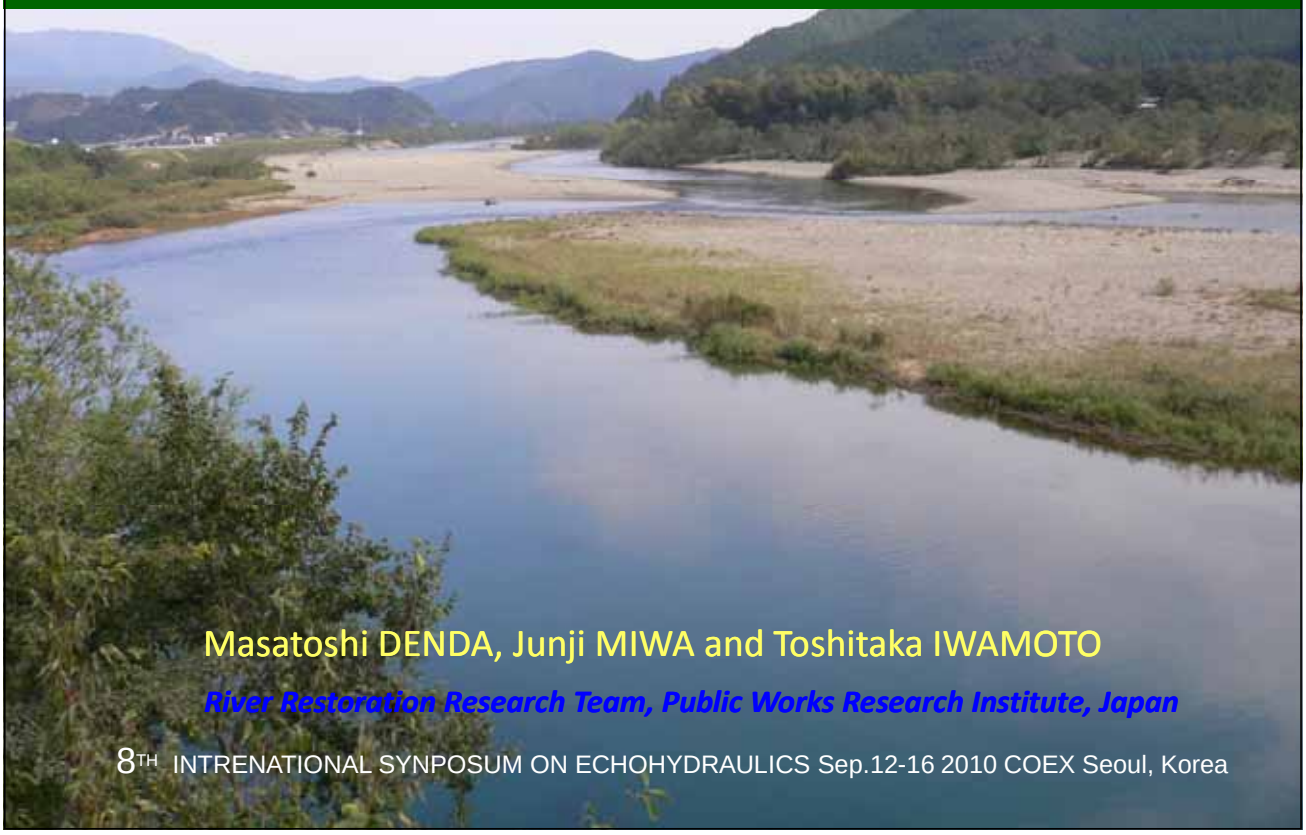
Individual-based models by using GIS and a wildlife auto-tracking system



