# New Effective Population Size Findings for Atlantic and Shortnose Sturgeons


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# Effective Population Size, *Ne* (*Nef*)

- The average number of individuals in a population that actually contribute genes to succeeding generations.
- Often considered as a hypothetical “idealized” population.
- In this ideal population there is random mating and no selection.
- *The effective size of a population is typically smaller than its actual size.*
- 50 / 500 rule

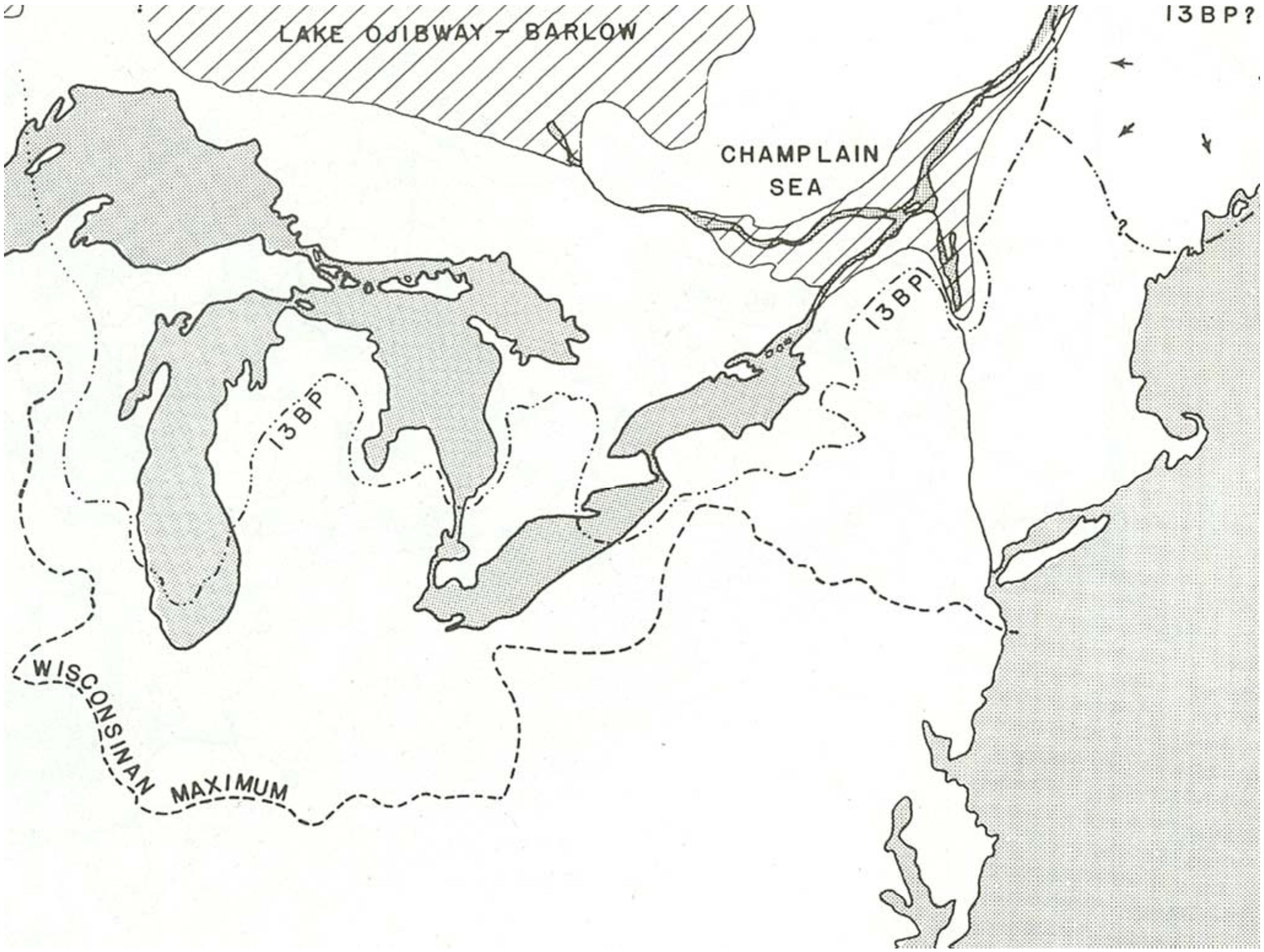
