

# Japan's Edo-Tokyo Region Mapped and Interpreted with GIS

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Edo-Tokyo has been Japan's defacto capital for over 400 years, serving as the Tokugawa shogun's capital, Edo, from 1603 onward in the early modern era and as the modern-era capital city, renamed Tokyo, after the Meiji Restoration of 1868.

Various aspects of the modern capital region's geographic and urban history -- such as shoreline and river changes, administrative boundary changes, population growth, and rail network growth -- have been extensively mapped in an ongoing project to produce a comprehensive "GIS spatial history of Tokyo."

More recently, the project's temporal scope has been extended back into the Edo era and early Meiji period by using historical maps, gazetteers, and survey data. These earlier historical data sources are: (1) Musashi kuniezu, government-produced maps showing villages, towns, and major rivers in Musashi, the province in which Edo was located, (2) Shinpen Musashi Fudoki-ko, an 1820s annotated and illustrated gazetteer listing villages and towns and giving their distance from Edo, position in county, east-west dimensions, north-south dimensions, number of households, number of Buddhist temples and Shinto shrines, and rice production capacity, and (3) Kyobuseihyo, an 1870s survey of conscriptable resources for military use, listing male and female population, number of households, government offices, temples, schools, slaughterhouses, waterwheels, oxen, horses (riding, pack, breeding), freight carts, rickshaws, oxcarts, horse carts, boats, post offices, telegraph offices, and length of electric power lines.

This presentation will convey the nature of the entire project and some of the challenges faced in using older historical sources for input, interpretation, and visualization in the historical GIS.

The material presented in this article for the conference proceedings consists of this abstract and seven sheets of Powerpoint "handouts". Each sheet has an introductory slide, followed by five representative examples of different aspects of mapping and interpretation. Additional slides will be shown and explained in the conference presentation.

The slides are reproduced at reduced scale and resolution here, and may be printed in black and white rather than in their original full color. Anyone wishing to see the originals should contact the author at [siebert@uakron.edu](mailto:siebert@uakron.edu).



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Presented at:

Reading Historical Spatial Information in the World  
 -- Studies of Human Cultures and Civilizations  
 based on Geographic Information Systems

Kyoto, Japan, February 7-11, 2005

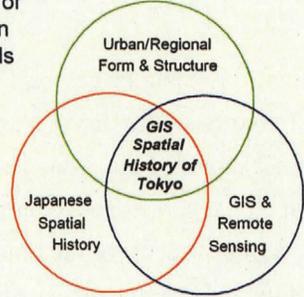
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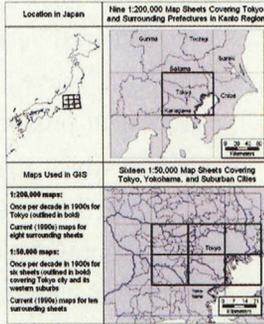
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## Integration of Research in Three Fields



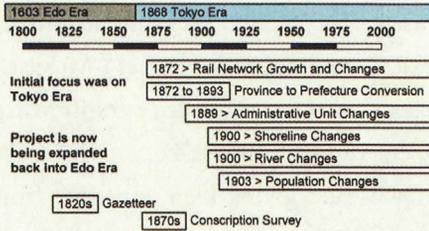
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## Spatial Scope of GIS Spatial History of Edo-Tokyo



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## Temporal Scope of GIS Spatial History of Edo-Tokyo



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## Thematic Scope of GIS Spatial History of Edo-Tokyo

- Hydrological features**  
 Shorelines, land reclamation, harbors  
 Rivers, canals, and moats
- Administrative features**  
 Conversion from provinces to prefectures  
 Establishment of villages, towns, cities, wards  
 Boundary changes, mergers, annexations
- Population and density**
- Rail network**  
 Company establishments, mergers, annexations  
 Rail line openings, multiple tracking, electrification  
 Rail station openings and service types and levels
- Landscape**  
 Land cover and land use  
 Landscape fragmentation

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## Main Data Sources for GIS Spatial History of Edo-Tokyo

