Do Leaf Beetles Alter Tamarisk Evapotranspiration?

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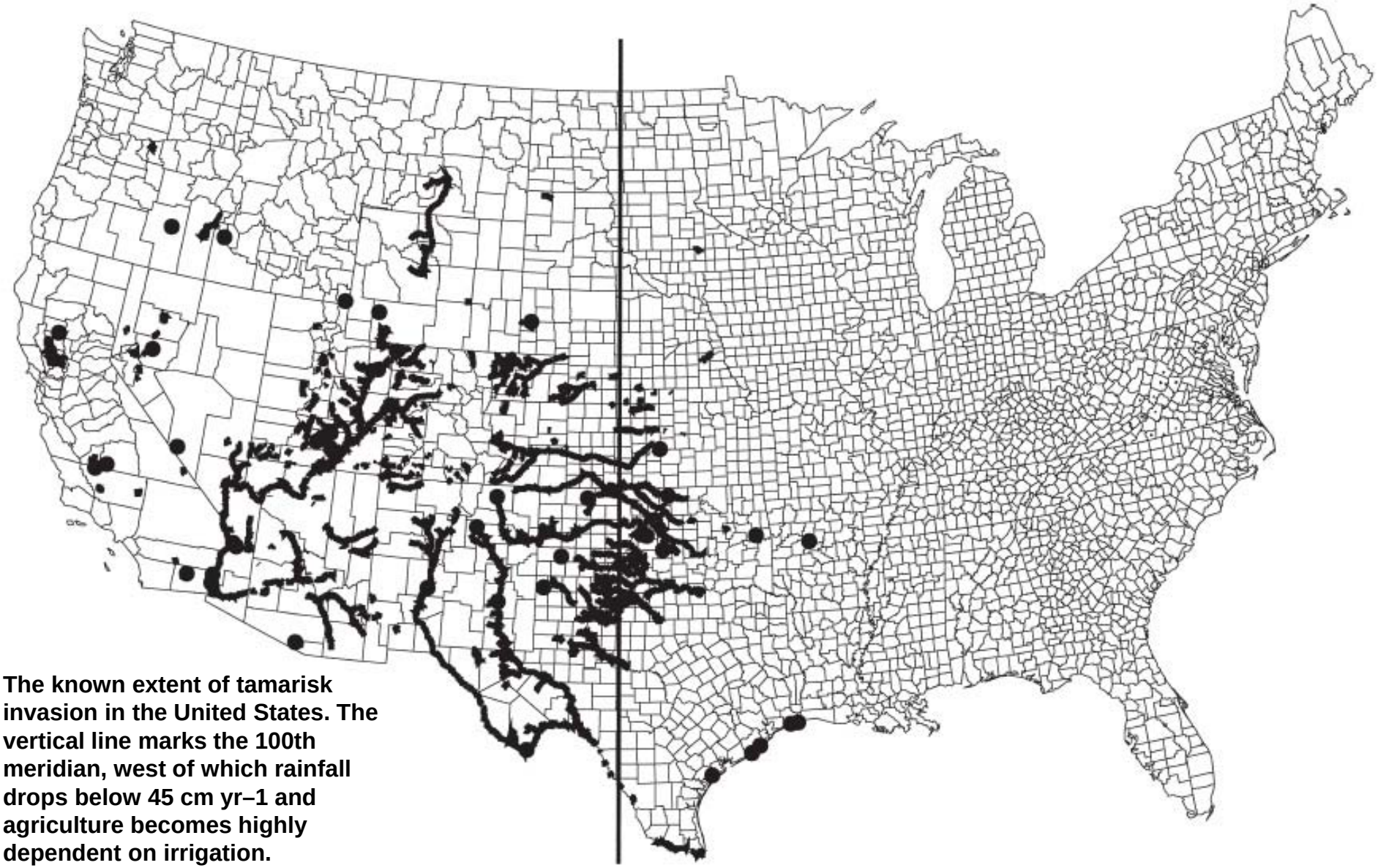
Tamarisk (*Tamarix*, Saltcedar)

- Native to drier areas of Eurasia and Africa
- Brought to the U.S. for
  - Wind breaks, creating shade, stabilizing eroding stream beds, ornamental shrubs
- Invasive in the U.S.
  - Narrow stream channel
  - Increase fire risk
  - Decrease/alter plant/animal diversity
  - Salinization of soils
  - **Increase evapotranspiration (ET)**
  - **Decrease groundwater levels**

Tamarisk

- **Tamarisk is an enormous problem in LCR and has severe impacts on**
  - Water cycling
  - Nutrients, soil salinity
  - Native species such as cotton wood & willows
- **Need better understanding of**
  - Biology
    - Reproduction, Germination, Seedling establishment etc.
  - Control Mechanisms
    - Biological
    - Mechanical
    - Prescribed Fire

