LINKING 'PEOPLE AND PIXELS' IN THE RUSSIAN FAR EAST: An Integrated Look at Harvesting of a Non-Timber Forest Product in Central Kamchatka

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ABSTRACT: Small-scale resource use became an important adaptive mechanism in remote logging communities in Russia at the onset of the post-Soviet period in 1991. We focused on harvesting of a non-timber forest product, lingonberry (*Vaccinium vitis-idaea*), in the forests of the Kamchatka Peninsula (Russian Far East). We employed an integrated geographical approach to make quantifiable connections between harvesting and the landscape, and to interpret these relationships in their broader contexts. Landsat TM images were used for a new classification; the resulting land-cover map was the basis for linking non-spatial data on harvesters' gathering behaviors to spatial data within delineated lingonberry gathering sites. Several significant relationships emerged: (1) mature forests negatively affected harvesters' initial choice to gather in a site, while young forests had a positive effect; (2) land-cover type was critical in determining how and why gathering occurred: post-disturbance young and maturing forests were significantly associated with higher gathering intensity and with the choice to market harvests; and (3) distance from gathering sites to villages and main roads also mattered: longer distances were significantly correlated to more time spent gathering and to increased marketing of harvests. We further considered our findings in light of the larger ecological and social dynamics at play in central Kamchatka. This unique study is an important starting point for conservation- and sustainable development-based work, and for additional research into the drivers of human–landscape interactions in the Russian Far East.

THIS POSTER presents recent work on the Kamchatka study site, one of the RFE Landsat case study sites incorporated into our NASA LCLUC synthesis project. The field and survey work for the research reported in this project was supported by an NSF Dissertation Improvement Grant to the first author (S. Hitztaler) who also would like to acknowledge the expertise and logistical assistance generously offered by the Forest Service (*leskhoz*) directors and staff in the villages of Kozyrevsk and Atlasovo, Kamchatka, Russia.

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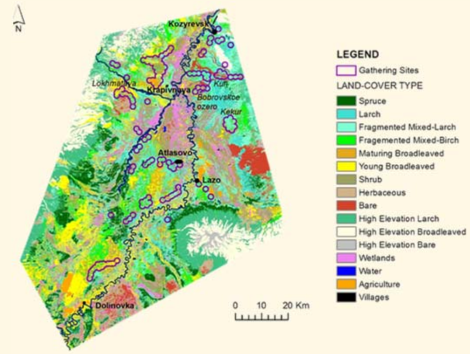
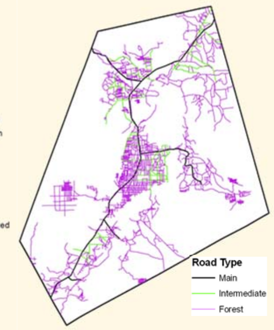




A detailed forest-cover and land-cover map of "Conifer Island" in the Central Depression of Kamchatka classified from Landsat TM imagery.

Class	Landsat land-cover type	Ecological description	Producers/Users accuracy (%)	Proportion (%) of total study site area	Proportion (%) of total gathering sites area
1	Spruce	Undisturbed or mature spruce (*Picea ajanensis*) forests	96/96	7.3	1.2
2	Larch	Undisturbed or mature larch (*Larix dahurica*) forests	73/85	5.7	7.8
3	Fragmented Mixed-Larch	Disturbed mixed forests, larch-dominant (*Larix dahurica*)	85/84	18.3	30.5
4	Fragmented Mixed-Birch	Disturbed mixed forests, birch-dominant (*Betula platyphylla*)	71/83	5.7	10.7
5	Maturing Broadleaved	Birch forest, maturing from past disturbance and regeneration	81/74	7.8	13.4
6	Young Broadleaved	Young birch forest (with aspen, alder, and willow; *Populus tremula, Alnus hirsuta, Salix spp*) following more recent regeneration [a]	82/94	10.3	8.7
7	Shrub	Woody-dominated regeneration following disturbance	89/91	12.8	18.5
8	Herbaceous	Herbaceous-dominated regeneration following disturbance	92/85	3.5	1.4
9	Bare	Very recently logged or burned area, sandbars, dry volcanic rivers, mudflats	100/83	3.1	3.1
10	High Elevation Larch	High elevation larch – Siberian dwarf pine (*Larix dahurica – Pinus pumila*) forests	100/100	9.1	1.0
11	High Elevation Broadleaved	High elevation stone birch – alder (*Betula ermanii – Alnus fruticosa*) forests	100/91	7.6	0.2
12	High Elevation Bare	Rocky outcrops on mountaintops	93/100	0.7	0.0
13	Wetlands	Lowland bogs/floodlands	91/79	6.2	2.4
14	Water	Rivers, streams, lakes	93/100	1.1	0.1
15	Agriculture	Active and fallow fields	83/94	0.7	0.9
16	Villages	Settlements	77/100	0.1	0.1
	Overall/Totals		88	100	100

