PFAS Exposure Pathways and Ecological Toxicity: Current Knowledge and Research Funding Priorities in New Mexico

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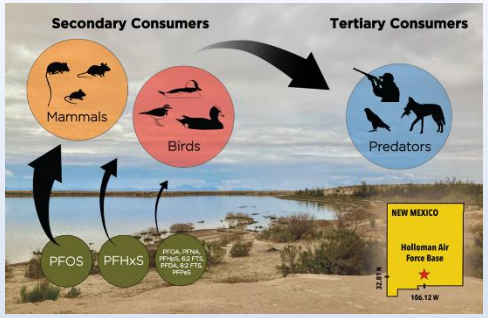
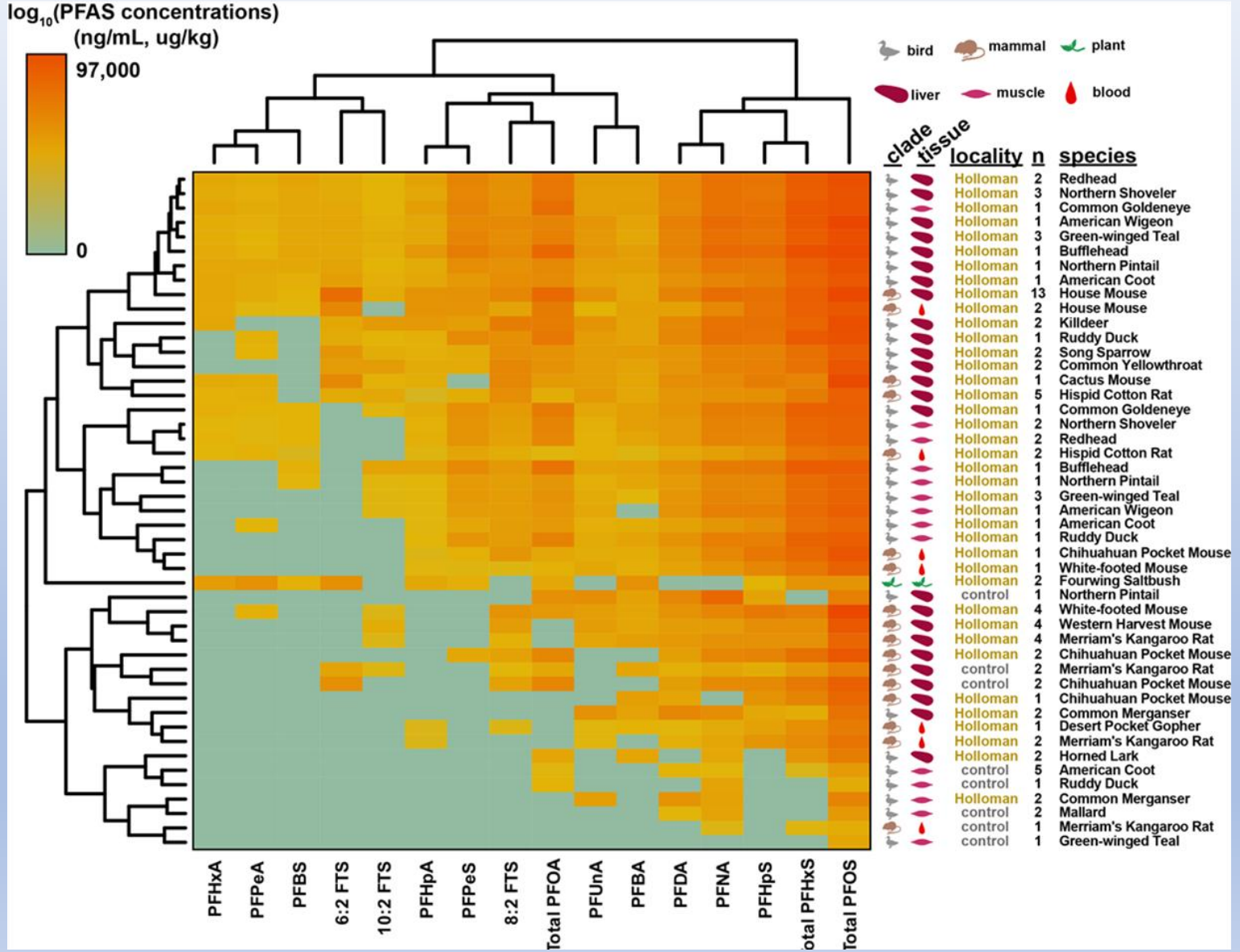