- Historical topographic maps**  
 1:50,000, 1:200,000 for each decade in 1900s;  
 some 1:10,000 and 1:20,000 for late-Meiji period
- Historical land use maps**  
 1:200,000 and 1:25,000 for 1970s and 1980s
- Population censuses**  
 Every five years for 1900s
- Administrative chronologies**  
 Year, month, day for most post-1868 events
- Rail chronologies**  
 Year, month, day for most post-1872 events
- Historical gazetteer & province maps**  
 Shinpen Musashi Fudoki from 1820s, Kuniezu
- Conscription survey**  
 Kyobuseiyo survey from 1870s

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### GIS Mapping of Changes in Physical Geography

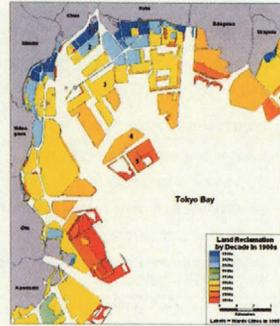
- Input from series of 1:50,000 and 1:100,000 topographic maps from Geographic Survey Institute of Japan
- Expansion of land area in Tokyo Bay in 1900s
- Complex water-land transition histories in Tokyo Bay, as revealed in topographic maps
- Expansion of Tokyo harbor areas
- Changes in river routes at head of Tokyo Bay and their effects on village, town, and ward boundaries

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### Expansion of Land Area in Tokyo Bay in 1900s

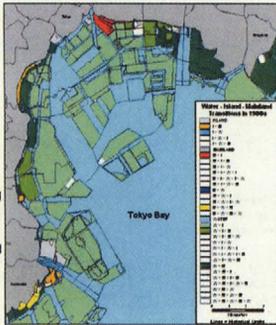
Early years: New landfill islands were created along coasts to south and east.  
 Later years: More and larger islands were created further into bay.



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### Water > Land Transitions in Tokyo Bay in 1900s

Many areas had simple transitions:  
 Water > island  
 Water > mainland  
 Water > island > mainland  
 Some areas had complex transitions, such as:  
 Water > mainland > island  
 (Analysis based on once-per-decade 1:50,000 topographic maps.)



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### Development of Enclosed Harbors in Tokyo Bay

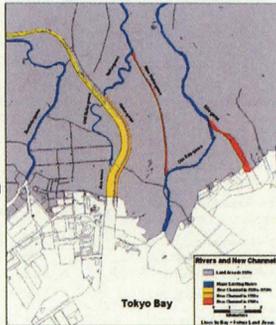
Inner harbor was enclosed by 1930s.  
 Infill islands were later created in inner harbor.  
 Outer harbor was enclosed by 1980s.  
 Additional islands were created beyond outer harbor in 1990s.



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### Rerouting of Rivers at Head of Tokyo Bay in 1900s

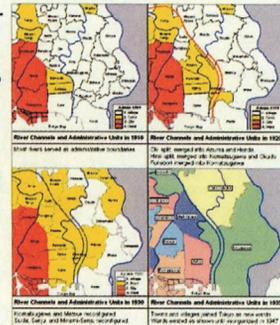
Arakawa bypass for Sumidagawa was created in 1920s and 1930s.  
 Nakagawa and Edogawa bypasses were created in 1960s.



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### Effect of River Rerouting on Village, Town, and Ward Boundaries

Some villages and towns were split apart.  
 Some ward boundaries follow old channels.  
 Some ward boundaries follow new channels.



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### GIS Mapping of Changes in Political Geography

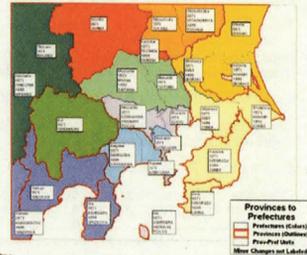
- Input from series of 1:50,000 and 1:100,000 topographic maps from Geographic Survey Institute of Japan, census records, and variety of other sources
- Conversion of provinces to prefectures in late 1800s
- Conversions from village to town to city to ward status
- Annexation and merger patterns
- Urbanization zones (sequential and nonsequential changes in administrative status)

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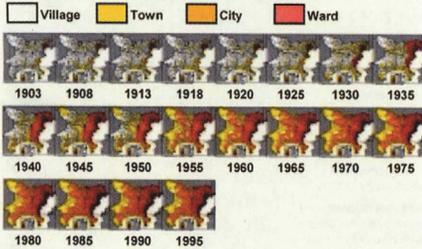
### Conversion from Provinces to Prefectures in Kanto Region

Process occurred in stages from 1871 to 1893, with some minor boundary changes even later. Some smaller prefectures were initially created, then later merged. Only a few areas maintained or ended up with original boundaries.



