

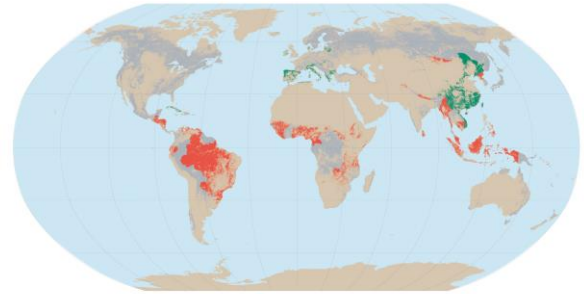
Linking Sustainable Forest Management with Habitat Conservation for the Amur Tiger (*Panthera tigris altaica*)

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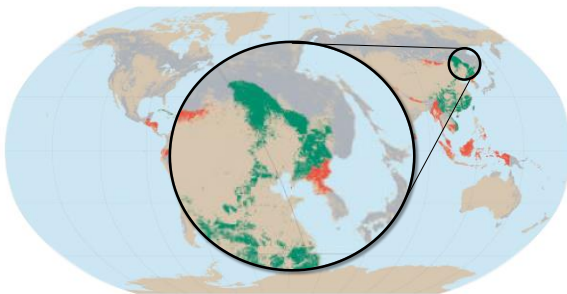
Countries with large net changes in forest area 2000-2005



>0.50% decrease per year
 >0.50% increase per year
 Change rate between -0.50 and 0.50% per year

© FAO 2006

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Cooperative Agencies



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Beijing Normal University



Northeastern Forestry University, China



State Forestry Administration, P. R. China



Far Eastern Branch, Russian Academy of Sciences

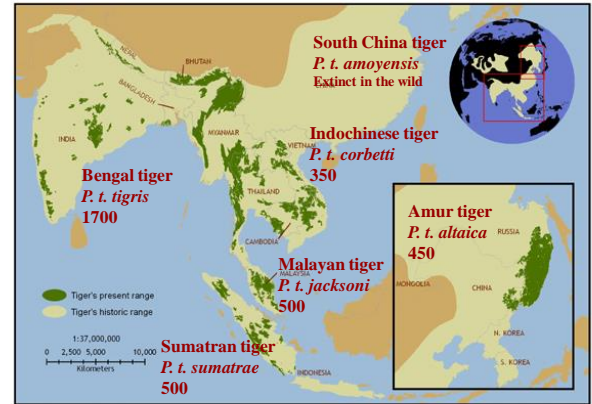


Environmental Sciences, University of Virginia



Outline

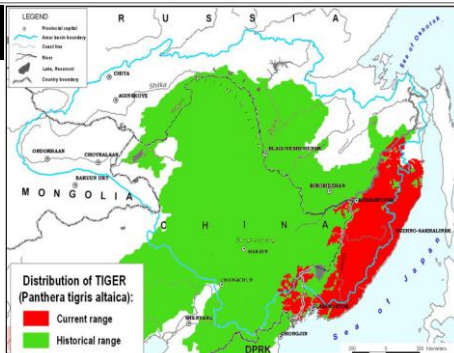
- Value of dynamic forest in providing wildlife habitat
- What does tiger need?
 - Describe suitable forest structures to tiger habitat
- What do we have for tiger now?
 - Assess current condition of forest stand structures
- How should we manage the forest for tiger habitat?
 - Forest management planning for tiger conservation
- Summary & Future



Distribution

Population

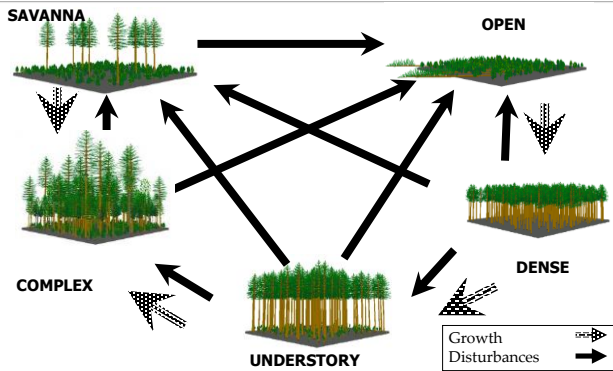
- Russia: ~450
- China: ~20
- N. Korea



Causes of Endangerment

- Expansion of agriculture land
- Hunting
 - Russia: hunting was banned in 1947
 - China: hunting was encouraged in 1950-60's
 - officially banned in 1977
 - guns were forfeited in 1998
- Forests

Forest dynamics and stand structures



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Prey & their suitable habitats



Open structures (dense shrubs or wet grassland)
 Complex structures of broadleaf forests
 Savanna structures of broadleaf forests

Openings (grassland and riverside shrub areas)
 Forest edges
 Savanna forests

What does tiger need?



