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# New insights into mating strategies of raccoons

*(Procyon lotor* L.) in northeastern Germany determined by VHF telemetry and paternity tests







## The "Project Raccoon" in Germany

- Three-year ranging wildlife research study
- Basic data about the population ecology of raccoons in the German lowlands (national park "Müritz"):
  - Spatial and social behaviour, habitat analysis (VHF-Telemetry)
  - Population structure & size (Cameratraps, Pathology, Capture-Mark-Recapture)
  - Genetic relatedness and paternity tests
  - Feeding ecology (scat analysis)

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#### Research status "mating behaviour"



- Observations on captive raccoons revealed that females after copulating with one male reject other males
- Mating happens 1 per a after winter (increased daytime length)
- Only one telemetric study on free-ranging raccoons (GEHRT & FRITZELL 1999):
  - No pair bond between males and females
  - No male parental care
  - Short-time associations (1-3 days) during mating season
  - Females rested together with multiple males
- New genetic study combined with telemetric investigations (NIELSEN & NIELSEN 2007):
  - 10 microsatellite markers for paternity tests
  - Most litters had >2 paternal alleles at each locus and 88% of 8 litters with >2 cubs were sired by multiple males!

## **Study Area – National Park Müritz**



- Located in the northeast German lowlands:
  - 120 km north of Berlin
  - National park "Müritz", subarea Serrahn
  - 5000 ha

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- Dominated by
  - a variety of waterbodies,
  - primeval beech forests (nom. UNESCO Natural Heritage)
  - 65% forest, 19% farmland, 15% water, 1% civilisation
- Temperate climate



0 0.5 1 2 Kilometer

💉 = Border of the national park Müritz (subarea Serrahn)

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#### **Study Area – Bogs and mature forests**





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# **Tracking & Genetics**

#### VHF Telemetry:

- Twice per night
- Once at daytime
- Kernel-Analysis: fixed KHR95, h=1.0
- 02/2007 05/2009









#### Genetics:

- Microsatellite marker method for 8 Loci
- Parentage analysis (Cervus 3.0): maternity, paternity and parent pair analysis
- Tissue samples of 58 adult and 55 juvenile raccoons

#### Home range distributions



- Extensive intersexual spatial overlap
- Male HRs: 702 ha
  Female HRs: 263 ha
  (Кöнnemann 2007)
- Male home ranges can include up to 4 female home ranges, but ...
- 1005 formed a coalition group with male 1017



KHR 95: 1005 / 2003 / 2014 / 2018 / 5015

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#### **Consortship events / Den sharing**

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- Females rested together with multiple males (up to 3 males)
- Males visited up to 4 females during one mating season
- Copulation probably in resting sites







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#### All for one ... and all for mating success



- High competition (fights included)
- Meeting at the resting sites
- Little joint traveling during night
- Reduced consortship behaviour



## Den sharing beyond mating season



Intersexual den sharing was documented for:

- May 2008 and early June 2009
  - Two females with a second estrus
    → probably lost their cubs
  - Late parturition (second litter) in July 08 and August 09
  - Consortship behaviour differed
    → Joint travelling increased! Escort for up to 5 days
- November 2007 and October 2008
  - Juvenile female 5015 travelled together and shared dens alternating or together with males 1005 and 1017 (coalition group) for 3 weeks. → Male 1017 was her father!
  - Adult female 5011 also travelled together with a male coalition group
    → higher familiarity between resident males and "their" females
    → better copulation prospects during next mating season?

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### Weather-dependent influences?



Mating season 2008	Mating season 2009
23.01.2008 – 08.02.2008 (15d)	01.02.2009 – 17.02.2009 (18d)
Mild winter (min.T: -3.4°C),	Cold winter (min.T: -18.2°C),
Snow cover: up to 5 cm, 5 days	Snow cover: up to 30 cm, 12 days
Wide-ranging male excursions	Travelling between winter dens
→ more passing males	→ males stayed in their HR

- During a cold mating season:
  - Decrease of multiple consortship events
  - Communal winter denning mixed up with mating events
  - Mating between resident males and females
    → Higher inbreeding factor? Lower heterozigosity?

#### **Preliminary genetic results**



- 8 marker with mean 7.75 alleles per locus (25 markers were tested)
- 1% of combined non-exclusion probability for the second parent, if the first parent (mother) is known
- For some cubs there are indications for a multiple paternity
  → more alleles at one locus than could be explained by one father

#### **Conclusions & Questions**



- Promiscous breeding system
  - Females rest and probably copulate with multiple males
- Copluation probably takes place in daytime resting sites
- Weather-dependent influences on mating behaviour
- Different consortship behaviour during second estrus
- Do we really have multiple paternities? If yes, ...
- Can multiple paternities reduce the inbreeding factor and increase heterozygosity?
- Do male coalition groups have advantages during mating season?
- Does higher familiarity between resident raccoons lead to higher mating success for males?



# Thank you for your interest!

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