



62nd

Annual Meeting EAAP 2011
August 29th – September 2nd

Stavanger NORWAY

Sculpture by Fritz Røed, Sverd i fjell, 1983 - © Fritz Røed / BONO 2010

Session 16: Challenges of rangeland farming systems

The use of GPS, pedometry and acoustics to infer activity of grazing animals

Eugene David Ungar

eugene@volcani.agri.gov.il

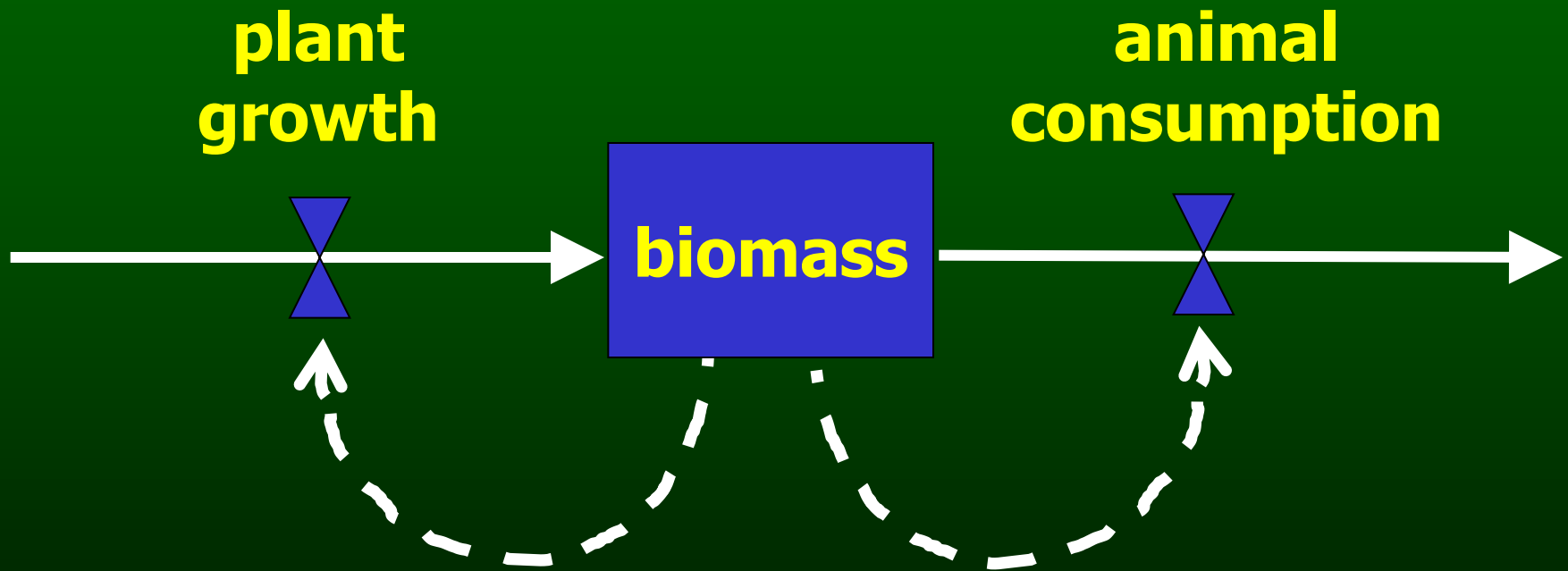
Department of Agronomy and Natural Resources

