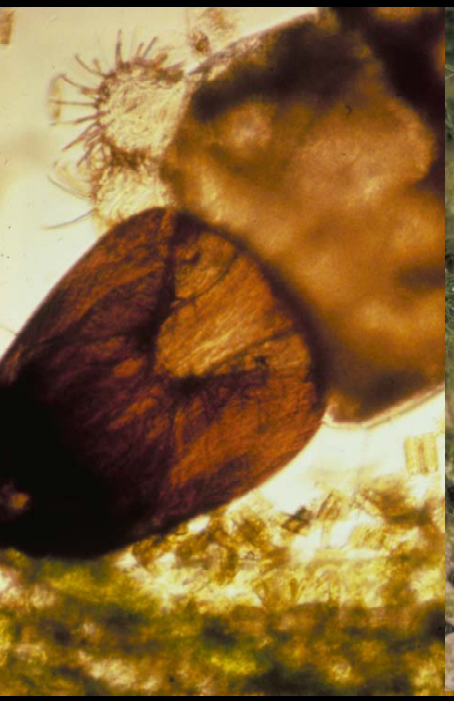
# Diet and incidence of predation for rainbow and brown trout near the Little Colorado River, Grand Canyon: Winter 2003

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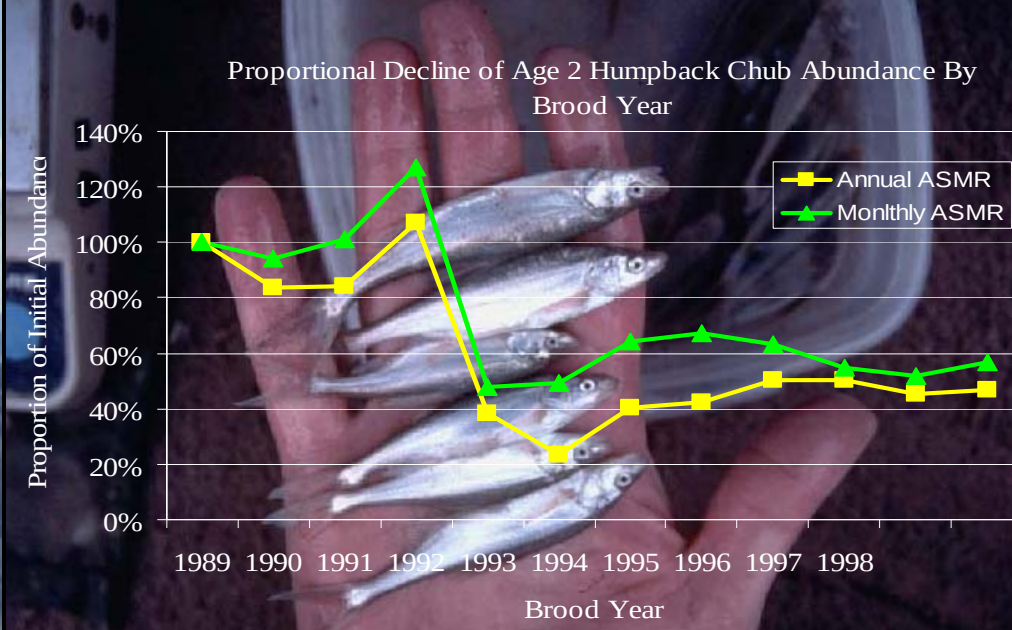
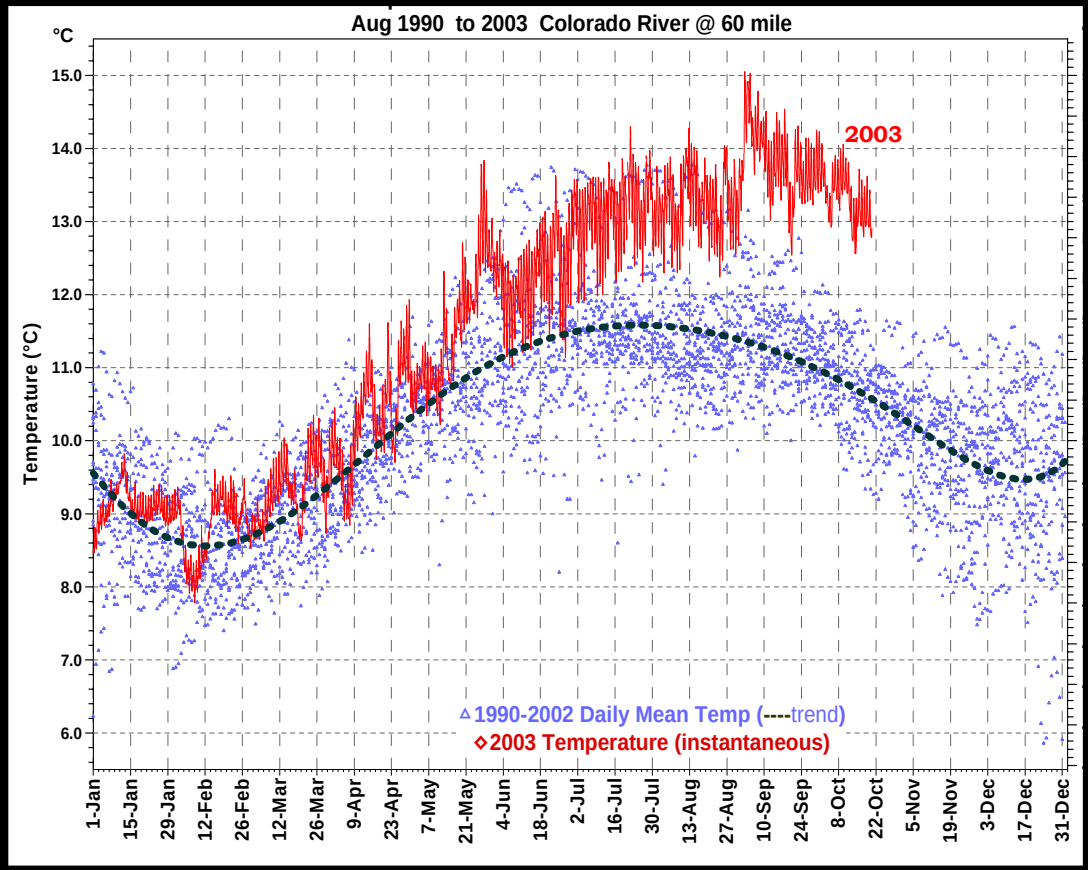
Southwest Biological Science Center,
Grand Canyon Monitoring and Research Center




- **Mechanical Removal**
  - Multi-year treatment
  - Reduce non-native abundance
    - Assess recruitment of HBC in out-years
- **Diet and incidence of predation**
  - Rainbow trout
  - Brown trout

# ENVIRONMENTAL FACTORS




- Trend departure from the typical annual thermal pattern
- Expected increase in seasonal warming for the coming years 2004 & 2005

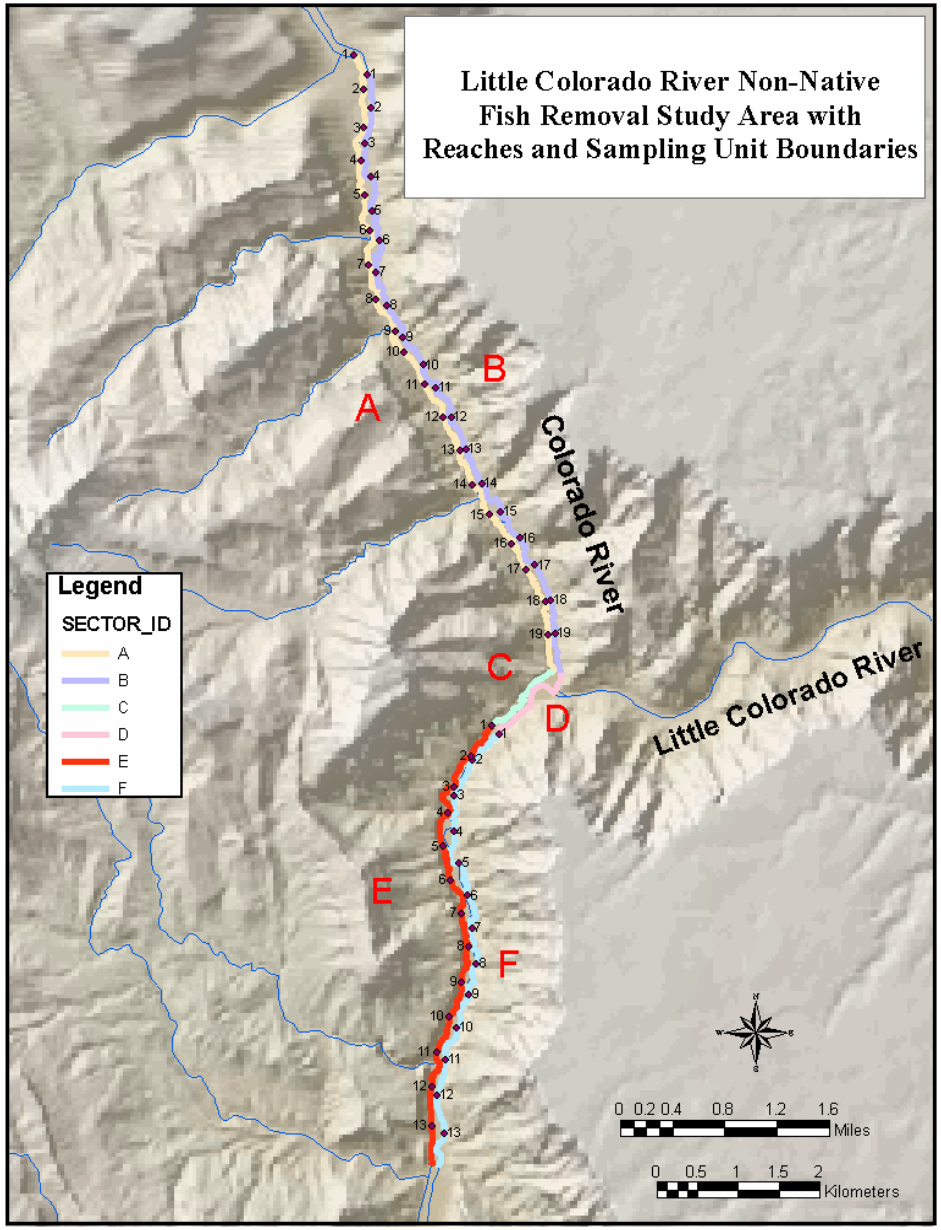
- **Changes in food consumption**
- **Changes in invertebrate composition and abundance**
- **Temperature Control Device**

