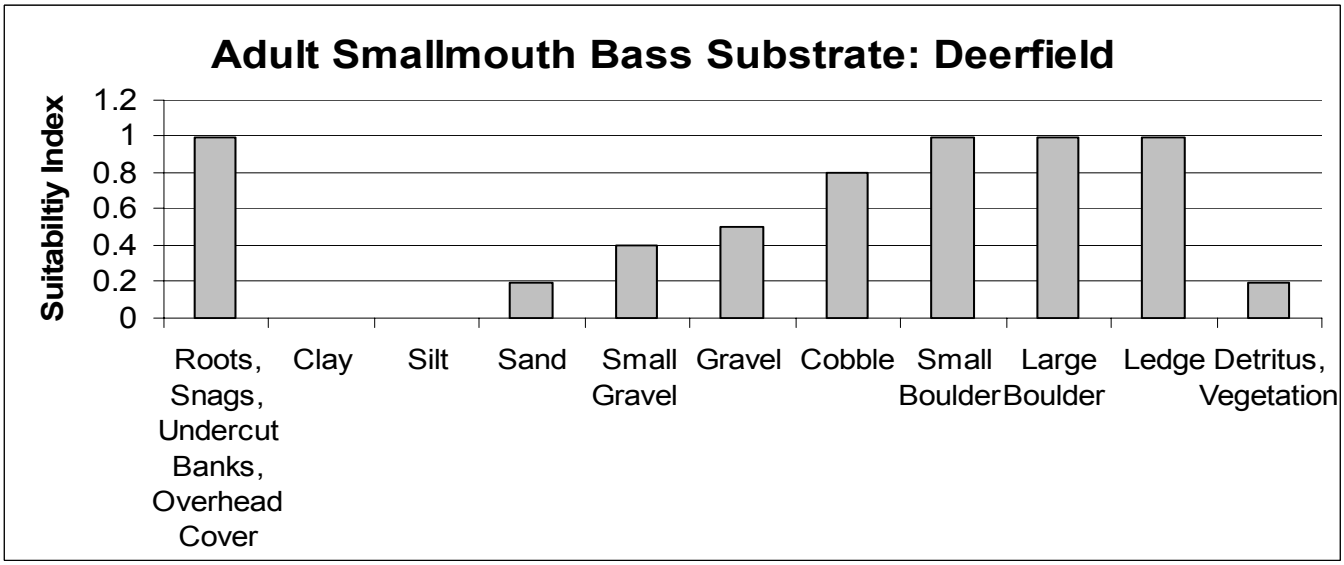
| Code | Description | Size (mm) | Size (in) |
|---|---|---|---|
| 1 | Organic | | |
| 2 | Fines | | |
| 3 | Sand | | |
| 4 | Small Gravel | | <2 inches diam. |
| 5 | Large Gravel | | 2-4 inches diam. |
| 6 | Small Cobble | | 4-7 inches diam. |
| 7 | Large Cobble | | 8-10 inches diam. |
| 8 | Small Boulder | | 10-24inches diam. |
| 9 | Large Boulder | | > 2 ft diameter |
| 10 | Bedrock | | |

