中国野生东北虎、豹监测技术应用和研究进展

Advance in research and application of monitoring methodology on wild Amur tiger/leopard in China

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2011年10月19日

报告内容概要：

Outline:

1、样线调查法的应用

Application of survey route

2、远红外相机调查的应用

Application of camera-trap

3、粪便\毛发DNA技术的应用

Application of fecal\hair DNA

4、信息网络监测的应用

Application of information network

5、FIT的开发与应用

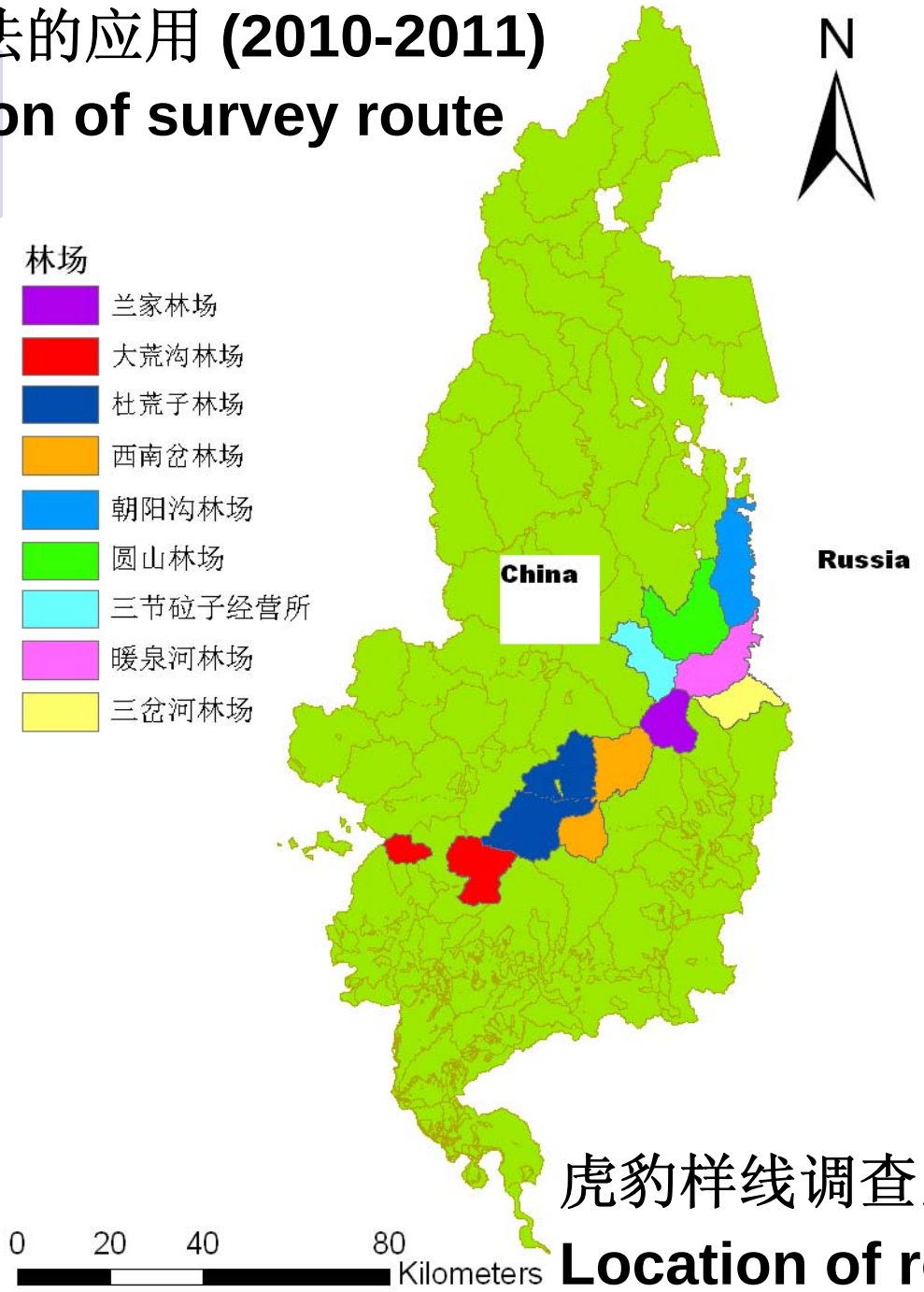
Pilot and application of Footprint Identification Technology (FIT)

6、中俄联合监测计划建议

Suggestions on Sino-Russia Joint monitoring plan

1、样线调查法的应用 (2010-2011)

Application of survey route



虎豹样线调查区域位置图

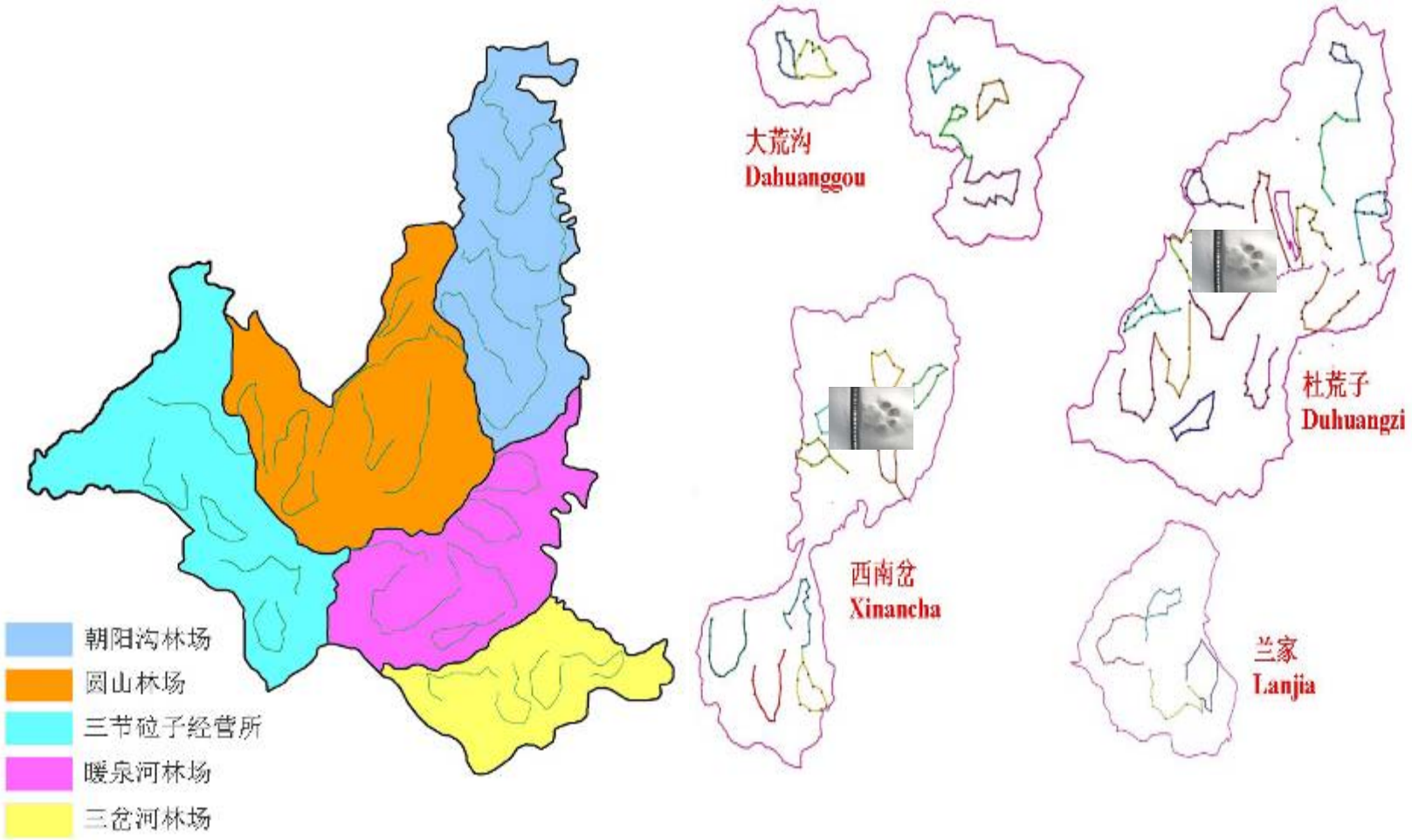
Location of route survey site


WWF东北虎及有蹄类调查方法培训

虎豹调查样线分布

Distribution of route survey for Amur tiger/leopard

（Survey areas 1735 km^2，length of survey route 609km，none of tiger was found and only 2 two leopard's snow tracks were found）



《东北虎野外保护项目示范区东北虎、豹样线数量调查报告（2010-2011年）》

<REPORT ON THE ROUTE SURVEY OF AMUR TIGER/ LEOPARD AND THEIR PREY IN WWF PILOT SITES OF NORTHEAST CHINA （2010-2011）>

主要结论：

Conclusion:

尽管俄罗斯虎调查样线布设的强度为36km/100km^{2}比较适宜，但由于中**国境内的虎密度**较低，几乎遇不到虎踪迹。因此，样线法在中国虎豹关键栖息地的数量调查中应用中投资高，收效低，具有明显的局限性。

Tiger tracks almost were not been found by route survey method according to sample 36km/100km^2 used by Russia experts, because low density of tiger in China. Therefore, this method is higher cost and shows obviously limitations.