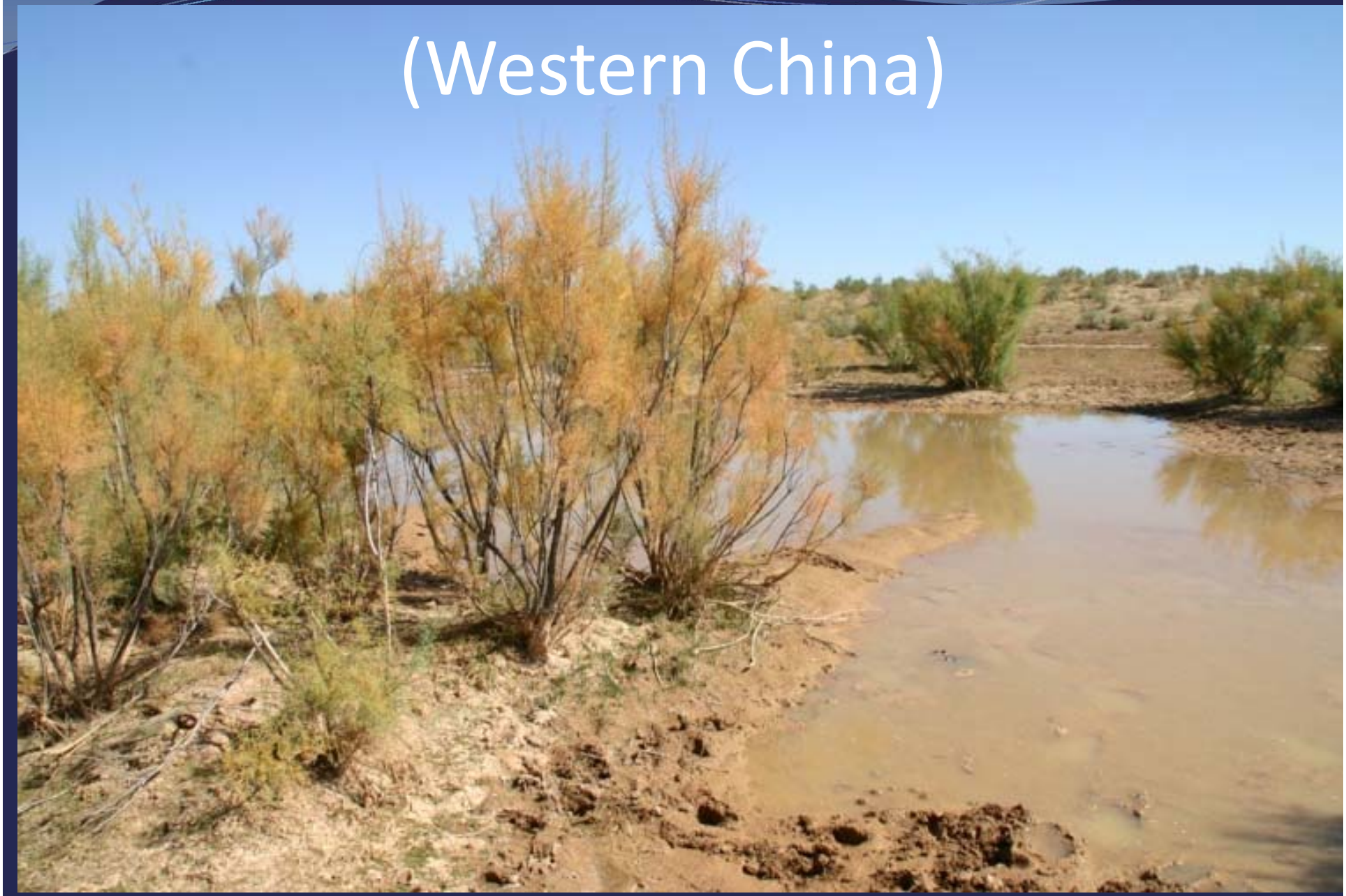
Map of Tamarisk Invasion in U.S.



The known extent of tamarisk invasion in the United States. The vertical line marks the 100th meridian, west of which rainfall drops below 45 cm yr–1 and agriculture becomes highly dependent on irrigation.

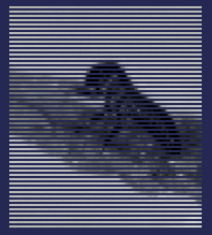
Invasive Tamarisk Stand (Lower Colorado River)

Native Tamarisk Stand (Western China)