# *Nef / Nf ratios*

- Nunney & Elam (1994) – theory indicates *Nef* / *Nf* should range between 0.25 and 0.75
- Red drum, Gulf of Mexico = 0.004
- Chinook salmon, Sacramento R. = 0.04
- Silvery minnow, Rio Grande = 0.005
- Frankham, 38 cases small pops = ~0.10

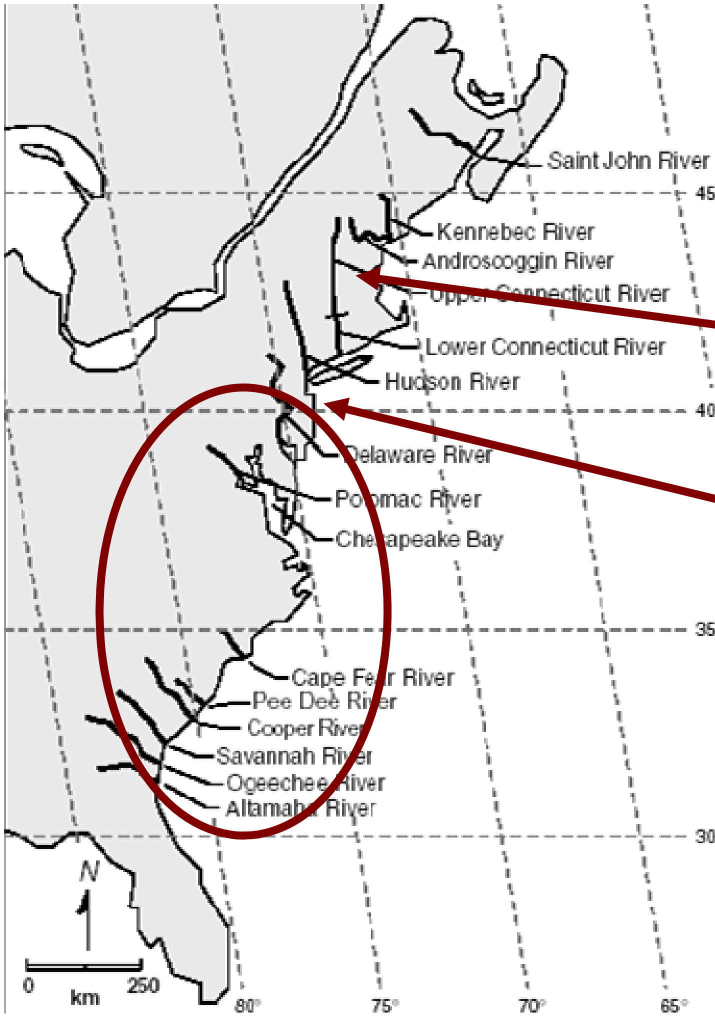
# Methods

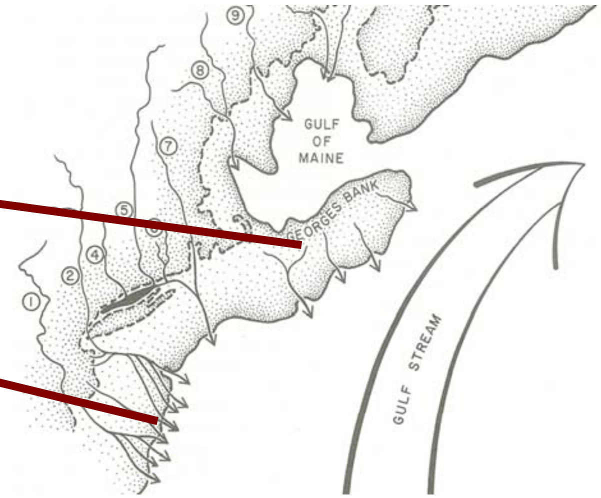
- MIGRATE software to estimate mutation-scaled effective population size parameter
- Bayesian inference (alternative of max likelihood did not stabilize)
- Independent runs: 4 Shortnose, 3 Atlantics
- More arcane details that I won’t mention
- The conceit: two species, many pops, wide abundance ranges

