



Woody Plant Water Use on Rangelands

Jim Ansley

Professor and Department Head

Natural Resource Ecology and Management

Oklahoma State University



DEPARTMENT OF
**NATURAL RESOURCE
ECOLOGY AND MANAGEMENT**

Woody Plant Water Use on Rangelands

Leaf or Sap Flow Measurements Upscaled to Whole Plant



Mesquite leaf transpiration and photosynthesis using Licor leaf chamber devices



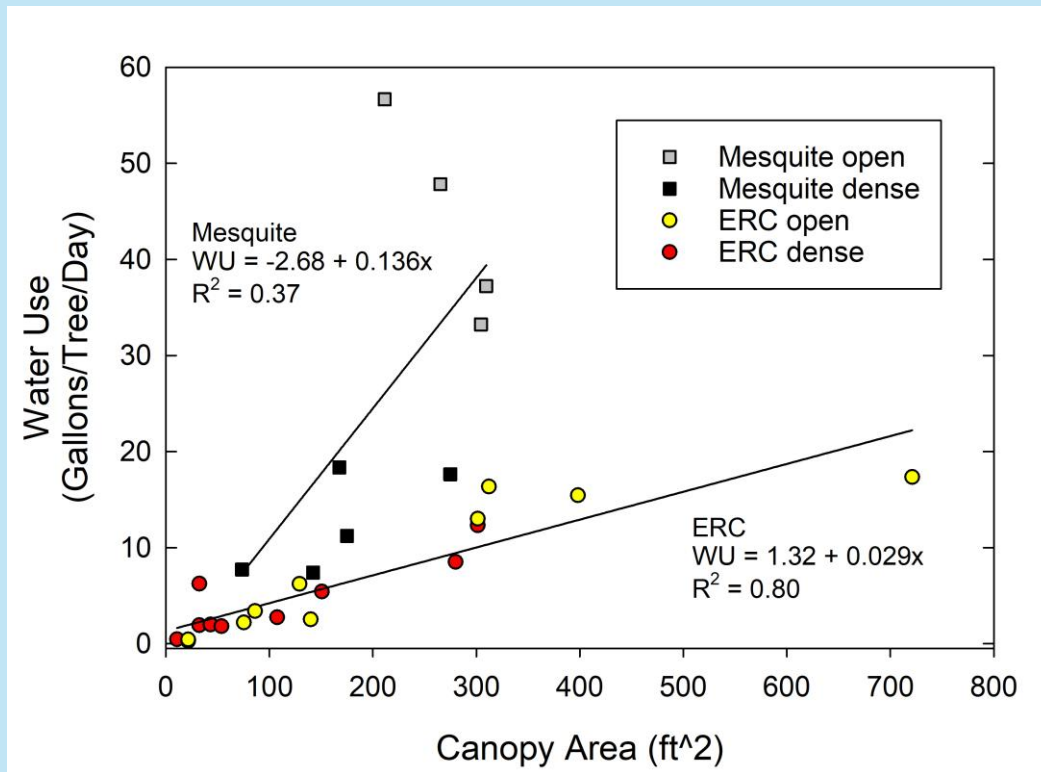
Mesquite Transpiration by Sap Flow using Dynamax SGB Gauges



Eastern Redcedar Transpiration by Sap Flow using Thermal Dissipation Probes

Woody Plant Water Use on Rangelands

Leaf or Stem Flow Measurements Upscaled to Whole Plant



Caterina et al. 2013 – Ecohydrology DOI: 10.1002/eco.1444
Ansley et al. 1998 – J. Range Manage. 51: 345-352

Caterina et al. (2013) - Eastern Redcedar (ERC; *Juniperus virginiana*); Payne Co.; 2011 (dry year)

- Increased water use with canopy size
- No difference between open and dense canopy sites

Ansley et al. (1998) – Mesquite (*Prosopis glandulosa*); North Texas; 1991 (wet year)

- Water use was ~3 times greater by trees in open (12% cover, 30 trees/acre) than dense (40% cover, 120 trees/acre) areas.
- Water use greater in mesquite than ERC (but studies were on different sites and precipitation levels)