Tiger carrying capacity
 $T = U/d/12p$
 U: Ungulate carrying capacity
 d: Tiger consumption
 p: Prey depletion rate

Structures	Carrying Capacity of		Minimum home range of Amur tiger (km ²)
	Ungulates (AUM/km ²)	Amur tiger (Number/km ²)	
Open	41	0.009	112
Dense	6	0.001	745
Complex	14	0.003	319

Tiger needs

- Amur tiger needs diversified stand structure as habitat
- When lower trophic-level forage regulates prey density, open, savanna and complex structures are needed to enhance tiger's conservation

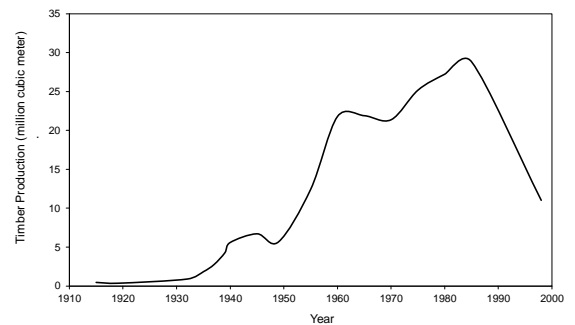
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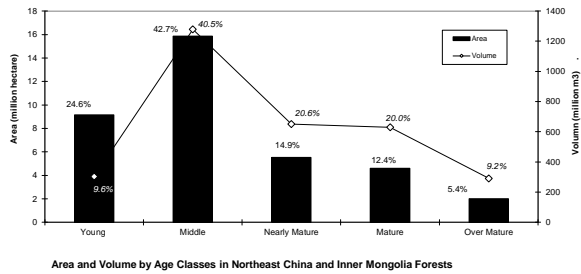
Forest evaluation



Timber harvesting history in Northeastern China



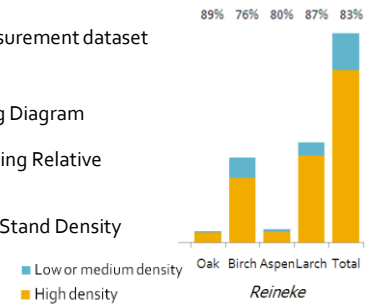
Forest evaluation



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Quantifying forest stand density

- **Data:**
 - Forest field measurement dataset
- **Methods:**
 - Gingrich Stocking Diagram
 - Drew and Flewelling Relative Density Indexes
 - Reineke Relative Stand Density Indexes

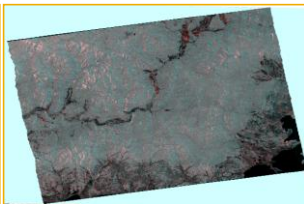


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Landscape level mapping Satellite imagery data



LANDSAT ETM+, June 24, 2007
30 M Resolution
Multispectral reflectance: R, G, B, NIR

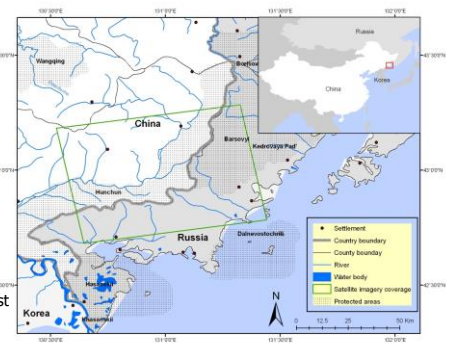


ALOS/Palsar radar, July 4, 2007
12.5 M resolution
Radar backscatter: HH, HV

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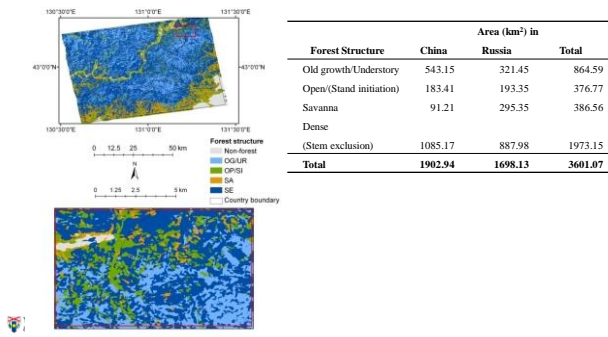
Landscape level mapping • Satellite images