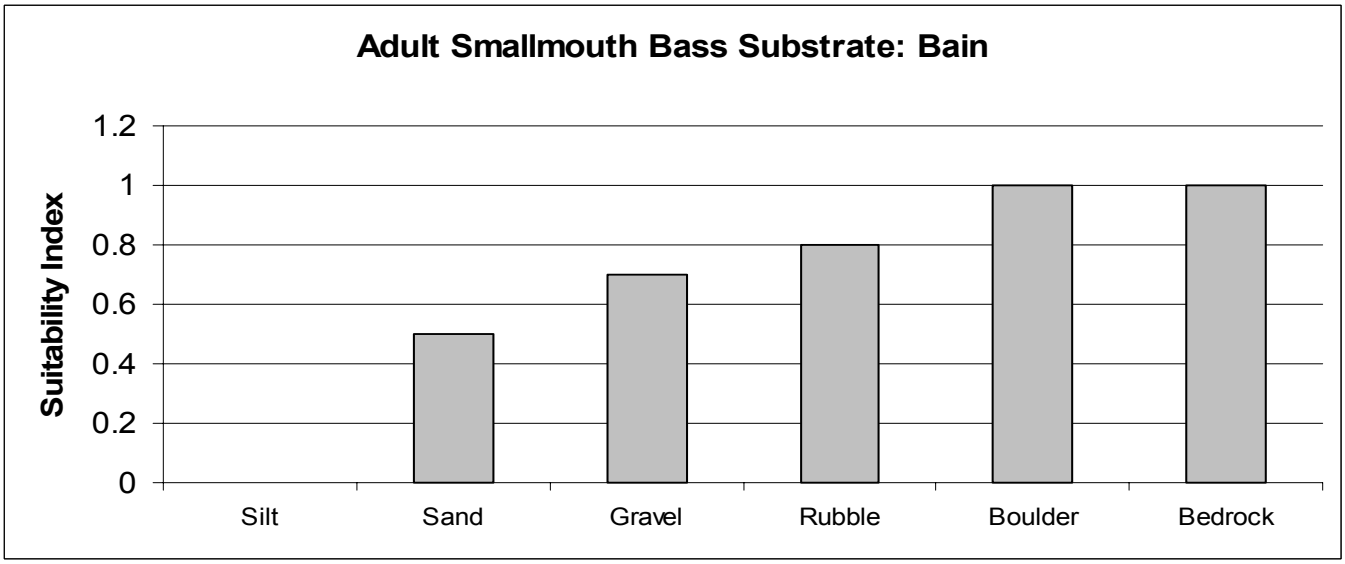
**Appendix C, Table 4: Substrate Classification Codes - Lockhart**

| Code | Description | Size (mm) | Size (in) |
|---|---|---|---|
| 1 | mud | <1 | < 0.4 |
| 2 | sand | 1 - 2 | 0.4 - 0.8 |
| 3 | small gravel | 2 - 16 | 0.8 - 6.3 |
| 4 | large gravel | 16 - 64 | 6.3 - 25.2 |
| 5 | small cobble | 64 - 128 | 25.2 - 50.4 |
| 6 | large cobble | 128 - 256 | 50.4 - 100.8 |
| 7 | small boulder | 256 - 512 | 100.8 - 201.6 |
| 8 | large boudler | > 512 | > 201.6 |
| 9 | bedrock | - | |