2、远红外相机调查的应用

Application of camera-trap

1) 远红外相机调查已经开始在关键的虎豹分布区进行应用，获取了相当数量的信息，而且信息量正在累积

Camera-trap has been used in key tiger/leopard habitat and got more and more image information

2012年3月珲春拍摄

2012年3月珲春拍摄

2011年11月东方红拍摄

2012年4月汪清拍摄

2012年4月汪清拍摄

2011年9月汪清拍摄

2) 远红外相机布设方法 (考虑虎豹和猎物丰度)
Method of camera-trap set up in field

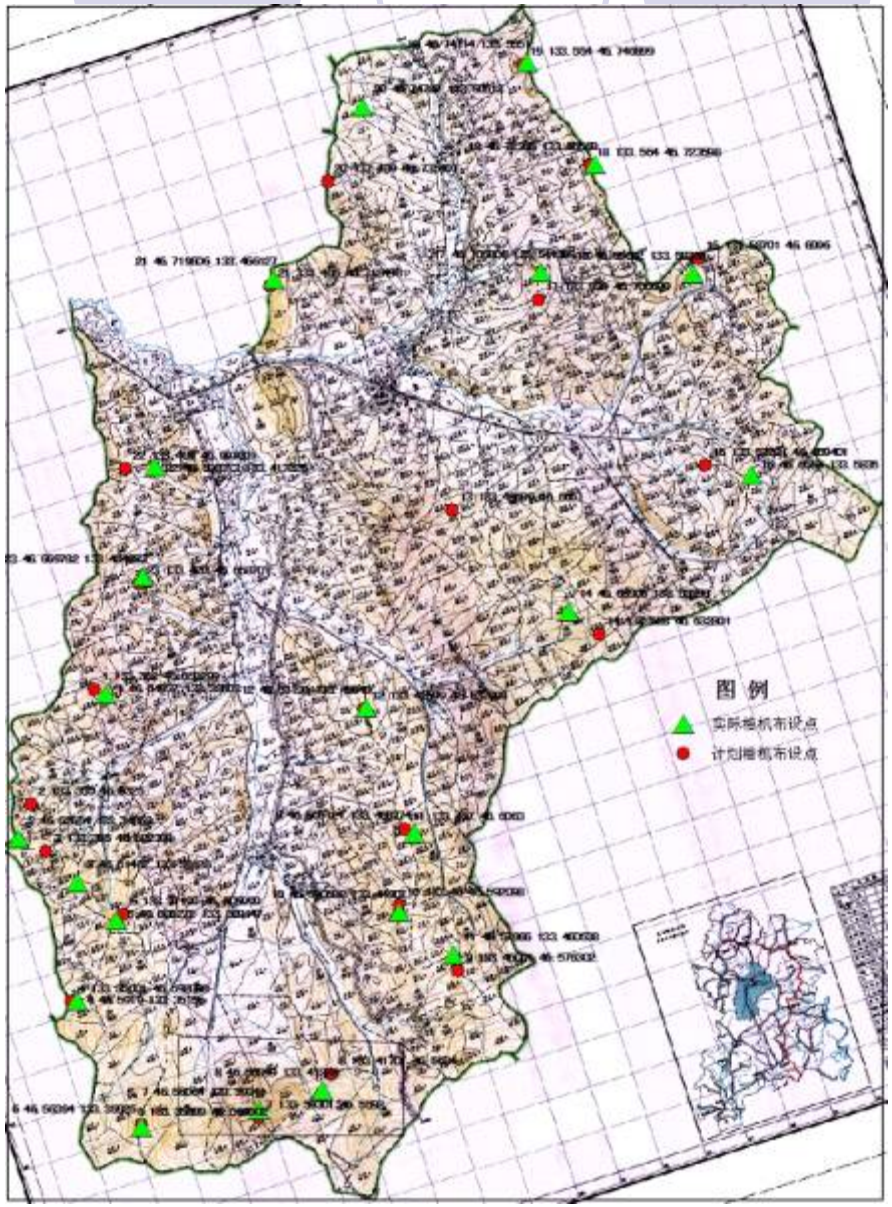
（1）以林场作为调查单元
Forest farm is as one survey block

（2）布设时间长度
About Two months

（3）布设密度1对/10km^2
Density of camera-trap is one pair/10km^2

（4）布设在山脊等位置的动物通道
Camera-trap was set up near the passage of animal at the top of ridge

注意：虎豹影像数量过少，无法应用**MARK**等软件统计和分析
Attention: too small number of images for tigers can not be analyzed by Mark etc. software.



3、粪便\毛发DNA技术的应用
Application of fecal\hair DNA

1) 主要监测地区已经配备了粪便、毛发等样品的收集设备，并已经启动了收集工作；

Equipments have been completed in HunchunNR\ Wangqing NR\ Dongfanghong FB\Yinhcun FB for collecting feces and hair samples and begin to work;

2) 已收集到珲春保护区豹唾液样本1份(食物残骸的毛发带有豹取食时的唾液)、粪便样本3份；虎粪便样本7份；东方红林业局虎毛发样本3份，准备在国家林业局猫科动物研究中心进行实验室分析和检测；

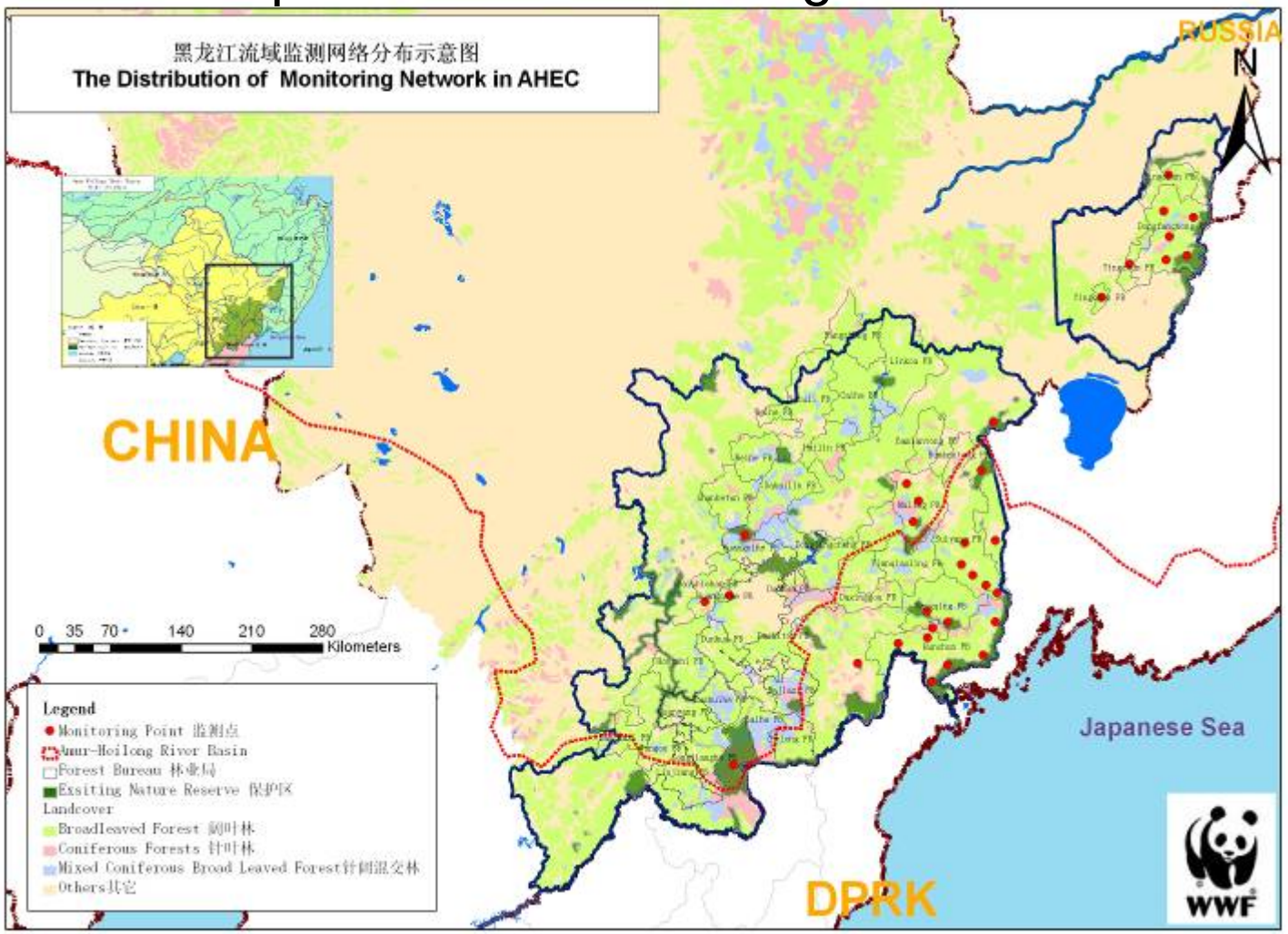
Hunchun NR: 1 Saliva \3 fecal sample of leopards, 7 fecal sample of tigers; Dongfanghong: 3 hair sample of tigers, all of these samples will be detected in laboratory in CSFA-FRC.

