FEDERAL AID ANNUAL RESEARCH PERFORMANCE REPORT

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
PO Box 115526
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Alaska Department of Fish and Game
Wildlife Restoration Grant

GRANT NUMBER: W-33 **SEGMENT NUMBER:** 9

PROJECT NUMBER: 1.66

PROJECT TITLE: Evaluating options for improving GSPE performance and developing a sightability correction factor

PROJECT DURATION: 1 July 2007–30 June 2012

REPORT DUE DATE: 1 September 2011

PRINCIPAL INVESTIGATOR: Kalin A. Kellie, ADF&G

COOPERATOR: Jay M. Ver Hoef, NOAA

WORK LOCATION: Interior Alaska-DWC Region III

I. PROGRESS ON PROJECT OBJECTIVES SINCE PROJECT INCEPTION

OBJECTIVE 1: Evaluate the effects of search intensity on sightability.

A college intern (C. Pylant) and I digitized data from the 1970s sightability study, organizing information into a Microsoft®Access™ database and relational GIS shapefiles. I combined this information with recent geospatial population estimator (GSPE) sightability data into a dataset useful for building a spatial sightability model. I combined sightability and search intensity data from the 1970s study and the current GSPE study into a single dataset in order to develop a logistic relationship between sightability and search intensity. This relationship expands on the one published in the moose survey technique manual developed by Gasaway et al. (1986:23) and encompasses a wider range of search intensities. I entered GPS data from a recent survey and analyzed the effect of moose density on search intensity and observer methods. No work was conducted under this objective during FY11. Data analyzed under this objective will be included in a technical report on methods for estimating sightability in FY12.

OBJECTIVE 2: Evaluate the sensitivity of the GSPE to variation in sightability and other sampling characteristics.

Gasaway et al. (1992) defines 3 different moose densities when describing population dynamics in Alaska (low: <0.4 moose/mi^2; moderate: 0.4–1.7 moose/mi^2; and high: >1.7 moose/mi^2). For GSPE sensitivity analyses, I generated 2 "known" populations from composites of >5 years of survey data in 2 game management units at the low and high extremes of moose density in Interior Alaska (Unit 25D = 0.3 moose/mi^2 and Unit 20A = 2.6 moose/mi^2). I averaged moose counts from units sampled in >1 year and interpolated unsampled units from those sampled. I developed a program in statistical software "R" to run simulated moose surveys and population estimates on the 2 "known" moose populations. Simulations included different levels of sampling, sampling ratios, and stratification error. In addition, each simulation recorded the performance of reported GSPE precision. I created plots used to evaluate the combined effect of all parameters (i.e., multivariate comparisons). Brian Taras (ADF&G) and Jay Ver Hoef (NOAA) recommended including sensitivity analyses related to trend detection as this is a significant goal of GSPE population estimation. I added the study area Unit 20E (1.0 moose/mi^2) in FY10 to address intermediate moose density using the same methods listed above. Also in FY10, Brian Taras and Jay Ver Hoef decided to depart from the original study design and analyses that had incorporated a multiple regression model. Instead, they recommended using code Ver Hoef had developed (independent of this project) to assess power for trend detection and Taras began to run power analyses for the 3 study areas. In FY11 we completed all work under this objective.

OBJECTIVE 3: Develop a spatial sightability model using percent canopy cover generated from satellite imagery.

Poor survey conditions prevented completion of sightability trials in Unit 20A scheduled for winter 2007. Because the original 2-year pilot study was designed to provide the Alaska Department of Fish and Game (ADF&G) with timely recommendations for future SCF and GSPE research, I modified the study design and used existing data for model development and analyses. I used FY08 operation funds slated for collecting Unit 20A sightability data to hire college intern Cortney Pylant in February 2008 to assist with data entry and basic analyses.