Masatoshi DENDA, Junji MIWA and Toshitaka IWAMOTO

River Restoration Research Team, Public Works Research Institute, Japan

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Introduction: Background

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river improvement

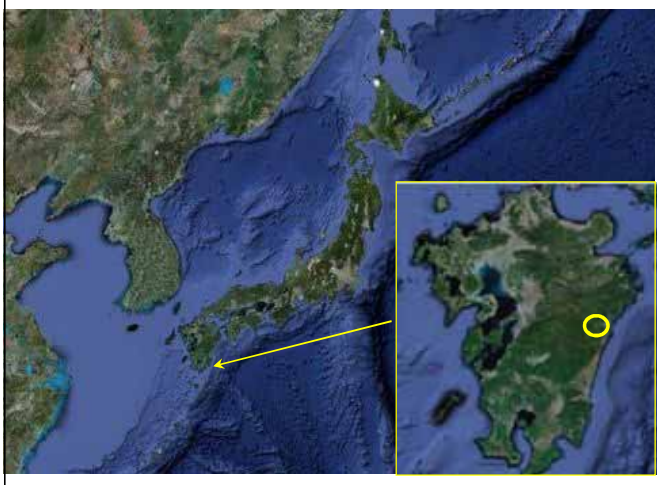
Simulation tool for conserve wildlife habitat

- In order to conserve wildlife habitat, information on the spatial suitability of the habitat is necessary.
- Additionally, for more effective policies and planning, it is important to have a simulation model and tools that can reconstruct the mechanism and preliminarily analysis effects of undertaking.

Introduction: purpose

- We describe the tracking results and spatial preferences of raccoon dogs (*Nyctereutes procyonoides*), using an Advanced Telemetry System (ATS), which is an automatic wildlife tracking.
- We then improved the individual-based models, which are actively studied in mathematical ecology.
- We developed a simulation taking into consideration their behavioral characteristics and spatial preferences.

Method: Study site Kita River

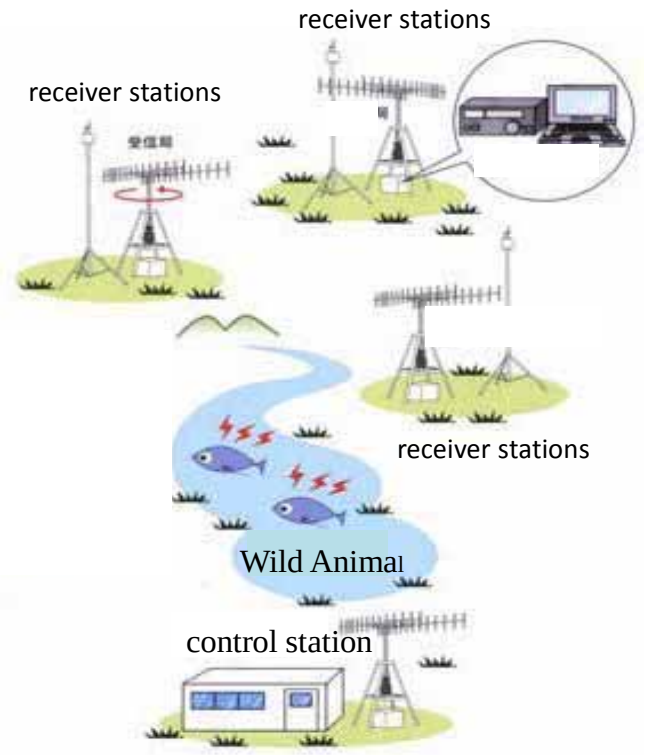


Basin area：1,820km^2
River Length：106km

- The study：Kita River in Miyazaki Pref., eastern Kyushu Island.
- Kita river frequently floods during typhoons. These floods disturb the river's topography and maintain its spatial diversity.
- Therefore, many land mammals inhabit in study site.

Method: General description of the ATS

- The ATS used consists of one control station and several receiver stations .
- The control station sends commands to each receiver station to measure the angle of a transmitter.
- Each receiver station rotates directional antenna and measures the angle data
- After collecting data from each receiver station, the control station computes the location of each transmitter by triangulation. The positioning accuracy of the ATS is within 30 m.



Method: Field survey methodology

Transmitter

We trapped three raccoon dogs, attached transmitters to them, and tracked their behavior for 1.5 months.