## Temporal/spatial variability in suspended loads

- Influences:
  - Autotrophic related production
  - Allochthonous inputs
  - Trout behavior
    - visual sight-feeding

- Why are we interested in the interactions between abiotic and biotic factors?
  - Stochastic events
  - Sediment augmentation

# Sampling Design – Mechanical Removal Reach




- January Trip:
  - 5 pass depletion in original reach
    - Above
    - Below
- February Trip
  - 5 pass depletion in original reach
    - Above
    - Below
- March Trip:
  - 5 pass depletion in original reach
    - Above
    - Below

# Field Process

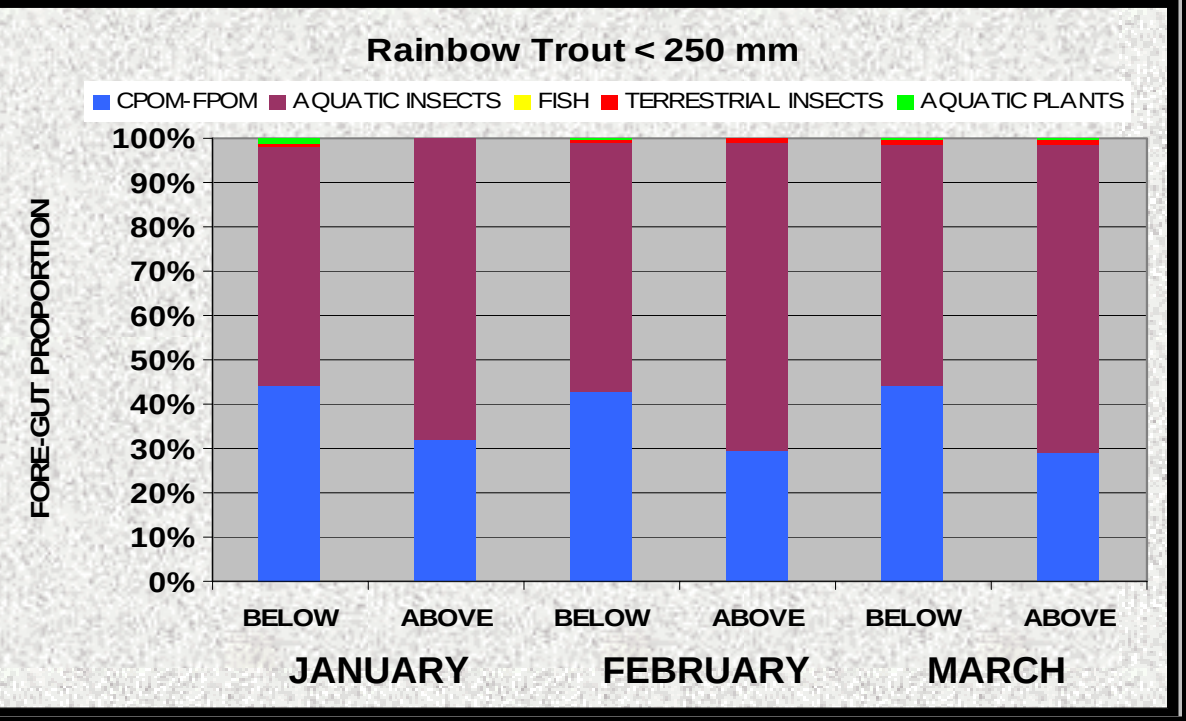
- Euthanized
- Field measurements
- Evisceration
- Sample Preservation

## Microscopic Assessment

- Diet Analysis
  - Rainbow trout (n = 360)
  - All Brown trout (n = 130)
- Incidence of predation
  - Rainbow trout (n = 6360)
  - Brown trout (n = 130)