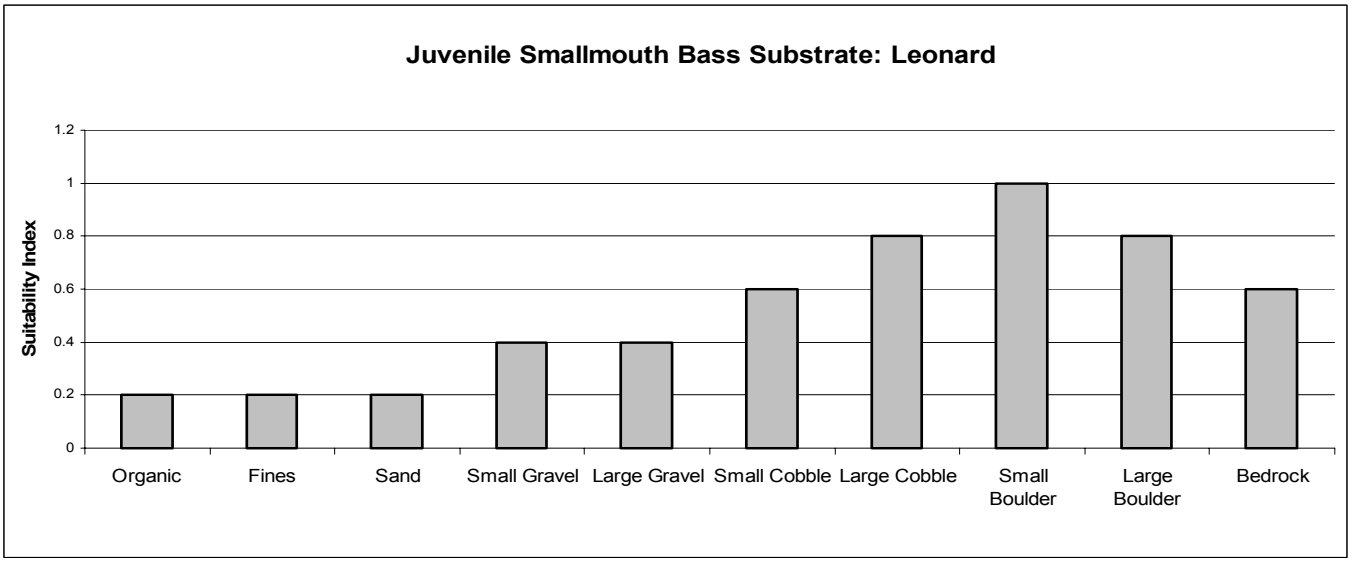
Adult Smallmouth Bass

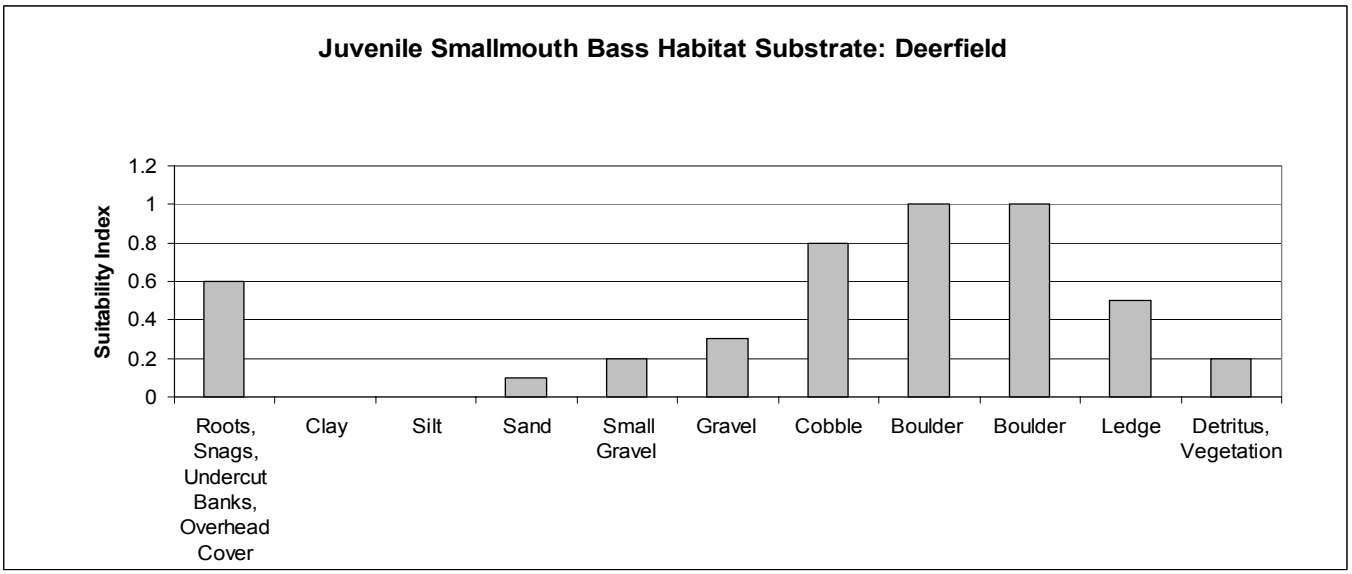