Extraordinary PFAS contamination levels in Holloman Lake wildlife



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Extraordinary levels of per- and polyfluoroalkyl substances (PFAS) in vertebrate animals at a New Mexico desert oasis: Multiple pathways for wildlife and human exposure

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ABSTRACT

Per- and polyfluoroalkyl substances (PFAS) in the environment pose persistent and complex threats to human and wildlife health. Around the world, PFAS point sources such as military bases expose thousands of populations of wildlife and game species, with potentially far-reaching implications for population and ecosystem health. But few studies shed light on the extent to which PFAS permeate food webs, particularly ecologically and taxonomically diverse communities of primary and secondary consumers. Here we conducted >2000 assays to measure tissue-concentrations of 17 PFAS in 23 species of mammals and migratory birds at Holloman Air Force Base (AFB), New Mexico, USA, where wastewater catchment lakes form biodiverse oases. PFAS concentrations were among the highest reported in animal tissues, and high levels have persisted for at least three decades. Twenty of 23 species sampled at Holloman AFB were heavily contaminated, representing middle trophic levels and wetland to desert microhabitats, implicating pathways for PFAS uptake: ingestion of surface water, sediments, and soil; foraging on aquatic invertebrates and plants; and preying upon birds or mammals. The hazardous long carbon-chain form, perfluorooctanosulfonic acid (PFOS), was most abundant, with liver concentrations averaging >10,000 ng/g wet weight (ww) in birds and mammals, respectively, and reaching as high 97,000 ng/g ww in a 1994 specimen. Perfluorohexanesulfonic acid (PFHxS) averaged thousands of ng/g ww in the livers of aquatic birds and littoral-zone house mice, but one order of magnitude lower in the livers of upland desert rodent species. Piscivores and upland desert songbirds were relatively uncontaminated. At control sites, PFAS levels were strikingly lower on average and different in composition. In sum, legacy PFAS at this desert oasis have permeated local aquatic and terrestrial food webs across decades, severely contaminating populations of resident and migrant animals, and exposing people via game meat consumption and outdoor recreation.