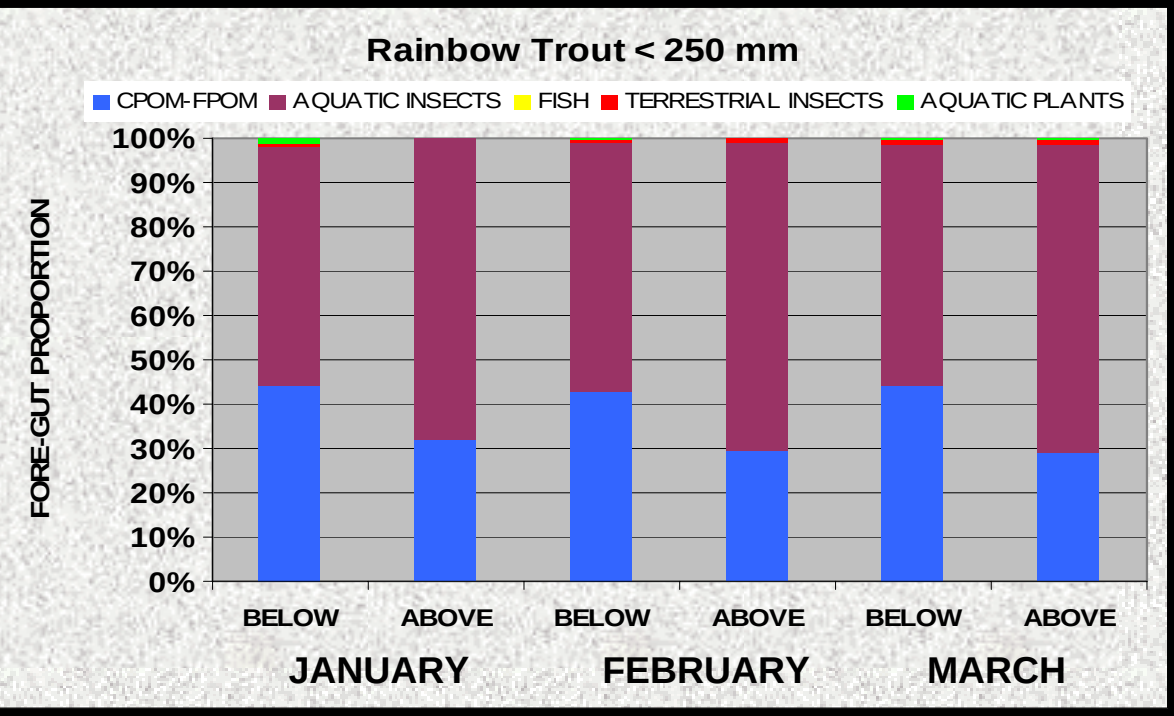

## Detailed diet analysis

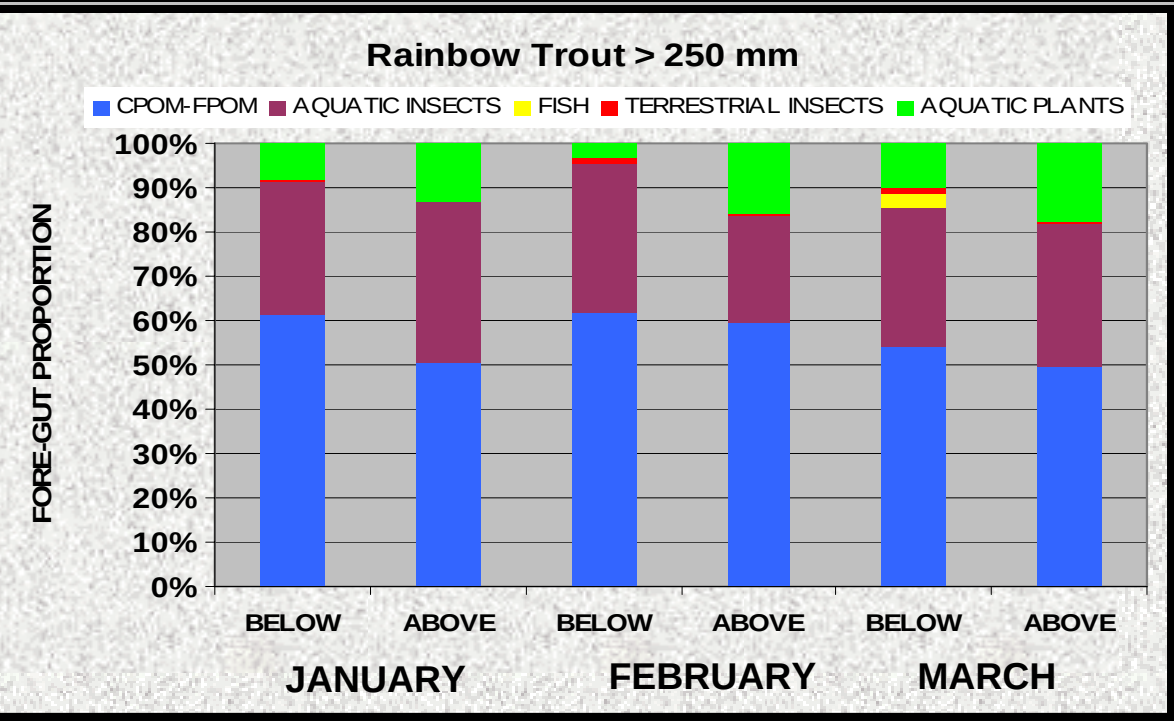
- **Randomly select stomach samples**
  - **Two size classes: <250 & >250mm**
  - **Above and below the LCR**
  - **Winter sampling trip**
    - **(January, February, & March)**




# GROSS CHARACTERIZATION

- **RBT (< 250 mm)**
  - 30% to 45% of detrital CPOM/FPOM
  - 55% to 70% aquatic insects
  - Spatial differences in the proportion of detritus to invertebrates consumed