Leaf or Stem Flow Measurements Upscaled to Whole Plant Growing Season Estimates

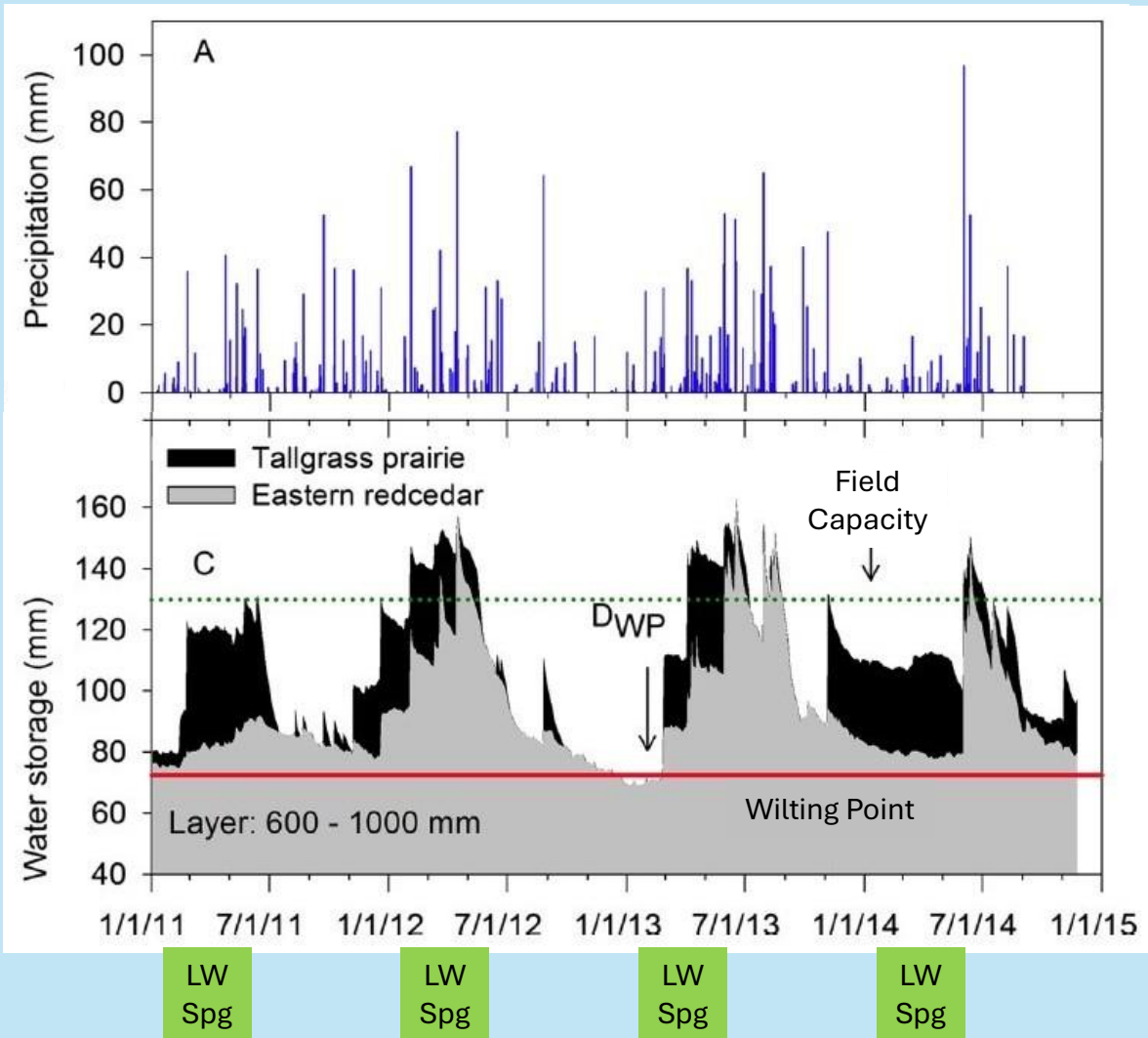
Growing Season (May-Sept.) 1991 – Wet Year

