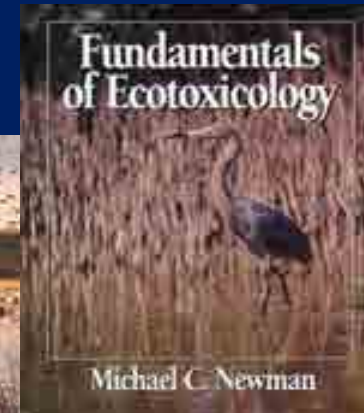
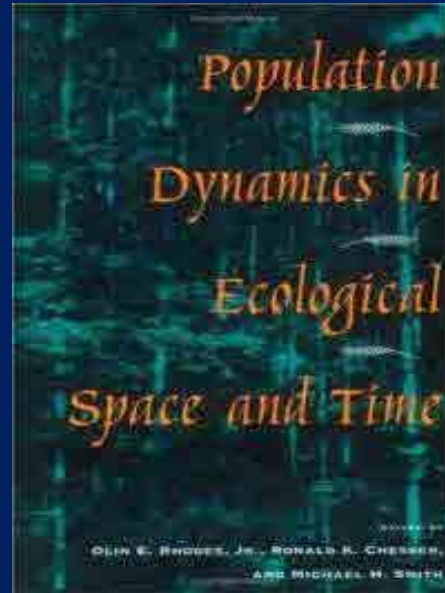


# SREL Research Program's

- >**3615** peer-reviewed scientific publications to date
- **64** books



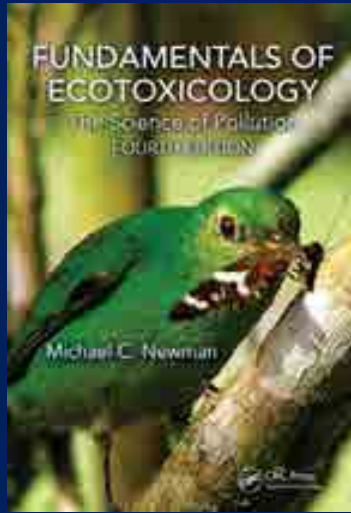
# Types of Projects on SRS

- **Remediation/Monitoring of Contaminants (DOE-EM, DOE-NNSA)**
- **Biogeochemistry of Metal Remediation (DOE-NNSA)**
- **Tritium Cycling (DOE-EM, DOE-NNSA)**
- **Grout Biogeochemistry (SRR)**
- **Stream Assessment and Restoration (USFS)**
- **Pollinator Habitat Enhancement/Reclamation (DOE-EM)**
- **Food Web Dynamics (DOE-EM, DOE-NNSA)**
- **Metal Toxicology (Mercury, Copper, Zinc) (DOE-EM, DOE-NNSA)**
- **Bioaccumulation of Contaminants in Fish and Wildlife (DOE-EM)**
- **Human – Wildlife Conflicts (Hogs, Deer, Coyote) (USDA, DOE-EM)**
- **Low Dose Radiation Effects (DOE-EM, NRC)**