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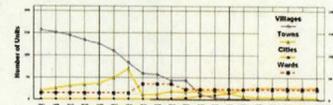
### Villages, Towns, Cities, & Wards in 1900s in Tokyo & Kanagawa Prefectures



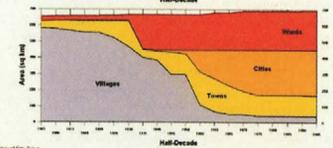
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### Historical Trends of Administrative Unit Change in Tokyo Prefecture

Change in Number of Units by Type



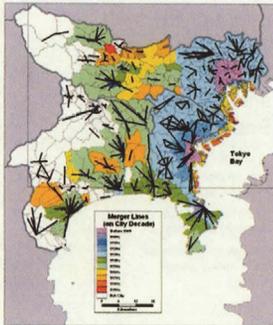
Change in Total Area by Type



(Izu islands not included)  
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### Annexation Patterns in Tokyo and Kanagawa

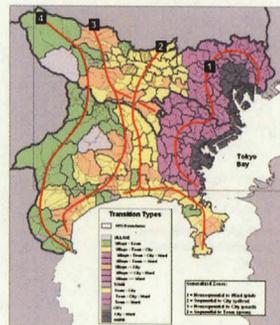
Some areas maintained their original boundaries. Some areas annexed surrounding areas in star-like historical pattern. Some areas had complex histories of consolidation followed later by division.



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### Urbanization Zones in Tokyo and Kanagawa

- 1 = Villages and towns directly added to Tokyo and Yokohama as wards
- 2 = Suburban cities with sequential transitions
- 3 = Mountain-edge cities that directly annexed surrounding villages
- 4 = Mountain villages and towns



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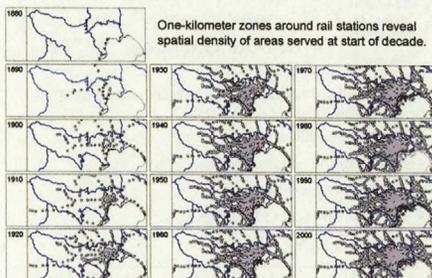
## GIS Mapping of Rail Network History

- Input from topographic maps and rail company chronologies
- Over 200 rail companies and lines and over 2000 stations
- Complete history of rail company mergers, acquisitions, dissolutions, nationalization, privatization
- Complete history of line openings, electrification, multiple tracking, grade separation, interline through service, etc.
- Complete history of station openings/closures, etc.
- Analysis of rail company, line, and station names

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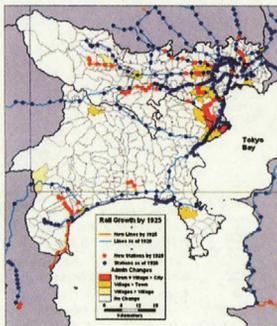
## Growth of Areas Served by Rail in Tokyo



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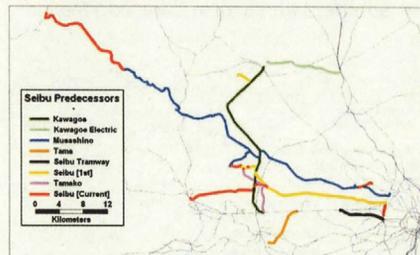
## Rail Network Growth vs. Administrative Change (1920-1925)

Many new stations opened in areas around Tokyo that became towns between 1920 and 1925.



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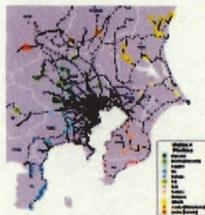
## Seibu Railway: Geographic Lineage



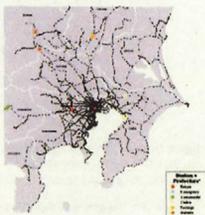
Lines are listed in order of company formation.

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## Rail Stations Named After Old Provinces vs. Modern Prefectures



Province-based station names: Many stations throughout region



Prefecture-based station names: Only a few stations

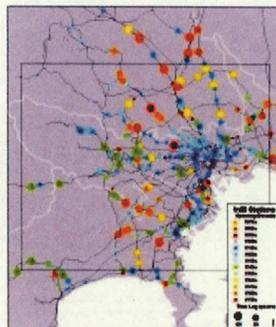
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## Infill Rail Stations in Tokyo Area

"Infill stations" are new stations interspersed between older stations to serve intermediate areas.