	Racoon dog #1	Racoon dog #2	Racoon dog #3
Gender	♀	♀	♀
Tracking period	2004.11.4-11.13	2006.10.27-10.30	2006.10.27-11.22
Age (estimate)	—	ca. 1 to 2	ca. 1 to 2
Body weight（kg）	4.6	4.78	4.56
Body length（㎜）	510	594	654
Tail length（㎜）	100	125	66
Transmitter weight (g)	93	61.7	75.6
Transmitter frequency	148.76	141.51	142.08

Methods: Data analysis

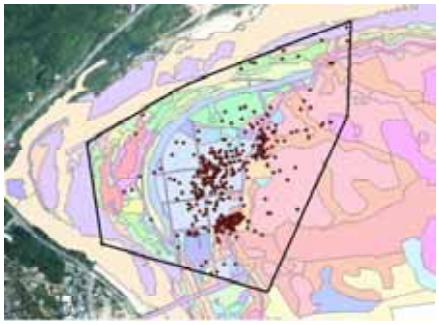
■Producing spatial data using image analysis

Field data about vegetation community was used as training data, and we re-ran the analysis until the results of the image analysis agreed with the filed data. a vegetation community map was made using image analysis (supervised classification).

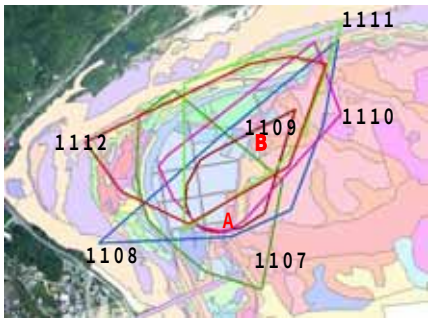
■Analysis of spatial preferences of the raccoon dogs

By analyzing the relationship between raccoon dog movements and the vegetation community, we identified the spatial preferences of the raccoon dogs. Spatial preferences were evaluated using the Ivlev selection index.

Result :Tracking results of the raccoon dogs

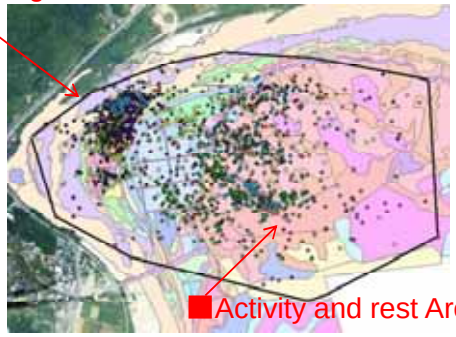


Data points showing movements of racoon dog #1

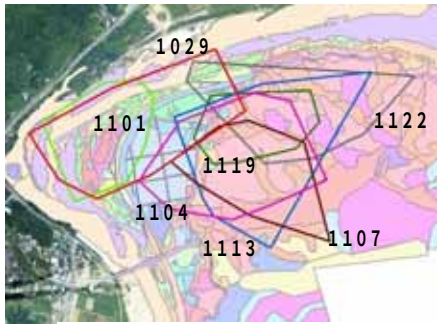


Each polygon shows the home range of racoon dog #1

■Feeding Area



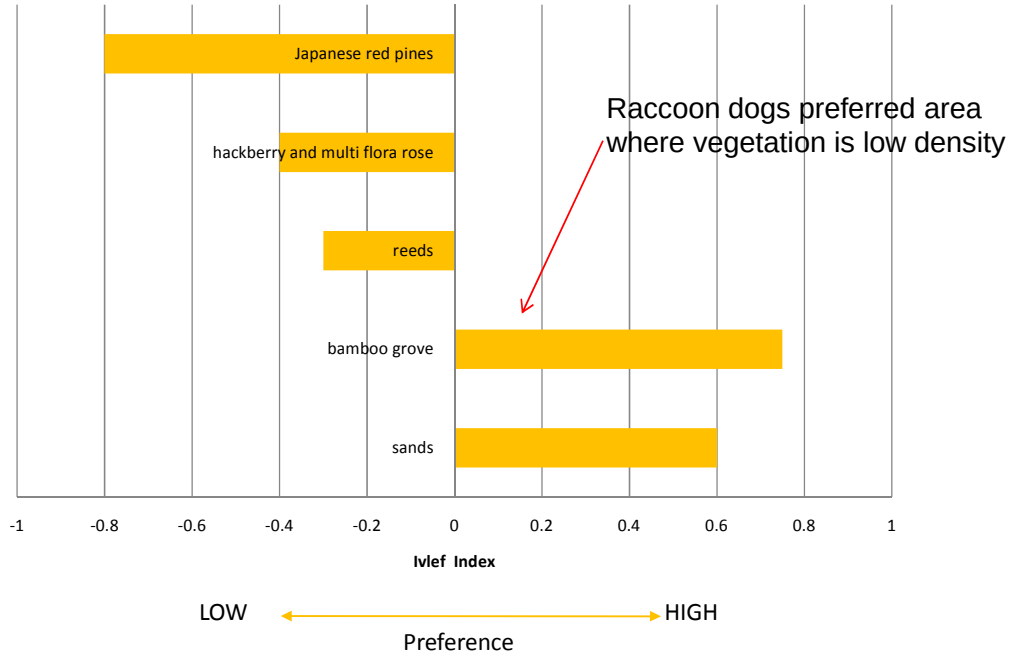
Data points showing movements of racoon dog #3