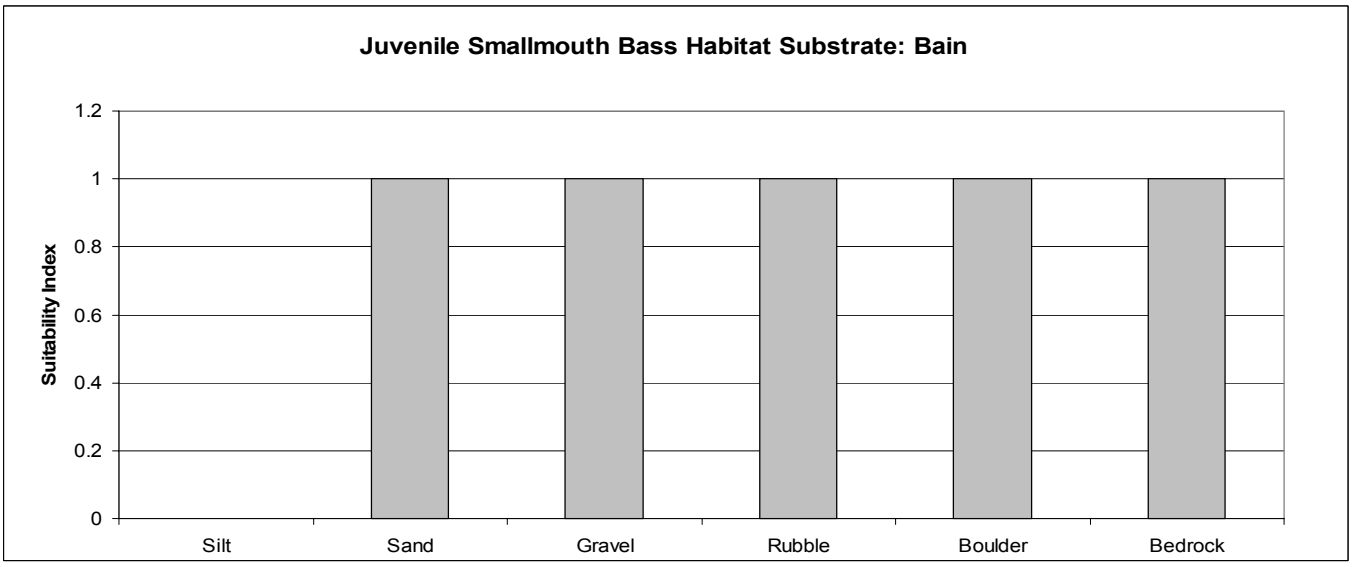



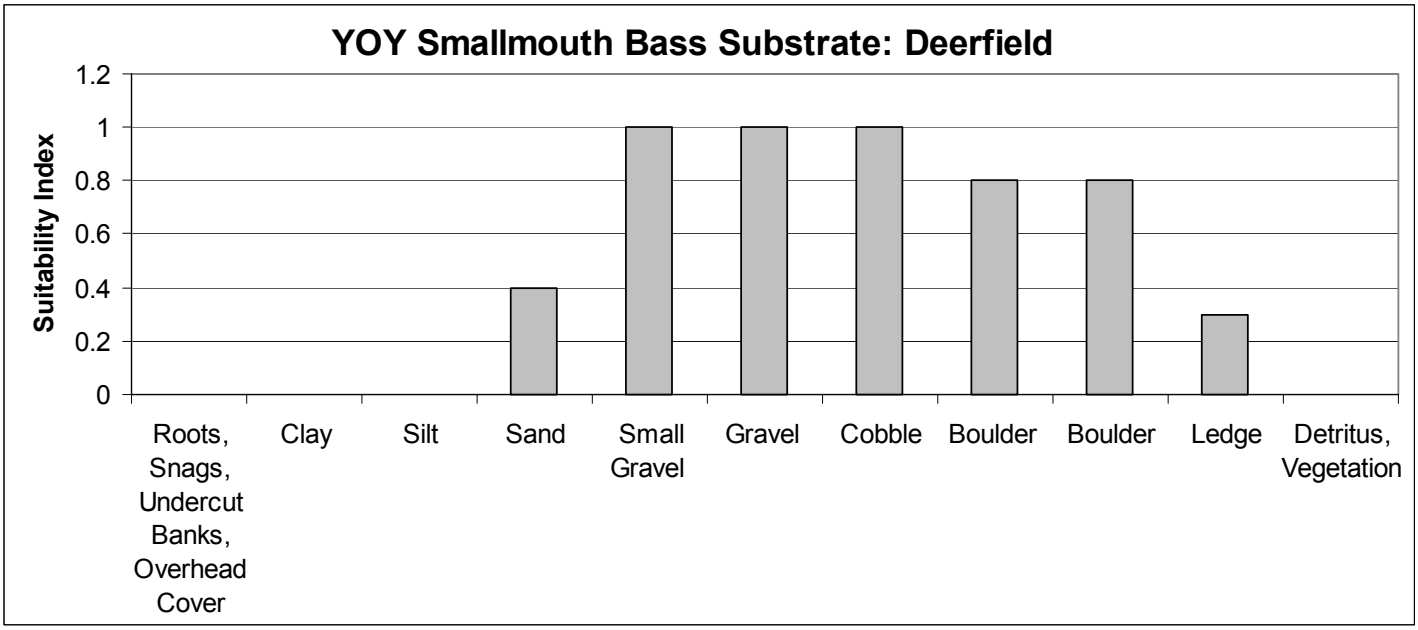
Juvenile Smallmouth Bass