- 131° 20' - 130° 39'E, 43° 17' - 42° 41' N
- 3,733 km²
- Amur tiger current range
- National Reserves
Hunchun (CH): 2001
Barosvyi (RU): 1976
- Mountainous area
- Korean pine – deciduous mixed forest



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Results -- forest structure mapping



Conclusions – what do we have

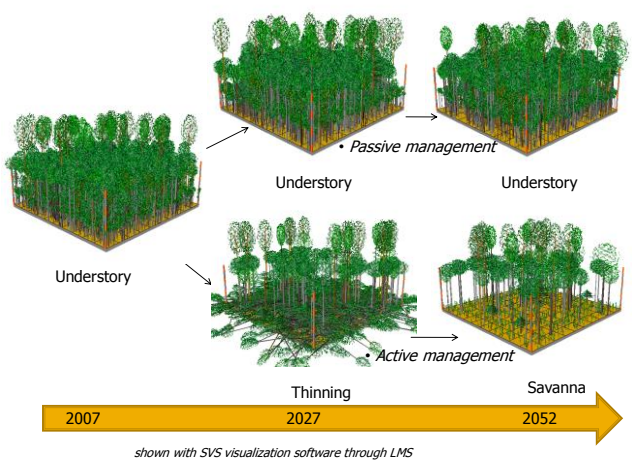
- Majority of forests in Northeastern China are indeed in a highly crowded stage, especially hardwood forest
- The current forest crowding is expected to cause a shortage of open and savanna structures, which may prevent recovery of tiger’s population in this area
- Spatial-explicit maps of the landscape with fine resolution, reliable accuracy and unique attributes of forest structure could be an informative resource for wildlife habitat modeling and evaluation, and for the design of multi-functional forest management

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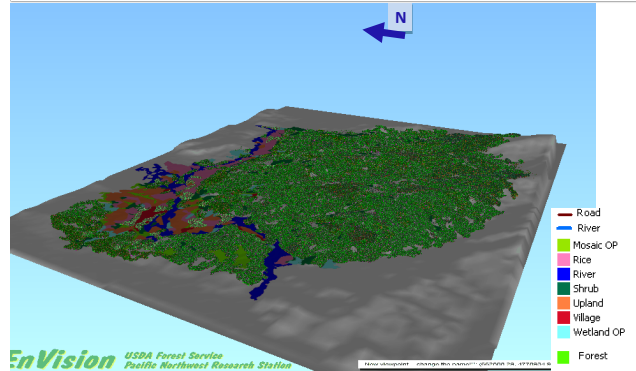
shown with SVS visualization software through LMS

Demonstration of designing a forest management plan for the Amur tiger conservation

Methods

- **Computer programs**
 - Landscape Management System (<http://lms.cfr.washington.edu/>)
 - Toogle program
 - ArcGIS
- **Data**
 - Field inventory measurements, 2006 and 2007
 - Subset of landscape-level mapping products

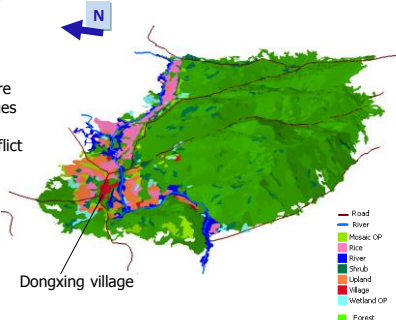
Study area



Study area

- **Hunchun Reserve**
 - Established in 2001
 - Compass 108, 700 hectare
 - Contains 29 natural villages
 - 15 thousand people
 - Intense human-tiger conflict
 - From 2001-2007, 204 livestock attacked

- **Dongxing village**
 - 130° 6'E, 43° 13'N
 - 7, 039 hectare, with 5, 576 in forests



Problems

- Low populations of the Amur tiger and other wildlife
- Human-tiger conflict
- Unemployment of former forestry employees
 - Annual timber production reduced 62.1% since 1998
 - More than half million unemployment