Institute of Plant Sciences

Agricultural Research Organization - The Volcani Center,
Israel



Core processes of grazing systems

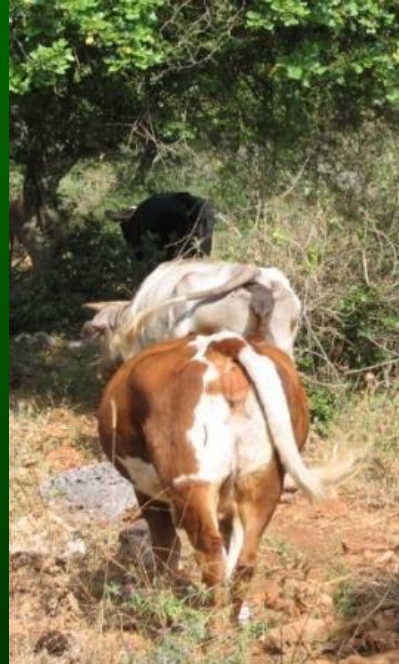


Activity categories

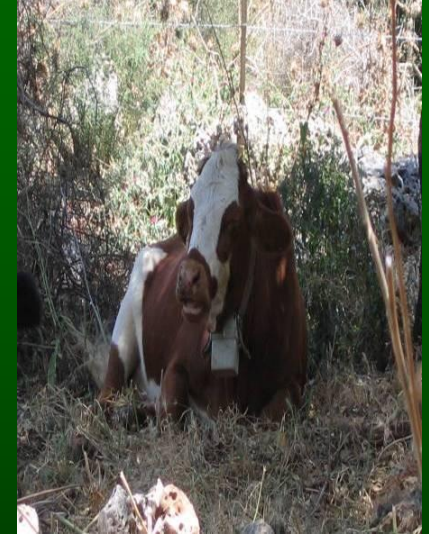
Graze



Travel



Rest



pictures courtesy of Iris Schoenbaum

Who cares?

- Add explanatory power to empirical treatment – output studies.
- With geolocation, refine our understanding of how animals interact with the landscape.
- Fine-tune group-level grazing management decisions.
- Improve individual-level management decisions related to selection, breeding, and early-detection of illness.

Measurement versus inference

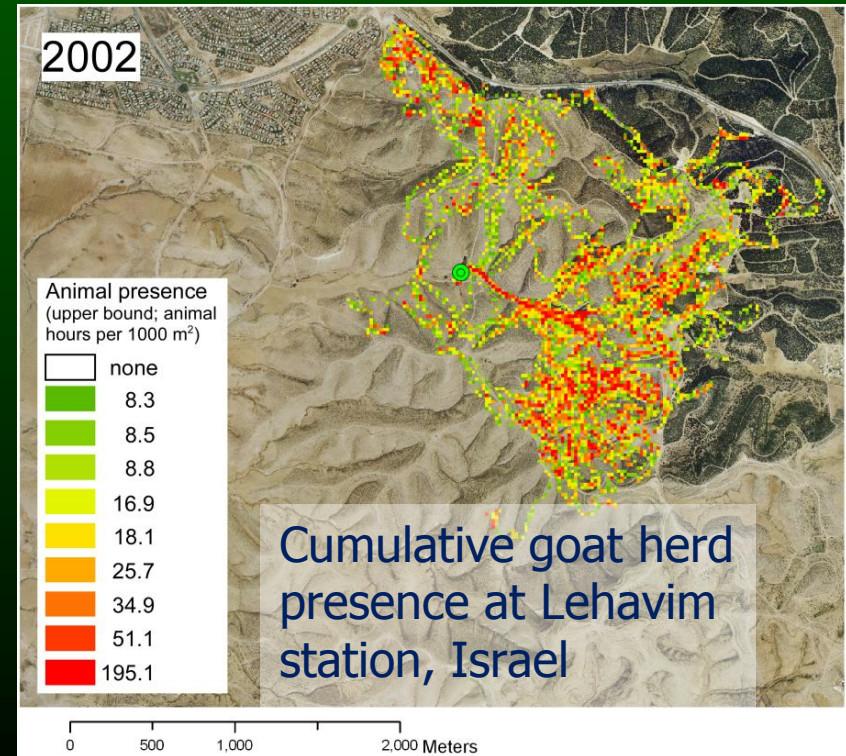
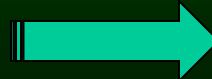
- Activity state can not be measured directly
- Activity needs to be inferred from direct measurement of something else
- Inference is a statistical process that is unlikely to yield perfect results
- Dependent on calibration