# GROSS CHARACTERIZATION

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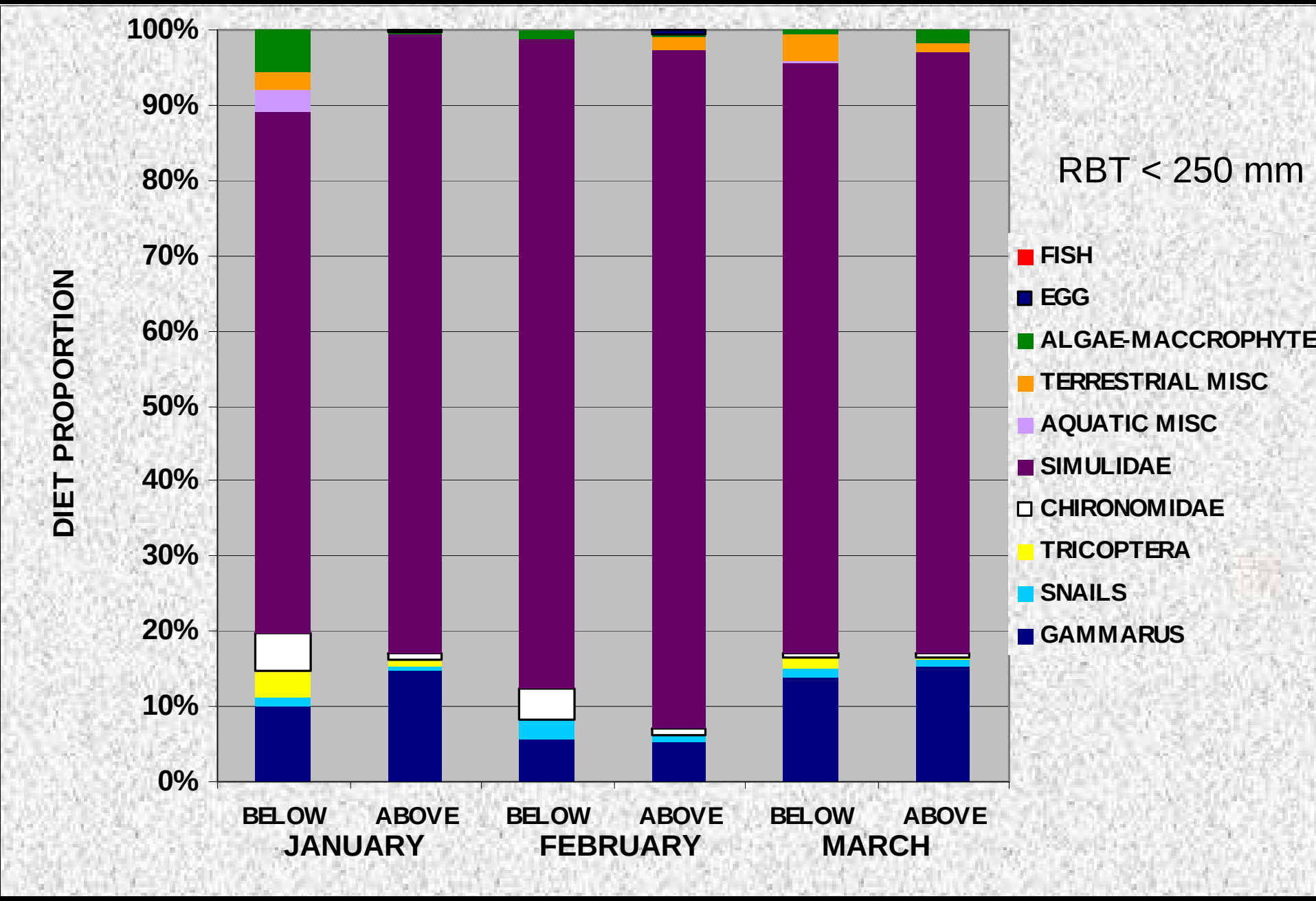
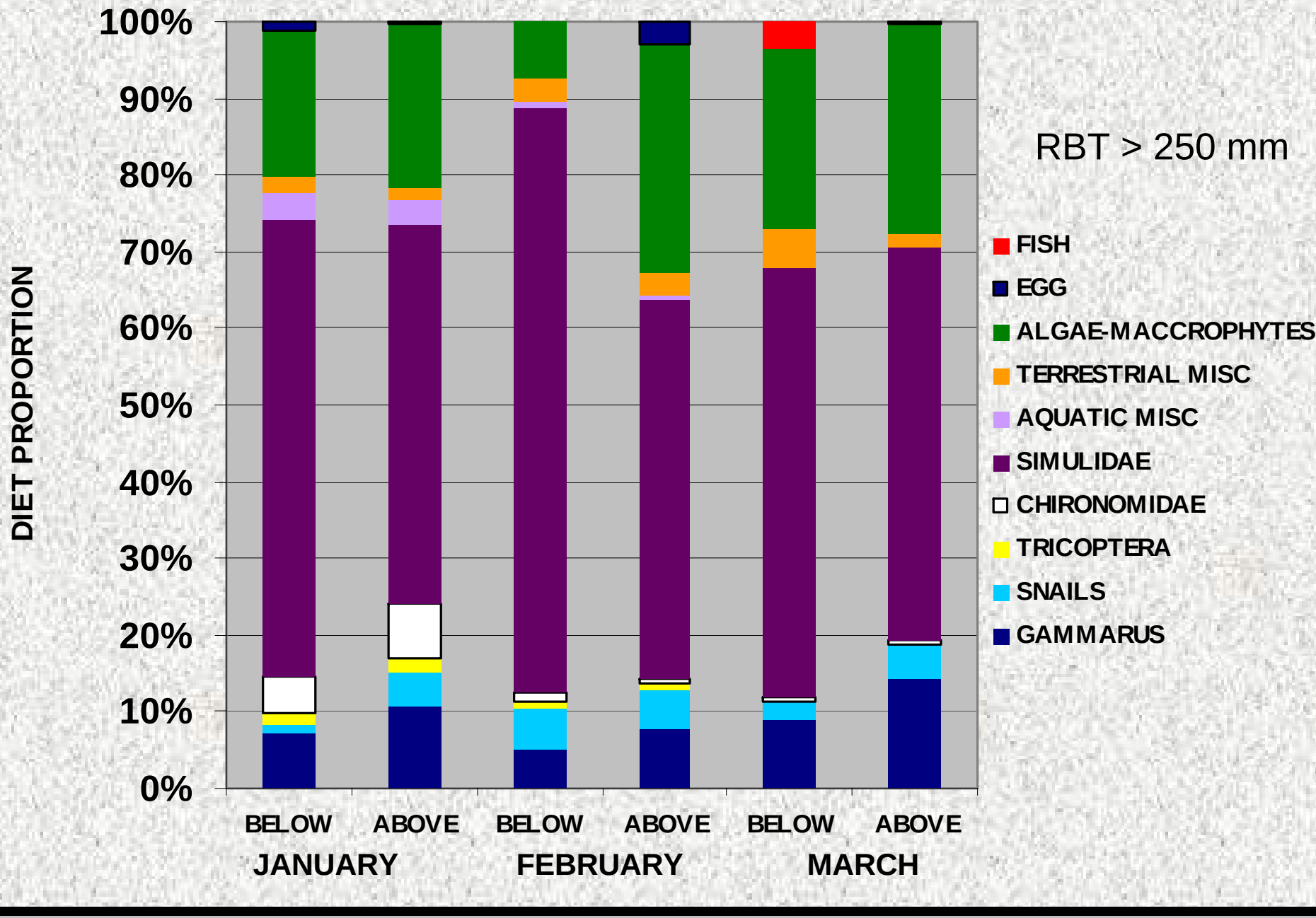
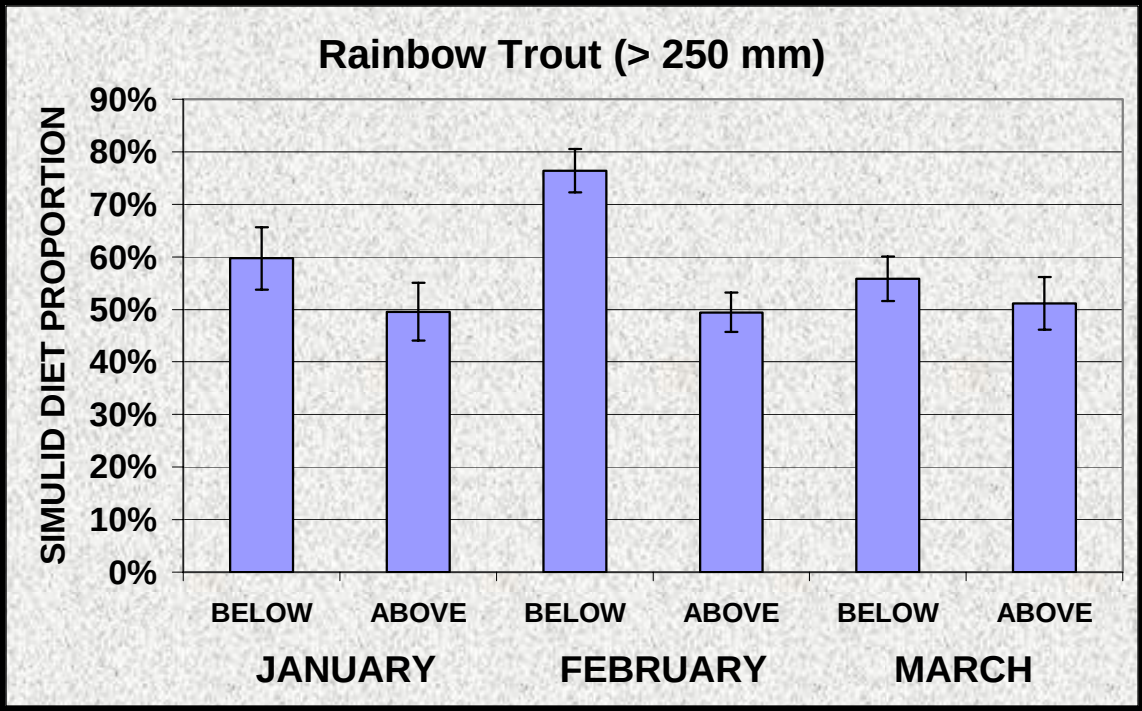
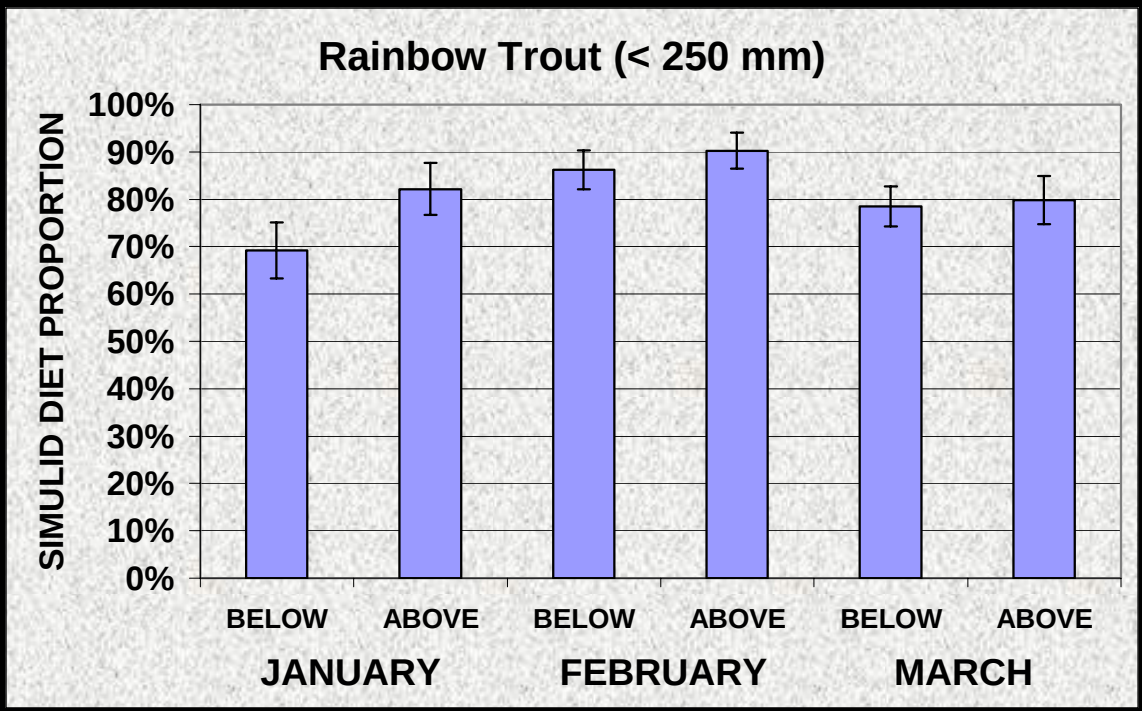
  - 30% to 45% of detrital CPOM/FPOM
  - 55% to 70% aquatic insects
  - Spatial differences in the proportion of detritus and invertebrates consumed
- **RBT (> 250 mm)**
  - Consume a larger proportion of detrital CPOM/FPOM
  - RBT consume a higher proportion of aquatic invertebrates over terrestrial invertebrates
  - RBT consume a higher proportion of aquatic plant material
  - RBT predation occurs with larger fish downstream of the LCR


RBT < 250 mm
DIET PROPORTION
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
BELOW
ABOVE
BELOW
ABOVE
BELOW
ABOVE
JANUARY
FEBRUARY
MARCH
FISH
EGG
ALGAE-MACCROPHYTE
TERRESTRIAL MISC
AQUATIC MISC
SIMULIDAE
CHIRONOMIDAE
TRICOPTERA
SNAILS
GAMMARUS


RBT > 250 mm
DIET PROPORTION
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
BELOW
ABOVE
BELOW
ABOVE
BELOW
ABOVE
JANUARY
FEBRUARY
MARCH
FISH
EGG
ALGAE-MACCROPHYTES
TERRESTRIAL MISC
AQUATIC MISC
SIMULIDAE
CHIRONOMIDAE
TRICOPTERA
SNAILS
GAMMARUS