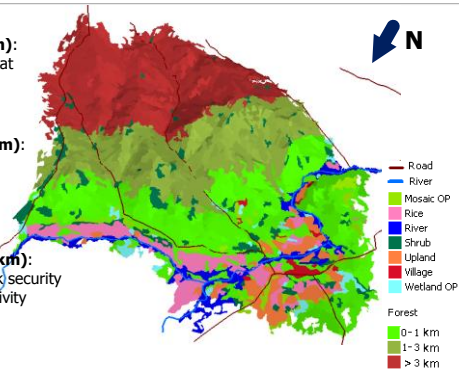


Management strategy

Tiger zone (> 3km):
Tiger and prey habitat

Buffer zone (1-3km):
Trespass prevention

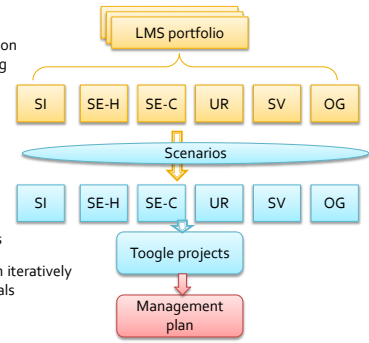
Human zone (0-1km):
Human and livestock security
Livestock productivity



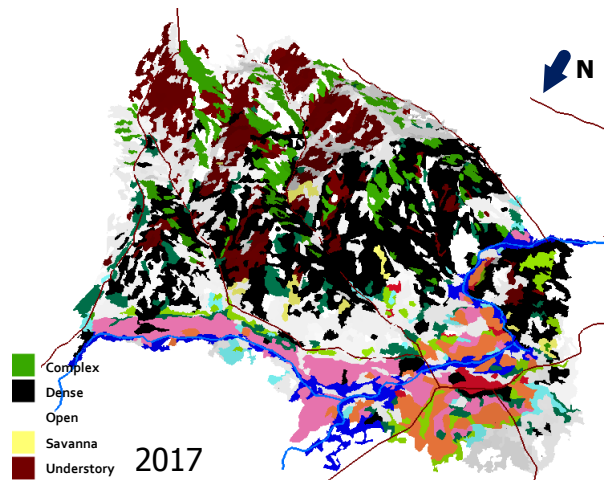
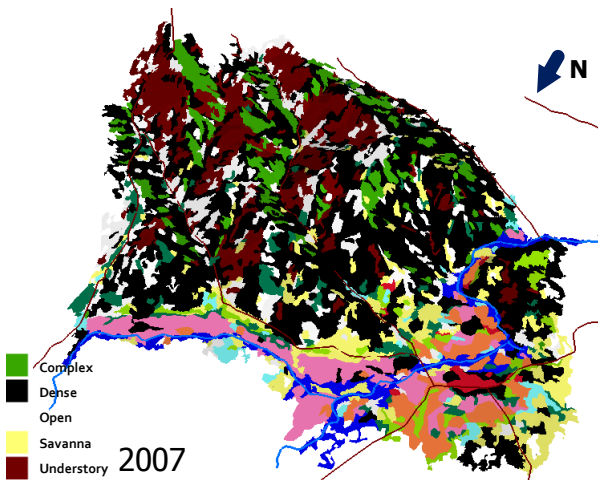
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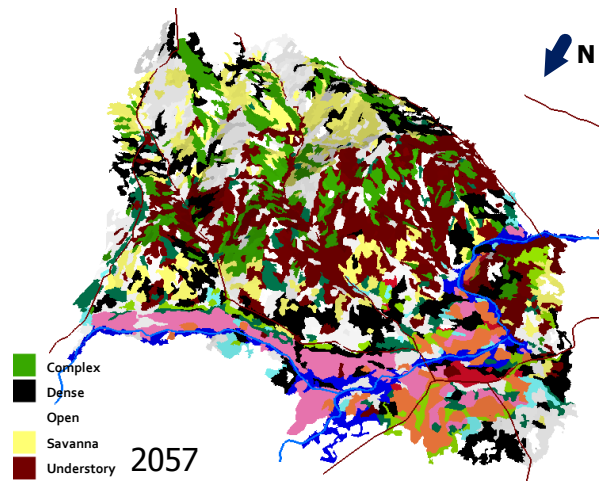
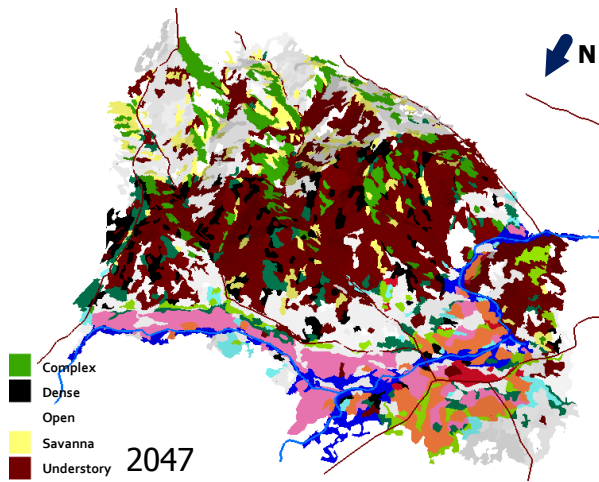
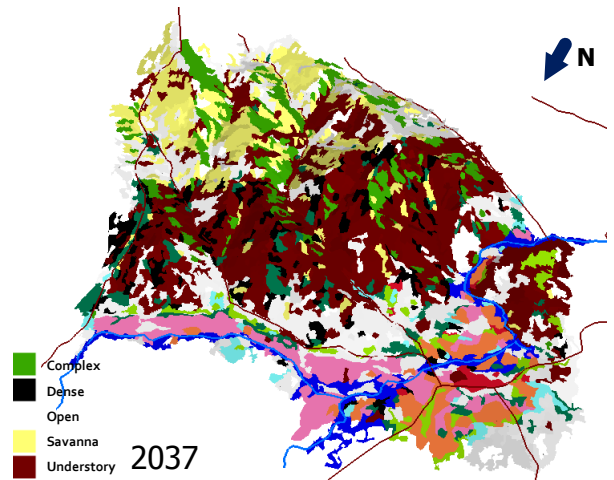
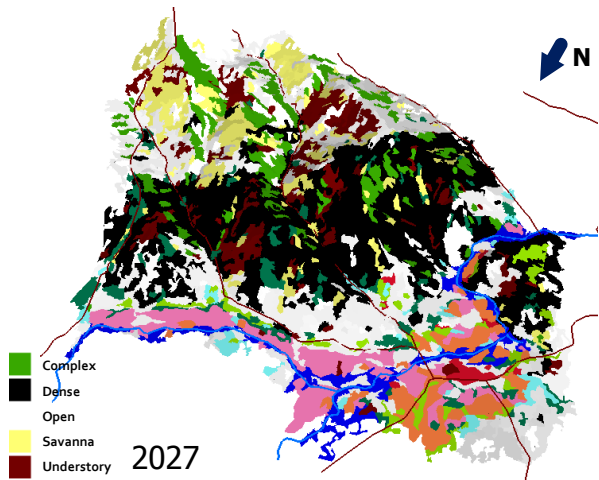
Procedures