VECTRONIC

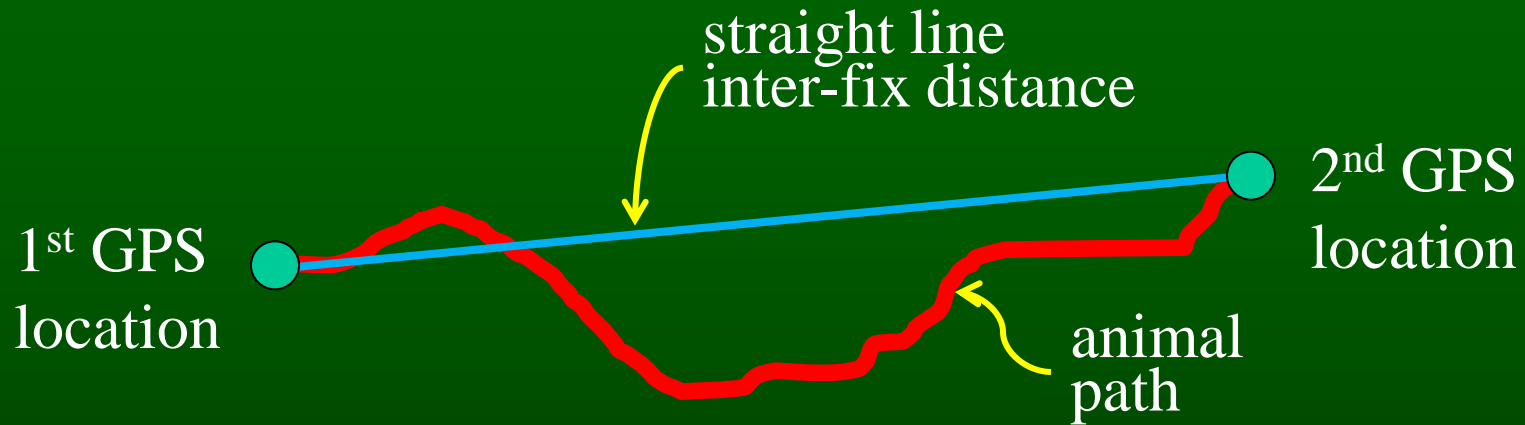
Beef cow with Lotek GPS collar on Karei Deshe station, Israel



Herd tracked using TriLogical (Israel) GPS girdle on (happy) volunteer animal



Infer activity from GPS: what's the big deal?



straight-line distance	Implied activity
small	Rest
medium	Graze
large	Travel

Lotek GPS collars

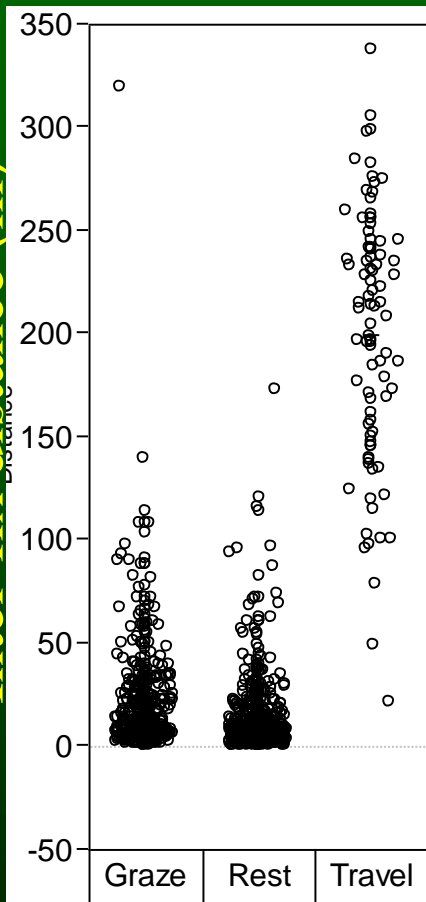
- GPS points —> inter-fix distance
- Motion sensor count in left-right axis
- Motion sensor count in fore-aft axis
- Head-down sensor (% time)