4、信息网络监测的应用

Application of information network

1) 监测站的基本分布格局

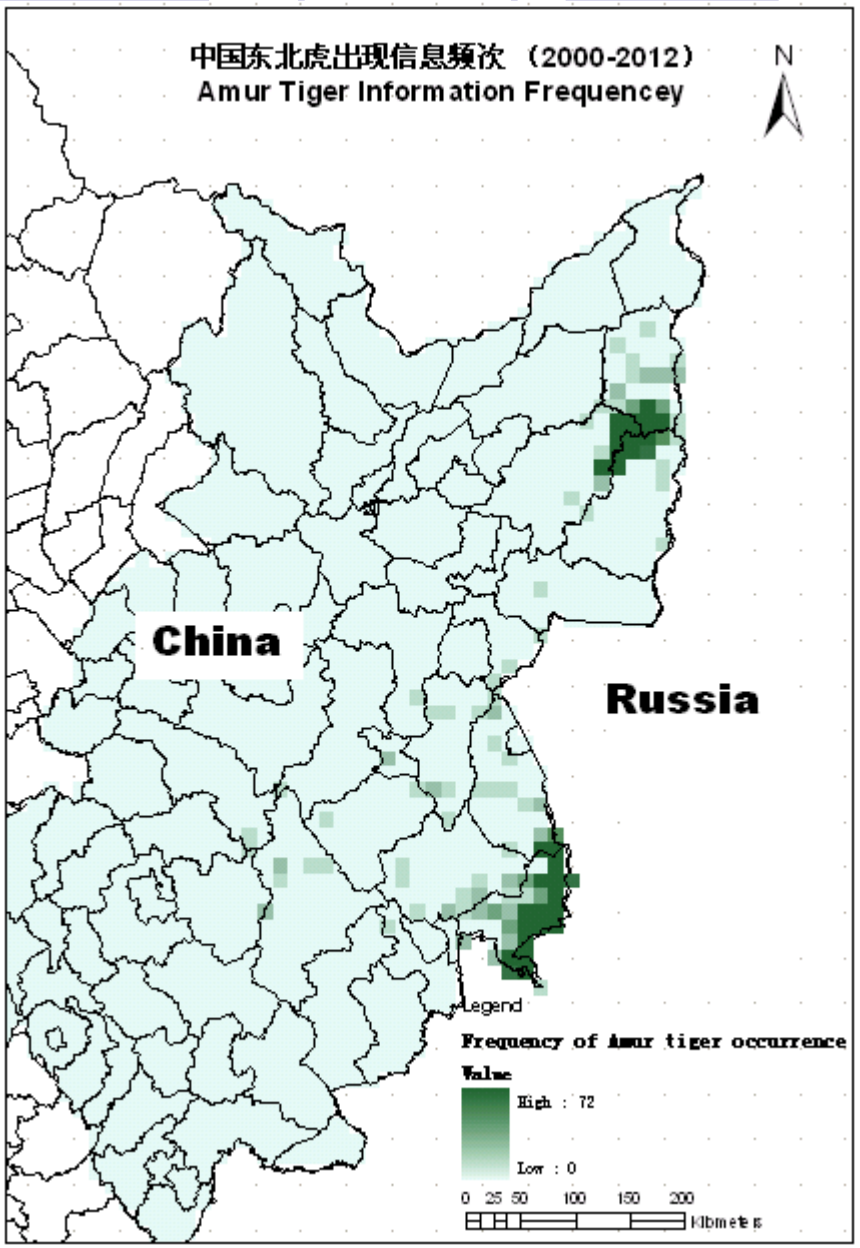
Distribution patterns of monitoring stations



2) 中国东北虎出现信息初步分析

Primary analysis on the Amur tiger information in China

- 共收集到东北虎出现信息600次；
  600 tiger information was collected;
- 距离中俄边境最远出现的点329km;
  Maximum distance to Sino-Russia board is 329km;
- 以196km^{2}的统计单元统计，单元内最高可达72次；
  The highest frequency of occurrence is 72 times/ 196km^2；
- 完达山种群与长白山种群出现的点最近距离不到90km,且有森林地带联接，可能存在交流；
  The least distance is 90km between Changbaishan information and Wandashan information, and there is narrow forest connection (may be corridor).



