Can crayfish and creek chub sustain river otters in the Mora River?

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Background

N. American river otters (*Lontra canadensis)* exert top-down control on lotic communities.[6,9] Historic loss from rivers in the southwestern US has led to trophic cascades.[3]
Problem: Invasive bullfrog (*Rana catesbeiana*) and crayfish (*Orconectes virilis, O. rusticus*) threaten local biodiversity[3] in Mora River, NM
Potential solution: Reintroduce river otters to re-establish top-down control[5,12]

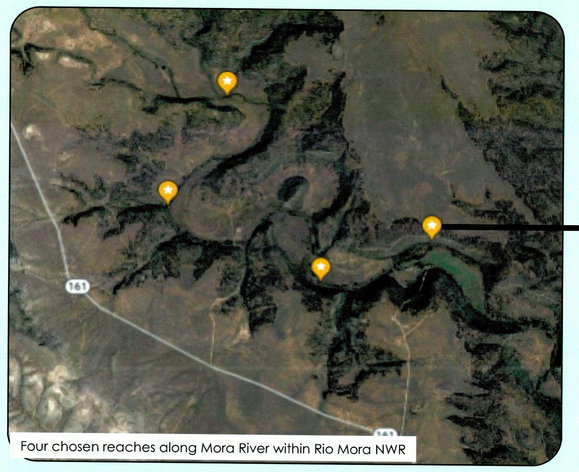
Can fish & crayfish calorically sustain river otters?


Mora River. Photo credit: Jenna Slabe

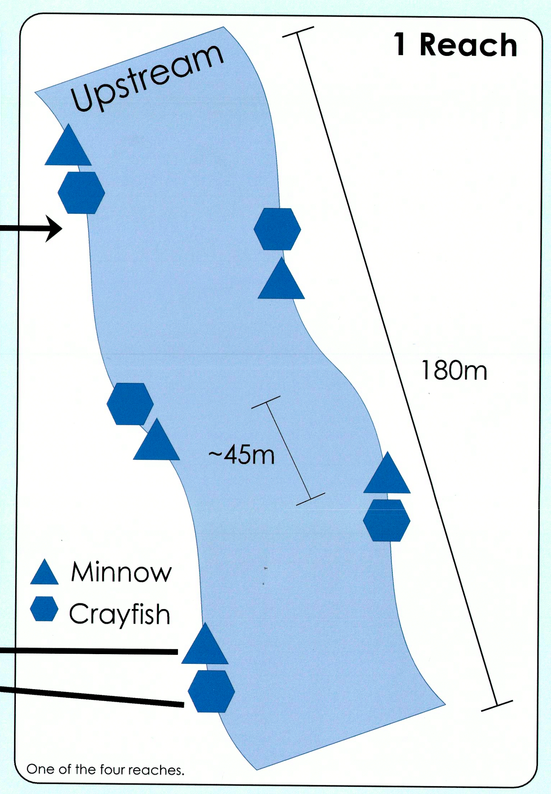

North American river otter. http://animalyou.blogspot.com/2013/02/giant-otter.html

Hypothesis & Prediction: River otters have been successfully reintroduced to other NM rivers. If the Mora River is similar to these systems, then the biomass & production rate of fish and crayfish will sustain the min. river otter dietary requirements[2,10]

Methods


Four chosen reaches along Mora River within Rio Mora NWR


Paired minnow & crayfish traps setup. Photo credit: Armando Toral Becker



One of the four reaches.

Methods cont'd

1. Four 180m reaches
2. Crayfish & minnow traps
   - Randomized order
   - Baited w/ tuna
   - Left out for ~24 hrs
3. Recorded length & weight of fish & crayfish
4. Calculations

$B = \log_{10}M + L \bullet \log_{10}L$ [13,14]
- B = biomass
- M = wet mass
- L = standard length

$P = B \bullet T$
- P = production rate
- T = published turnover rates[8,11]


Measuring standard length in cm. Photo credit: Chris Scott

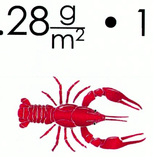

Crayfish trap. Photo credit: Chris Scott

Results

Avg. Biomass Caught*


$0.28\frac{g}{m^2} \pm 0.06$

$0.28\frac{g}{m^2} \bullet 1.20\frac{kcal}{g} = \boxed{0.34\frac{kcal}{m^2}}$

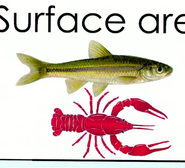

$3.4e^{-5}\frac{g}{m^2} \pm 1.17e^{-5}$

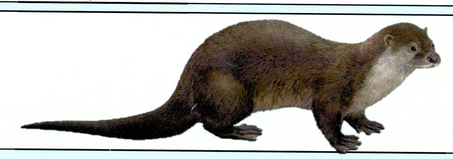
$3.4e^{-5}\frac{g}{m^2} \bullet 0.77\frac{kcal}{g} = \boxed{2.6e^{-5}\frac{kcal}{m^2}}$

*Assuming trap area of attraction = $40m^2$ [1,7]