Beef cow with Lotek GPS collar (and heart rate girdle) on Hatal station, Israel

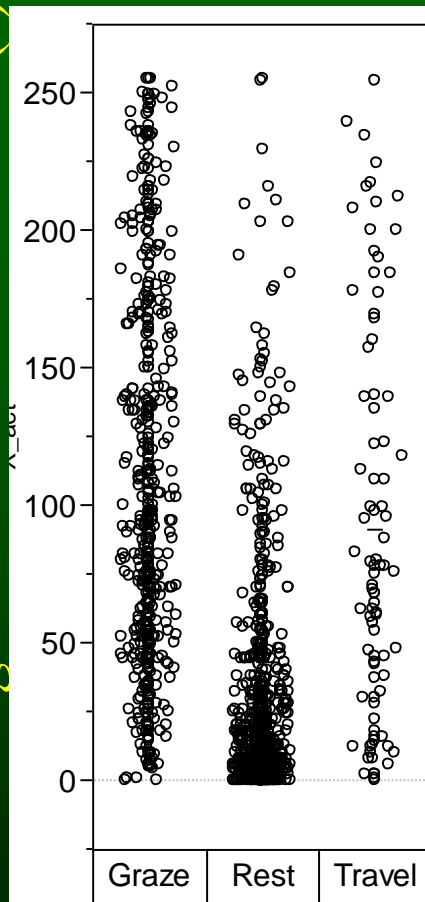
Henkin, Dolev & Schoenbaum data: 9 cow-collar combinations; 1475 5-min observations; 2006

Inter-fix distance (m)



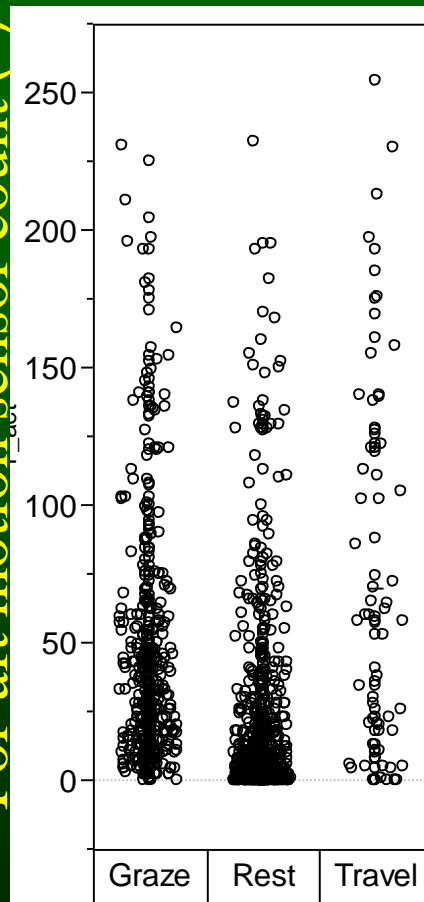
Graze
Rest
Travel

Left-right motion sensor count (-)



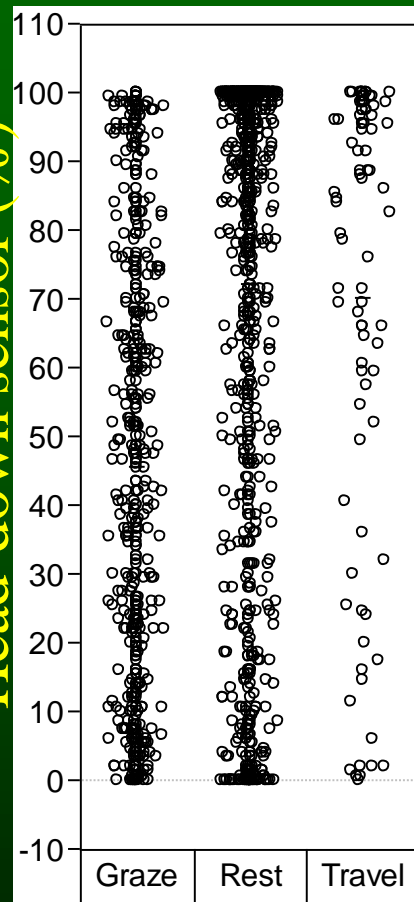
Graze
Rest
Travel

For-aft motion sensor count (-)