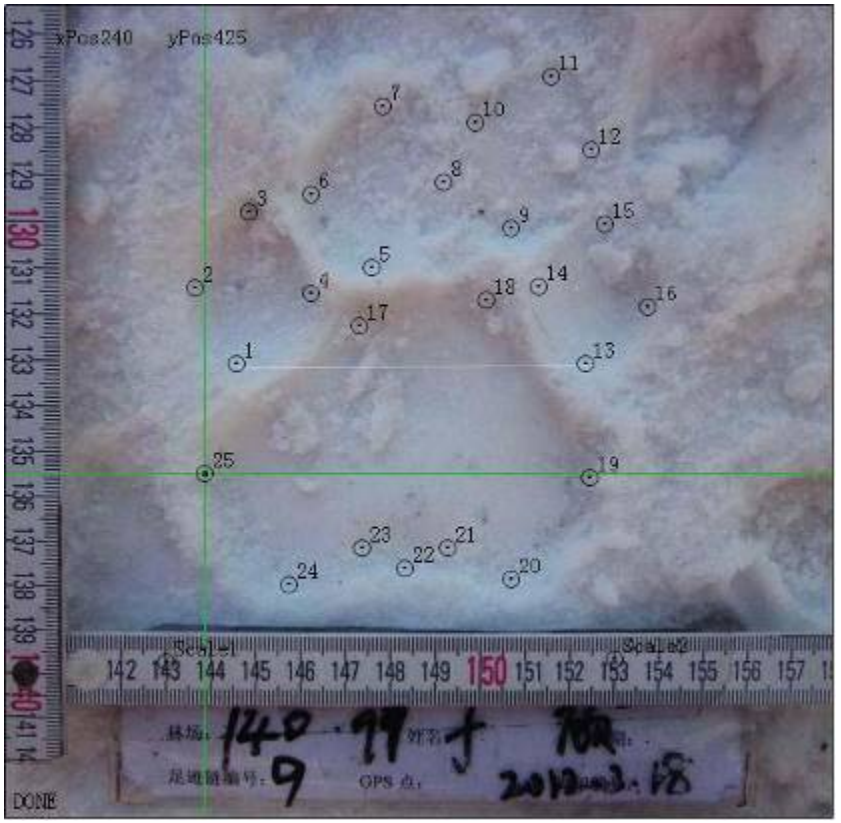
5、FIT的开发与应用

Pilot and application of Footprint Identification Technology

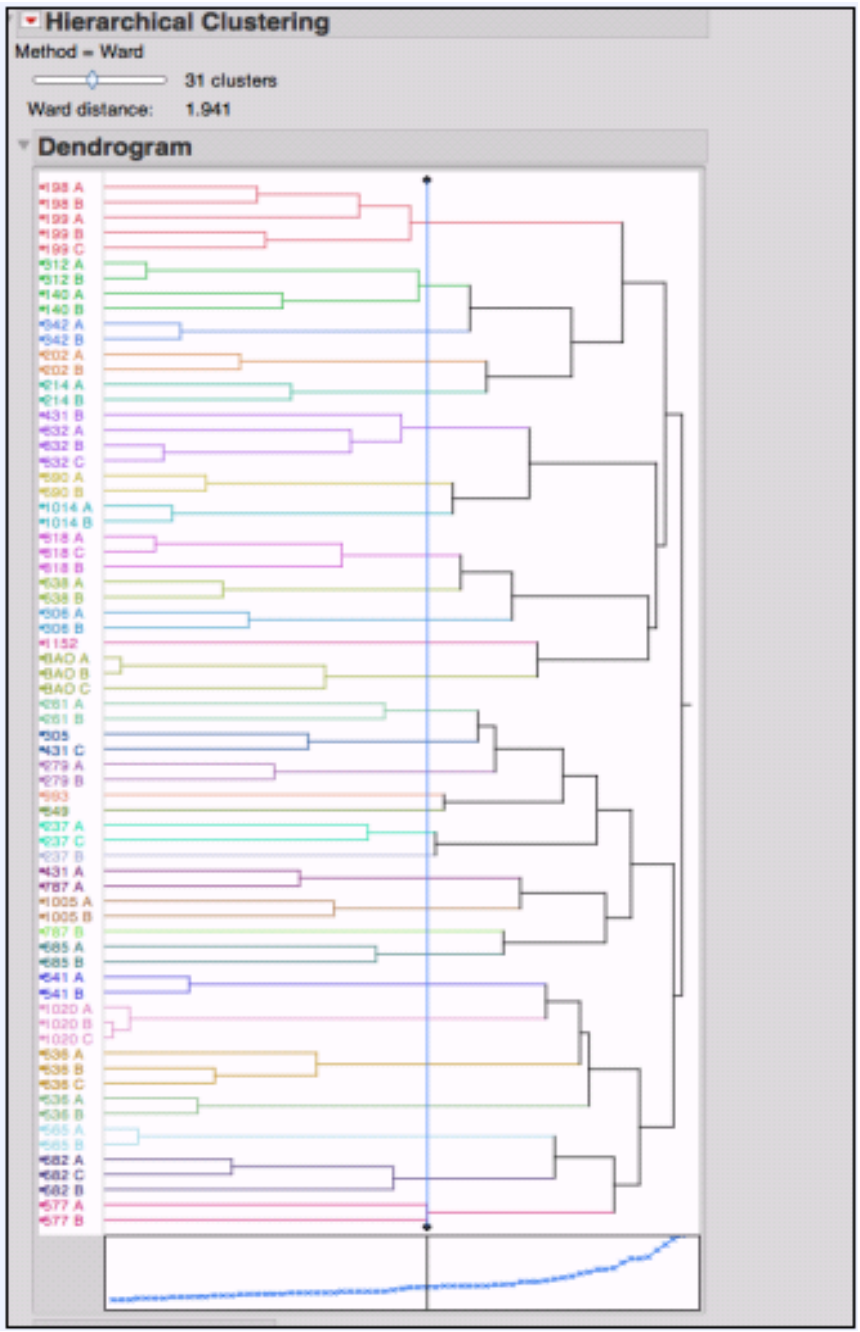
1) 圈养虎数码足迹个体识别和性别判定模型的建立

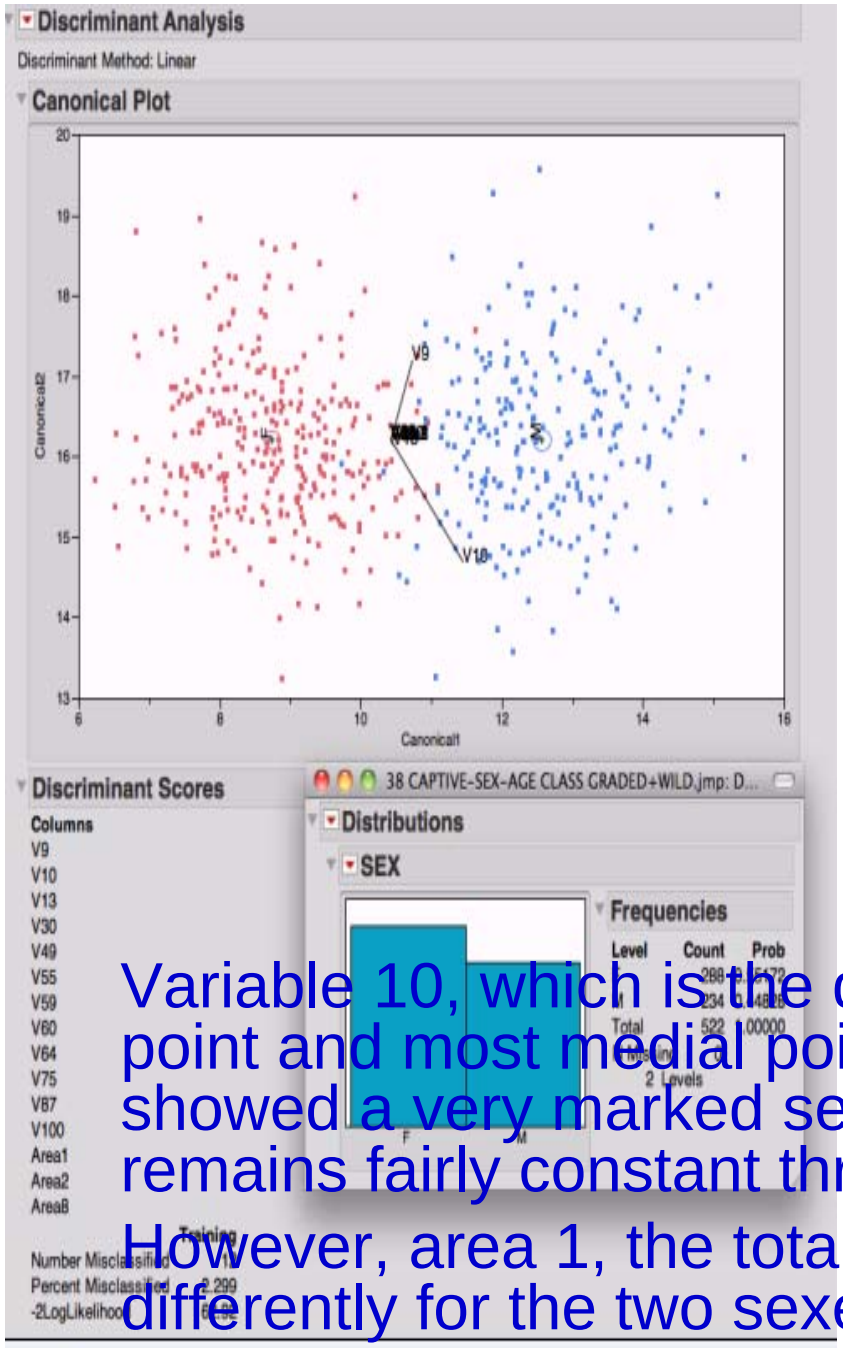
Building individual and sex footprint identification model