Most early lines had stations spaced far apart, with later infill.

Most newer lines opened with closely spaced stations.



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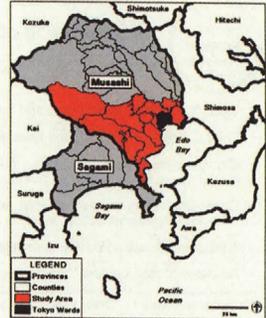
### Village & Town Data from *Shinpen Musashi Fudoki* Provincial Gazetteer (1820s)

- Distance from Edo-Nihonbashi (official "starting point" for measuring distances in Japan)
- Position of settlement within county
- East-west and north-south dimensions
- Number of households
- Buddhist temples and Shinto shrines
- Production capacity (*kokudaka*)

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### Study Area: Southern Musashi Province



Area now equals Tokyo prefecture and parts of Kanagawa and Saitama prefectures.

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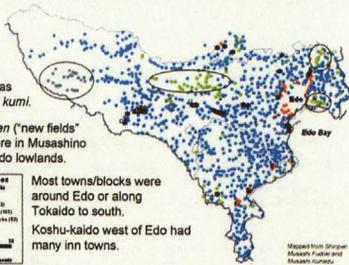
### Settlement Types in Southern Musashi in Late Edo Period

Hinohara was divided into *kumi*.

Most *shinden* ("new fields" villages) were in Musashino upland or Edo lowlands.



Most towns/blocks were around Edo or along Tokaido to south. Koshu-kaido west of Edo had many inn towns.

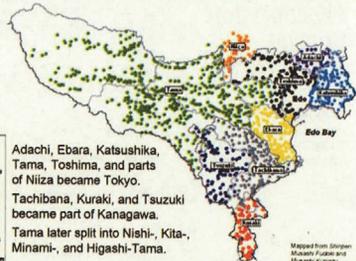


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### Counties (*Gun*) in Southern Musashi in Late Edo Period



Adachi, Ebara, Katsushika, Tama, Toshima, and parts of Niiza became Tokyo. Tachibana, Kuraki, and Tsuzuki became part of Kanagawa. Tama later split into Nishi-, Kita-, Minami-, and Higashi-Tama.



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### Districts (*Ryo*) in Southern Musashi in Late Edo Period



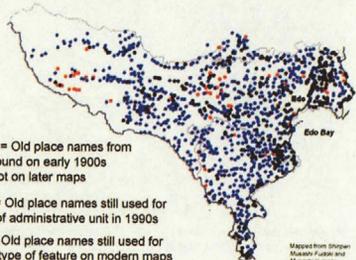
Total of 28 *ryo* plus Musashino Shinden. Some *ryo* (e.g., Nogata) spanned more than one *gun*. Some *ryo* (e.g., Kanagawa and Kozukue) overlapped significantly. Some *ryo* (e.g., Setagaya and Yamaguchi) had outlying villages.



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### Surviving Place Names of Edo-Era Settlements in Southern Musashi Province

- Black Dots** = Old place names from 1820s still found on early 1900s maps, but not on later maps
- Blue Dots** = Old place names still used for some level of administrative unit in 1990s
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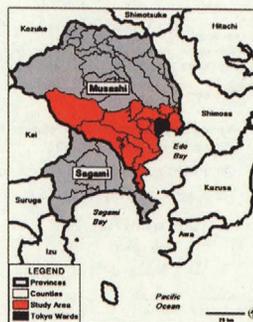
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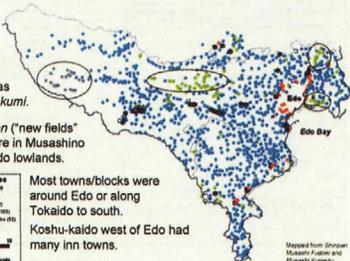
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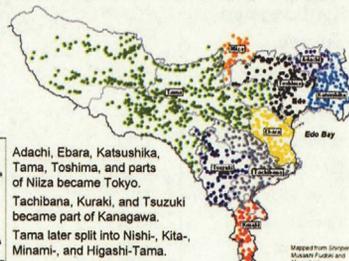
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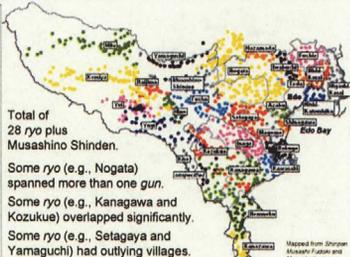