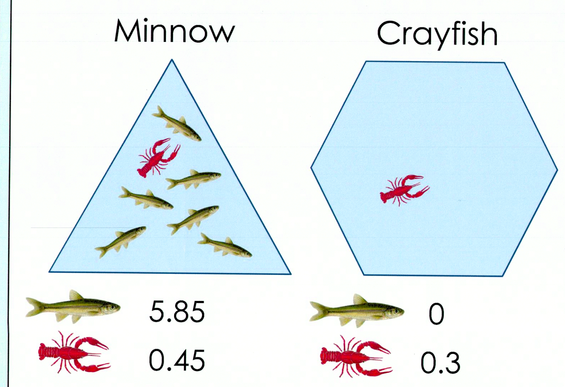
Biomass in Mora River

Surface area = 61,441.55 m^2


20,890.13 kcal
2.06 kcal


Dietary reqs. = **508,810** $\frac{kcal}{yr}$ [5]

Mean No. Caught in Traps



No difference between minnow traps and crayfish traps in catching minnows (p=0.96, GLMM Poisson) or crayfish (p=0.44, GLMM Poisson)*
*Placement of trap had no influence (p=0.79)

Production Rate Calculations

Biomass	•	Turnover	=	Prod. rate
20,890.13 kcal	•	$2.84\frac{1}{yr}$ [11]	=	59,327.96 $\frac{kcal}{yr}$
2.06 kcal	•	$1.24\frac{1}{yr}$ [8]	=	2.55 $\frac{kcal}{yr}$
		Total	=	**59,330.51** $\frac{kcal}{yr}$

Can sustain **11.7%** of the total

Discussion

- Production rate indicates that the Mora River **could not support** the reintroduction of river otters
- Fulfills **11.7%** of one adult otter's annual dietary reqs.
- Our results should be interpreted as lower bound because:
  - We did not include other species (i.e. bullfrogs, birds, snakes, etc.) that otters could eat
  - Trapping methods
  - Prey presence changes from season to season
- Our results are sensitive to the area of attraction assumptions (i.e. halved area = doubled biomass)
- Using published P/B ratios rather than our own may have affected these results
  - Did not calculate our own production rates
  - May not have been accurate to our results because they were from a different stream
- While our results showed that traps placed downstream of another did not influence the number of crayfish or minnows caught, we did find that minnow traps caught more crayfish and fish than crayfish traps.
- Future studies:
  - Using minnow traps over crayfish traps to quantify prey availability for otters
  - Include better survey methods for bullfrogs to include their biomass as well
  - Replicate the study in other times of the year to account for seasonality of prey presence

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References: **1.** Acosta, C.A., & Perry, S.A. (2000). Effective sampling area: A quantitative method for sampling crayfish populations in freshwater marshes. *Crustaceana, 73,* 425-431. **2.** Crait, J.R., & Ben-David, M. (2006). River otters in Yellowstone Lake depend on a declining cutthroat trout population. *Journal of Mammalogy, 87,* 485–494. **3.** Day, C.C., Westover, M.D., & McMillan, B.R. (2015). Seasonal diet of the northern river otter (*Lontra canadensis*): What drives prey selection? *Canadian Journal of Zoology, 93,* 197-205. **4.** Degerman, E., Nilsson, P.A., Nyström, P., Nilsson, E., & Olsson, K. (2007). Are fish populations in temperate streams affected by crayfish?–A field survey and prospects. *Environmental Biology of Fishes, 78,* 231-239. **5.** Findley, W.R. (1992). The reintroduction of river otter to the Green River, Utah. Progress Report III. Brigham Young University. **6.** Fitzgerald, J.P., Meaney, C.A., & Armstrong, D.M. (1994). Mammals of Colorado Denver Museum of Natural History and University Press of Colorado. Niwot, Colorado. **7.** McQuinn, I.H, Gendron, L., & Himmelman, J.H. (1988). Area of attraction and effective area fished by a whelk trap under variable conditions. *Canadian Journal of Fisheries and Aquatic Sciences, 45,* 2054-2060. **8.** Momot, W.T., & Gowing, H. (1977). Production and population dynamics of the crayfish *Orconectes virilis* in three Michigan lakes. *Journal of the Fisheries Research Board of Canada, 34,* 2030-2040. **9.** New Mexico Department of Game and Fish Conservation Services Division Santa Fe, New Mexico (NMDGF). (2006). Feasibility Study: Potential for Restoration of River Otter. **10.** Ruiz-Olmo, J., Lopez-Martin, J. M., & Palazon, S. (2001). The influence of fish abundance on the otter (*Lutra lutra*) populations in Iberian Mediterranean habitat. *Journal of Zoology, 254,* 325–336. **11.** Storck, T.W., & Momot, W.T. (1989). Annual production of creek chub and southern redbelly dace in a small woodland stream. *Ohio Journal of Science, 89,* 55-61. **12.** Savage, M & Klingel, J. (2004). The case for river otter restoration in New Mexico. *The River Otter Journal, XIII(II),* 1-10. **13.** Schneider, J. C., Laarman, P. W., Howard Gowing, J. C., Laarman, P. W., & Gowing, H. (2000). Length-weight relationships. **14.** Simon, T. P., & Stewart, C. R. (2014). Growth, length-weight relationships, and condition associated with gender and sexual stage in the invasive northern crayfish, Orconectes virilis Hagen, 1870 (Decapoda, Cambaridae). In Proceedings of the Indiana Academy of Science (Vol. 123, No. 2, pp. 196-203). 14.