Species	Density ID and Cover %	Density (tr/acre)	Transp Rate (gal/tr/d)	Growing Season Days May-Sept	Water Used by Mesquite (gal/ac/gs)	GS 1991 May-Sept Rainfall (in/gs)	GS 1991 May-Sept Rainfall (ft/gs)	1 Acre-ft Water (gal)	GS 1991 May-Sept Rainfall (gal/ac/gs)	Pct. of Rainfall Used by Mesquite
Mesquite	Open 12%	30	45	150	202,500	29.64	2.47	325,851	804,852	25.2
Mesquite	Dense 40%	120	15	150	270,000	29.64	2.47	325,851	804,852	33.5
						avg 14.5				

Estimates from **Data** from Ansley et al. 1998 – J. Range Manage. 51: 345-352

Water Storage in Soil

Tallgrass vs Eastern Redcedar Encroachment



Western Payne County
January 2011- January 2015
ERC – 75% canopy cover

- Storage greater in grassland in late winter (LW) and spring
- Storage same in late summer

From Archarya et al. 2017. Plant and Soil 414: 379-391
Dr. Chris Zou's lab (NREM-OSU)

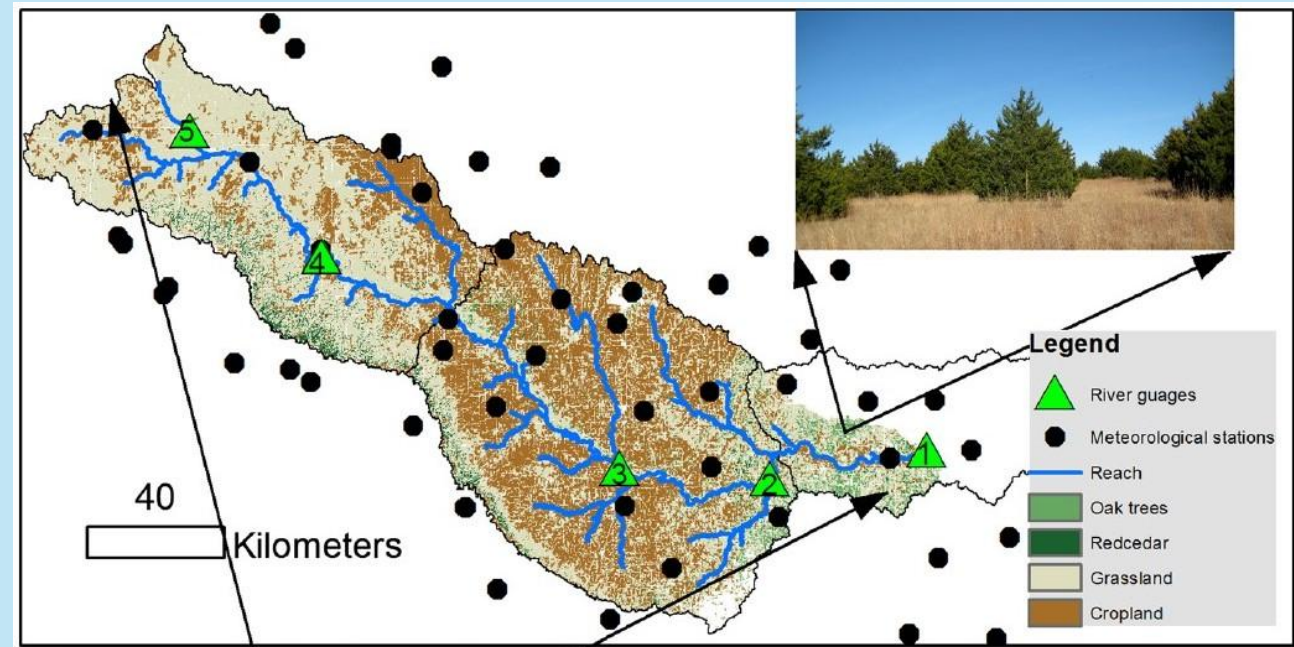


DEPARTMENT OF
**NATURAL RESOURCE
ECOLOGY AND MANAGEMENT**

Regional Scale Streamflow – Eastern Redcedar Effects

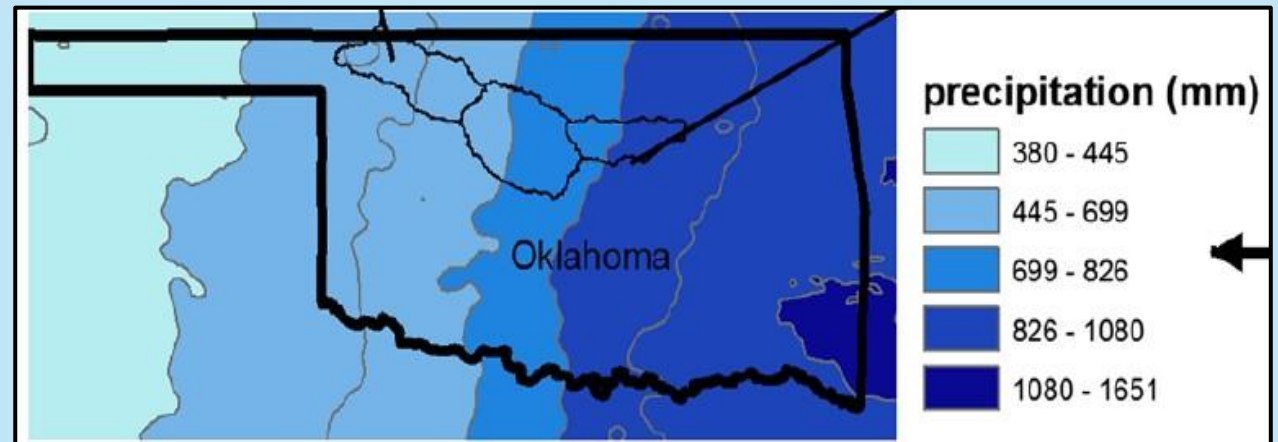
Lower Cimarron River Basin

Used SWAT (Soil and Water Assessment Tool) Model to project water dynamics if ERC went to 100% cover on grassland areas