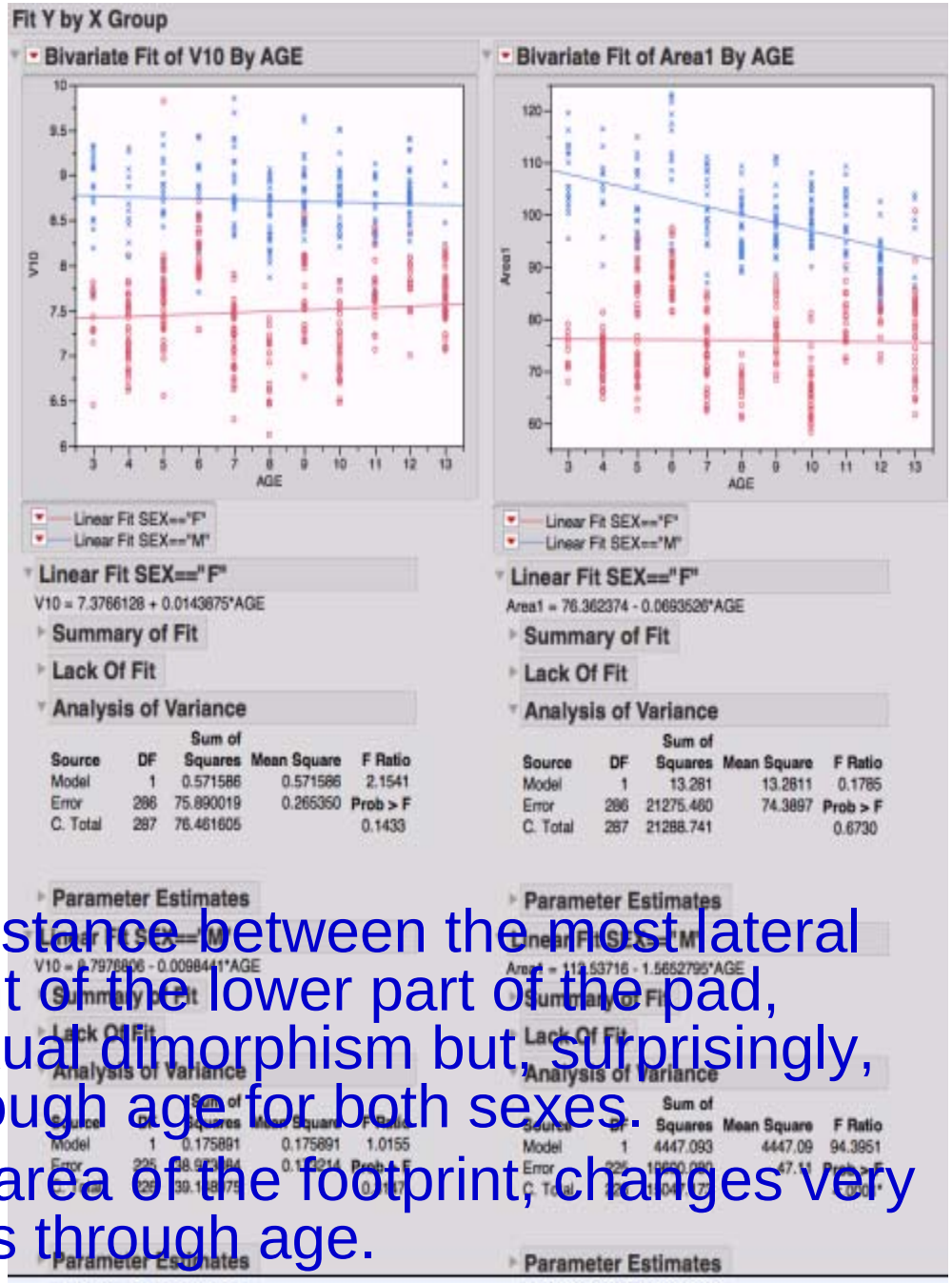
208 variables were extracted from the footprint image.



TIGER ID	SEX	AGE (yrs)	# OF FOOTPRINT IMAGES (set)	# OF TRAILS
1005	M	3	14	2
1152	F	3	11	1
1014	F	4	15	2
1020	F	4	23	3
0993	M	4	11	1
0787	M	5	12	2
0818	F	5	19	3
0832	F	5	18	3
0849	M	5	08	1
0682	F	6	18	3
0685	M	6	13	2
0690	F	6	12	2
0577	M	7	14	2
0636	F	7	18	3
0638	F	7	17	2
0536	F	8	16	2
0541	M	8	15	2
0565	M	8	15	2
431	M	9	18	3
0305	M	9	9	1
0342	F	9	11	2
0261	M	10	13	2
0279	M	10	16	2
0306	F	10	14	2
0312	F	10	16	2
0214	F	11	14	2
0237	M	11	19	3
0198	M	12	15	2
0199	M	12	17	3
0202	F	13	14	2
0140	F	13	13	2
BAO	F	13	21	3
32 Tigers	17 females/ 15 males	Range (3-13)	Total 479	Total 69





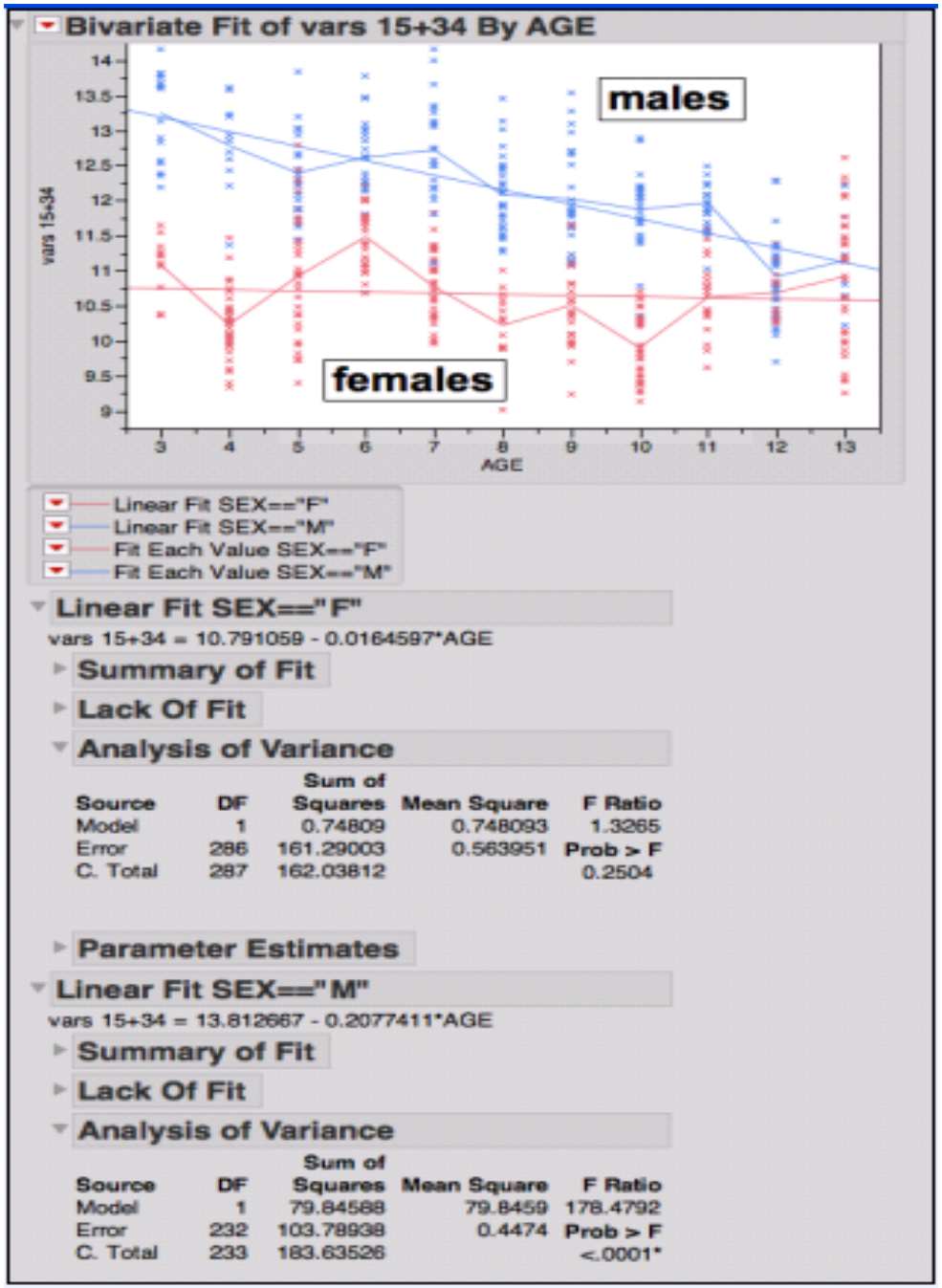


Variable 10, which is the distance between the most lateral point and most medial point of the lower part of the pad, showed a very marked sexual dimorphism but, surprisingly, remains fairly constant through age for both sexes. However, area 1, the total area of the footprint, changes very differently for the two sexes through age.

这种模式特征，雌性并没有表现出来与年龄的相助负相关的特征，但雄性却表现出明显的特征。我们获得了最佳的拟合向15和34号变量与年龄之间的关系。

This pattern, where females showed no correlation with age in footprint measurements and males showed a significant negative correlation with age was apparent for several variables. We achieved the best fit for males when we combined the measurements for two variables (15 & 34) as shown

in Fig.