Graze
Rest
Travel

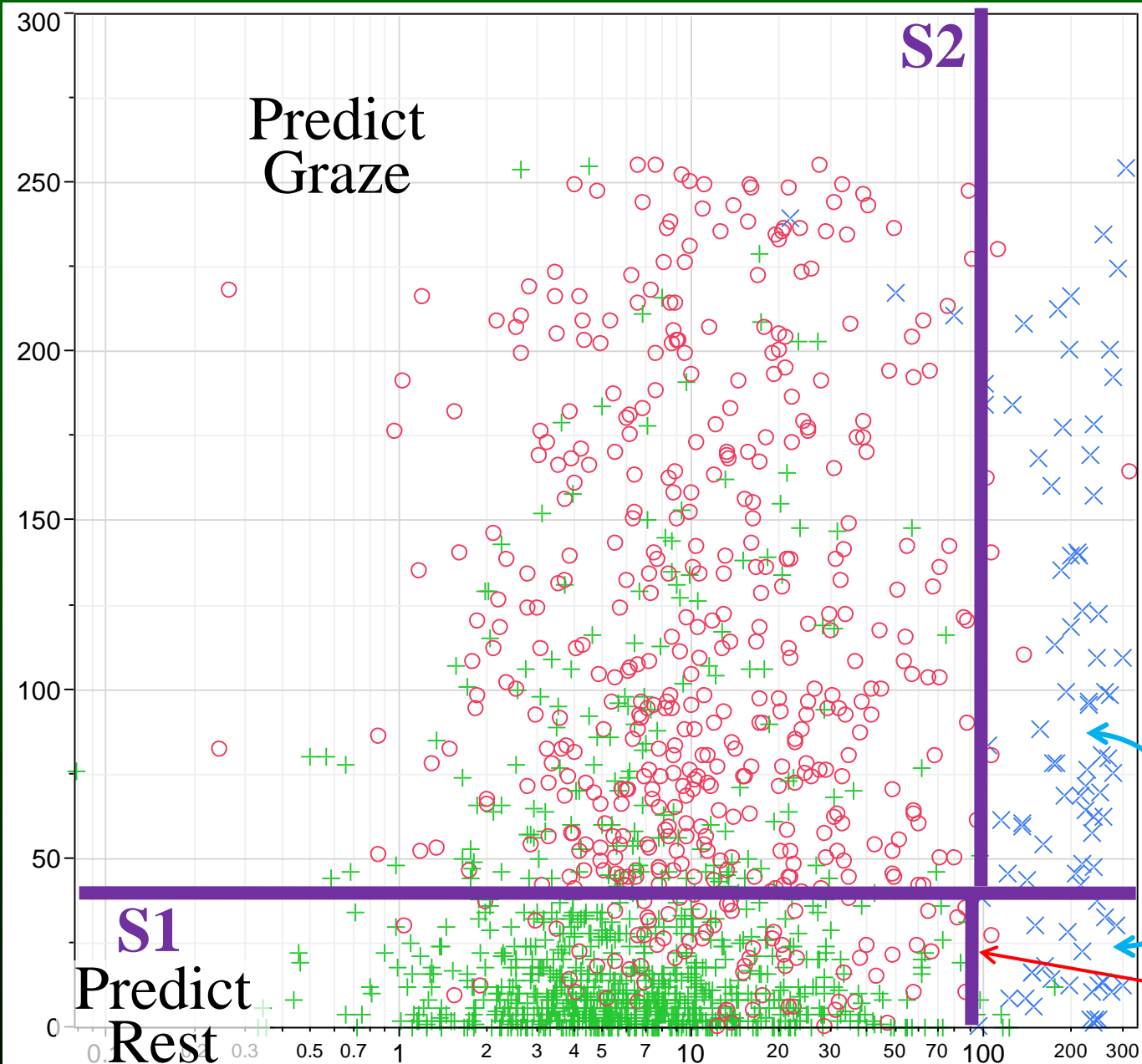
Head-down sensor (%)



Graze
Rest
Travel

CART analysis

Left-right motion sensor count (-)



-  Graze
-  Rest
-  Travel

Predict Travel

S3

Inter-fix distance (m)

Confusion matrix for CART analysis of Hatal calibration data: GPS data

Predicted Activity

		Predicted Activity		
		Graze	Travel	Rest
Observed Activity	Graze	409	7	73
	Travel	3	85	0
	Rest	167	5	726