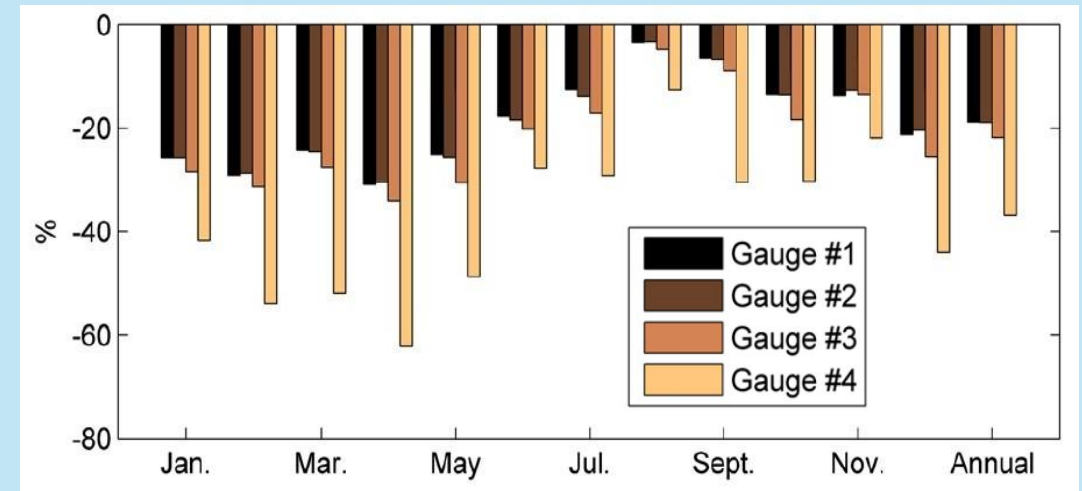
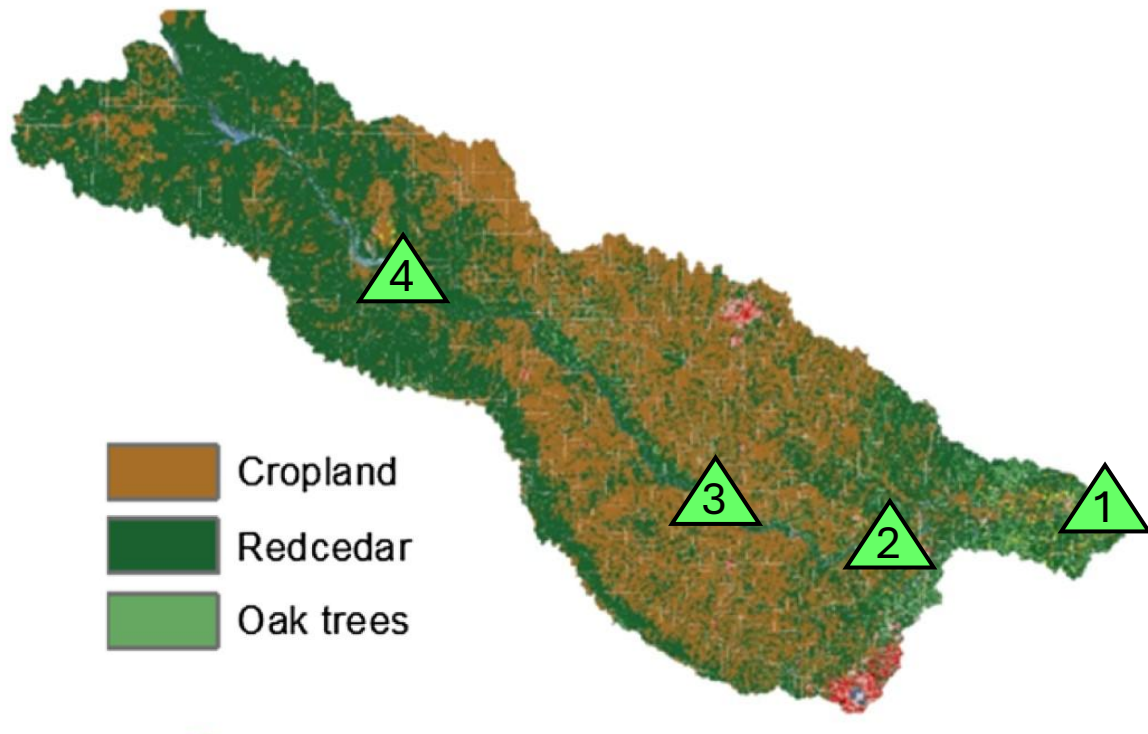
From Zou et al. 2015 – Ecohydrology
DOI: 10.1002/eco.1684

Dr. Chris Zou (NREM-OSU)