Question: What is the relationship between land-cover types within gathering sites and distances to these sites (from nearest village and main road)?

Case	Variable	Land-cover type (measured in propotion to gathering site)	Pearson Correlation	Sig. (p-value) (2-tailed)
1	Distance (km) (village to site)	Larch-dominant forest (i.e. later successional)	-0.394	**0.026****
		Cleared Land (i.e. recently logged)	0.390	**0.027****
2	Distance (km) (distance from main road to site)	Fragmented birch-dominant forest	-0.346	**0.052***

Result: Early-successional forests are found further from villages, while later-successional forests are located in proximity to villages.

Question: What is the relationship between land-cover types within gathering sites and road density?

Case	Variable	Land-cover type (in propotion to gathering site)	Pearson Correlation	Sig. (p-value (2-tailed)
1	Density of Main Roads	Fragmented birch-dominant forest	0.314	**0.080***
		Maturing deciduous forest	0.315	**0.079***
2	Density of Forest Roads	Fragmented birch-dominant forest	0.298	**0.097***
		Maturing deciduous forest	0.446	**0.010****
		Bare land	-0.325	**0.069***

Result: Higher road density in gathering sites is correlated to higher proportions of early- to mid-successional forests.

What factors influence people's initial choice to gather in a particular site?

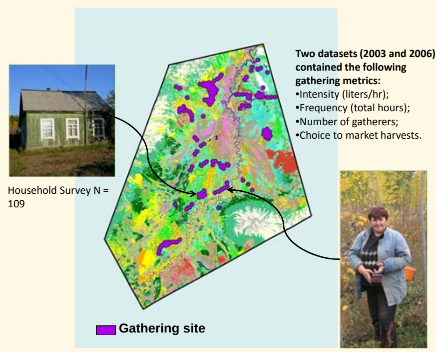
Model	Covariate:	Beta	Wald Chi-Square	df	Sig.
1	Year (2003, 2006)	0.631	2.943	1	**0.086***
2	Proportion of primary, spruce-dominant forest in gathering site	-9.245	5.425	1	**0.020****
3	Proportion of dense deciduous regeneration in gathering site	14.720	4.748	1	**0.029****
4	Proportion of bare land in gathering site	6.707	3.619	1	**0.057***
5	Distance (km) (from nearest village to gathering site)	-0.039	3.309	1	**0.069***
6	Distance (km) (from nearest main road to gathering site)	-0.053	2.929	1	**0.087***

Result: Land-cover type and distance mattered in people's initial decision to gather in a site.

Question: What factors affect the gathering metrics of intensity, frequency, number of gatherers, and marketing of lingonberry harvests? (bottom three tables)

Model	Covariate: Proportion of land-cover type	Dependent Variable	Estimate	Std. Error	T	df	Sig.
1	Larch- dominant forest (later successional)	Intensity	-7.183	3.997	-1.797	20.934	**0.087***
2	Maturing deciduous forest	Intensity	13.472	5.700	2.363	15.499	**0.032****
3	Dense deciduous regeneration	Intensity	11.544	5.632	2.050	14.132	**0.059***
4	Larch- dominant forest (later successional)	Frequency	-50.198	26.236	-1.913	16.712	**0.073***
5	Bare land	Number of gatherers	0.314	0.136	2.308	19.222	**0.032****
6	Maturing deciduous forest	Marketing	1.481	0.675	2.195	13.284	**0.046****

Influences on Gathering Decisions



Two datasets (2003 and 2006) contained the following gathering metrics:
- Intensity (liters/hr);
- Frequency (total hours);
- Number of gatherers;
- Choice to market harvests.