2) 东方红林业局野生虎的雪地足迹个体判别试验

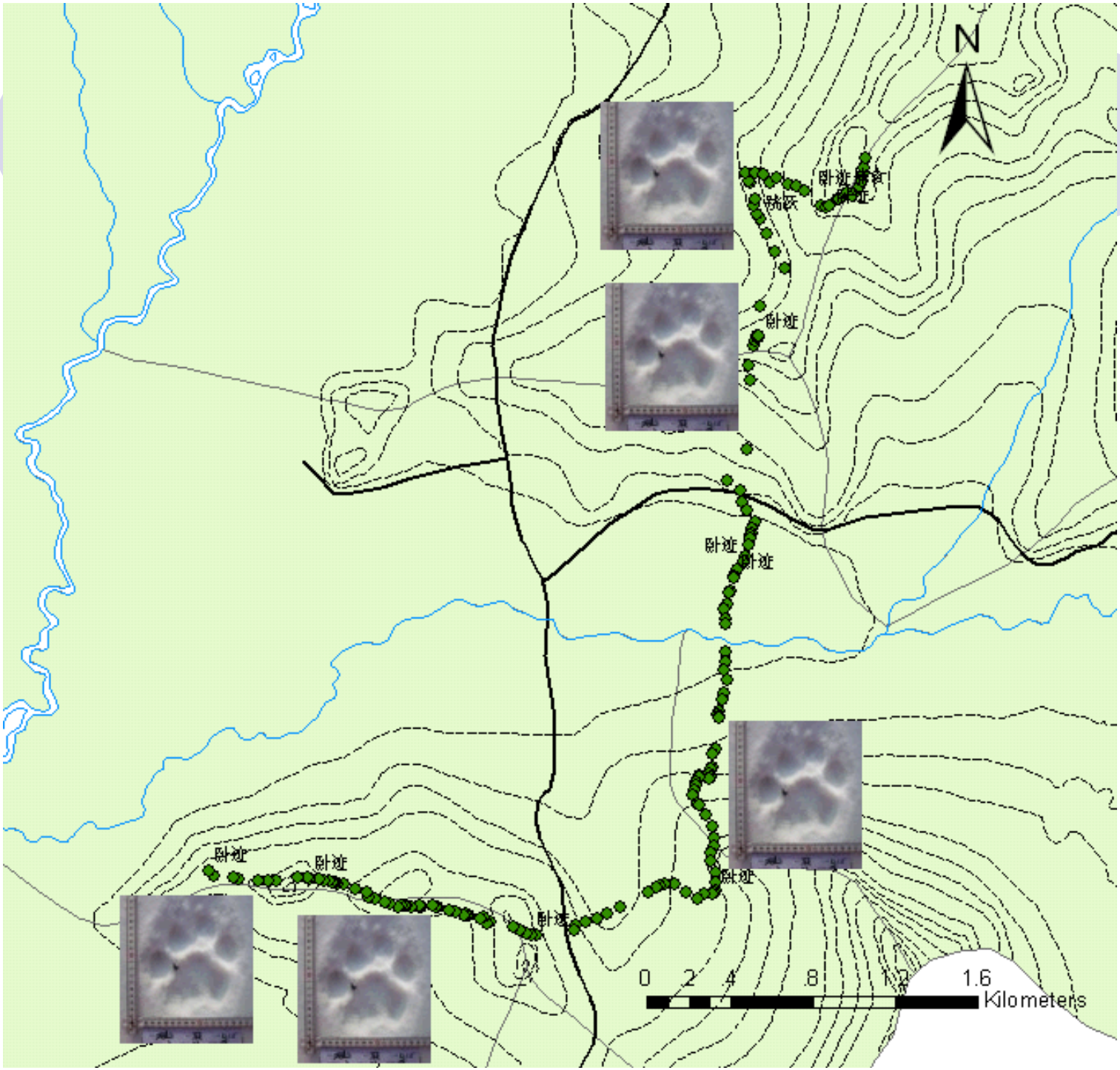
Wild Individual identification trial in Dongfanghong Forest Bureau

- 反向跟踪新鲜虎足迹链，寻找轮廓清晰的雪地足迹，收集带有标尺的雪地足迹照片，跟踪长度不少于20km；

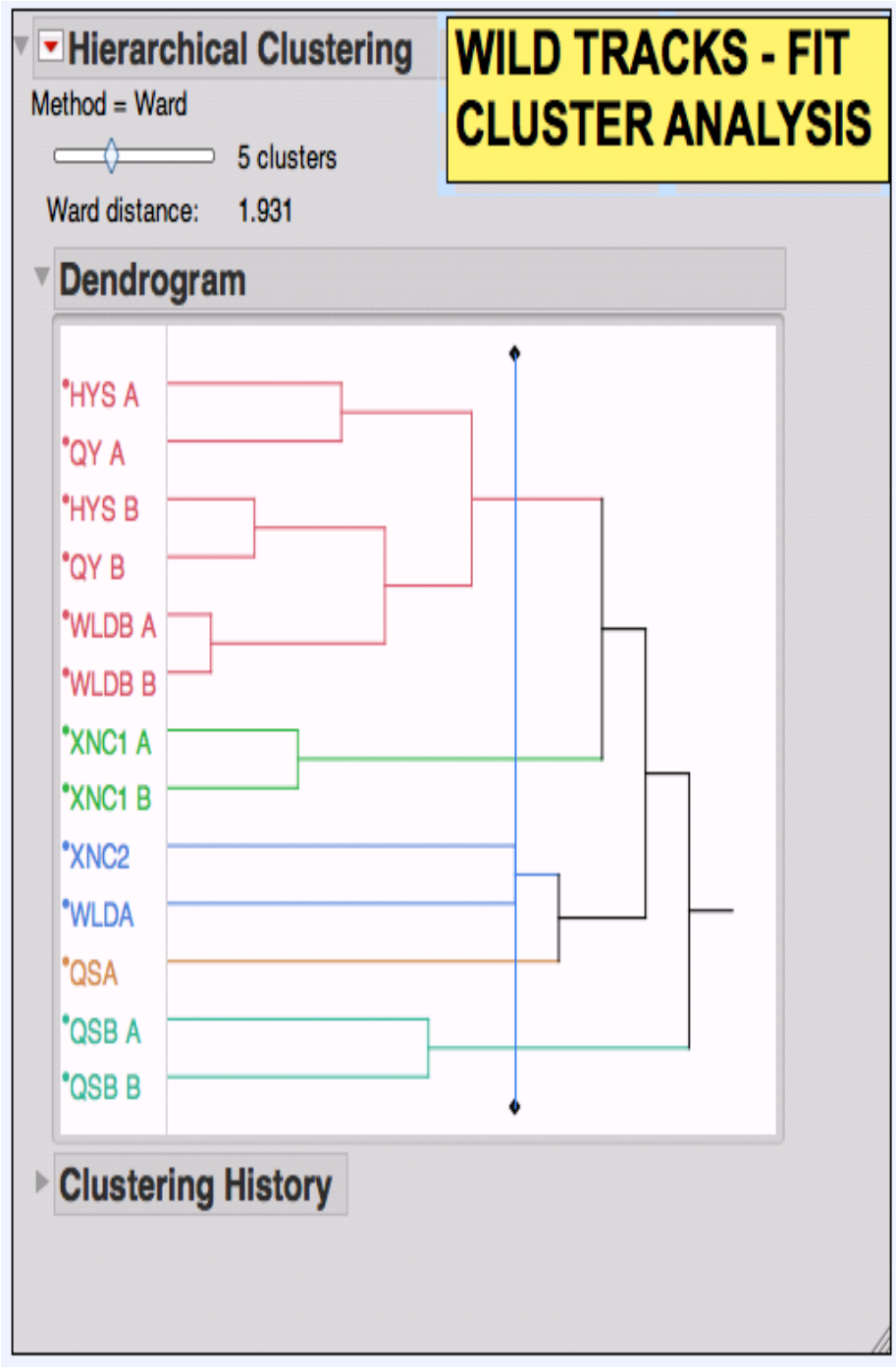
  Following the fresh snow tracks of tiger backward, look for the clear footprint and take photos with scales, length of following snow tracks is not less than 20 km;