Regional Scale Streamflow – Eastern Redcedar Effects

SWAT projection with 100% ERC cover
on grassland areas



Percent change in streamflow
of gauges along Cimarron River

From Zou et al. 2015 – Ecohydrology
DOI: 10.1002/eco.1684

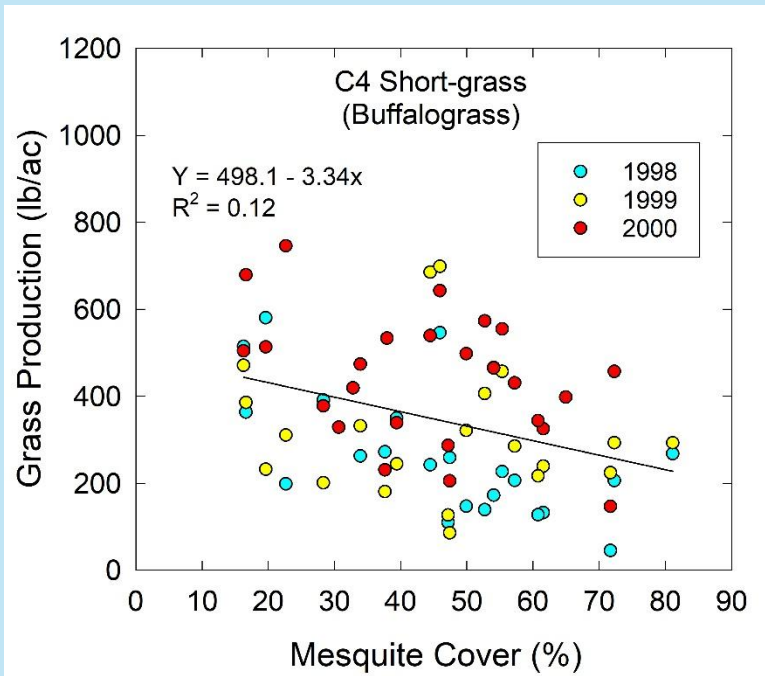


DEPARTMENT OF
**NATURAL RESOURCE
ECOLOGY AND MANAGEMENT**

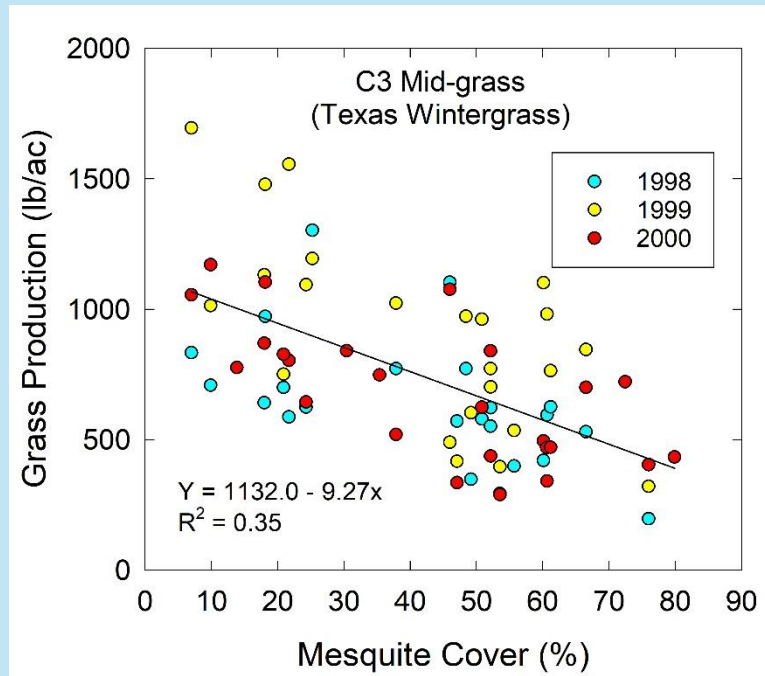
Mesquite Effects on Grass Production

North Central Texas (3 Years Combined)