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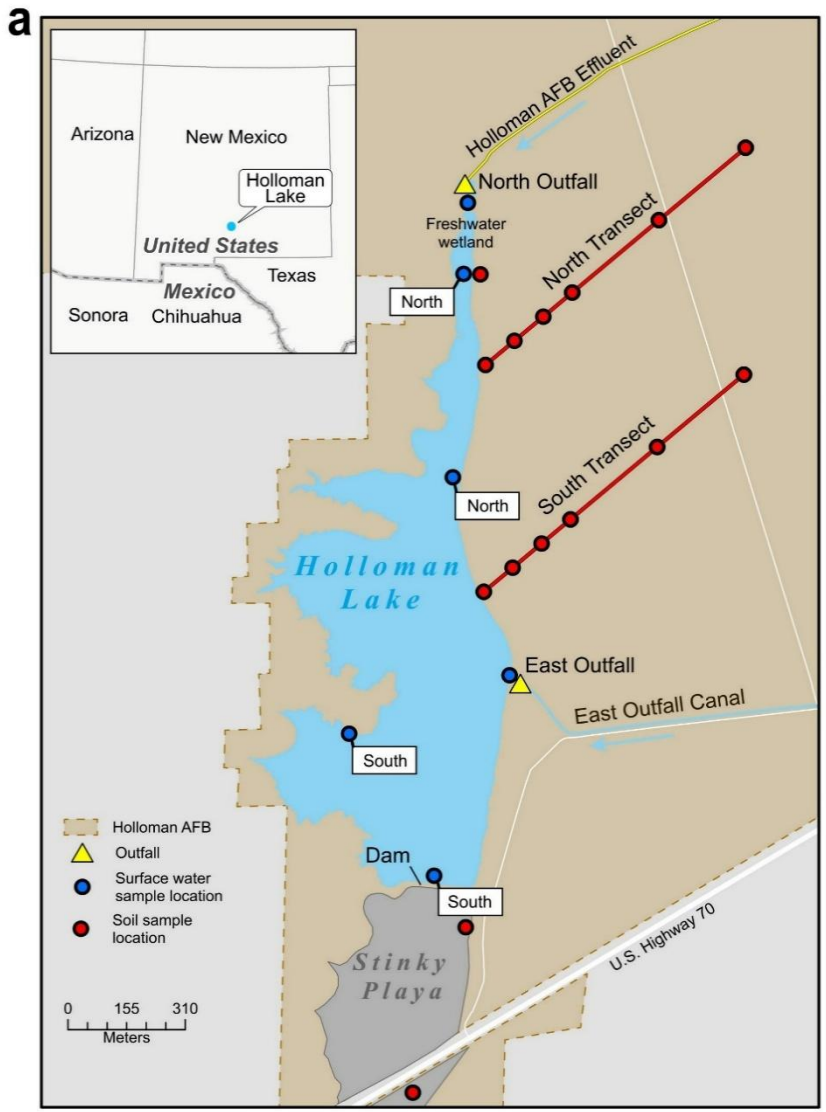
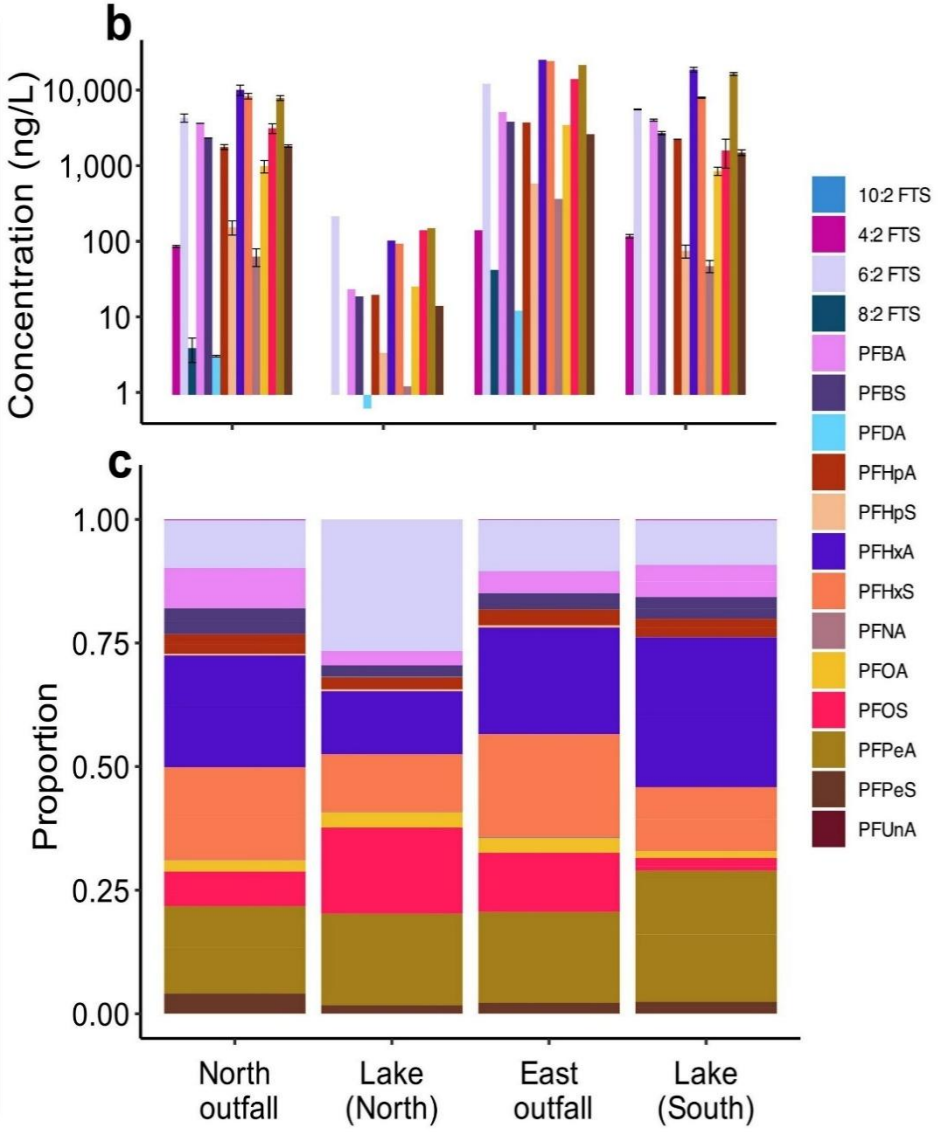
Chemical	Proposed MCL
PFOA	4 ppt
PFOS	4 ppt
PFNA	1.0 (unitless)
HFPO-DA (GenX)	Hazard index
PFHxS	
PFBS	

PFAS are pervasive throughout the entire Holloman Lake ecosystem





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ELSEVIER

Ecosystem-wide PFAS characterization and environmental behavior at a heavily contaminated desert oasis in the southwestern U.S.