- Inventory data
- Management zones
- Current situation examination
- Management goals setting
 - Grouping
 - Representative stands
- Design silviculture pathways
 - Simulation
- Output: consequences tables
- Assign pathways and proportion iteratively
 - Meet management goals



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Conclusions

- It is feasible to manage the forest stand structure for Amur tiger conservation using forest management decision support tools
- Through appropriate management the forests could become more suitable for tiger habitat. At the same time, people and livestock can be more protected from tiger attack.
- More forestry employment can be provided for the local society as a side benefit
- The strategies demonstrated by this study could be refined using the expertise of wildlife biologists and policy makers
- Cautions: Strong committed government responsibility to enforce the law is required, as the road and openings will make poaching easier



To be continued...

- In collaborating with wildlife biologists, make the relationship explicit and more detailed between stand structures and certain ungulate species.
- Apply the satellite imagery processing methodology to other areas of the Amur tiger's potential range to determine the remaining forest conditions in regards to Amur tiger habitat.
- Work with Chinese forestry administration, and other local, regional, and international stake holders to develop sound forest inventory and management plans that could be implemented for tiger conservation.
- Transboundary conservation and forest management
- Landscape Management System localization, Chinesization, knowledge transfer, and capacity building
- As a more precise examination about the forest becomes needed, develop a growth model for the forest region of Northeastern China and Russian Far East
-



Acknowledgements

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 - Prof. Chadwick D. Oliver, Prof. Timothy G. Gregoire (Yale)
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Thank you!

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