Overall misclassification rate: 17%

IceRobotics

DATA KNOWLEDGE INSIGHT



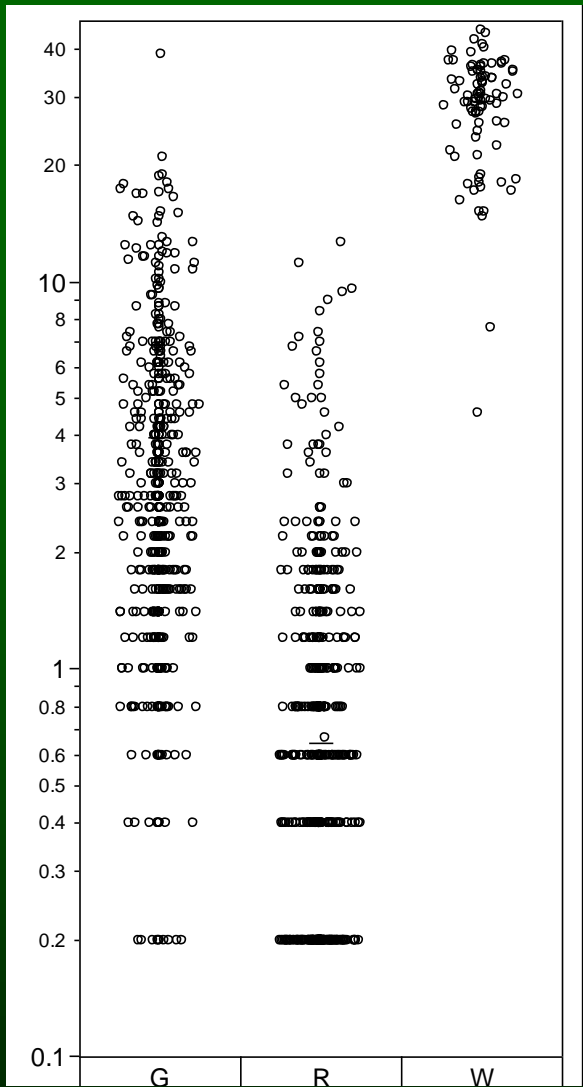
IceTag Sensor

- Designed specifically for livestock researchers
- 16Hz sample rate
- On-board data storage up to 60 days
- Data view and export by the second
- Data export for in-depth statistical analysis
- 5 year graduated warranty
- Optional neck-based attachment for recording grazing behaviour
- Data download wirelessly to PC via desktop **IceReader** unit



IceTag output: step rate

Steps per minute



Graze

Rest

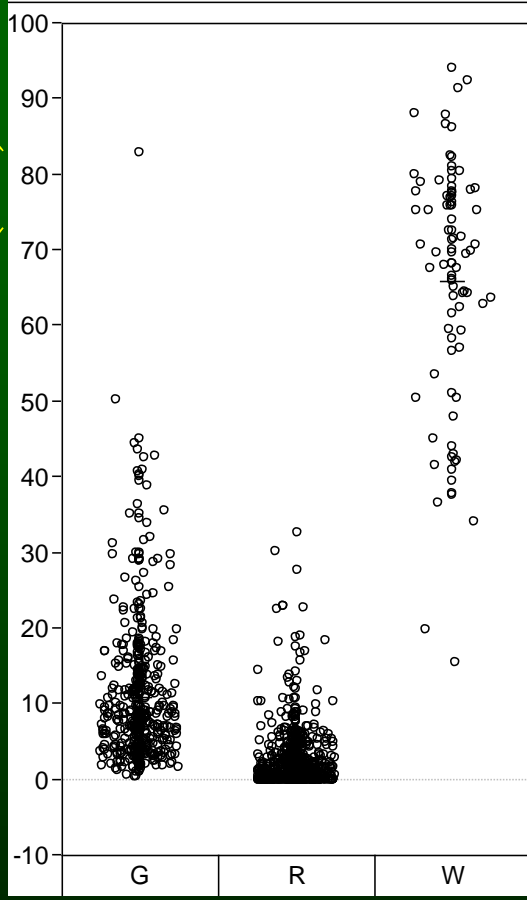
Travel

Points jittered horizontally to reduce overlap

IceTag output: 3 states

Henkin, Dolev & Schoenbaum data

Active state (%)