# “Northern” vs. “Southern” Rivers



# Alternate Refugia



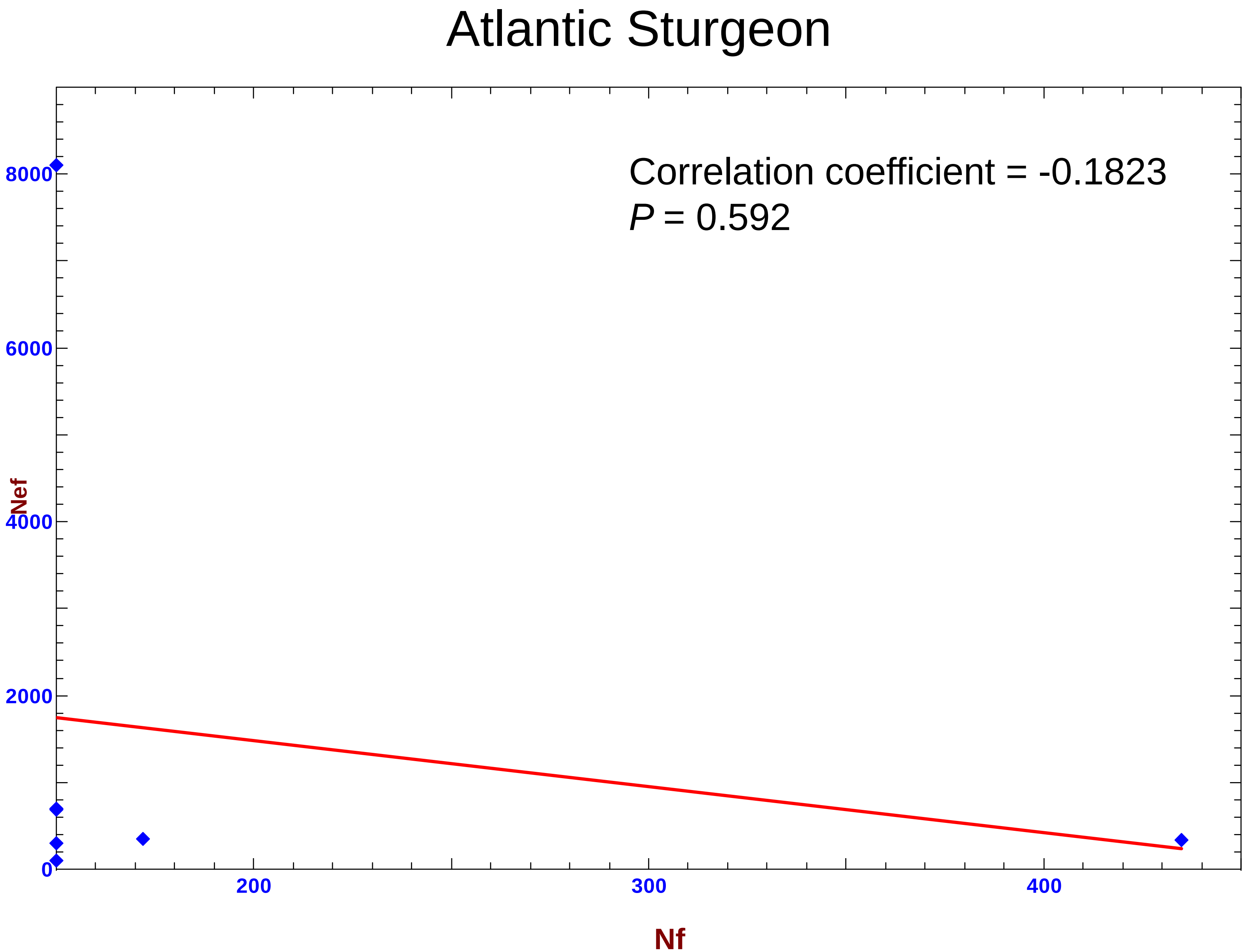
# Atlantic Sturgeon

| River | Sample size | # Haplotypes | *Nef* | *Nf (adults)* |
|---|---|---|---|---|
| St. Lawrence | 46 | 1 | 82 | 150 |
| St. John | 76 | 1 | 97 | 150 |
| Kennebec | 19 | 2 | 2432** | 150 |
| Hudson | 128 | 8 | 341 | 435 |
| Delaware-YOY | 19 | 6 | 106 | 150 |
| James | 65 | 4 | 294 | 150 |
| Albemarle | 48 | 6 | 680 | 150 |
| ACE basin | 72 | 11 | 5636 | 150 |
| Savannah | 58 | 18 | 8108 | 150 |
| Ogeechee | 47 | 9 | 697 | 150 |
| Altamaha | 140 | 5 | 352 | 172 |

(** estimates never stabilized)