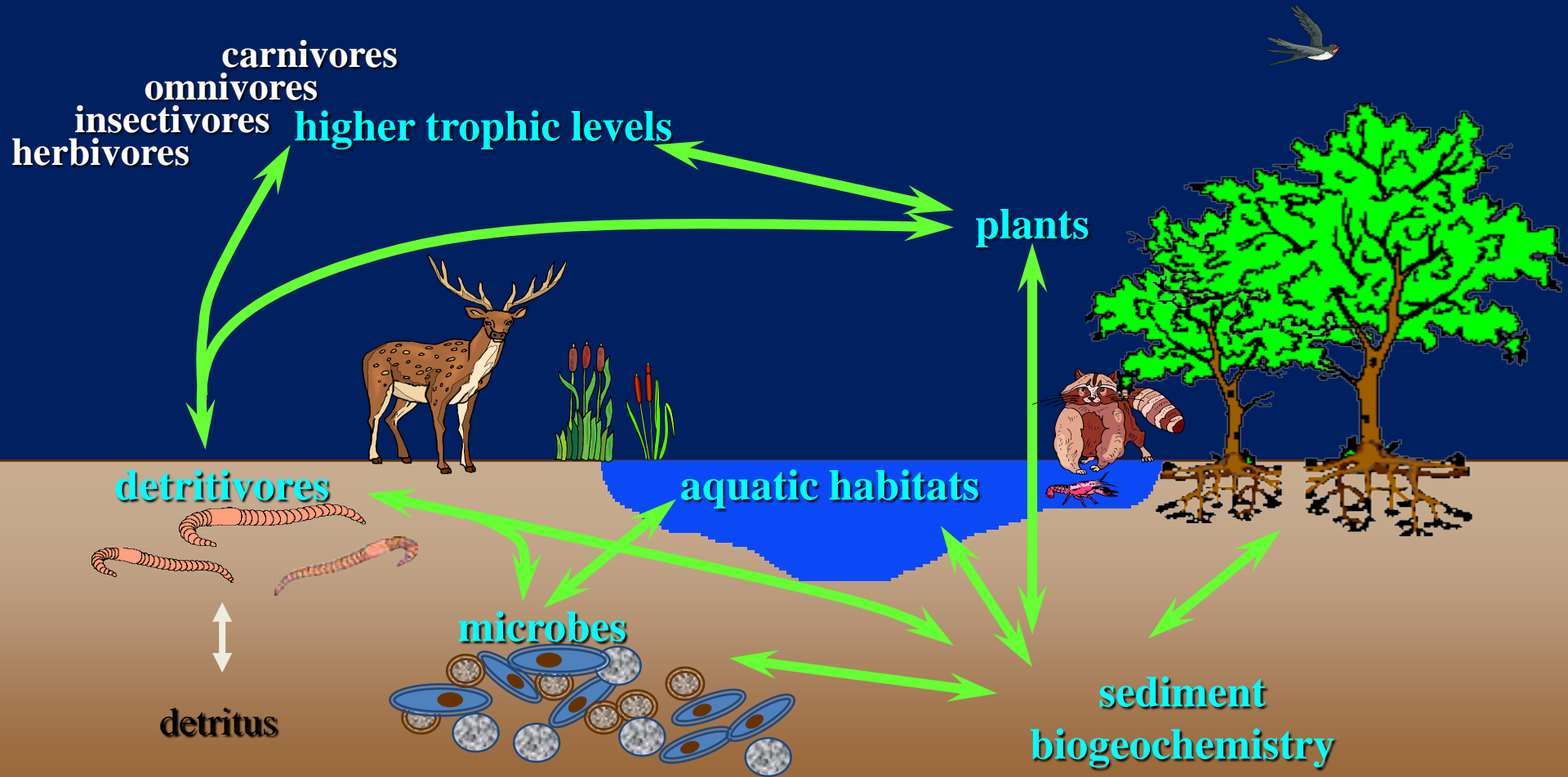
# Types of Projects off SRS

- **Radioecology (US, Belarus and Japan) (NSF, NRC)**
- **Metal Toxicology (Mercury, Copper, Cadmium) (USFWS)**
- **Contaminant Accumulation in Wildlife Species (DoD, COE)**
- **Scavenging Ecology and Food Web Dynamics (DoD, USDA)**
- **Reintroduction of Threatened/Endangered Species (USGS, DoD)**
- **Wildlife Ecology and Management (USDA, State Agencies, DoD)**
- **Disease Ecology (Ticks, Mosquitoes, Rabies, etc.) (USDA, EPA)**
- **Genomics, Proteomics, Epigenetics, and Glycomics (NSF, NIH)**

# Ecological Impacts of Contaminants



# Ecosystems Approach to Ecotoxicology





# The performance of a young wetland

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## ARTICLE INFO

Keywords:  
 Constructed wetland  
 Design  
 Model calibration  
 Model efficiency  
 etc.

## 1. Introduction

Constructed wetlands are water treatment, wastewater treatment, and stormwater management systems that replicate natural wetland processes to improve water quality and provide ecosystem services (Crittenden et al., 2012). Constructed wetlands are used to improve water quality in agriculture, industry, and municipal wastewater treatment plants (Crittenden et al., 2012). Constructed wetlands are used to improve water quality in agriculture, industry, and municipal wastewater treatment plants (Crittenden et al., 2012).