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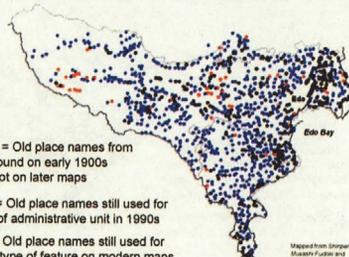
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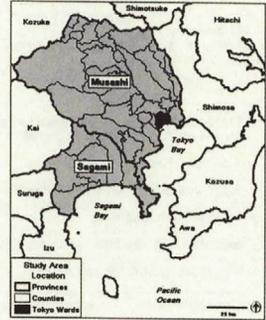
Village, Town, County, & Ward Data from *Kyobuseihyo* Conscription Survey (1870s)

- *Kyobuseihyo* government survey in 1870s of resources usable for military purposes
- Organized by province (*kuni*) and county (*gun*)
- Three spatial survey units:
  - Tokyo wards (*ku*)
  - Counties (*gun*)
  - Major settlements

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Study Area: Musashi and Sagami Provinces

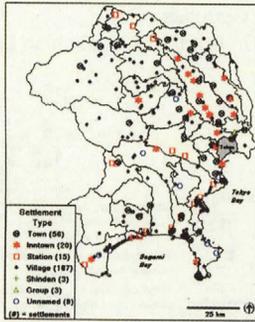


Area now equals Saitama, Tokyo, and Kanagawa prefectures.

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Settlements Included in *Kyobuseihyo* Survey

- 56 towns/blocks (*machi, cho*)
- 20 inn towns (*shukuba*)
- 167 villages (*mura*)
- 3 "new fields" (*shinden*)
- 3 groups (*kumi*)
- 9 unnamed



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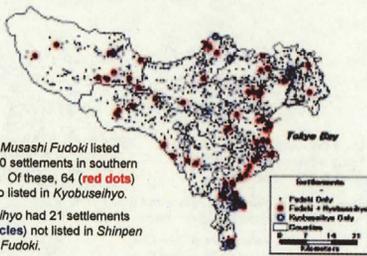
*Kyobuseihyo* Conscription Survey Data

Tokyo Wards	Counties	Settlements
Dimensions (EW, NS)	Dimensions (EW, NS)	Population (Total, Male, Female)
Population (Total, Male, Female)	Population (Total, Male, Female)	Population (Total, Male, Female)
Households	Households	Households
Government offices		Government offices
Buddhist temples		Buddhist temples
Schools		Schools
	Post offices	Post offices
		Telegraph offices
	Electric power lines (distance.)	
Waterwheels		Slaughterhouses
Oxen	Oxen	Waterwheels
Horses	Horses	Oxen
Carts (freight, rickshaw, ox, horse)	Carts (freight, rickshaw)	Horses (riding, draft, breeding)
Boats	Boats	Carts (freight, rickshaw, ox, horse)
	Products	Boats (Japanese, Western, size)
		Products

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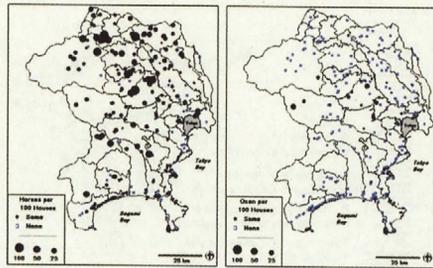
Settlements Listed in *Kyobuseihyo* and *Shinpen Musashi Fudoki*

*Shinpen Musashi Fudoki* listed over 1000 settlements in southern Musashi. Of these, 64 (red dots) were also listed in *Kyobuseihyo*. *Kyobuseihyo* had 21 settlements (blue circles) not listed in *Shinpen Musashi Fudoki*.