Jean-Luc E. Cartron, Chauncey R. Gadek, Jonathan L. Dunnum, Christopher C. Witt, Mariel L. Campbell, Samuel J. Romero, Andrew B. Johnson, Julie Kutz, Christopher Wolf, Sarah J. Choyke, Joseph A. Cook

ARTICLE INFO

ABSTRACT

1. Introduction

Ongoing Research: Risk/Damage Assessment

1. Study of PFAS contamination in ducks and geese at the scale of New Mexico (funded by NMED through 2024, with additional private funds)

2. Study of PFAS contamination in oryx (in partnership with the New Mexico Department of Game and Fish)

Ongoing Research: Risk/Damage Assessment

3. PFAS contamination of regional playas (Maki Foundation grant; BLM assistance)

4. PFAS contamination along Tijeras Arroyo (UNM Graduate Studies grant)

Ongoing Research: Risk/Damage Assessment

5. Study of metabolic and immune toxicity in Holloman Lake wildlife (T&E Foundation grant)

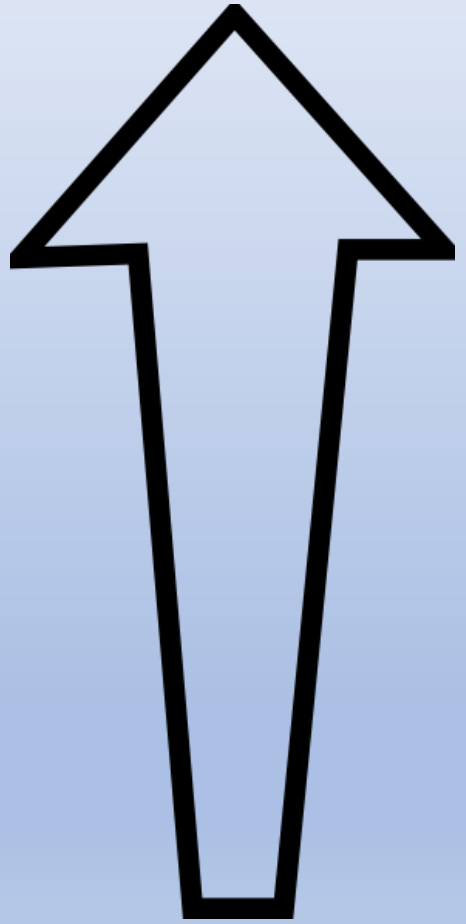
6. Developmental toxicity in shorebirds at Holloman Lake (with Audubon Society)

Functioning ecosystem?

Animal PFAS toxicity

Toxicity = f (Exposure, Toxicodynamics)
Exposure = f (Dose, Time)

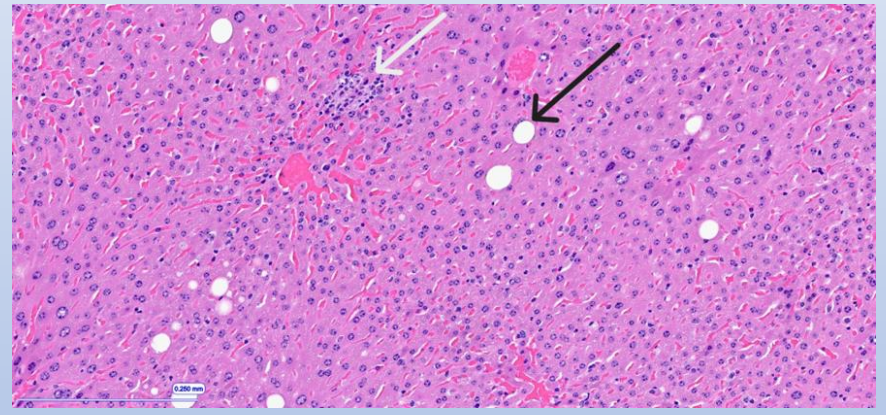
Liver, hormonal, reproductive, developmental, metabolic, and immune toxicity; liver, pancreatic, and testicular tumors in lab animal studies



120,000 ng/g (liver)

1000s-10,000s ng/g

+



100s ng/g (egg) 20 percent decrease in hatching success (tree swallows)

ng/g (liver) Disruptions of amino acid and lipid metabolism, energy production, and oxidative stress response; altered egg composition; hatchling deformities (turtles)

With T&E Foundation funding, in collaboration with VDS

Metabolic and Immune Toxicity

Animal Necropsies
Histopathology
Lipidomics
PFAS Testing

Control, blind study
Three Groups of rodents:
- Holloman Lake
- Control Group
- PFAS-free Site

Two rodent species

In collaboration with the Audubon Society

Developmental toxicity

Nest searches and remote camera monitoring

Necropsies

Histopathology

Lipidomics

Thank you!!

For more information, please contact me:

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