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# Science of the Total Environment

## Removal of low levels of elements – Implication

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<sup>b</sup> Department of Aquatic Biology, University of South Carolina, USA

## ARTICLE INFO

- Keywords: Constructed wetland; Design; Model calibration; Model efficiency; etc.

## 1. Introduction

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# Science of the Total Environment

## Effects of industrial disturbances on beetles

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## ARTICLE INFO

- Keywords: Industrial disturbance; Beetle; Distribution; Diversity; etc.

## 1. Introduction

Industrial disturbances are water treatment, and stormwater management systems that replicate natural wetland processes to improve water quality and provide ecosystem services (Crittenden et al., 2012). Industrial disturbances are used to improve water quality in agriculture, industry, and municipal wastewater treatment plants (Crittenden et al., 2012).

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# Environment International

Journal homepage: [www.elsevier.com/locate/EnvironmentInternational](http://www.elsevier.com/locate/EnvironmentInternational)

## Radioisotope (<sup>137</sup>Cs) accumulation by fish within a legacy reactor cooling canal system on the Savannah River Site

Christina M. Fugbun<sup>a,c</sup>, Elizabeth R. O'Rourke<sup>a</sup>, James C. Loehart<sup>a</sup>, Aaron M. Kozmar<sup>a</sup>, James C. Braley<sup>a,b</sup>, A. Lawrence Bryan<sup>a,b</sup>

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## ARTICLE INFO

Keywords:  
 Fish  
 Radioisotope  
 Accumulation  
 etc.

## ABSTRACT

The aquatic cooling canal system associated with a nuclear reactor built in the early 1950s formed an isolated source of radioisotopes (<sup>137</sup>Cs) that did not occur before 1964 and 1964, resulting in the deposition of <sup>137</sup>Cs to the canal system. The primary purpose of this study was to determine the accumulation of <sup>137</sup>Cs in aquatic organisms from the cooling canal system. A total of 21 organisms, in 10 different locations, were sampled during June 2016. Organisms, including fish, were sampled for potential exposure to <sup>137</sup>Cs. The mean concentration of <sup>137</sup>Cs in fish was 1.1 Bq kg<sup>-1</sup> (range 0.1–4.1 Bq kg<sup>-1</sup>). The mean concentration of <sup>137</sup>Cs in aquatic organisms was 1.1 Bq kg<sup>-1</sup> (range 0.1–4.1 Bq kg<sup>-1</sup>). The mean concentration of <sup>137</sup>Cs in aquatic organisms was 1.1 Bq kg<sup>-1</sup> (range 0.1–4.1 Bq kg<sup>-1</sup>). The mean concentration of <sup>137</sup>Cs in aquatic organisms was 1.1 Bq kg<sup>-1</sup> (range 0.1–4.1 Bq kg<sup>-1</sup>).

## 1. Introduction

Radioisotope (<sup>137</sup>Cs) accumulation by fish has been widely documented in large water bodies, but little is understood about small, isolated aquatic systems (e.g., complex systems, wetlands, and streams) (e.g., water treatment, wastewater, and stormwater treatment plants) (Crittenden et al., 2012). Radioisotope (<sup>137</sup>Cs) accumulation by fish has been widely documented in large water bodies, but little is understood about small, isolated aquatic systems (e.g., complex systems, wetlands, and streams) (e.g., water treatment, wastewater, and stormwater treatment plants) (Crittenden et al., 2012).

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\* This journal has been recommended by the International Association of Agricultural and Fisheries Scientists (IAAFS). For more information, please contact: [iaafs@iaafs.org](mailto:iaafs@iaafs.org). The journal is also recommended by the International Association of Agricultural and Fisheries Scientists (IAAFS). For more information, please contact: [iaafs@iaafs.org](mailto:iaafs@iaafs.org).