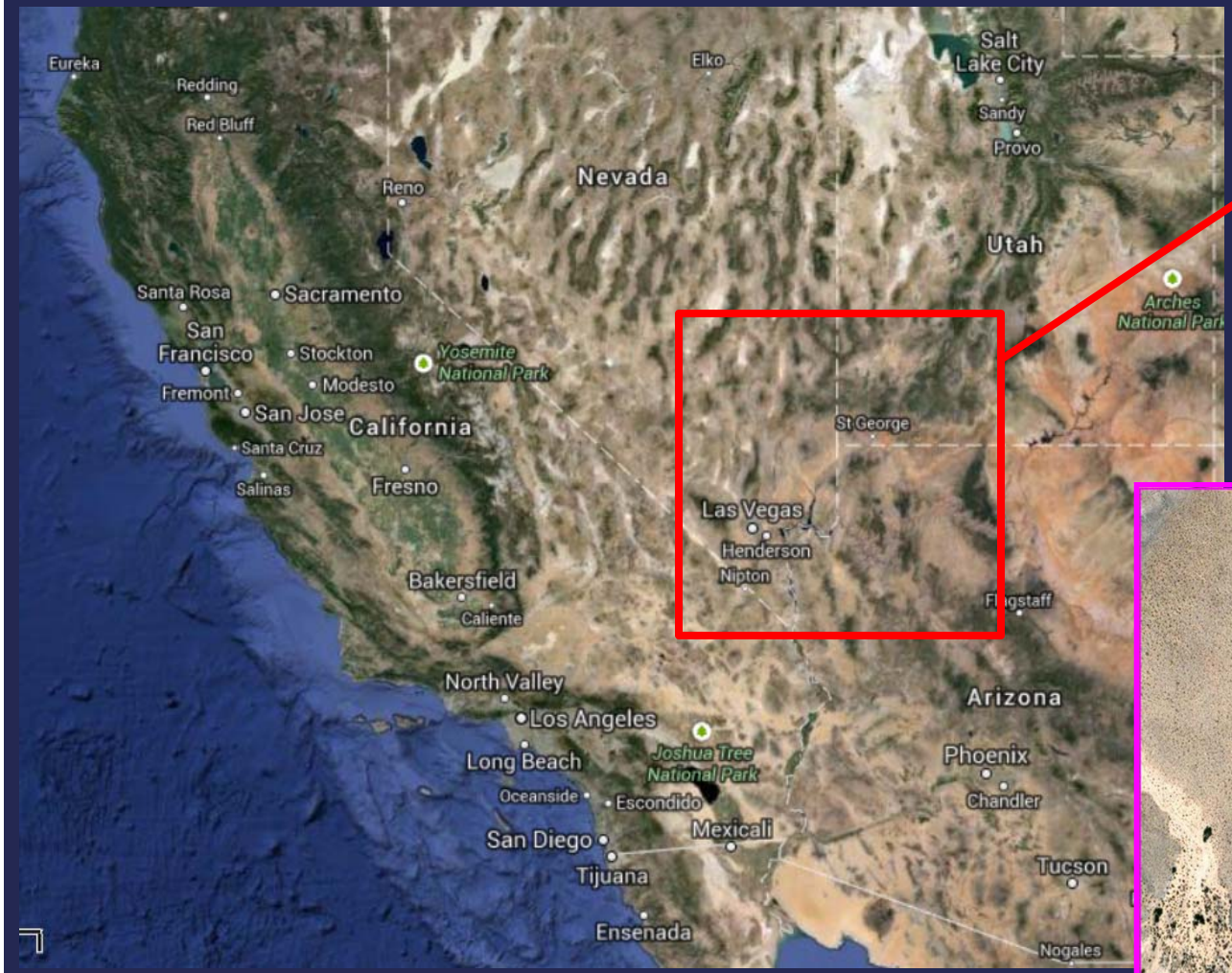
Tamarisk Control

- Chemical
- Mechanical: cutting and raking
- Biological: Leaf beetle (*Diorhabda carinulatae*)
  - Brought from central Asia



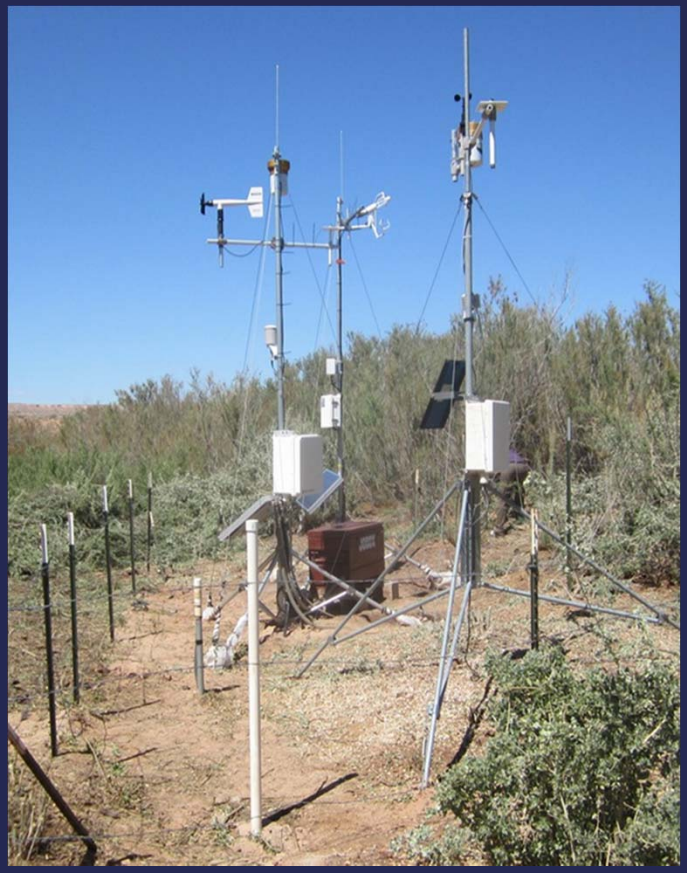
Tamarisk Stand along Virgin River

ET Measurement



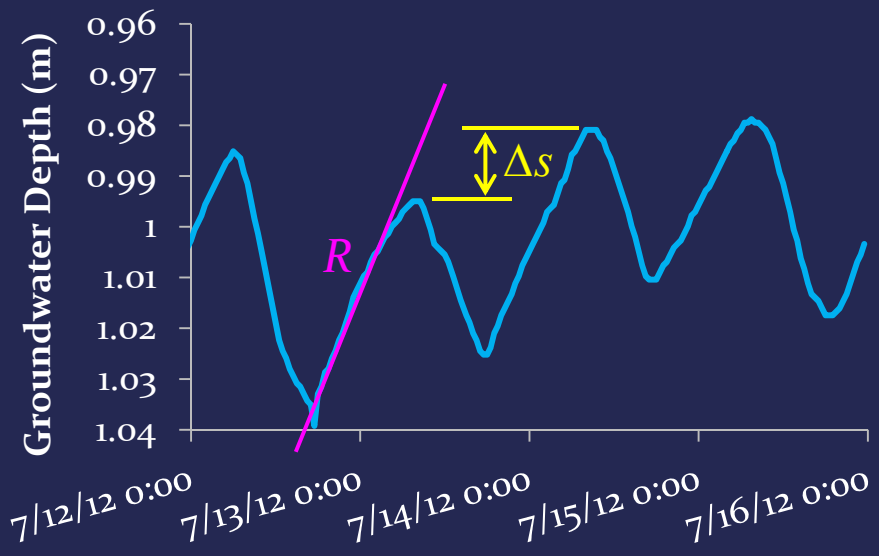
Field Measurement

- Sonic Anemometer
- Gas Analyzer
- Net radiometer
- Air temperature/RH
- Precipitation
- Groundwater Table