BACKGROUND

We combined detailed ethnographic data on small-scale resource use with remotely sensed data and an explicitly spatial methodology in our study situated in central Kamchatka in the Russian Far East. Here the shift from state-driven, large-scale resource exploitation to household-based, small-scale resource consumption in its logging and farming communities occurred abruptly following the dissolution of the Soviet Union. We looked specifically at harvesting of the NTFP species lingonberry (*Vaccinium vitis-idaea*) given its wide distribution throughout disturbed forest landscapes in the study area and its high socio-cultural and economic importance (Hitztaler 2010, Kabanov 1963). Our guiding research questions were: 1) which landscape factors were associated with harvesters' choice of lingonberry gathering sites? and 2) which landscape factors affected four gathering behaviors: gathering intensity, time allocated to gathering, number of household members gathering, and the choice to market harvests?

APPROACH

(1) Map land-cover type through Landsat image classification coupled with ancillary spatial data;
(2) Map lingonberry gathering sites using our existing forest ecological plot and ethnographic data;
(3) Link these ethnographic data on harvesters' gathering decisions and behaviors to specific gathering sites in the landscape;
(4) Develop several types of statistical models to identify coupled relationships between complex landscapes and harvesting of lingonberry.

Results (left): People gather more intensely in early- to mid-successional forests, and less intensely in later-successional (or primary) forests.

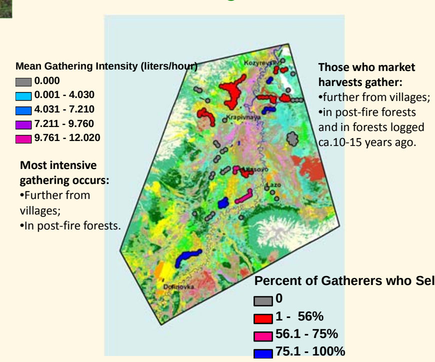
Landscapes with deciduous forests appeared to be the most favorable in which to gather, especially among those who marketed their harvests.

LANDSAT CLASSIFICATION

We obtained two mostly cloud-free Landsat TM (Thematic Mapper) Level 1T (terrain corrected) satellite images from July 23, 2007 for path 99, rows 21 and 22. Image pre-processing included cloud removal, atmospheric correction using the COST method (Chavez 1996), and subsetting the images to the study area. We performed unsupervised classification using the ISODATA algorithm in ERDAS IMAGINE 9.2 (Leica Geosystems 2009). Ancillary data were important in developing a land-cover classification scheme (right) and assigning clusters to land-cover classes. These data included our own large set of geolocated field photos, ecological literature, and Russian 1:100,000 topographic maps (Roskartografia 2001). Reference data had been previously created from the forest plot data (N=43, Hitztaler 2010) and 364 additional testing pixels were collected from visual interpretation of unclassified Landsat imagery and Russian topographic maps.

We created vector data in ArcMap 9.3.1 (ESRI 2009) based on the topographic maps and the Landsat imagery (above). Roads (all unpaved) were digitized and classified into Primary, Intermediate, and Forest classes: Primary roads connect villages in Central Kamchatka to the cities of Petropavlovsk-Kamchatsky (capital) and Elizovo in southeast Kamchatka; Intermediate roads are arterial roads within forested areas; and Forest roads are least traveled and maintained.

Gathering Behaviors



Most intensive gathering occurs:
- Further from villages;
- In post-fire forests.

Those who market harvests gather:
- further from villages;
- in post-fire forests and in forests logged ca.10-15 years ago.

Model	Covariate (all distances in km)	Dependent Variable	Estimate	Std. Error	T	df	Sig.
1	Village to site	Intensity	0.046	0.034	1.347	17.286	0.195
2	Village to site	Frequency	0.536	0.210	2.551	14.441	0.023**
3	Village to site	Marketing	0.005	0.004	1.281	15.918	0.218
4	Village to site	Number of gatherers	-0.001	0.001	-0.848	19.739	0.407
5	Main road to site	Intensity	0.089	0.100	0.892	25.228	0.381
6	Main road to site	Frequency	1.532	0.599	2.558	23.961	0.017**
7	Main road to site	Number of gatherers	-0.001	0.002	-0.107	21.051	0.916
8	Main road to site	Marketing	0.020	0.011	1.813	24.975	0.082*

Result (right): Increasing distances were associated with increases in gathering frequency and marketing.