## Sediment and Biota Trace Element Distribution in Streams Disturbed by Upland Industrial Activity

Dean E. Fletchler<sup>1</sup>, Angela L. Lindell<sup>1</sup>, John C. Salonen<sup>2</sup>, Paul T. Gunkel<sup>3</sup>, Nathaniel D. Finkbein<sup>4</sup>, Christopher D. Narkin<sup>5</sup>, Richard A. Benfield<sup>6</sup>, and J. Van Mulbregt<sup>6</sup>

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**Abstract:** Extensive industrial areas in headwater stream watersheds can severely impact the physical condition of streams and stream biota. We compared 3 streams that received stormwater runoff and industrial effluents from industrial complexes to 3 reference streams. Reference streams provide a benchmark of composition, form and stability in stream plan, and biota. We measured trace elements in sediment and biota in the absence of industrial disturbance. We used crayfish (*Decapoda leucostriata*, *Procambarus carolinensis*, *Procambarus aculeatus* and *Palaemonetes pugio*) as biomonitors of 15 trace elements entering aquatic food webs. Streams with industrial areas were more acidic, steeply inclined, and less stable. Sediment organic matter content broadly correlated to trace element accumulation, but fine sediments and organic matter were pooled from the bottoms of disturbed streams. Trace element concentrations were higher in depositional zones than in upland streams. Despite streamflow increases in the headwaters, trace element concentrations were generally not elevated in sediments of the middle streams. However, element concentrations were frequently elevated in biota from these streams with increasing distance in streamflow amplified. In wooded, sand-bottomed coastal plain streams with variable sediments, single invertebrates of sediment trace element concentrations did not effectively well bioavailable trace elements. If we that invertebrates exposed to the food web and avoid when they found higher better bioavailable concentrations than sediments. Environ Toxicol Chem 2014;33:115–121. © 2014 SETAC.

**Keywords:** Stream; Aquatic invertebrates; Bioaccumulation; Sediment assessment; Trace elements; Stormwater runoff

### INTRODUCTION

Streams and rivers draining watersheds with industrial urban areas act as vectors for dispersal of contaminants from these areas (Taylor and Owens 2009). Downstream elements in non-point-source runoff from impervious surfaces can originate from numerous sources associated with buildings, automobile components, pavement, and land use, the source can be from the nearby environment or from atmospheric deposition that is subsequently washed off by rain (Paul and Meyer 2001, Davis et al. 2003, Walsh et al. 2005, Casey et al. 2006). Point sources such as industrial effluents or water treatment plants can further introduce a variety of contaminants into streams. For example, occurrence of total phosphorus loads in watersheds has required aquatic organisms to tolerate levels of a variety of elements not

only at the Sewanee River Site, South Carolina, USA, where the present study was conducted, but worldwide (How et al. 2002, Ruhl et al. 2012, Howe 2014). Consequently, the broad number of contaminants present in watersheds receiving both runoff from impervious surfaces and industrial effluents can result in contamination by a broad variety of trace elements. Surface runoff from impervious surfaces associated with urban areas can result in low flows with high velocity and increased runoff volume and peak flows that in turn cause bottom siltation, channel incision, and subsequent deposition, reducing overall channel stability (Paul and Meyer 2001, Walsh et al. 2005). This channel instability can result in fine sediments and associated contaminants being mobilized and relocated during rain events (Taylor and Owens 2009). Large-scale industrial complexes in upland areas may have similar effects on watersheds as urban areas. Outgoing contaminants in sediment and biota will provide critical information on concentrations that are stored in or have passed through a stream.

Contaminants in stream water may be low or even barely detectable but a few accumulate to higher levels in sediments