**OVERALL TREND**

**RBT (> 250 mm & <250 mm)**

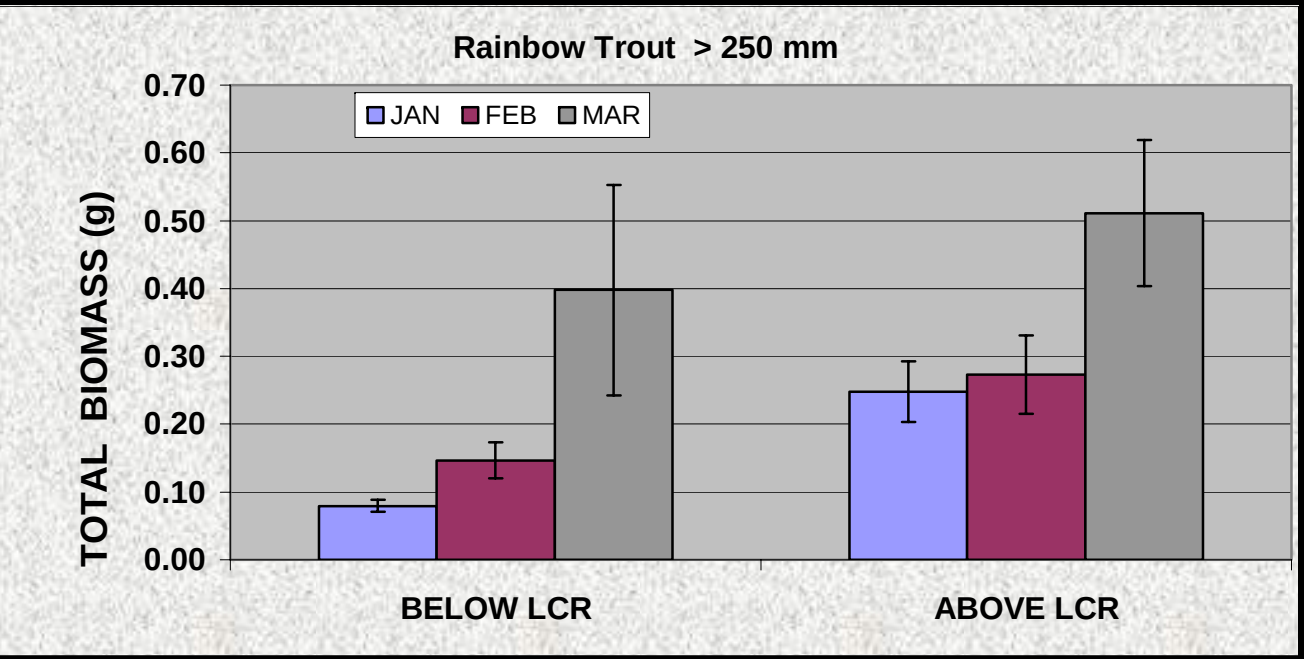
- Significant difference between different size-classes
  - < 250 mm (81% CI ± 4%)
  - > 250 mm (57% CI ± 5%)

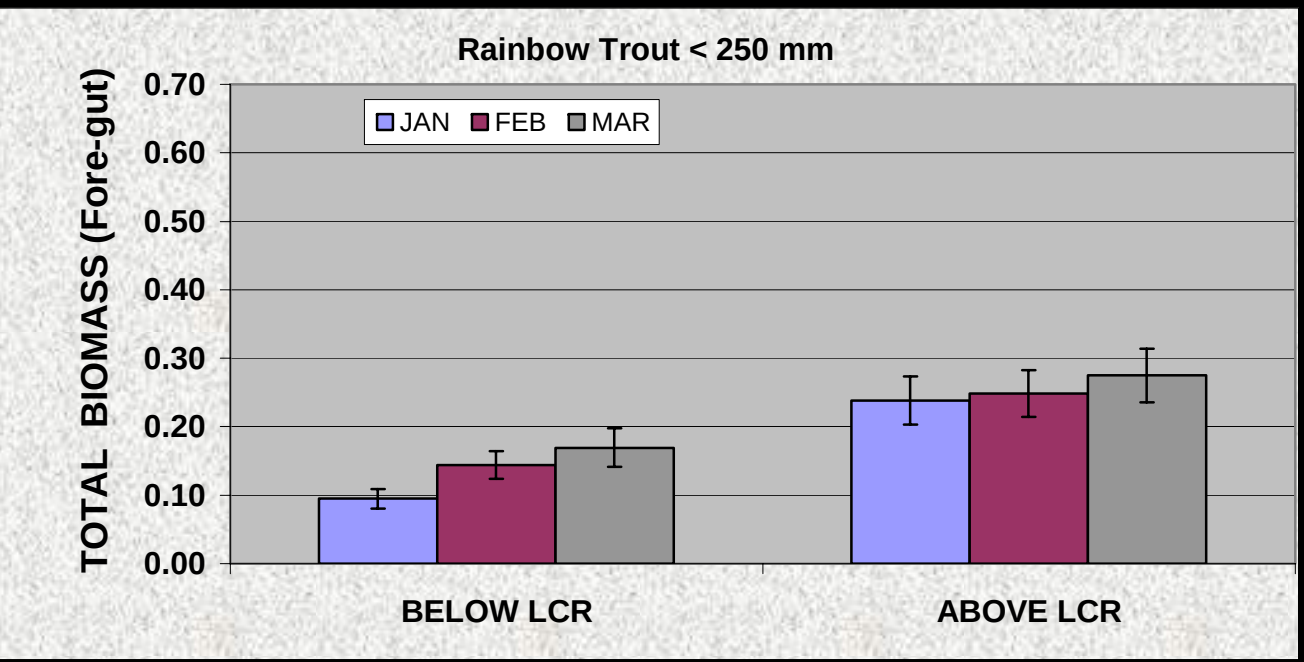
**RBT (> 250 mm)**

- Marginal significance for spatial difference
  - Below (63% CI ± 6%)
  - Above (50% CI ± 7%)

**RBT (< 250 mm)**

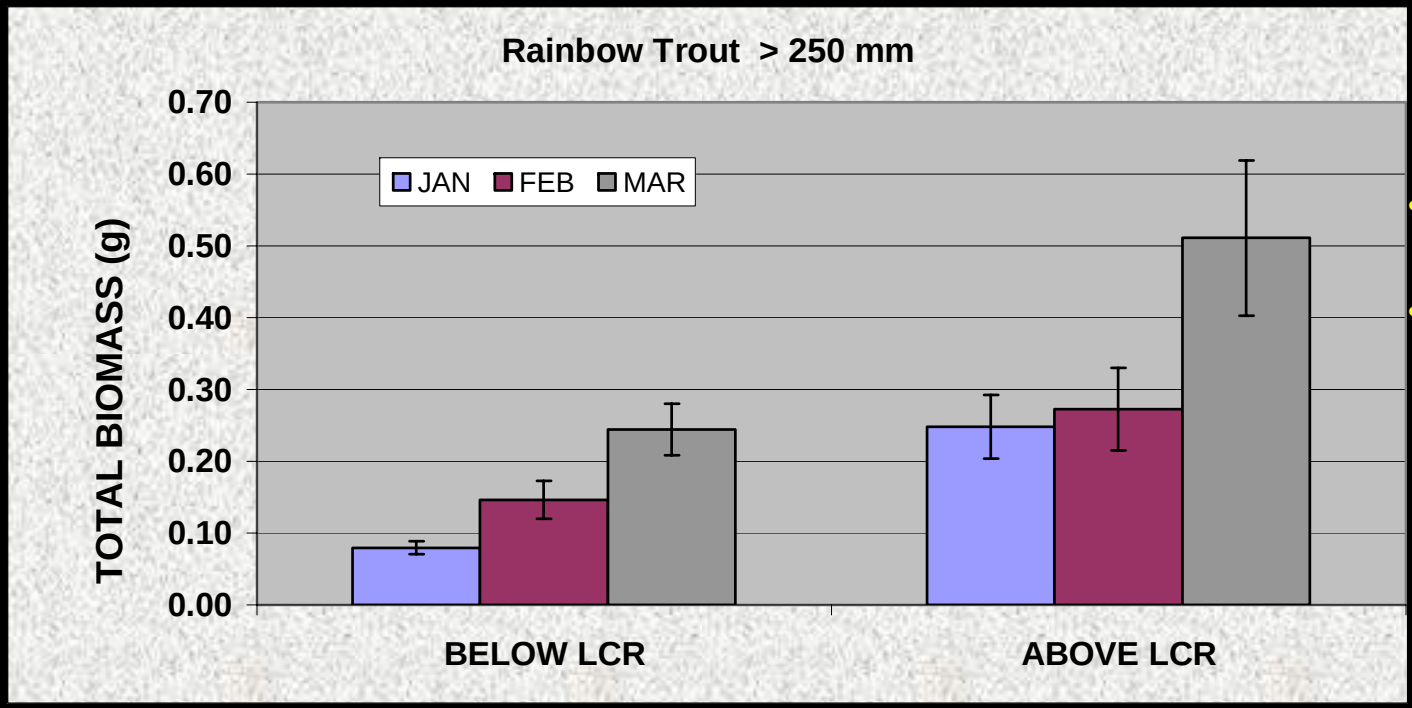
- No significant spatial difference
  - Below (77% CI ± 6%)
  - Above (84% CI ± 5%)