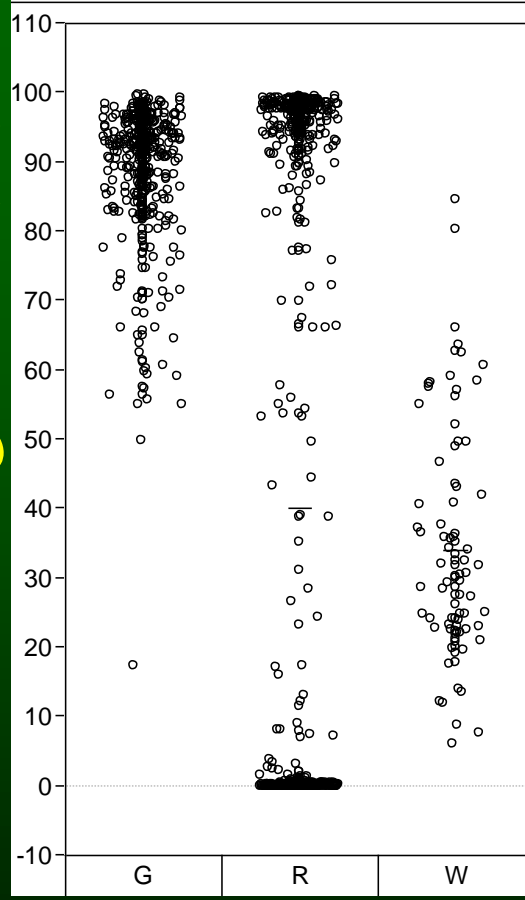


Graze

Rest

Travel

Standing state (%)

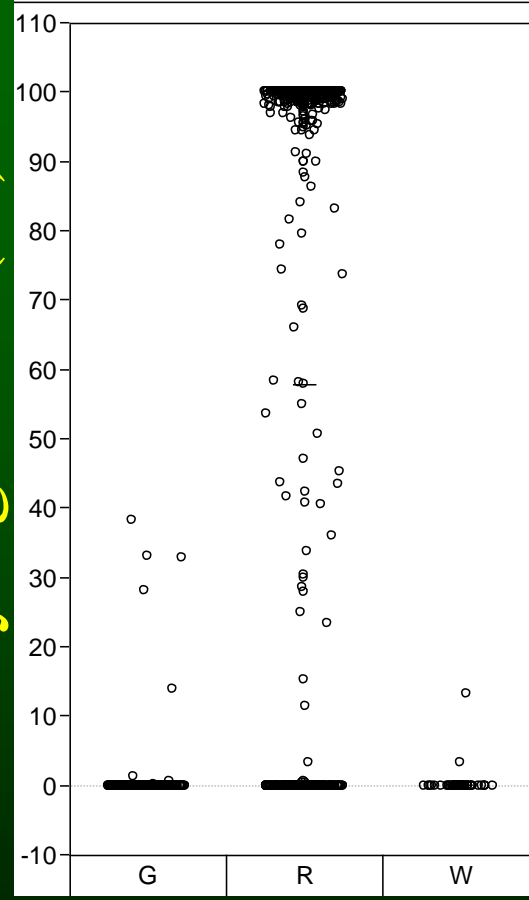


Graze

Rest

Travel

Lying state (%)



Graze

Rest

Travel

Confusion matrix for CART analysis of Hatal calibration data: IceTag data

Predicted Activity

		Predicted Activity		
		Graze	Travel	Rest
Observed Activity	Graze	429	13	47
	Travel	3	85	0
	Rest	198	0	700