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Article

## From Farms to Forests: Landscape Carbon Balance after 50 Years of Afforestation, Harvesting, and Prescribed Fire

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**Abstract:** Investigating landscape carbon balances are landowners desiring to maintain carbon sequestration and identify opportunities to mitigate land management impacts on carbon balance is important; however, national and regional assessments are not designed to support individual landowners. Such landowners become increasingly valuable when landowners convert land use, change management, or when disturbance occurs. We used forest inventories to quantify carbon stocks, net ecosystem carbon fluxes, and determine net biomass production (NBP) over a 50-year period coinciding with a massive afforestation effort across ~80,000 ha of land in the South Carolina Coastal Plain. Forested land increased from 48,714 ha to 73,824 ha between 1951 and 2001. Total forest biomass increased from 1.73–3.03 Gg to 37.4–18.3 Gg, corresponding to biomass density increases from 35.4–62.2 Mg ha<sup>-1</sup> to 231.4–240.0 Mg ha<sup>-1</sup>. Harvesting removed 1340.3 Gg C between 1955 and 2001, but annual removals were variable. Fire consumed 527.1 Gg C between 1952 and 2001. Carbon exported by streams was <0.5% of total export. Carbon from roots and other harvested material that remained in-use or in landfills comprised 49.7% of total harvested carbon. Mineral soil carbon accounted for 41.6 to 50% of 2001 carbon stocks when measuring depths of 1.0 or 1.5 m, respectively, and was disproportionately concentrated in wetlands. Moreover we identified a soil carbon deficit of 39–20 Mg C ha<sup>-1</sup>, suggesting opportunities for future soil carbon sequestration in post-agricultural soils. Our results provide a robust baseline for this site that can be used to understand how land conversion, forest management, and disturbance impact carbon balance of the landscape and highlight the value of forest biomass data for other sites. Our work also identifies the need to manage forests for multiple purposes especially protection of soil carbon accumulation in low-density pine plantations that are managed for red-cockaded woodpecker and therefore demand low aboveground carbon stocks.

**Keywords:** agriculture change; biomass; carbon cycle; carbon sequestration; inventory; restoration; soil carbon

### 1. Introduction

The southeastern USA is an important region for assessing temporal dynamics of carbon (C) stocks in response to both management and natural processes. This region contains about 10% of total C stocks and produces over 60% of total forest products in the USA (Liu, 2012). Net C sequestration in southeastern USA exceeds most other regions but is expected to decline in the next few decades, primarily due to forest aging and conversion to urban and non-agricultural development (Liu). Overall,

# Wildlife Movement, Behavior, Diseases, and Ecotoxicology





## Examining the Effect of Used Stress Parasitism on *mississippiensis*

John W. Finger Jr.<sup>1,2,3,4</sup> · Tracy D. Taborville<sup>1</sup>

Received: 11 December 2016 / Accepted: 16 September 2017 / Published online: 16 October 2017

**Abstract**  
Environmental contaminants from potential pathogens (OCs, stress hormones), to morphology (variation of) ... So affects OCs have been ... of long-term to exposure ... to maintain in United States ... and had prey spiked with ... Following the 7-week test ... the main (oxidation OC), ... body condition. To evaluate ... (fluorescence) study was ... was more CORT. Our ... and body condition in the ...

Many environmental stressors in wildlife due to their (oxidation OCs), (Huglin 2010), the stress hormone that is considered the stress hormone, and/or prey the ...

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## Efficiency and composite interface in the Chemobyl

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<sup>2</sup> University of California, Davis, CA, USA

### KEYWORDS

Chemobyl  
Efficiency  
Composite interface  
Chemobyl

Keywords  
Chemobyl  
Efficiency  
Composite interface  
Chemobyl



## Variation in metal tolerance associated Southern toads (*Anaxyrus terrestris*)

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### ARTICLE INFO

Keywords  
Southern toads  
Metal tolerance  
Variation

### ABSTRACT

Keywords  
Southern toads  
Metal tolerance  
Variation

### 1. Introduction

Environmental contaminants are widespread in aquatic food webs and have the potential to affect the health of aquatic organisms (Flynn and Lovv 2016). The potential for contaminants to affect the health of aquatic organisms is a function of the chemical properties of the contaminants, the exposure routes, and the sensitivity of the organisms to the contaminants (Flynn and Lovv 2016). The potential for contaminants to affect the health of aquatic organisms is a function of the chemical properties of the contaminants, the exposure routes, and the sensitivity of the organisms to the contaminants (Flynn and Lovv 2016).