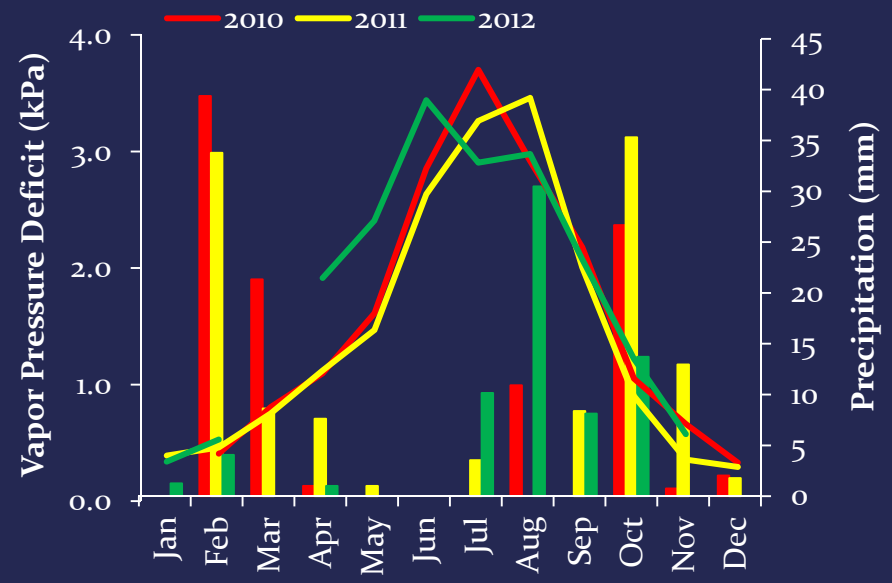


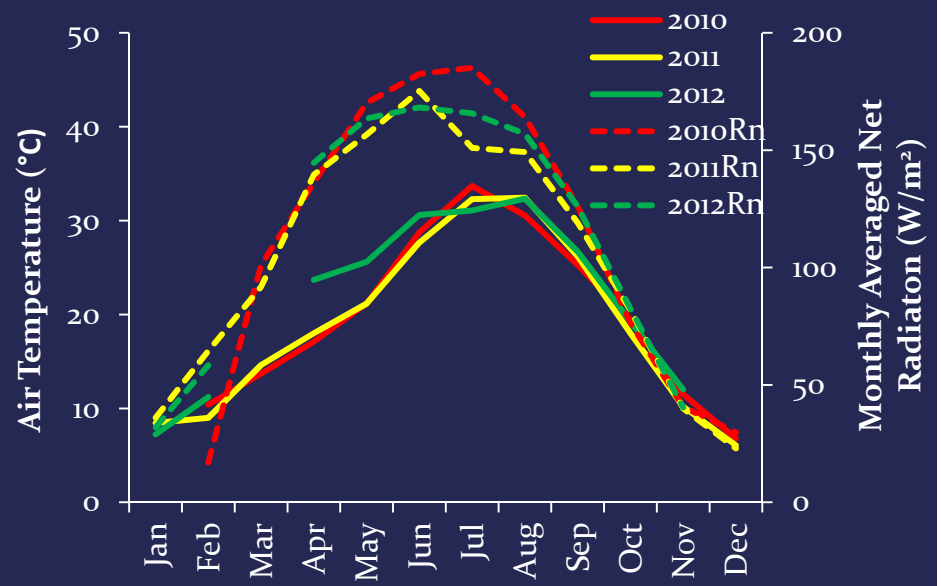
ET Calculation

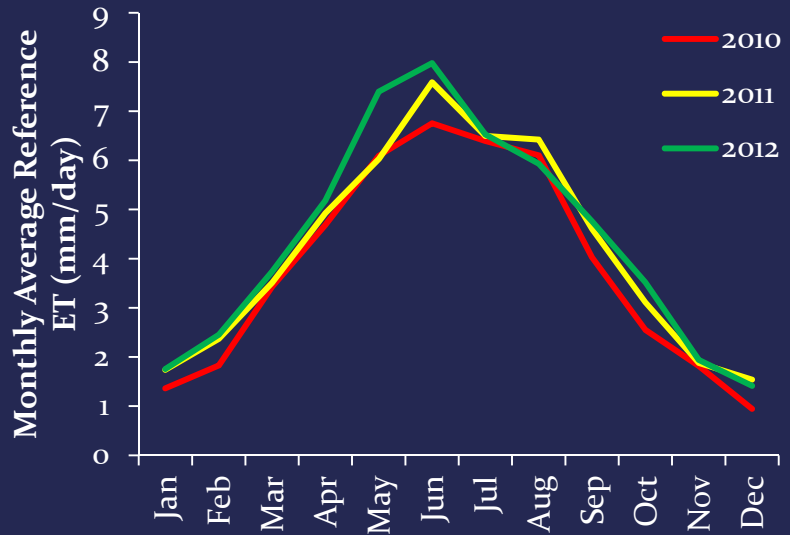
- Eddy Covariance Data
  - EddyPro software (LI-COR, Inc.)
- White Method (White, 1932)
  - Diurnal water level fluctuation
  - $ET_G = S_y\ (\Delta s/t + R)$
    - S_y: specific yield
    - Δs: daily change in storage
    - t: time period
    - R: net inflow rate