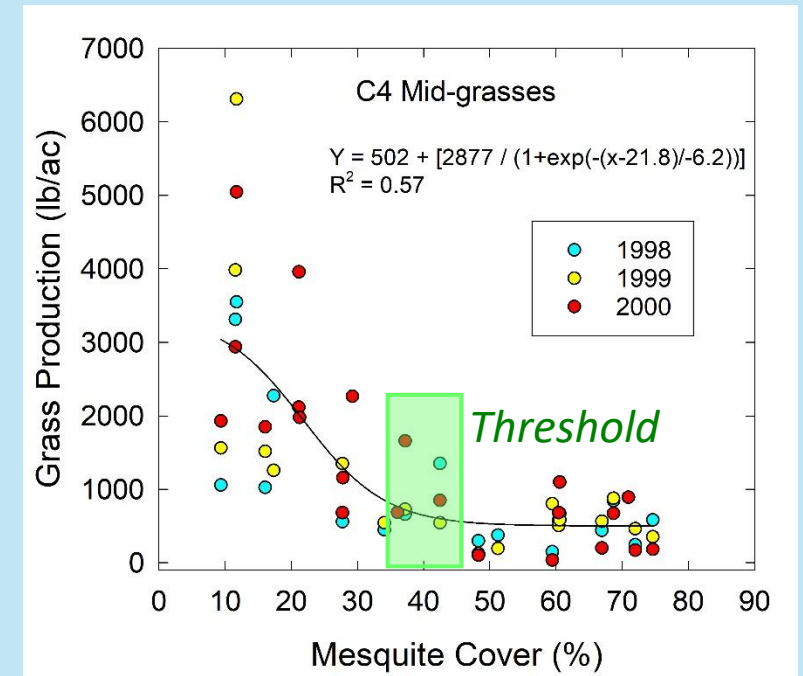
C4 Buffalograss



C3 Texas Wintergrass



C4 Mid-grasses



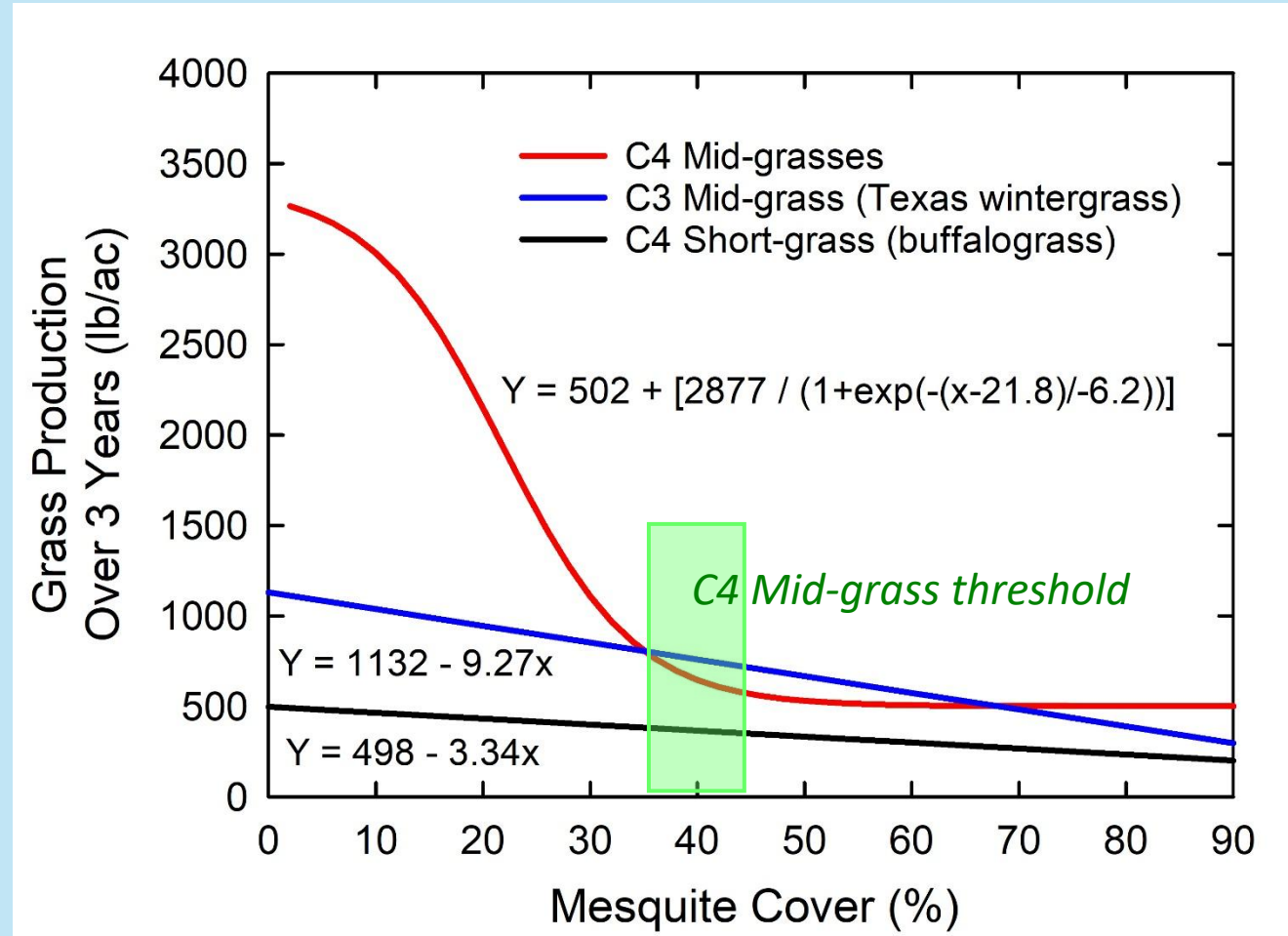
English unit conversion from Ansley et al. 2023,
Rangeland Ecology & Mgmt 90: 279-289