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Keywords  
Southern toads  
Metal tolerance  
Variation



## Ecotoxicoparasitology of mesomammals and their endoparasites

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### KEYWORDS

Ecotoxicoparasitology  
Mesomammals  
Endoparasites

Keywords  
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### ARTICLE INFO

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Keywords  
Ecotoxicoparasitology  
Mesomammals  
Endoparasites



## Effects of methylmercury on mosquito oviposition behavior: Maladaprive response to non-toxic exposure

Eric Nell<sup>1,2</sup>, Austin L. Coleman<sup>1</sup>, Ripe W. Malone<sup>1</sup>, Maestre Yaneche<sup>1</sup>, Xiaoyu Xu<sup>1</sup>, Gaby Dhammarajan<sup>1</sup>

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Keywords  
Methylmercury  
Mosquito oviposition  
Behavior

### KEYWORDS

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Behavior

### GRAPHICAL ABSTRACT



### ARTICLE INFO

Keywords  
Methylmercury  
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Keywords  
Methylmercury  
Mosquito oviposition  
Behavior



# Where Have All the Turtles Gone, and Why Does It Matter?

JEFFREY S. LONCH, JOSHUA N. LINDIN, MICKY RICH, AND J. WHITFIELD GIBBONS

Of the 343 species of turtles worldwide, approximately 47% are threatened or already extinct. Turtles are among the most threatened of the major groups of vertebrates, in general more so than birds, mammals, fishes or even the much larger amphibians. Factors for the high extinction of turtles worldwide include the limited size of habitats in other species including habitat destruction, unsustainable overexploitation for pet and food, and climate change (water turtles face environmental sea level rise). Two notable characteristics of pet and food turtles were their mature population sizes and corresponding high turnover, the latter among the highest rates (over 400 individuals per female) ever reported for animals. As a result of their numerical dominance, turtles have played important roles in significant components of such abundant sources of sea foods, fisheries and provisioning industries of local, national, global, and commercial. The collapse of turtle populations in a global scale has greatly diminished their ecological roles.

Keywords: biomass, ecological engineers, freshwater species, turtles, longevity

Turtles are so universally recognized by virtually all cultures and age groups that it is easy to see them as merely commonplace animals, even though there are 325 turtle species. This pervasive status makes them easy to take for granted or even overlook as important ecosystem components worthy of protection. The word turtle applies to all animals with a bony shell and a backbone, whether they are locally referred to as turtles, tortoises, or terrapins (Frost and Lovich 2009). That such remarkable and familiar animals are considered by many to be ordinary is unfortunate, because no vertebrate animal that has ever lived has possessed the unique architecture of turtles, with their bony plates and pliable bony shell. As previous paleontologists have noted, if they were known only from fossils, they would be easy to misread. Turtles are an ancient group going back over 300 million years (Frost and Lovich 2009). Their enduring success is due in no small part to a conservative morphology and slow-paced adaptation that allowed them to survive over the decades, which despite 60 over 95 million years ago when turtles were already an old lineage.

Turtles are struggling to persist in the modern world and that fact is generally unappreciated or even ignored. Scientists identify 18 living families and many extant ones. As of 2017, 26 turtle species were recognized worldwide (Turtle Taxonomy Working Group 2017), of which approximately 47% are threatened or have become extinct in modern times. Turtles are arguably the most threatened of the major groups of vertebrates in general and are proportionately more so than fish, mammals, birds or even the much larger and so

heavily publicized amphibians (Hoffmann et al. 2016). The vulnerability of turtles, in part, is due to a global focus by conservation programs to identify and target what the protected birds and mammals but do not adequately consider turtle diversity (Jell et al. 2017).

Specific examples of the recent plight of turtles are exemplified by several species worldwide. For example, some turtle species are no longer found in their natural habitat and exist only in zoos. One such species, the Yangtze giant softshell turtle (*Apalone muticus*) is reduced to perhaps five or six living individuals and this one is known to be a female. For the past 8 or more years, she has not produced fertile eggs, despite international efforts to propagate the species, including the use of artificial insemination. Others, such as the beautiful Hawaiian monk seals (*Monachus monachus*) and the leatherback sea turtles (*Dermochelys coriacea*) require international efforts to propagate the species, including the use of artificial insemination. Others, such as the beautiful Hainan star tortoise (*Geochelone platynota*) and the leatherback sea turtles (*Dermochelys coriacea*) require international efforts to propagate the species, including the use of artificial insemination. Others, such as the beautiful Hainan star tortoise (*Geochelone platynota*) and the leatherback sea turtles (*Dermochelys coriacea*) require international efforts to propagate the species, including the use of artificial insemination. Others, such as the beautiful Hainan star tortoise (*Geochelone platynota*) and the leatherback sea turtles (*Dermochelys coriacea*) require international efforts to propagate the species, including the use of artificial insemination.