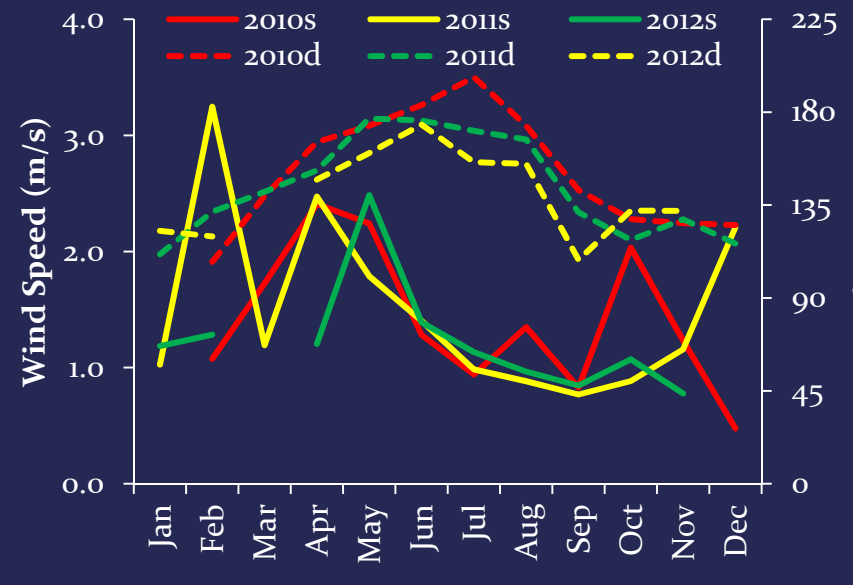


Weather Data

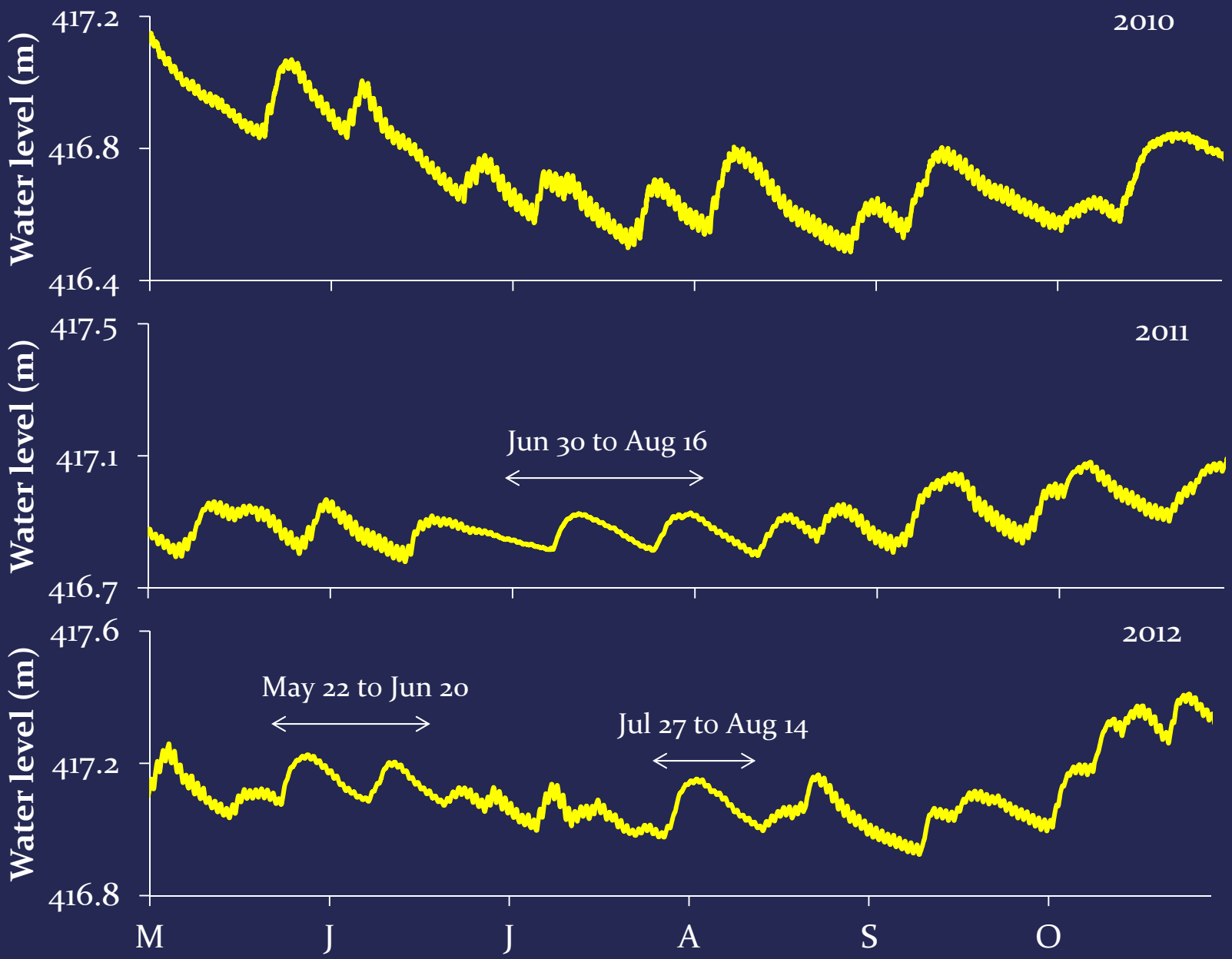




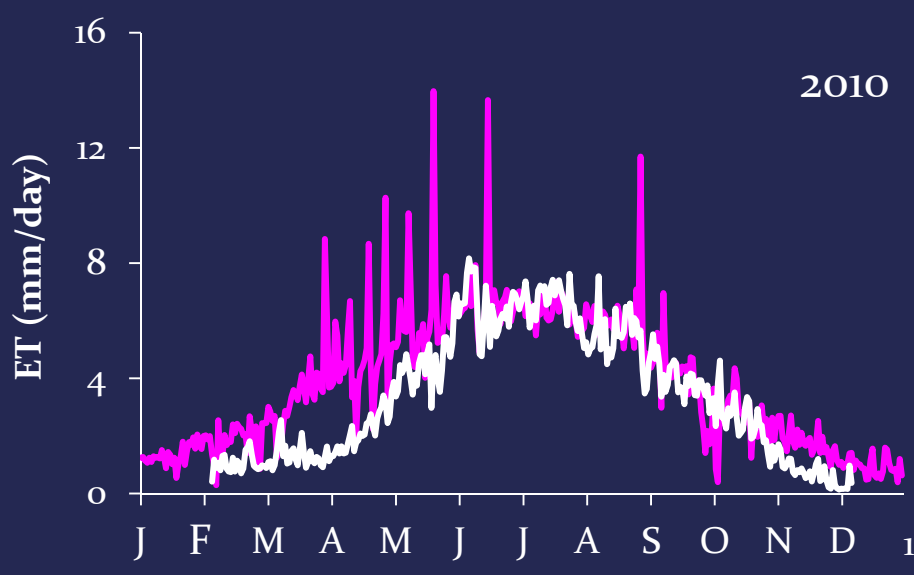


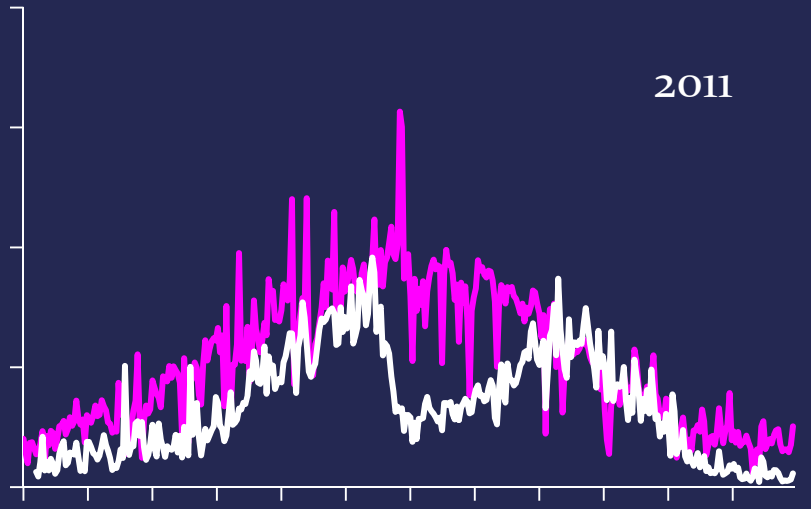


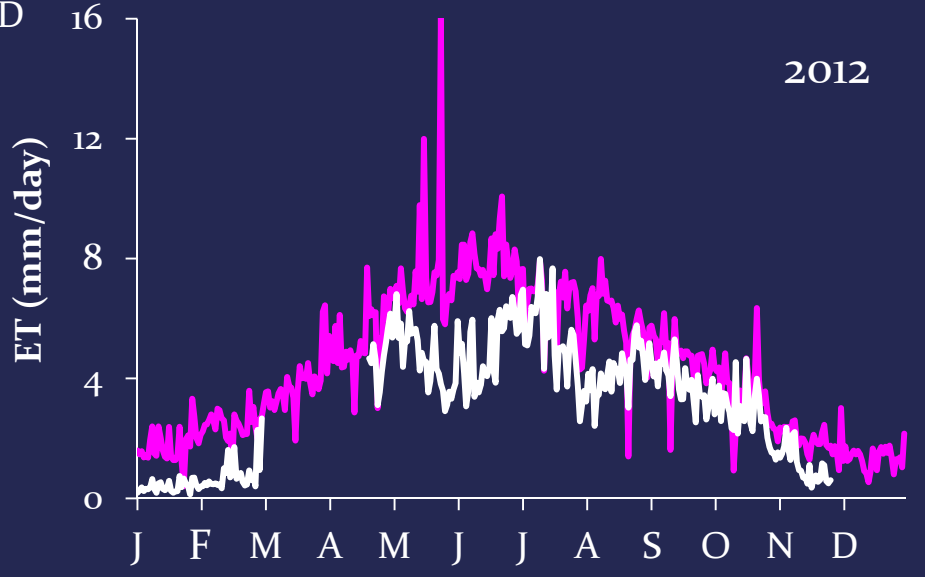
Groundwater Level Fluctuations



ET from Eddy Covariance Data

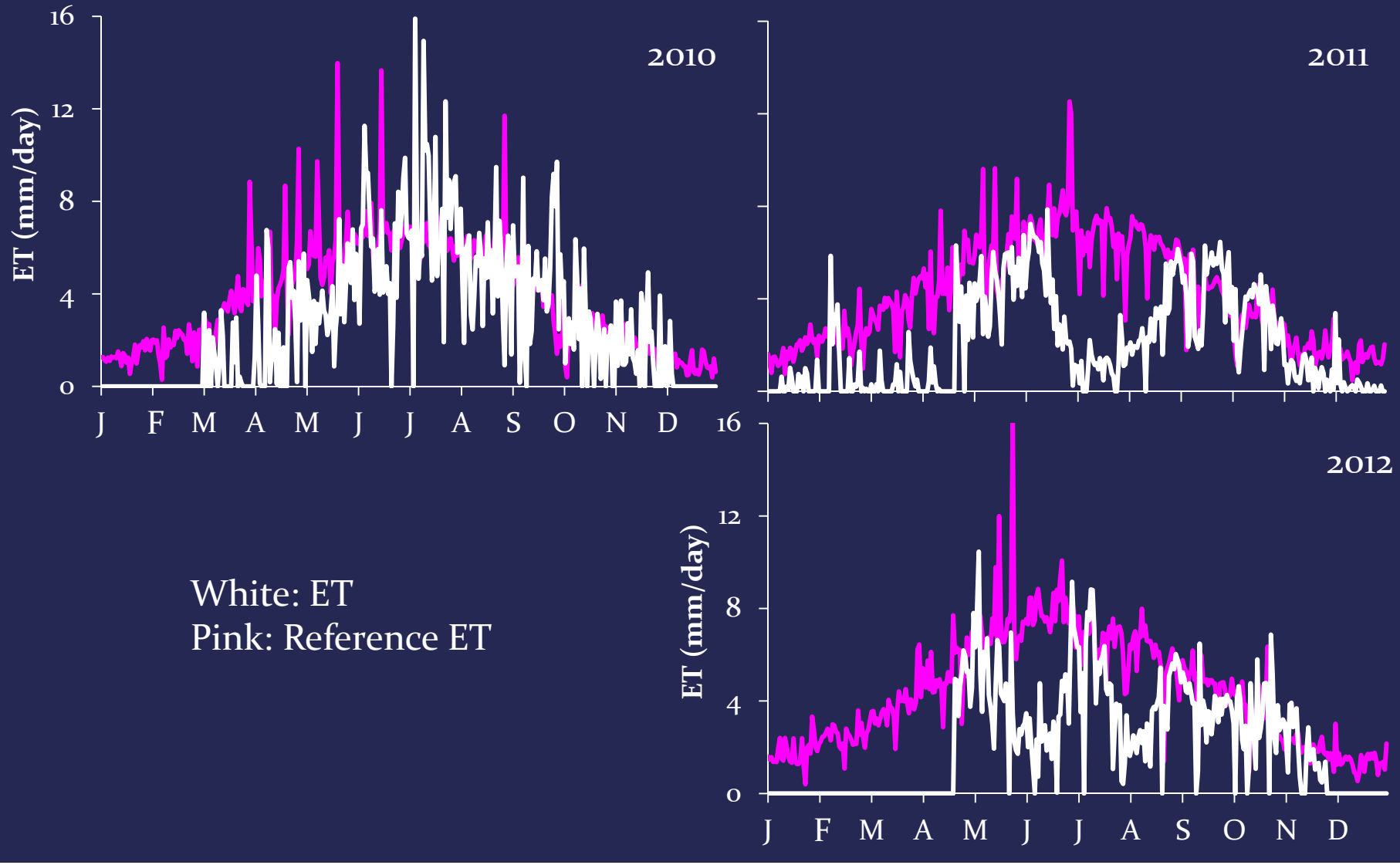






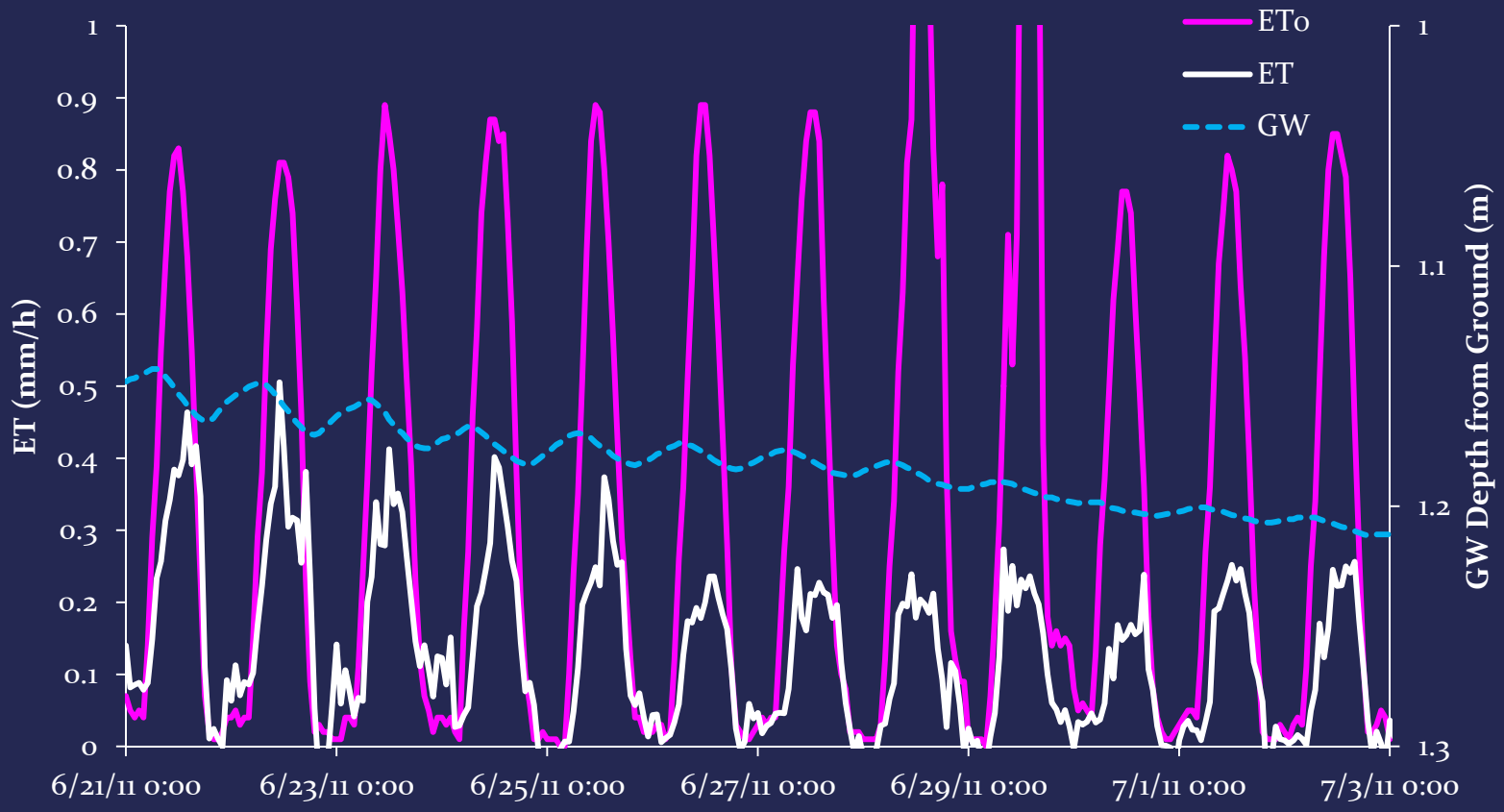
White: ET