A statewide vegetation classification called the National Land Cover Data set (NLCD 2001)[1], available through the U.S. Environmental Protection Agency, provided 30 m-resolution vegetation information for all of Alaska. I summarized vegetation into 3 different classification systems for building the veg layer for the SCF model, summarizing for each GSPE sample unit by percent veg type. Jay Ver Hoef and I evaluated the effectiveness of these 3 classification systems as a covariate for sightability. Percent forest was chosen as the best covariate. Jay Ver Hoef then used a logistic regression with random effects to model sightability as a function of average search intensity during the survey and the percent of forest pixels (30 m resolution) in the GSPE unit. The model was based on all Unit 20A data and McGrath EMMA data through 2006.

The development of a spatial SCF model was completed at the beginning of FY10 and is now ready for publication. The spatial SCF has many merits including application to any survey area, application to previous GSPE surveys, and easy incorporation into the existing WinfoNet computational framework. However, the spatial SCF provides only a broad, generalized estimate of sightability for each survey area and does not reflect annual variation in survey conditions stemming from weather conditions or human elements (e.g., pilot experience). Initially, this shortcoming was heavily criticized by ADF&G biologists during the July 2010 regional meeting because the model failed to provide the correction when it is most necessary: during years when the SCF is unusually high or low. A field test of an alternative, survey-specific method for estimating sightability using intensive searches of some areas (intensive SCFs: Gasaway et al. 1986, Kellie and DeLong 2006) was conducted in FY11 under Federal Aid project 1.69 to

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[1] http://www.epa.gov/mrlc/nlcd-2001.html

investigate alternatives to the spatial SCF that better reflect survey-specific sightability. Interviews performed in FY11 indicate that, after provided with additional information, area biologists have become more amenable to using spatial SCFs. We intend to publish the basic spatial SCF model in a statistical journal and then reference the method as one of several different SCF options in a final technical report on methods for estimating sightability slated for publication in FY12.

II. SUMMARY OF WORK COMPLETED ON JOBS IDENTIFIED IN ANNUAL PLAN THIS PERIOD

JOB/ACTIVITY 1D: Determine how moose density affects the relationship between search intensity and sightability.
No work was conducted under this job during this segment.

JOBS/ACTIVITIES 2B AND 2C: Run simulations on various sampling characteristics of the GSPE and create a model to evaluate GSPE sensitivity.
The sensitivity analyses, including power analyses, yielded a number of findings that will help ADF&G plan future GSPE surveys.

Examples include:

- In general, the power of the GSPE to detect trends in population abundance is greater in areas with higher moose density and higher rates of population change. Based on the analysis of 3 survey areas selected to represent relatively high, moderate, and low moose densities, areas surveyed annually at current resource levels were able to detect moderate trends (4% change per year) with power = 0.80 and $\alpha = 0.05$ on the order of 7–10 years in high density areas, 10–13 years when density was moderate, and ~15 years where moose density was low. Less time is needed to detect more dramatic trends. For example, an 8% change in moose abundance per year may be detectable in 5–7 years in areas of high moose density, 6–8 years in moderate densities, and 9–10 years in low densities. Because of the wide variety in site conditions, management objectives, precision requirements, and the uncertainties inherent in power analyses, these results serve only as a general guide and we recommend consulting with a biometrician when designing a specific monitoring program.
- Monitoring smaller areas may offer some advantages for detecting trend because estimate precision improves when a much a higher proportion of the area is sampled.
- In some survey areas where moose distribution is somewhat unpredictable (e.g., Unit 25D East) misclassification rates when stratifying can be high. Where this occurs, a simple random sample may yield an abundance estimate with higher precision than one from a stratified random sample.
- We have learned that confidence intervals associated with estimates of moose abundance in low density areas can, under some conditions, be biased low (i.e., estimated confidence intervals are tighter than they should be).

JOB/ACTIVITY 2D: Review GSPE survey data for Interior Alaska.

I summarize the GSPE survey results that were used in various analyses during this study (Tables 1 and 2). This information was gathered from ADF&G management reports and WinfoNet data. These summary tables can be used in the development of individualized study designs for GSPE surveys.