Reasons for the dire situation of turtles worldwide include the familiar list of impacts in other species (Gibbons et al. 2009) including habitat destruction, unsustainable overexploitation for food and the commercial pet trade, and climate change (water turtles face environmental sea level rise). These have also contributed to the rapid

## Research Article

# Survival and Movements of Head-Started Mojave Desert Tortoises

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CLYDE W. MOORE<sup>4</sup>, US Geological Survey, Georgia Cooperative Fish and Wildlife Research Unit, University of Georgia, Athens, GA 30602, USA  
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**ABSTRACT:** Head-starting is a conservation strategy in which young animals are protected in captivity temporarily before their release into the wild in a larger size, when their survival is presumably increased. The Mojave desert tortoise (*Gopherus agassizii*) is declining, and head-starting has been identified as one of several conservation measures to assist in recovery. To evaluate the efficacy of captive head-starting, we released and radio-tracked 48 juvenile tortoises from a 2015 cohort at the Mojave National Preserve, California, USA. We released 20 tortoises at hatching (October) in September 2015, and reared 28 indoors and 20 outdoors in pre-release enclosures for 7 months before releasing them in April 2016. We monitored tortoises at least weekly after release until 27 October 2016, and documented survivorship, movement, and activity levels. We estimated survivorship by maximum likelihood estimates of movement, proximity to a river (Carrizo Creek) and population, conditionally established when release, distance moved, between monitoring events, surface activity, and release size on individual fine to a generalized linear model. Although indoor head-started tortoises reached the size of 3–6-year-old wild tortoises by about 7 months of age, survival did not differ significantly among the 3 release groups. Conditional annual survival was 0.44 (95% CI = 0.24–0.58). Tortoises that were closer to an active river and less significantly more likely to die, as were those seen more often outside their burrows and active aboveground. Predicted estimates for short-term probability of survival approached 1.0 at distance from a river and occurred approximately 1–6 km. Releasing tortoises, movement distance, and body size were not significant predictors of fate over the 1-year monitoring period. Head-started tortoises released 21.6 km from areas of river activity will likely have higher short-term survival. Population recovery through head-starting alone is unlikely to be successful if systemic ecosystem-level issues, such as habitat degradation and conditions that prevent burrow-dwelling predators, are not addressed. © 2019 The Wildlife Society.

KEY WORDS: California, conservation, desert tortoise, endangered species, head-start, Mojave Desert, population augmentation, species recovery, terrestrial snail, turtle.

Population interventions are often controversial in species recovery both because outcomes of such measures are difficult to predict (Sedell et al. 2014) and are inadequately measured and reported. With ever-increasing anthropogenic effects on wildlife populations, however, interventions may be necessary in present situations. In recent years, there has been interest in reintroducing extirpated species (e.g., black-footed ferret [*Mustela nigripes*] Miller et al. 1994), halibut dispersal to respond to climate change (McLachlan et al. 2007; Howitt et al. 2011; Sedell et al. 2014), and augmenting small

populations (e.g., Kemp's ridley sea turtle [*Legallia chelonioides*] Caldwell et al. 2015).

Head-starting is one approach to population augmentation that involves protecting and rearing animals through early life stages when they are typically most vulnerable before releasing them into the natural environment at a more advanced state of development when survival is presumably greater (Ribeiro 2013). Head-starting has been a useful conservation tool for several species, including California condors ( *Gymnogyps californianus*; Cahn 1999), rock ptarmigan (*Gallus oregonus*; Wirthmanna et al. 2008), Galapagos tortoise ( *Galapagos tortoise*; Gibbons et al. 2014), and Hawaiian monk seals ( *Monachus monachus*; Hoffmann et al. 2015). Condors, the most threatened group of vertebrates globally (Stratford et al. 2018), may be uniquely suited to head-starting because survivorship in the wild is typically low in early life and high during additional order most

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