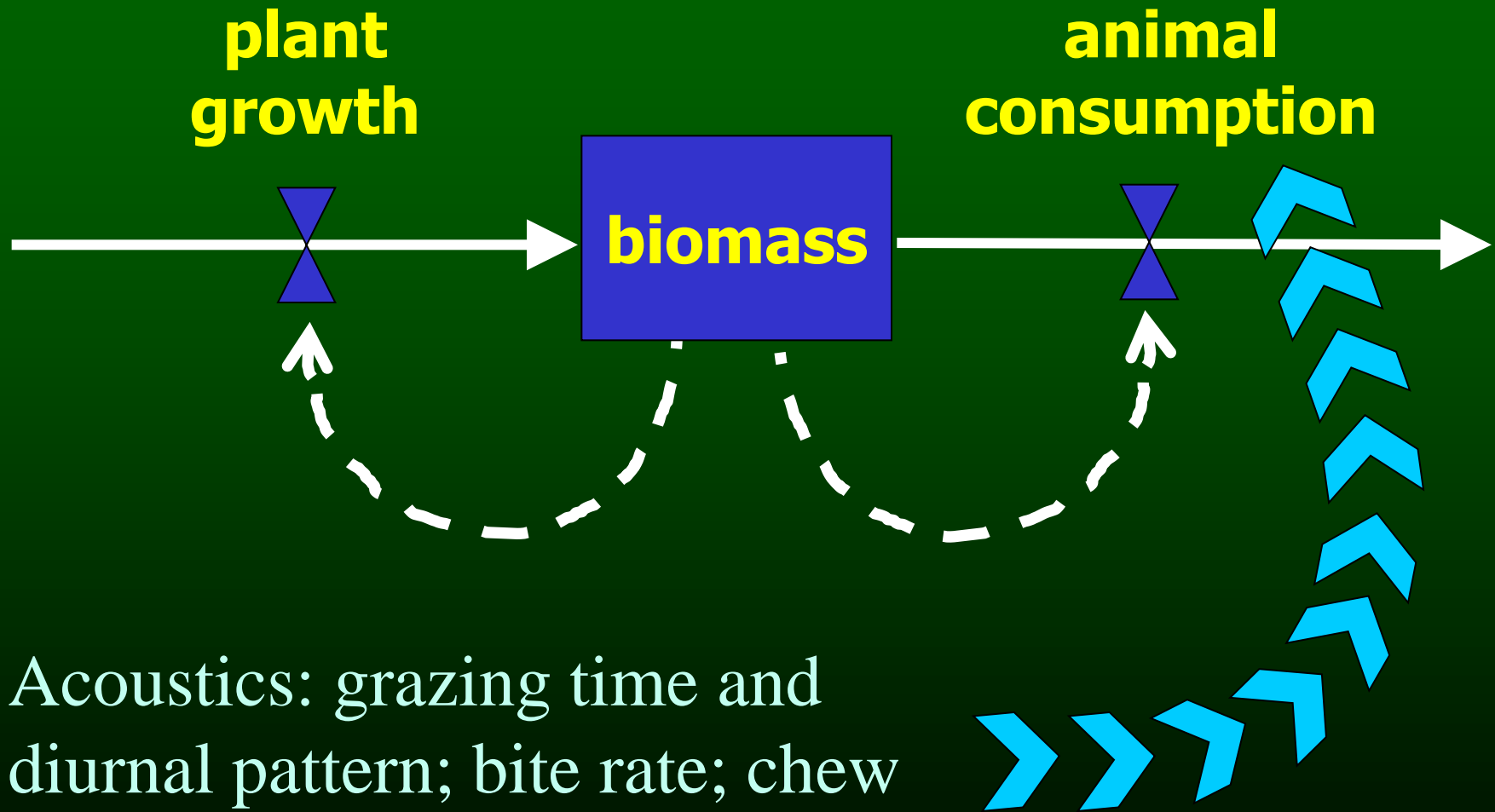
Overall misclassification rate: 18%

Acoustic monitoring of ingestive behaviour



11:37:44 AM

Central processes of grazing systems



Acoustics: grazing time and diurnal pattern; bite rate; chew rate; chew-to-bite ratio

Summary

- Measurement remains a challenge in rangeland science.
- The activity timeline provides useful information.
- Distance between GPS fixes can be used to infer Activity, but there is error.
- Advanced pedometers can achieve similar results.
- Grazing and Resting (while standing) are simply too similar!
- Acoustics should nail it down.

(Famous last words!)