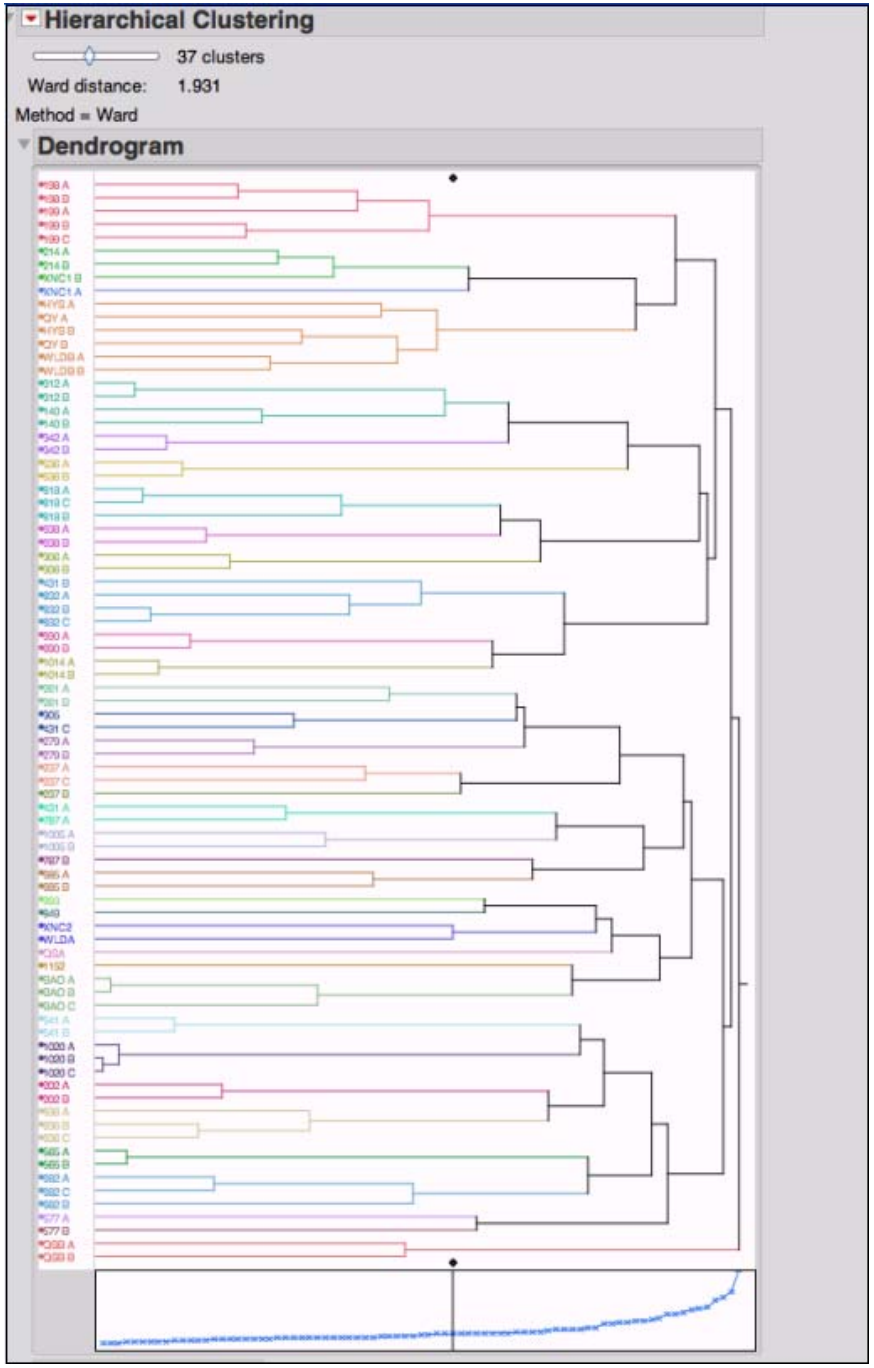
- 跟踪过程中收集老虎的毛发、粪便、取食猎物残骸等样本，记录老虎的卧息、行走、挂爪等行为信息，以便辅助核实老虎个体鉴定的准确性；并在足迹链经过的不同栖息地类型设置栖息地植被调查样方等信息。

  Collecting hair, feces, remains of prey etc. samples along the tracks of tigers, recording bedding，movement, scratch etc behavioral information to testify the individual accuracy; vegetation and other habitat factor were also recorded by plot survey in different habitat types.


N
0 2 4 8 1.6
Kilometers

LOCATION	DATE	# OF TRACKS PER SET	# OF TRAILS	TRAIL NAMES
WLDA	2012.01.01-01.02	04	1	WLDA
HYS	2012.01.04-01.05	13	2	HYS A & HYS B
WLDB	2012.01.12-01.13	14	2	WLDB A & WLDB B
QSA	2012.01.14-01.15	06	1	QSA
QY	2012.01.16-01.17	12	2	QY A & QY B
XNC1	2012.02.10-02.12	13	2	XNC1 A & XNC1 B
XNC2	2012.02.10-02.12	5	1	XNC2
QSB	2012.02.11	13	2	QSB A & QSB B
		TOTAL = 80	TOTAL = 13	


Hierarchical Clustering
WILD TRACKS - FIT CLUSTER ANALYSIS
Method = Ward
5 clusters
Ward distance: 1.931
Dendrogram
HYS A
QY A
HYS B
QY B
WLDB A
WLDB B
XNC1 A
XNC1 B
XNC2
WLDA
QSA
QSB A
QSB B
Clustering History


Hierarchical Clustering
37 clusters
Ward distance: 1.931
Method = Ward
Dendrogram

●基于变量15+34雄性圈养虎的年龄是可以预测的，因此，青山林场发现的雄性虎预测年龄12-13岁，西南岔林场雄性虎的年龄10-11岁，青山林场发现的雄虎年龄3岁；由于圈养模型的年龄样本少，需进一步增加样本数量来检验模型的可靠性。

●For the **males**, the predictive model based on variables 15+34 extracted from captive Amur tigers indicated that the trail collected at location QSA (predicted to be a male) was in the 12-13 year range (see Table 3 and Fig. 5). Similarly, male XNC2 was 10-11 years old and male QSB was about 3 years old. However, we must emphasize that this part of the analysis should be treated with a great deal of caution.

●To be at all confident about developing a predictive model for age identification we believe we need to increase the reference data base and test the efficacy of this model more thoroughly.

LOCATION	# OF TRACKS PER SET	# OF TRACK CLASSIFIED AS M/F	PREDICTED SEX	Mean of Variables 15+34
WLDA	04	2/2	?	-
HYS	13	0/13	F	-
WLDB	14	2/12	F	-
QSA	06	5/1	M	11.3
QY	12	2/10	F	-
XNC1	13	0/13	F	-
XNC2	4	5/0	M	11.7
QSB	13	13/0	M	13.3

结论：

Conclusions:

1) 这一试验研究表明FIT技术可能是一项识别东北虎的个体、性别甚至年龄的有效工具。基于圈养虎数据的研究，个体和性别识别的准确率相当高（分别达到97%和95%）。然而，由于缺乏锻炼，不同的基质特征，不同的食性特征以及遗传因子等可能导致圈养虎与野生虎在足印特征上可能有一定程度的差异。

   This pilot study suggests that FIT could be an effective tool in identifying Amur tiger by individual and sex, and possibly also by age. Based on the captive data sets, accuracy levels for individual and sex identification are very high (97% and 95% respectively). However, it is possible that the captive animal feet are to some extent anatomically different from those of free-ranging animals due to less exercise, a different substrate, different diet, genetic factors etc.

2) 此项试验的下一步是收集更多的野生虎足迹链信息，最好是在部分种群的个体已经是可以识别的区域进行。这一工作在俄罗斯可能得到检验，因为俄罗斯的科学家在做东北虎的无线电遥测过程中已经获取了大量的野生虎个体的信息。

The next stage in this pilot study is to collect more trails from free-ranging tigers, preferably in a situation where a proportion of the animals are identifiable. In Russia, this work may be tested well because some collared work may have collected some individual information(Sex,age or individual characteristics)

3) FIT 技术可能在两个水平上对野生东北虎进行检测：即收集到的一定数量的足迹链信息可能是多少只老虎；在一定区域内老虎之间存在何种相互关系以及利用栖息地。

FIT might be adopted at two levels for Amur tiger monitoring. It can provide a simple overall census estimate from a footprint collection over a sample area, which might then be extrapolated to a larger area using knowledge of tiger ranges and habitat preferences. For example, one might ask: 'How many animals are represented by the 50 trails collected in area A? '. Alternatively it can also map distributions of individual animals based on the clustering of their trails in the cluster dendrogram. An example might be: 'How are the animals in area A interacting and using their habitat?' The latter approach could enable the monitoring of sub-sections of the population for better understanding of habitat use and social interaction.