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Horses vs. Oxen



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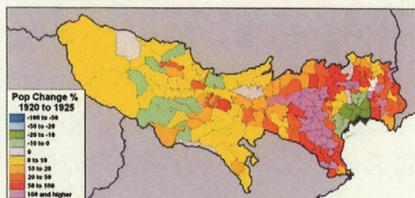
- Changes in Population
- Landscape Fragmentation
- Some Key Benefits of GIS

- Population changes by half-decade from 1903 to 1918, then 1920 to 1995
- Preliminary mapping of fragmentation of land by creation of blocks bounded by streets, railroad tracks, rivers, canals, etc.
- Some thoughts on key benefits of using GIS for recording, visualizing, and interpreting spatial history

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### Population Change in Tokyo Prefecture, 1920-1925

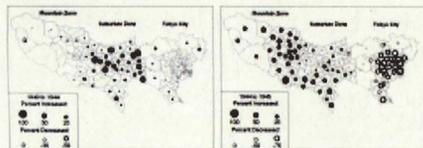


Redistribution of population from *shitamachi* area to new suburbs after Great Kanto Earthquake of 1923

Development of new suburban rail lines

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### Population Change in Tokyo Prefecture During World War II

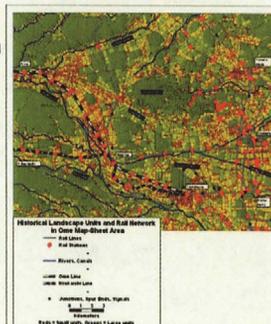


First years (1940-1944): Shift from city to central lowland areas of prefecture

Final year (1944-1945): Many deaths in city, as well as shift from city to more-distant hill and mountain areas in prefecture (and elsewhere)

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### Landscape Fragmentation in Tama Area of Tokyo Prefecture



Polygons represent fragmentation by roads, rivers, and rail lines during 1900s.

"Fragmentation" is based on features shown in once-per-decade series of 1:50,000-scale topographic maps.

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### Some Key Benefits of GIS for Historical Analysis

Spatial relationships among various historical geographic and related spatial phenomena can be recorded, visualized, and interpreted.

Both qualitative analysis using human pattern-recognition skills and quantitative analysis using underlying spatial geometry are possible.

Metadata about data sources can be recorded for each entry or group of entries, then used to reveal uncertainties in visualizations and interpretations.

GIS database structure encourages researcher to attempt to find missing information and resolve conflicts.

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 University of Akron (faculty summer grant)  
 Japan Society for the Promotion of Science (JSPS postdoctoral research fellowship)

**Guidance from PhD Committee:**  
 Drs. John Hancock, Frank Westerlund, George Kakiuchi, Anne Vernez Moudon, Timothy Nyerges

**Guidance from JSPS Host Researcher:**  
 Dr. Koichi Watanabe  
 Department of Historical Documents  
 National Institute of Japanese Literature

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## GISで見る「江戸－東京」－図化と解釈－

ローレン・シーバート

アクロン大学

「江戸－東京」は、1603年からの徳川将軍時代には「江戸」として、1868年の明治維新以降は「東京」と名を変えて、事実上の首都として400年にわたって機能してきた。近代都市の地理・都市史の様々な側面について、現在進行中のプロジェクトにおいて、包括的な「東京の歴史空間GIS」として広範にわたり地図化された。ここでは、海岸線や河川の改修、行政界の変更や人口増加、街路ネットワークの成長などがデータ化された。最近、このプロジェクトの時間軸について、古地図や地名辞典、調査データなどを参照しつつ、江戸時代から明治初期にまで、その対象範囲が拡大された。

資料は、

- ①武蔵国絵図 [行政府作成：武蔵（江戸）の村・町および主要河川が記録されたもの]
- ②新編武蔵風土記稿 [1820年代の地名辞典のリストと注釈（村・町とそれらの江戸からの距離のほか、郡の位置、東-西・南-北の規模、世帯数、神社・仏閣数、米生産容量）]
- ③共武政表 [軍が徴兵用に1870年代に調査したもの（性別別人口、世帯数、行政府機関、寺社、学校、屠殺場、水車、雄牛、馬（乗馬・運搬・繁殖用）、荷車、人力車、牛車、馬車、船、郵便局、通信局、電気回線の長さ、などが記載される）]などがデータソースとなっている。

このプレゼンテーションでは、プロジェクトの全容について紹介し、また歴史GISにおいてより古い史料をインプットしたり、解釈したり、視覚化したりする際に直面するいくつかの挑戦的試行についても紹介する。

(和訳：津村宏臣)