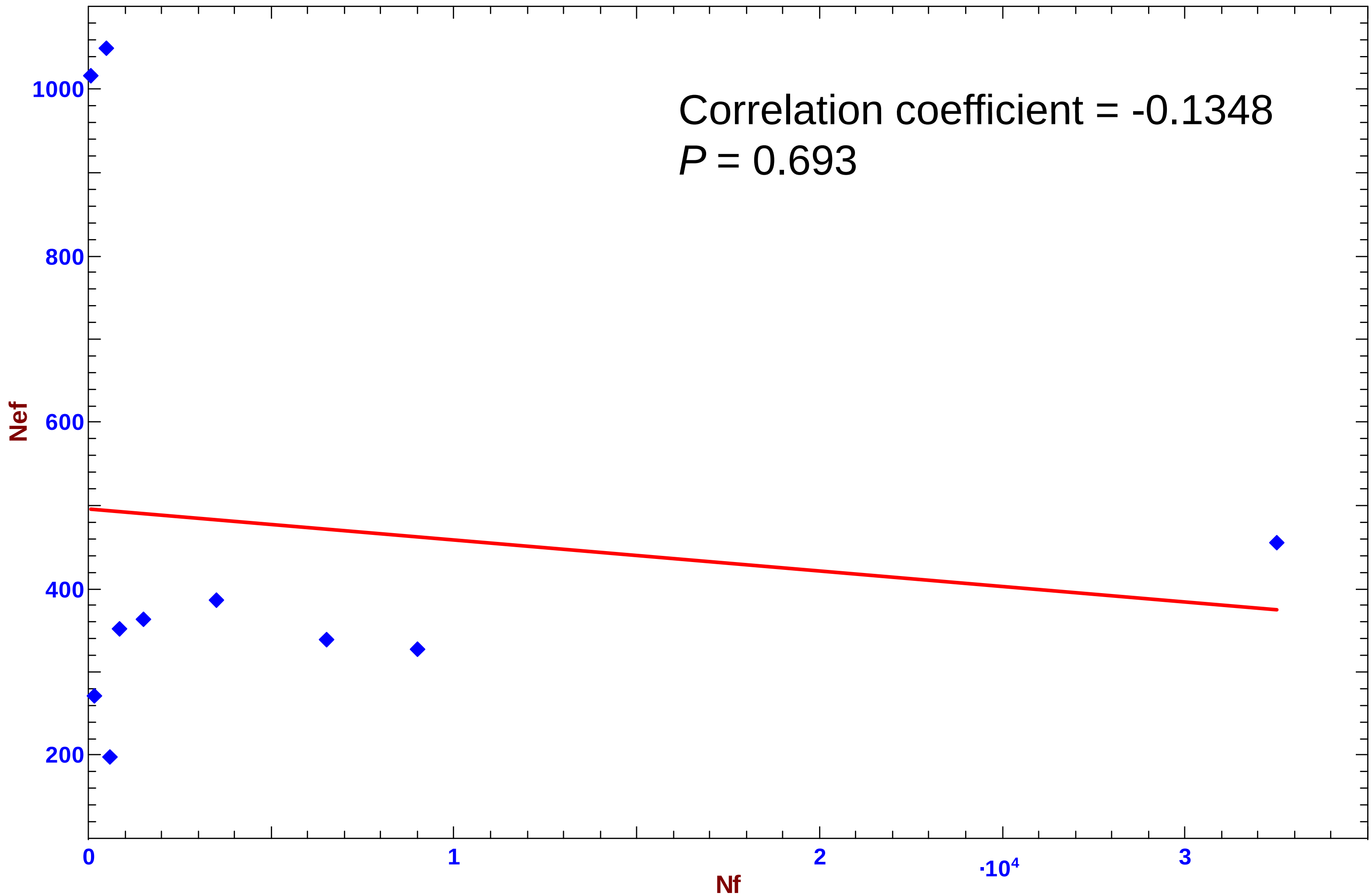
# Shortnose Sturgeon

| River | Sample size | # Haplotypes | *Nef* | *Nf* (all ages) |
|---|---|---|---|---|
| St. John | 42 | 8 | 327 | 9000 |
| Kennebec | 54 | 8 | 386 | 3500 |
| Androscoggin | 48 | 8 | 364 | 1500 |
| Connecticut | 46 | 4 | 198 | 600 |
| Hudson | 56 | 9 | 456 | 32,500 |
| Delaware | 57 | 8 | 339 | 6500 |
| Winyah Bay | 46 | 13 | 1099 | 500 |
| Cooper | 62 | 6 | 271 | 150 |
| Savannah | 25 | 7 | 352 | 837 |
| Ogeechee | 53 | 11 | 1016 | 74 |
| Altamaha | 69 | 10 | 583 | 3160 |



Atlantic Sturgeon
Correlation coefficient = -0.1823
P = 0.592
8000
6000
4000
2000
0
Nef
200
300
400
Nf

# Shortnose Sturgeon



# Two-Species Comparison

| | Mean *Nef* | SD *Nef* | *Nef/Nf* | Range *Nef/Nf* |
|---|---|---|---|---|
| Atlantic | 1711 | 2693 | 9.49 | 0.647 – 54.05 |
| Shortnose | 490 | 298 | 1.47 | 0.014 – 13.73 |

Note: Quattro et al. (2002) - shortnose sturgeon *Nef* in Southeast ~12,000
Zhang et al. (2003) – Chinese sturgeon in Yangtze, Nef ~2,800, Nef/Nf ~0.85

# mtDNA vs. nDNA Microsatellites for Atlantic Sturgeon (Tim King)

- King used linkage-disequilibrium approach
- nDNA range *Ne* = 7 – 169
- nDNA Ne vs. N = 0.02 – 0.30
- mtDNA *Nef* & nDNA *Ne* not correlated ($P > 0.05$)
- Confounding factors: molecular markers, genders, age classes in census estimates & statistical approaches

# Preliminary Conclusions

- AS *Nef* higher but more variable than SNS
- *Nef* not correlated with *Nf* for either species
- AS *Nef* using mtDNA higher than with nDNA
- *Nef/Nf* much higher than for many other low abundance vertebrates
- 50/500 rule a concern depending on whether you trust mtDNA or nDNA results

# Preliminary Conclusions

- No clear response either to range of current pop sizes nor to recent pop changes
- Benefits of “genetic storage effect”?
  - Long lived; skip spawning years; long time to maturity with sex differences – leading to considerable generation overlap that limits genetic drift