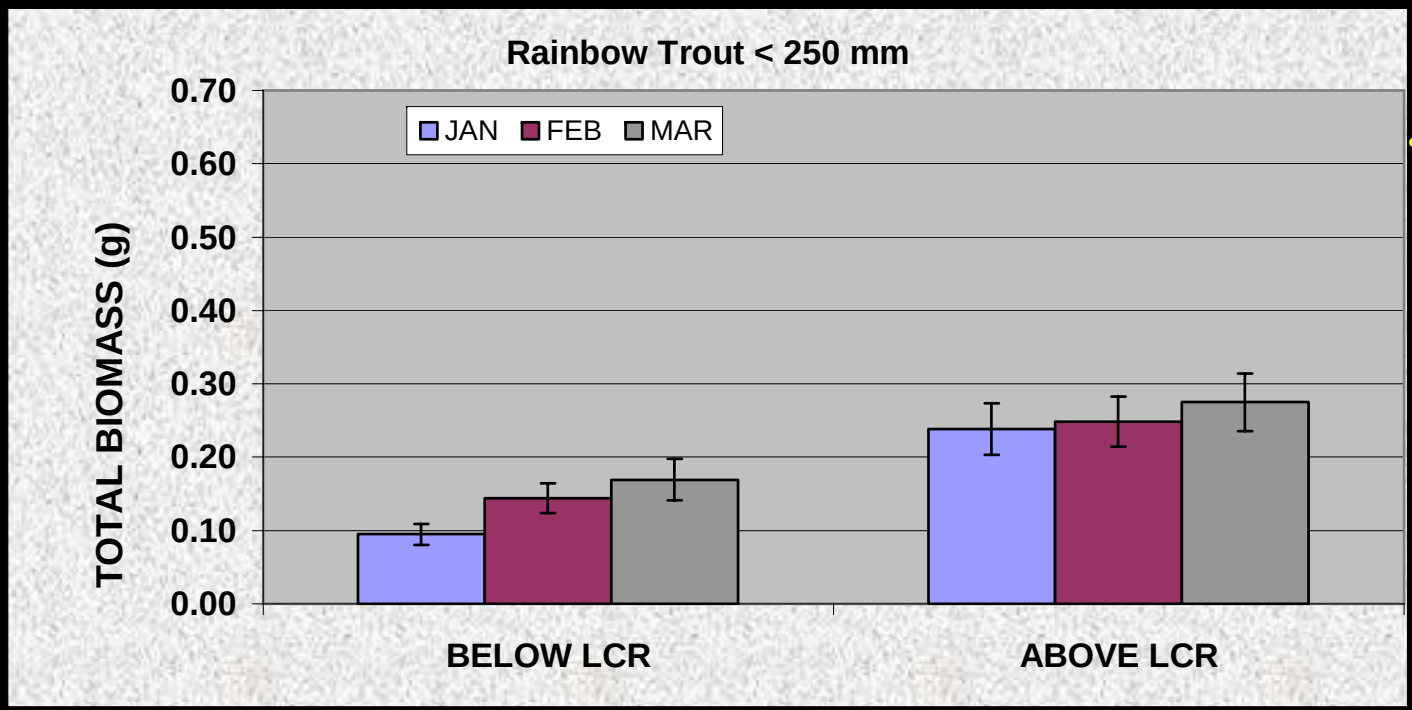



## OVERALL TRENDS

- RBT (> 250 mm)
  - Spatial variability in biomass
  - Due to a single occurrence of predation on HBC
- Restricted intake???
  - Foraging behavior
  - Foodbase availability
    - Spatial trend
    - Seasonal trend




# TOTAL BIOMASS

## RBT (> 250 mm)

- Excluding influence due to fish predation
- There was a significant difference in total biomass between RBT located above and below the LCR