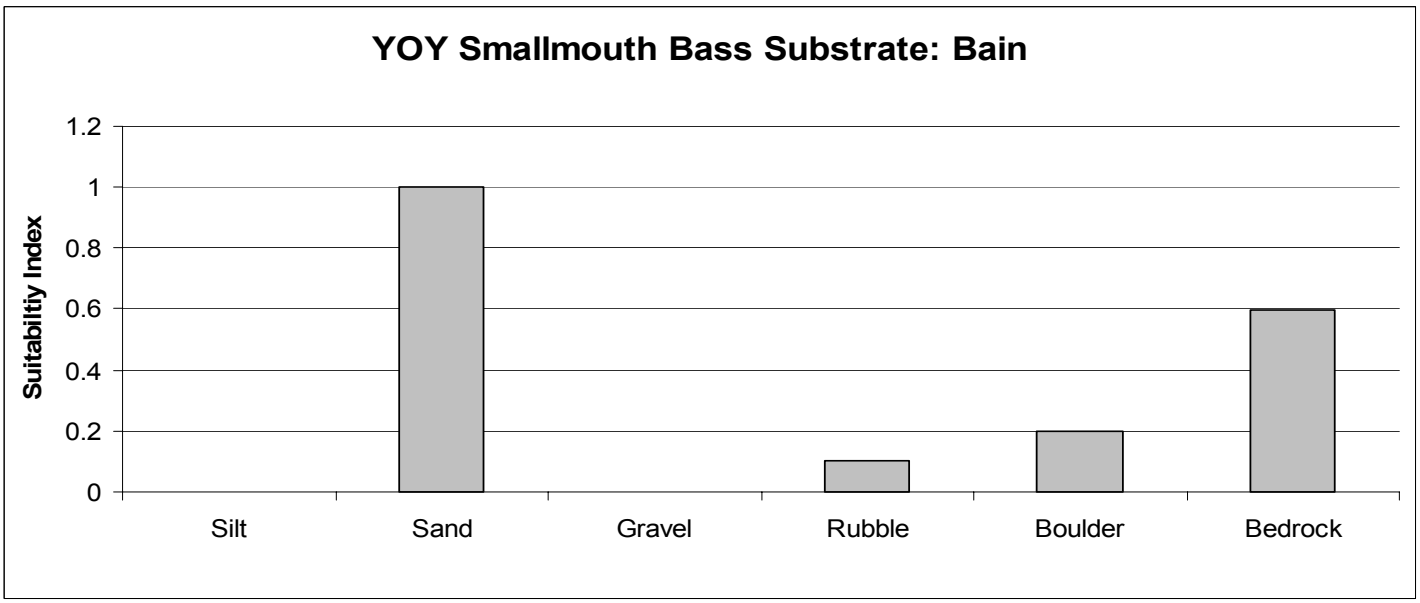


Smallmouth Bass YOY



Smallmouth Bass Spawning