Each polygon shows the home range of racoon dog #3

The average home range of the three raccoon dogs tracked for a week was 15.6 ha .

Result :Vegetation community preferences of the raccoon dogs



Method: General description of the model

Step1：Consideration of stored energy and consumption energy：
start and stop of the action based on stored energy in the body.

$E=E_f-(M_B+M_A)$
E:Total energy in the body
E_f: Energy by feeding
M_B: Base Metabolic Rate
M_A: Active Metabolic Rate

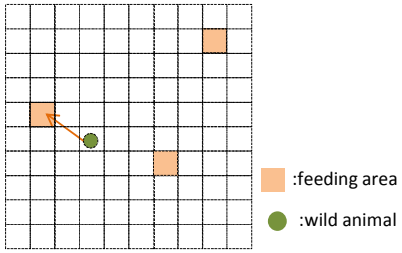
$M_B=70W^{3/4}$ (Kleiber,1963)
W:Body weight

$M_A=0.16(10)^e$ (Tucker,1970)
$e=1.67W^{-0.126}$
W:Body weight

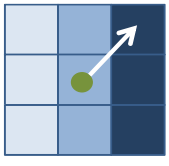
Step2：Judgment Of Action

$E<1.2M_B$:move to feeding area
$1.2M_B<E<2.2M_B$:action

Step3：Spatial recognition
Virtual animal stores important spatial information(e.g. feeding area)

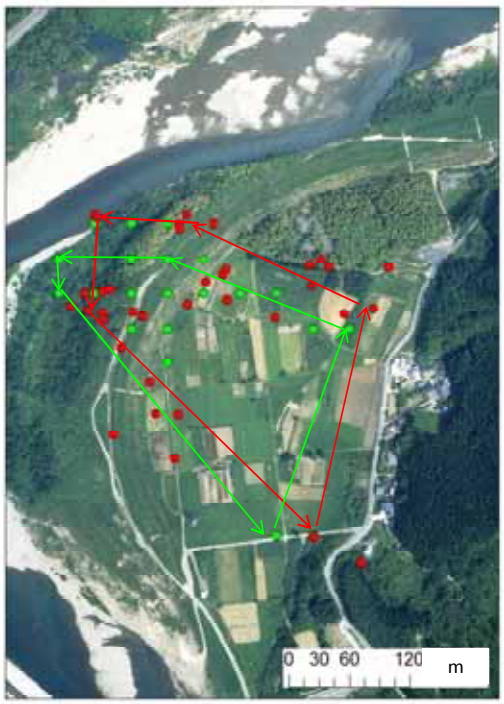


Step4：Direction selection：virtual animal select one grid where selection index is high to a target direction



Selection Index of Ivlef：LOW⇔high

Result : Comparison of observed behavior and simulation behavior



・The model reproduced each animal's movements relatively accurately. In particular, the model reproduced round-trip movements between the river terrace and fields around the mountain.
・The order of the animal of the simulation acting roughly agrees with an actual animal behavior.

Conclusions

- We describe the tracking results and spatial preferences of raccoon dogs (*Nyctereutes procyonoides*), using an Advanced Telemetry System (ATS)
- The average home range of the three raccoon dogs tracked for a week was 15.6 ha.
- The animals frequently used sand, bamboo grove, hackberry, and multiflora rose communities and did not use reeds or Japanese red pines.
- We then improved the individual-based models, and developed a simulation tool ,taking into consideration their behavioral characteristics and spatial preferences. In the result, we recorded successfully the raccoon dog behavior.
- Combination of results of preset research and actual behavior data improve individual based model.