Above mean value
**340 mg (SE ± 70)**

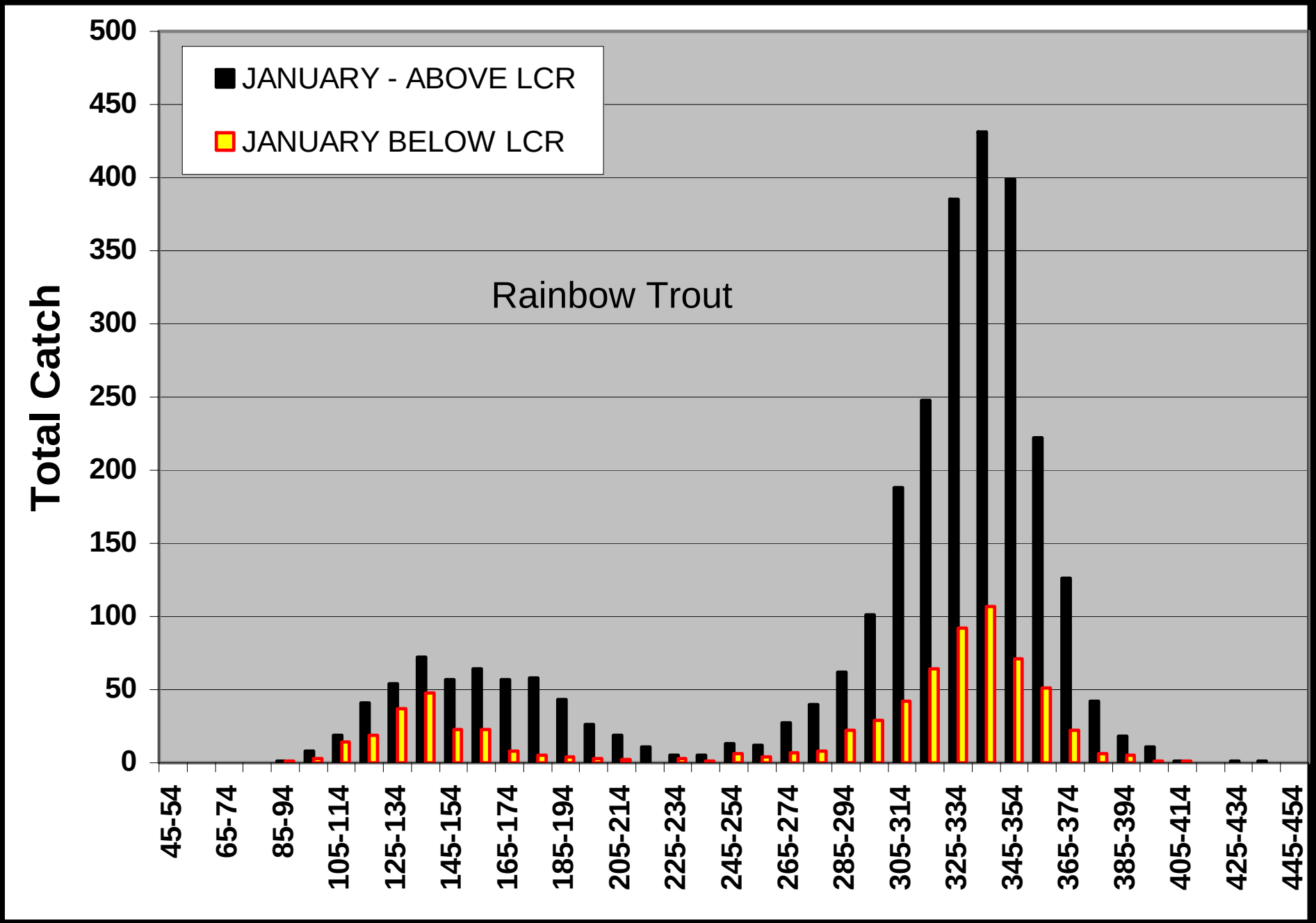
Below mean value
**157 mg (SE ± 23)**

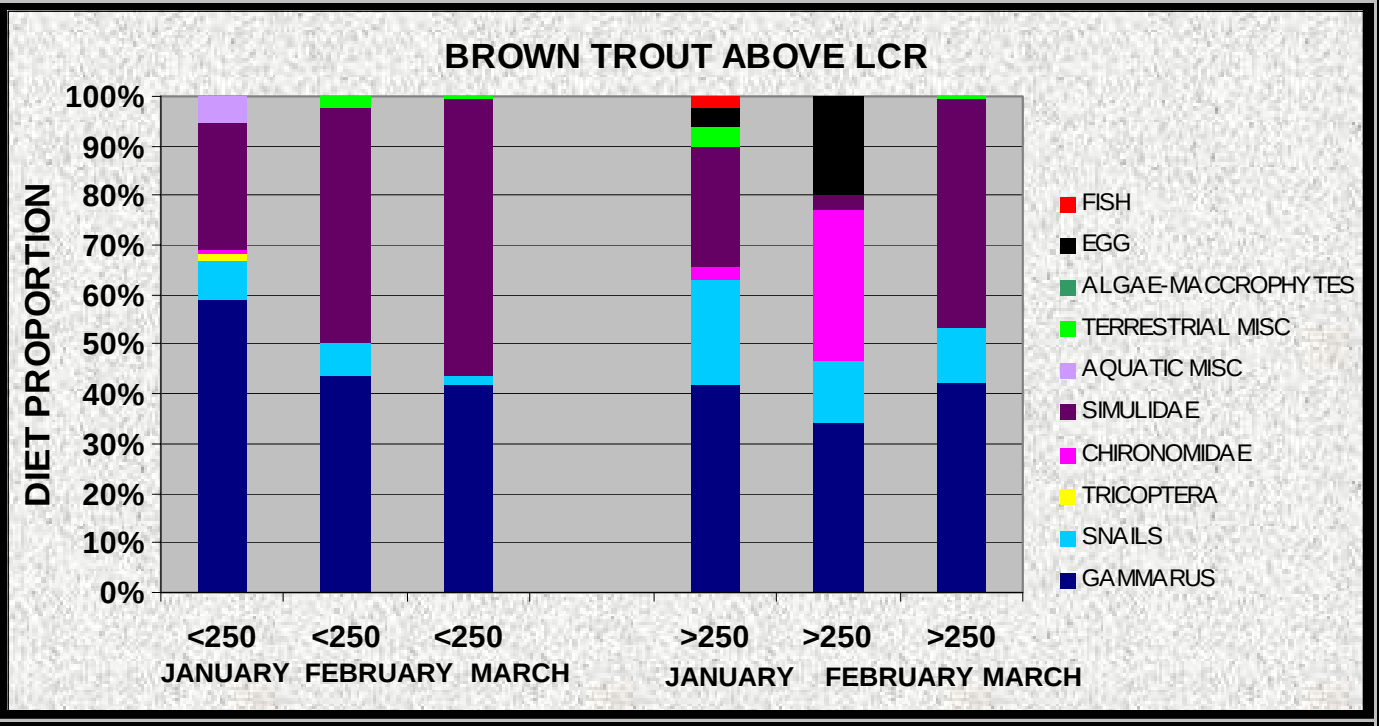
## RBT (< 250 mm)

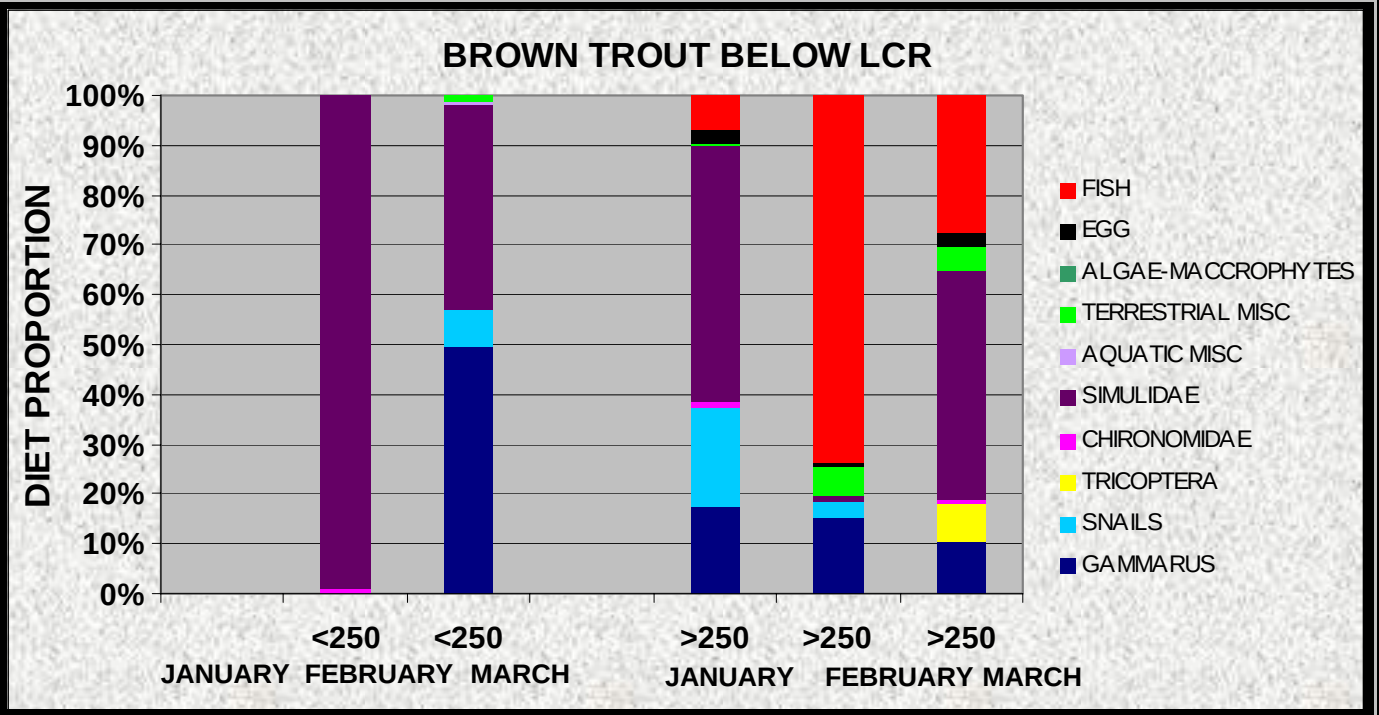
- There was a significant difference in total biomass between RBT located above and below the LCR

Above mean value
**254 mg (SE ± 36)**

Below mean value
**136 mg (SE ± 20)**


JANUARY - ABOVE LCR
JANUARY BELOW LCR
Rainbow Trout
Total Catch
500
450
400
350
300
250
200
150
100
50
0
45-54
65-74
85-94
105-114
125-134
145-154
165-174
185-194
205-214
225-234
245-254
265-274
285-294
305-314
325-334
345-354
365-374
385-394
405-414
425-434
445-454