6、中俄联合监测计划建议

Sino-Russia Joint monitoring plan recommendations

1) 联合监测的目标：

从足迹影像、花纹影像和DNA检测三个技术层面对东北虎进行个体识别，比较鉴定效果，确定中俄边境分享家域的虎豹个体性别、年龄、数量和分布区位置，同时记录冬季东北虎对栖息地的利用情况，探究东北虎在冬季的在中俄边境的迁移规律。

Objective of joint monitoring:

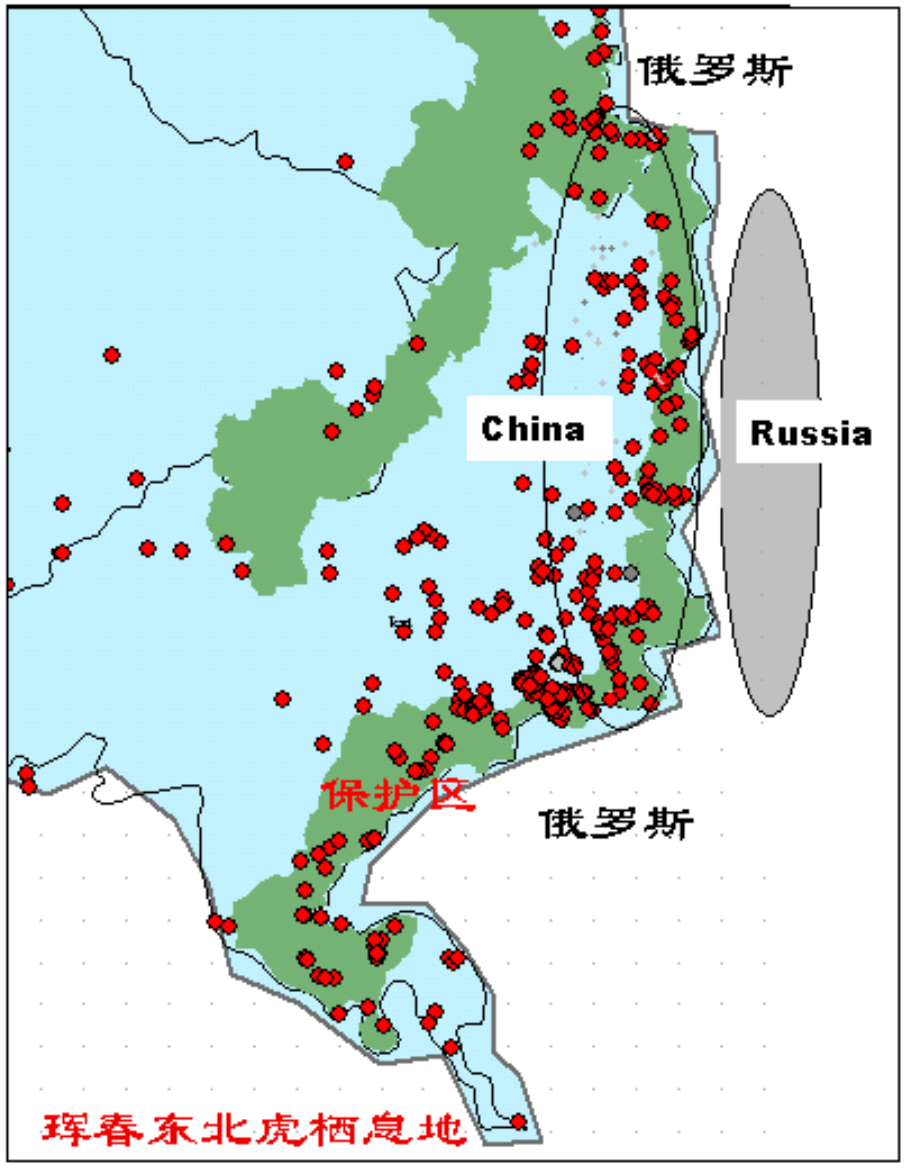
Individual identification was analyzed by FIT (digital footprint), Camera-trap and DNA detection. We can compare the results of them to determine the sex, age and number of Amur tiger/leopard sharing home range between Russia. And we can record the habitat use or migration in Sino-Russia border areas.

2）监测试验项目区域建议

Pilot areas recomendation

吉林珲春自然保护区与俄罗斯毗邻的俄罗斯境内6000km²；珲春自然保护区(或东方红)内6000 km²；以400 km²的面积作为一个调查单元；俄罗斯境内15个调查单元，中国境内15个调查单元（见示意图）。

6000km² (about 15 females home ranges) sample areas were determined in China and Russia, respectively; 400 km² was treated as one survey unit, then 15 units in Russia, 15 units in China (Hunchun or Dongfanghong) (See the figure).

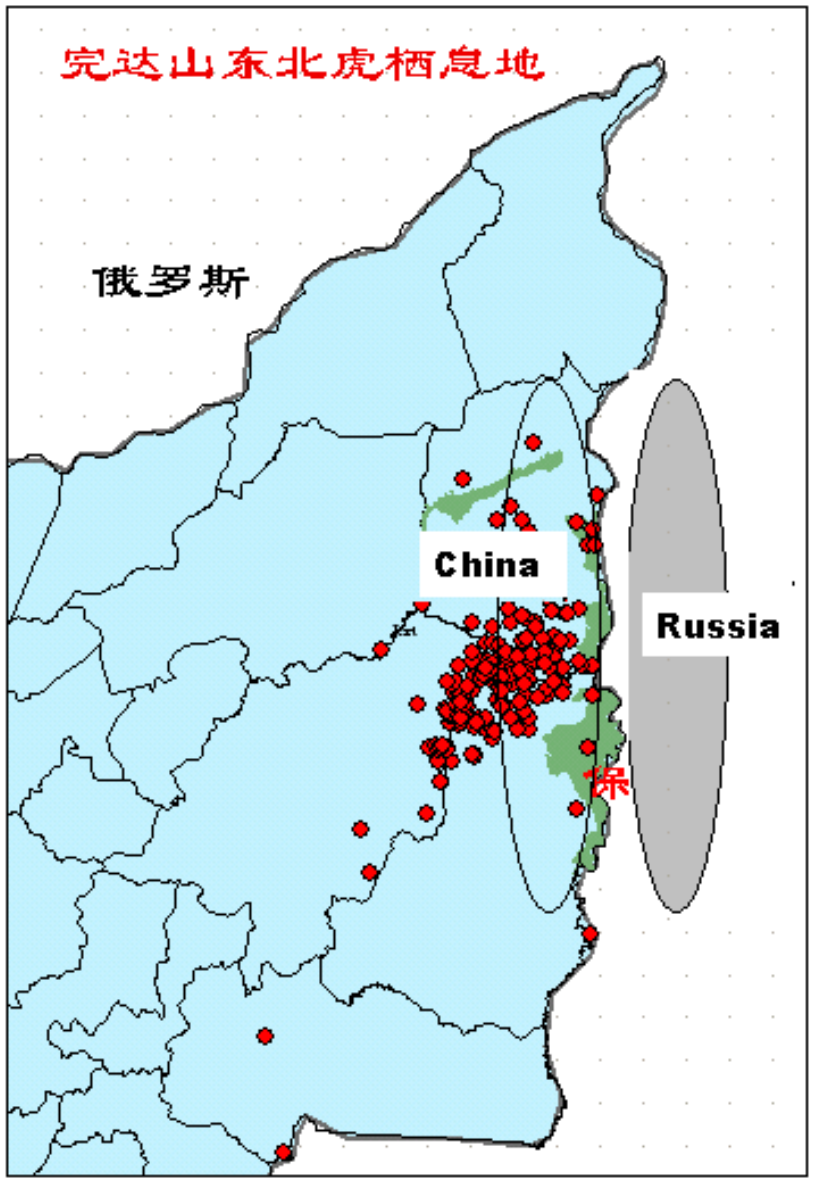


3)项目执行时间建议

Project Schedule,

2012年11月-2013年3月，中俄野外监测专家4名合作工作约80天，其中40天在中国珲春自然保护区，40天在俄罗斯境内临近珲春保护区的区域；结合日常巡护监测人员的信息，在固定的单元内只要发现东北虎的足迹信息，就去追踪，获取相关数码足迹信息、粪便、毛发等辅助鉴定样本。

80 working days during November in 2012 to 2013 March can be finished, half of it in China and half of it in Russia; This work can be joint with patrolling information or traditional route survey work. At the same time, we can collected the digital footprint images, feces, hairs ect. samples.



谢谢!

Thank you!