

### Lactate values in live-trapped American marten: what can we learn from 1 drop of blood?





Photo by D. Unger

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Room 160 PBB, 12:20 p.m., October 2, 2013

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### Wildlife capture

- Risk is present even in healthy animals
- Mortality versus morbidity
- Capture may have effects on subsequent telemetry or mark-recapture data



“Researchers have a special responsibility to the animals they handle to be certain that animals are released in the best possible condition” (Guidelines for the capture, handling, and care of mammals, American Soc. of Mammalogists)

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### Blood lactate

- Result of anaerobic metabolism
- Produced by many organs
- Cleared by liver, kidneys or converted for energy
- Causes of elevated lactate?
  - Exercise/exertion, shock, severe anemia, respiratory distress, toxins, infection, and “hypermetabolic state”
- Prognostic indicator in humans and domestic animals




Photo by B Silet

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### Advantages of

- Rhinoceros
- Hippopotamus
- Reindeer
- Elk
- Moose
- Pudu
- Chamois
- Manatee
- Ibex
- Brown bear
- Wild boar
- Flamingo
- Mourning dove
- Ostrich
- Green turtle
- Crocodile
- Map turtle
- Musk turtle
- Painted turtle
- Sea turtle
- Pacific whiteleg shrimp
- Norway lobster
- American lobster
- Eastern rock lobster
- Mantis shrimp
- Rainbow trout
- Lemon shark
- Tuna
- European sea bass
- Skipjack tuna
- School shark
- Lake sturgeon
- Sockeye salmon
- Pink salmon
- Atlantic cod
- Chum salmon
- Sand tiger shark
- Largemouth bass
- Cobia
- Herring
- Bonnethead shark
- Bull shark
- Atlantic sharpnose shark
- Grass carp
- North pike
- Coho salmon
- Little skate

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### *Martes americana*

- Family Mustelidae
- Mesocarnivore
- Reintroduced to Michigan in 1900s



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### Research objectives

- Compare blood lactate values in live-trapped American marten to those of other species
- Determine the influence of environmental variables and marten-specific variables on lactate

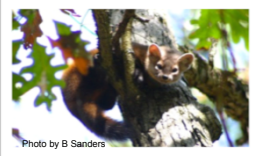


Photo by B Sanders

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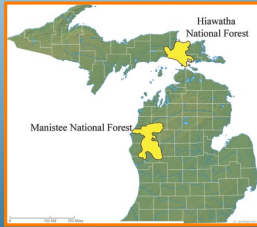
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### Methods

- **Observational study**
- **Part of a larger health assessment of martens in Michigan**
- **Martens (n=37) were live-trapped in Michigan**
- **At each capture event (n=42) data was collected**



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### Trapping methods

- **Tomahawk trap – 2 sizes**
- **Raw meat bait - venison, beaver, chicken, beef, elk**
- **Long distance lure (Caven's Gusto Lure, Alpena, MI 49707)**
- **Trap is covered, shaded and checked minimum daily**
- **Trap covered for transport**
- **Record trap size & time from trap discovery to immobilization**



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### Sample collection

- Isoflurane anesthesia delivered in oxygen
- Blood collected from the jugular vein
- Record: sex, body weight (grams), body temp (°F), ambient temp (°F), lactation status, collaring status



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### Data collection



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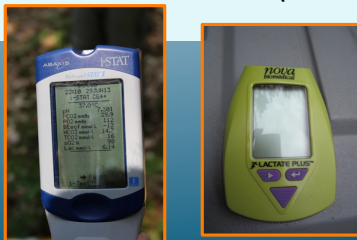
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### Methods

- Lactate level measured via either iSTAT (Abbott, Princeton, NJ 08540) (n=35) or Lactate Plus (Nova Biomedical, Waltham, MA 02254) (n=7)
- Strong correlation between these methods (Karon et al., 2007)



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### Statistical analysis

- **Dependent variable:** Lactate
- **Independent variables:** Body weight, body temp, ambient temp, time between trap discovery and immobilization, # of damaged toenails, collared (y/n), lactating (y/n), oral trauma (y/n), trap size (lg/small)
- Stepwise logistic regression
- Least squares linear regression
- Shapiro Wilk W test for normality
- Correlation between lactate (iSTAT) and lactate (Lactate Plus)
- JMP® Pro 10.0.2 (SAS Ins., Cary, N.C.)