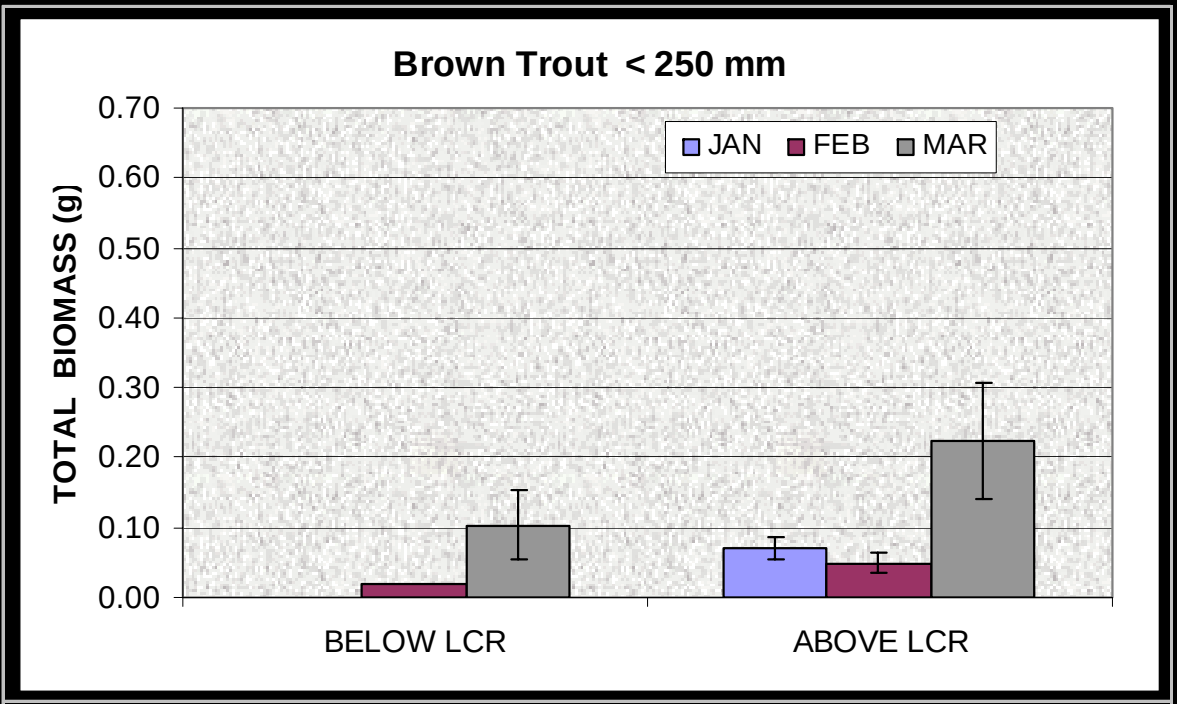



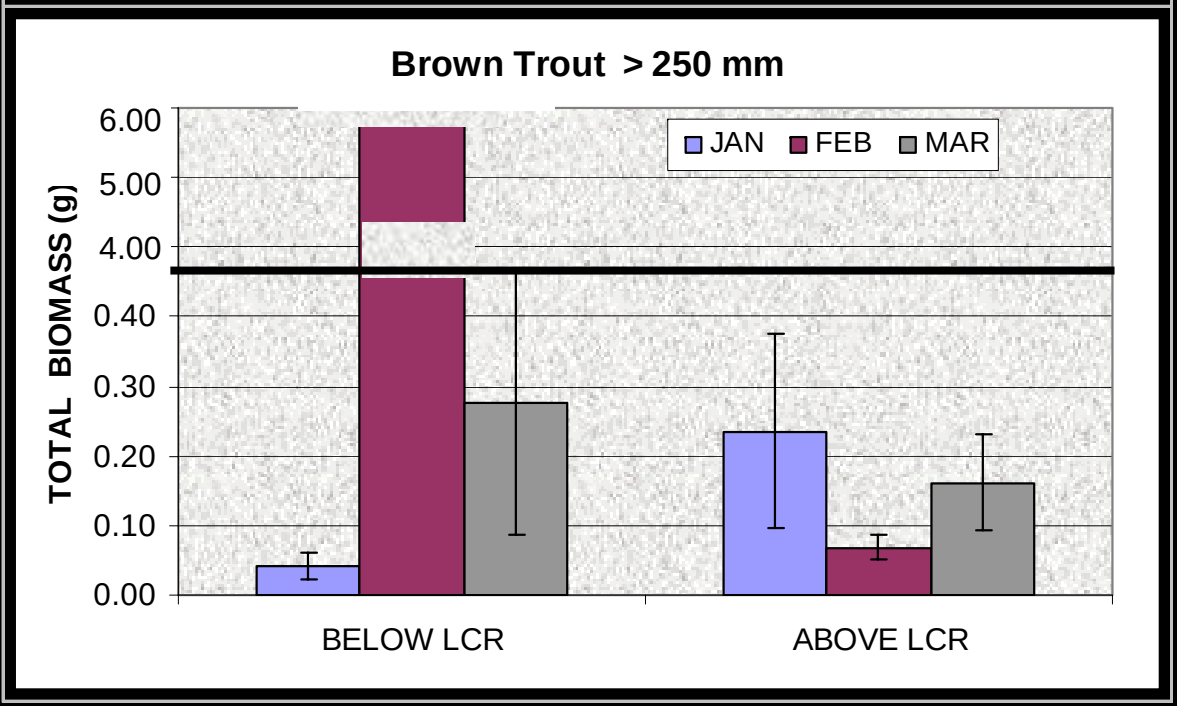

## BNT ABOVE LCR

- BNT >250 mm
  - 39% Gammarus
  - 24% Simulids
  - 1% Fish
- BNT <250 mm
  - 46% Gammarus
  - 40% Simulid

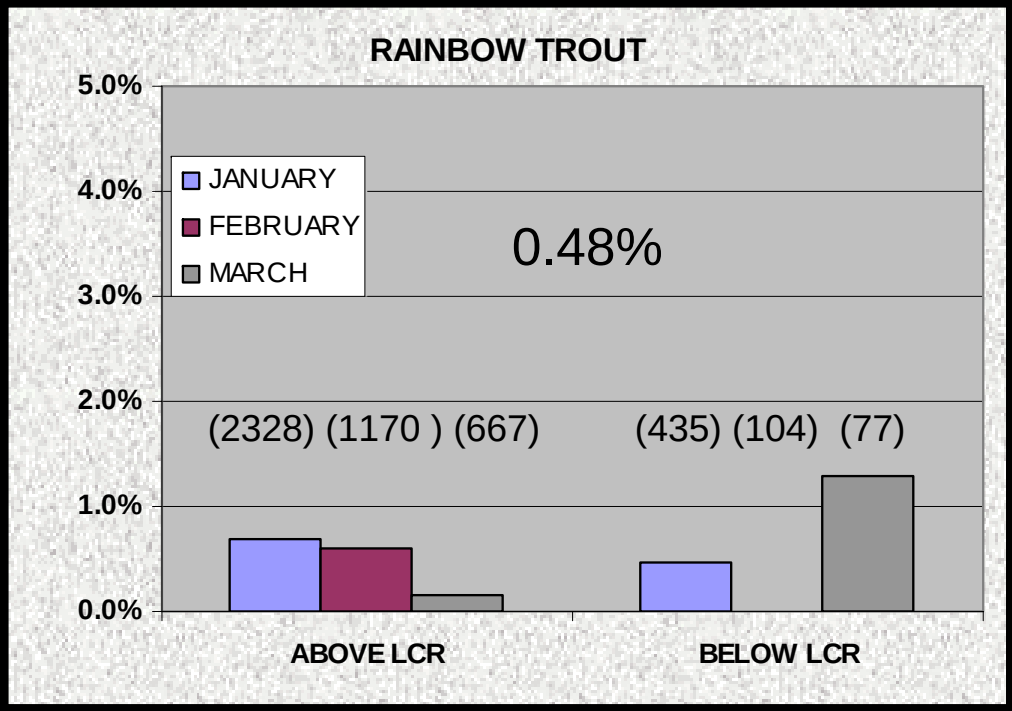
## BNT BELOW LCR

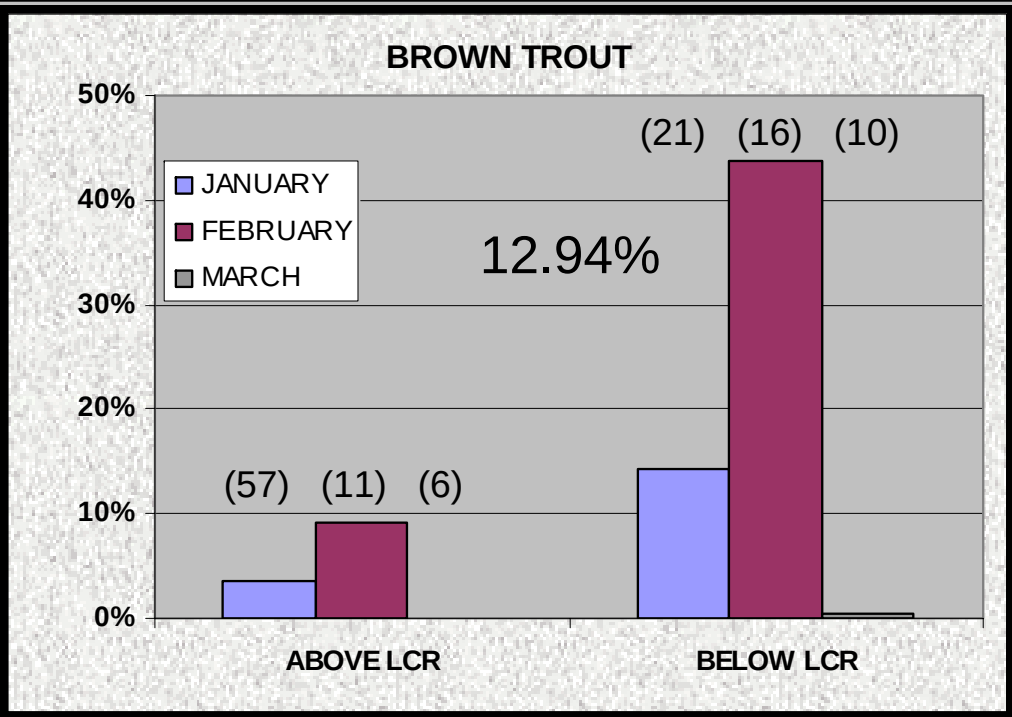
- BNT >250 mm increased predation
- BNT >250 mm
  - 36% Fish
  - 32% Simulids
  - 14% Gammarus
- BNT <250 mm
  - 75% Simulid
  - 25% Gammarus




- BNT abundance for smaller size-class less common below the LCR
- BNT average total biomass reduced in comparison to RBT
- Average total biomass highly variable
- Incidence of predation for BNT > 250 mm


RAINBOW TROUT
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
JANUARY
FEBRUARY
MARCH
0.48%
(2328) (1170 ) (667)
(435) (104) (77)
ABOVE LCR
BELOW LCR


BROWN TROUT
50%
40%
30%
20%
10%
0%
JANUARY
FEBRUARY
MARCH
12.94%
(21) (16) (10)
(57) (11) (6)
ABOVE LCR
BELOW LCR

# WINTER 2003 - CONCLUSIONS

- **Diet composition and proportion varies between trout species**
- **Diet proportion differs between size classes (< 250 mm & > 250 mm)**
- **Diet proportion differs spatially (i.e., above and below LCR) within larger size class**
- **Diet proportion does not differ spatially (i.e., above and below LCR) within the smaller size class**
- **Total biomass in fore-gut differs spatially, temporally and between trout species**
- **Incidence of predation greatest for BNT, alternately RBT are the least predaceous but highest in abundance**