Public Abstract

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Title:Implications of Commercial Harvest of River Turtles in Missouri

Commercial turtle harvest is considered a major influence of worldwide turtle population declines. In Missouri, three turtle species are legal for commercial harvest: the common snapping turtle (Chelydra serpentina), smooth softshell (Apalone mutica), and spiny softshell (Apalone spinifera). Missouri regulations allow these turtles to be harvested year-round, with no size- or bag-limits, using nets. Harvest is restricted to the Missouri River, the Mississippi River, and the St. Francis River at the Arkansas border, and not within 300 m of tributary confluences with these rivers. Currently, little information is available on population abundance or effects of harvest on Missouri's harvested turtle populations. Our goal was to assess the impacts of harvest on these populations. We completed mark-recapture studies of the three harvested species in 2011 and 2012 at four sites on the Missouri River where commercial turtle harvest occurs, and at two sites in each of two tributaries where commercial turtle harvest is not legal, the Osage and Gasconade rivers. Using our capture-recapture data, we estimated the abundance of these three species per 2 km of river. We then compared turtle abundance in harvested versus unharvested rivers and found that snapping turtle abundance on the harvested Missouri River was lower than on the unharvested tributaries. For both softshell species, no difference was detected between harvested versus unharvested sites. The softshell results are inconclusive because we were unable to recapture any softshells at three of the four unharvested sites and one of the four harvested sites. We conducted mock harvests at the same sites to simulate the effects of harvest on turtle populations. These mock harvests were based on capture methods used by Missouri's primary commercial harvester and were conducted to estimate plausible commercial harvest rates. Mock harvest rates for all turtles averaged a removal of 23% of the population based on our estimates of abundance, ranging from 6-79% (SE = 5%) for all three species, suggesting that a substantial portion of snapping turtle, smooth softshell, and spiny softshell populations can be harvested at a local scale using commercial harvest methods. Using these abundance estimates and harvest rates, we modeled population growth to examine the long-term effects that commercial-scale harvest might have on these three species.

To model population growth, we collected data on survival rates and reproductive rates from the literature for the three harvestable turtle species in Missouri, and developed matrix population models to assess the response of turtle populations to the effects of harvest. We developed one model for snapping turtles and another for the softshell species combined due to the lack of available information for either softshell species. Using average survival and reproduction rates, snapping turtle population size increased over time at a growth rate of 1.030 when no harvest rates were applied and harvesting less than or equal to 2.3% of adults and juveniles resulted in population declines. When survival and reproductive rates were at minimum reported values, populations declined at a rate of 0.891, but at maximum reported survival and reproductive rates, populations grew rapidly with a growth rate of 1.199. For softshells, populations declined at a growth rate of 0.952 over time without harvest, and these decreases became more rapid when harvest was incorporated at a growth rate less than or equal to 0.899. When survival and reproductive rates were at minimum reported values, declines continued to occur at a rate of 0.838, but for populations exhibiting maximum survival and reproduction reported in the literature, population size increased over time with a growth rate of 1.163. For both snapping turtles and softshells, survival of adults had the greatest effect on growth of the population. These deterministic results are limited because turtle vital rates are known to fluctuate over time based on predation, flooding, and drought. Still, these results illustrate the plausible effects that varying rates of harvest might have on the growth of turtle populations.

Commercial turtle harvest is restricted to specific rivers in Missouri, but wildlife managers have no way to ensure turtles are collected from legal waters. To address this, we used microchemistry analysis on nail samples collected from snapping turtles, smooth softshells, and spiny softshells in 2010 through 2012 to determine if we could distinguish the river of capture for individuals. We used stable isotope analysis (SIA) to determine the composition of stable hydrogen and oxygen isotopes, and inductively coupled plasma mass spectrometry (ICP-MS) to determine the strontium and calcium ratios and concentrations found within turtle nail samples. We used classification and regression tree modeling to determine which microchemistry analysis (SIA or ICP-MS) or elements could be used to determine river of capture at the scale of individual rivers or within a classification of legal or illegal waters. The ratio of Sr:Ca was found to best determine location of capture for turtles in central Missouri, correctly classifying turtles 83.5% of the time to either the Missouri or to one of the two tributaries (which are both heavily groundwater-fed, flowing from the Ozark region). These results indicate that microchemistry analysis may be used by wildlife managers to confirm that commercially harvested turtles were collected from legally- versus illegally-harvested waters in central Missouri on the rivers we sampled.

The results of this study provide insight and information on harvested turtle populations, and are the first to estimate abundance of Missouri river turtles and plausible commercial harvest rates. The last chapter discusses the potential implementation of slot limits, limiting the harvest season to specific times of the year, rotating harvestable areas annually, requiring thorough harvest reports from harvesters, creating a turtle-specific commercial harvest permit, the use of microchemistry to confirm legal collection, and restricting or eliminating commercial turtle harvest. These recommendations are intended to aid in maintaining sustainable turtle populations.