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### Results

Measure	Mean +/- S.D.	Range
Body weight (grams)	881.5+/-190.0	544-1223
Females (n=15)	706.5+/-85.6	544-911
Males (n=22)	1018.5+/-123.8	792-1223
Body temperature (°F)	103.8+/-1.3	100.5-106.1
Ambient temp. (°F)	68.0+/-12.2	27-90
Time between trap discovery and immobilization (hours)	2.2+/-1.2	0.5-5.5
# of damaged toenails	5+/-3.5	0-12

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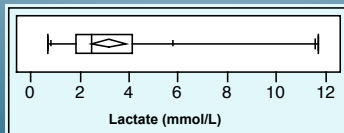
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### Results

- 23.8% (10/42) collared at time of capture
- 28.6% (12/42) caught in larger size Tomahawk
- 47.6% (20/42) had gum or teeth trauma
- 44.4% (8/18) females were lactating



3.17 +/- 2.3 mmol/L (range 0.68-11.67)  
 Upper 95% CI= 3.89  
 Lower 95% CI= 2.45

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### Results

Parameter	Estimate	nDF	SS	F ratio	Prob>F
Intercept	-0.416	1	0	0.000	1
Collared{1-0}	0	1	0.0050780659	0.012	0.9118065833
Initial temp	0	1	0.7733621459	1.992	0.1662706773
Amb. temp	0.0196	1	2.3374606757	5.871	0.0201320019
Time to imm	0	1	0.7358334298	1.890	0.1771990542
Body weight	0	1	0.3956262185	0.994	0.3251727524
Trap Size{0-1}	0	1	0.0003220217	0.001	0.9777501444
# broken nails	0	1	0.0317060244	0.078	0.7818721048
Oral trauma{0-1}	0	1	0.0668918294	0.164	0.6873918502
Lactating{0-1}	0	1	0.0835736814	0.206	0.6527792628