Pink: Reference ET

ET from the White Method

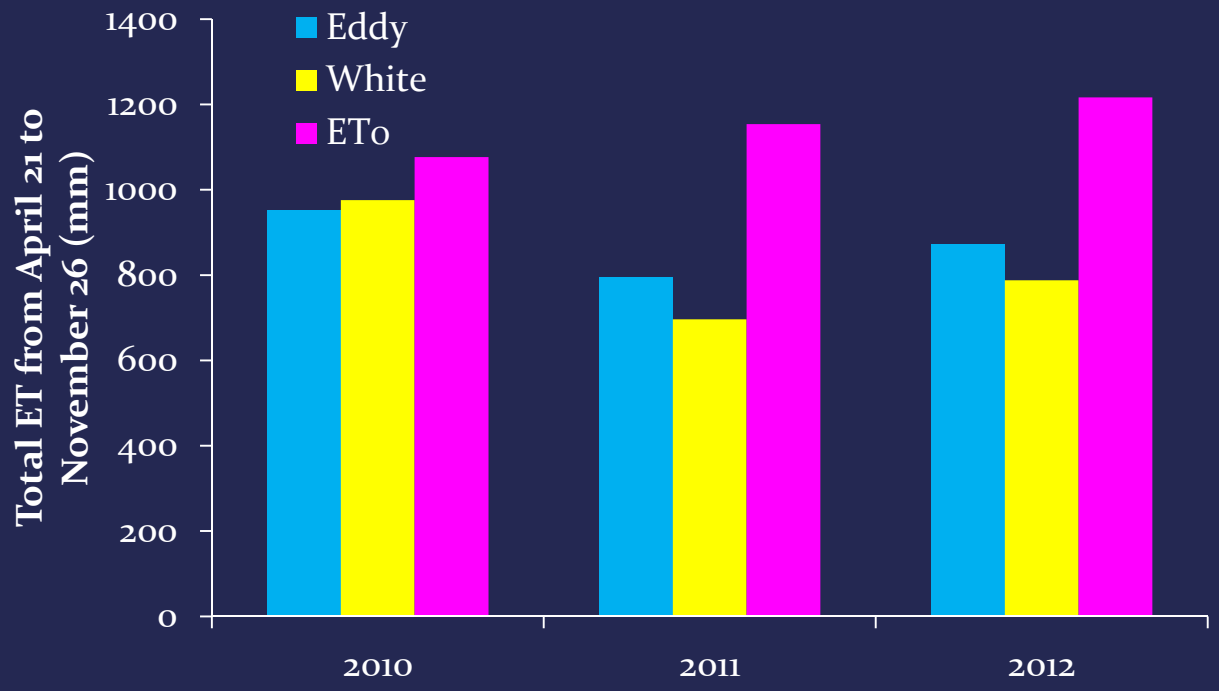


White: ET
Pink: Reference ET

ETo, ET and GW


ETo
ET
GW
ET (mm/h)
GW Depth from Ground (m)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
1.1
1.2
1.3
6/21/11 0:00
6/23/11 0:00
6/25/11 0:00
6/27/11 0:00
6/29/11 0:00
7/1/11 0:00
7/3/11 0:00

Total ET from Apr 21 to Nov 11



Pre-Beetles	Post-Beetles	Changes in ET
960 mm	790 mm	170 mm

Do Leaf Beetles Alter Tamarisk Evapotranspiration?

- Post defoliation ET values and the magnitude of diurnal GW level fluctuations decreased compared to predefoliation value
- ET recovered within a month as tamarisk established new leaves
- Long-term changes in ET are highly dependent on repeated defoliation occurrences

What We still don't Know

- How many defoliations it would require to actually eradicate tamarisks?
  - ET returns to its predefoliation condition as soon as the beetles moves on and tamarisk refoliates
  - Tamarisks are still standing after three years of repeated defoliation
- Relationship between leaf biomass and ET
  - The amount of water saved depends on the timing and extent of defoliation – LAI vs. ET - ???

Questions?