DEPARTMENT OF
**NATURAL RESOURCE
ECOLOGY AND MANAGEMENT**

Mesquite Effects on Grass Production

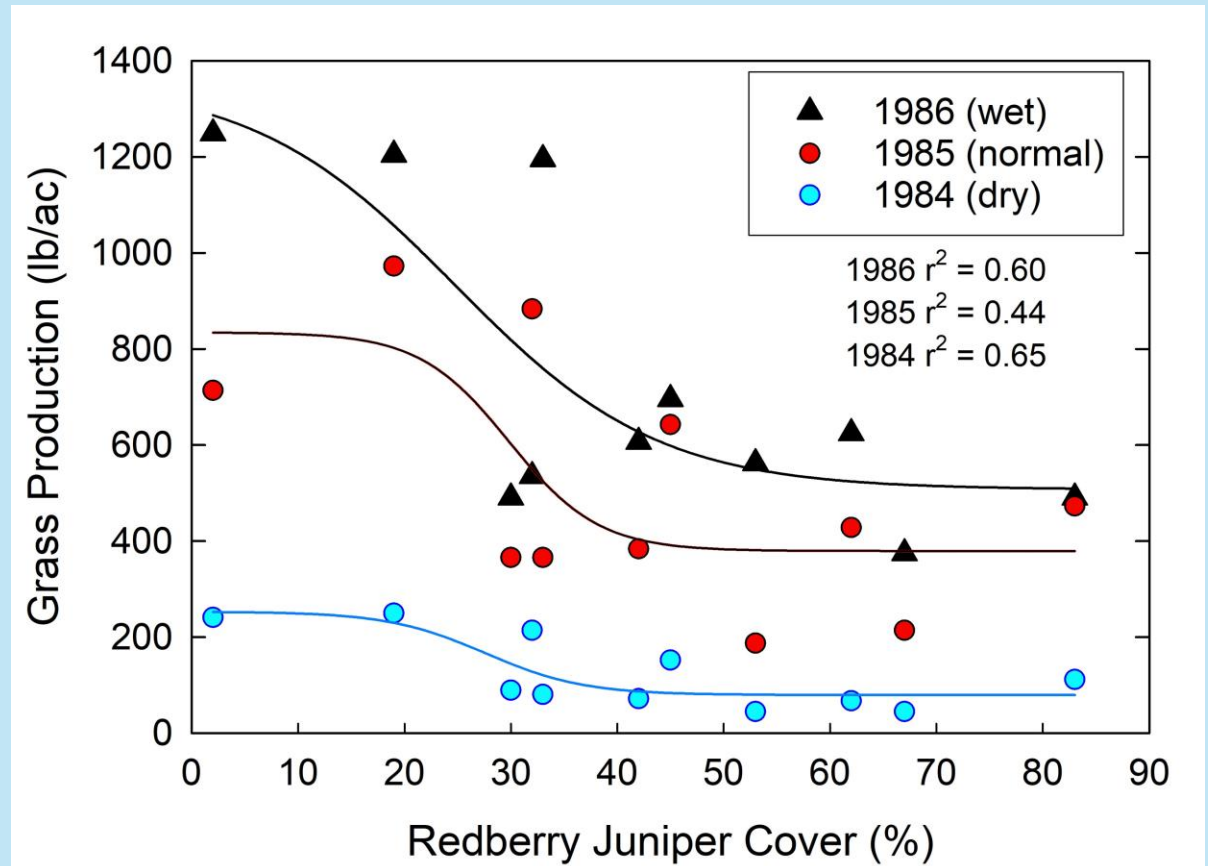
North Central Texas (3 Years Combined)



Redberry Juniper Effects on Grass Production (*Juniperus pinchotii*)

West Texas – near Snyder 3 Years (1984-1986)

- All grass species combined
- Low production potential (1,300 lb/ac with no brush)
- Sigmoidal effect – juniper effects most damaging in the wet year.



Modified from: McPherson and Wright 1990
Amer. Midl. Nat. 123:144-151