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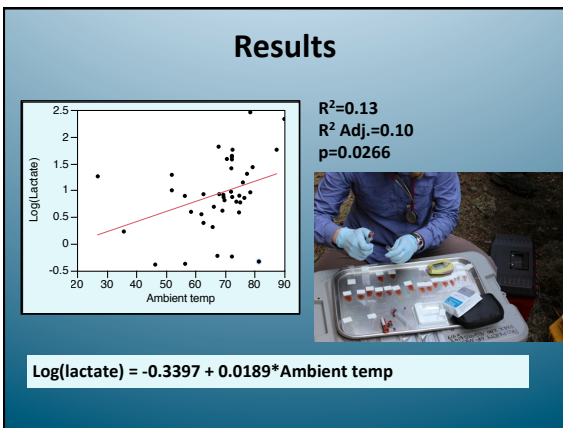
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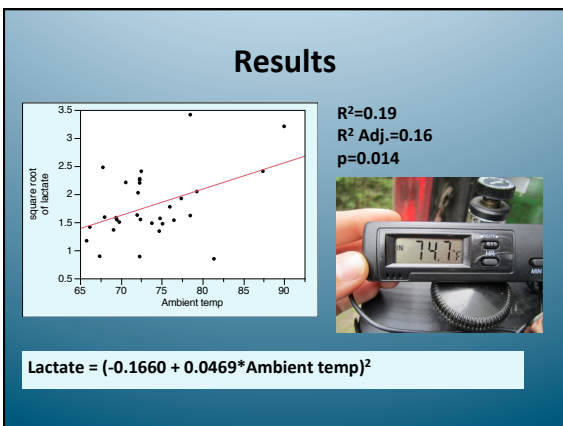
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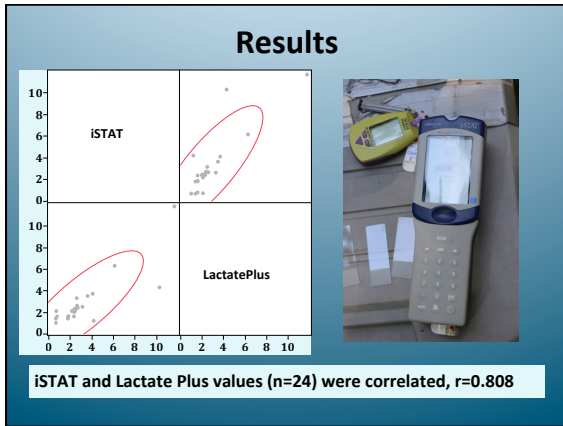
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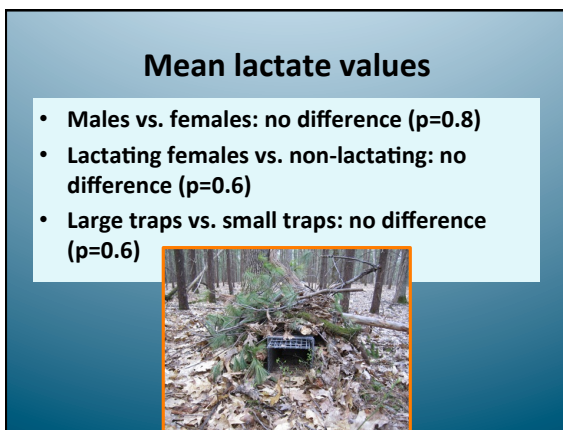
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### Lactate comparisons (mmol/L)

Species	Condition	Mean +/- S.D.	Range	Reference
American marten, n=42	Live-trapped	3.17 +/- 2.30	0.68-11.67	N/A
Wolverine, n=8	Darted from helicopter	3.4 +/- 1.8	1.1-6.8	Fahlman et al., 2008
Sea otter, n=6	Resting/conscious, trained	0.97 +/- 0.46	0.33-1.65	Yeates et al., 2007
Domestic dog	Healthy dogs reference range		0.9-1.7	iSTAT Corp., product info, 2013
White-tailed deer	Clover trapped then hand injected, n=6	8.9	7.2-14.0	Boesch et al., 2011
	Stalked, darted n=14	1.4	0.7-3.0	
Wild boar, n=35	Cage or corral trapped	13.44 +/- 5.28	Max 27.1	Barasona et al., 2013

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- **Hyperthermia leads to tissue hypoxia and increased lactate** (Lambert, 2004)
- **Elevated ambient temperature contributes to capture myopathy in other species** (Henderson et al., 2000; Nicholson et al., 2000; Evans et al., 2012)



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### Implications

- **What can we do about it?**
  - **Oxygen** (Risling et al., 2011)
  - **Fluids** (Allen and Holm, 2008)
  - **Thermal support**
  - **Other (nonsteroidal anti-inflammatories, antioxidant supplementation)** (Lambert, 2004)
  - **Be quick!**
- **Serial lactate measurements have prognostic value**
- **Average high temp > 65 °F in Michigan:**
  - **Upper Peninsula: June-Sept.**
  - **Lower Peninsula: May-Sept.**



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### Study limitations and future direction

- **Unknown kinetics of lactate in marten**
- **Time in trap may be important**
- **More data points in cold needed**
- **Check correlation btwn Lactate Plus and iSTAT at high values**
- **Evaluate the impact of different trapping methods**
- **Measure lactate after treatment to assess efficacy**



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