JOB/ACTIVITY 3C: Develop a spatial model for sightability.

In July 2010 I presented the basic techniques and methods of estimation for 3 sightability correction factors (spatial SCFs, intensive SCFs, and radio collar SCFs) to an audience of area biologists and solicited their opinion on how well these techniques incorporate the main elements of poor sightability. The spatial SCF was initially rejected during this meeting because it disregards annual variation in weather conditions and pilot/observer variation (see Section I). However, upon presenting further explanation to area biologists in July 2011, the spatial SCF was better received as an approach that could be narrowly applied. In general, when moose population estimates need to be corrected from observable moose to total population size, there was agreement that the spatial SCF can provide a low-cost, low-precision correction factor in areas where survey conditions can be shown to be less variable and sightability is demonstrated to be relatively similar among survey years. SCFs calculated using multiple years of sightability trials with radiocollared moose was considered the most accurate method of calculating an SCF. Upon hearing a description of the intensive SCF technique, biologists expressed interest in pursuing this alternative because of its ability to incorporate survey-specific variation in weather and pilot-observer teams. In cooperation with ADF&G biologist Tom Paragi under Federal Aid Project 1.69, I will evaluate the field and computational aspects of conducting intensive SCFs to estimate sightability in 2 GSPE survey areas where annual variation in sightability is likely higher and radio collars are not available.

I also began researching the steps needed to implement the spatial SCF as part of our existing online WinfoNet program for the GSPE. The main hurdle to implementation of the spatial SCF in WinfoNet is the creation and maintenance of the percent forest covariate within wildfire footprints that create short-term, drastic changes to habitat. In FY12 I will prepare a proposal for contracting the modeling percent forest cover within burn footprints throughout various stages of re-growth.

JOBS/ACTIVITIES 4A AND 4B: Draft a manuscript that presents findings on search intensity, GSPE sensitivity to variation in sampling characteristics.

Our findings are not conducive to providing extensive prescriptive guidance for managers. Rather, we intend to apply the knowledge gained from our sensitivity analysis to the design of future surveys on a case-by-case basis. Eventually, we hope to build a suite of monitoring programs that can be applied successfully in a variety of situations. Further deliberation is needed to determine whether analyses of search intensity warrant inclusion in the technical report on sightability.

III. ADDITIONAL FEDERAL AID-FUNDED WORK NOT DESCRIBED ABOVE THAT WAS ACCOMPLISHED ON THIS PROJECT DURING THIS SEGMENT PERIOD

I spent 0.25 months assisting with the design and collection of sightability trials in Unit 20D (*n* = 21) and 24B (*n* = 27). These data will be used in this project to investigate the performance of the spatial SCF model in these areas. The operating costs for this effort were included in area management budgets. The sightability trial data will be used to develop multi-year radio collar SCFs (Boertje et al. 2007, Keech et al. 2011) for the Units 20D and 24B GSPE survey areas. I coauthored a memo with Tom Paragi documenting the field methods for the radio collar SCFs. Area staff plan to obtain additional trials in FY12.

V. PUBLICATIONS

None.

VI. RECOMMENDATIONS FOR THIS PROJECT

- We recommend considering a new Federal Aid project designed to apply and build on knowledge gained during this project. This new project would focus on developing monitoring programs for 1–2 survey areas with patterns of moose distribution representative of those observed in low-density populations. This project could commence upon the completion of Federal Aid Projects 1.66 and 1.69, based on the findings from those projects.
- We recommend pursuing a contract to develop the annual GIS vegetation layers needed to calculate the spatial SCF.
- We recommend conducting additional sightability trials in Units 20D South and 24B to improve sample sizes for sightability estimation in these areas.

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Table 1. A summary of GSPE surveys conducted in Interior Alaska from 1997 through 2009. To report total moose density relative to biological thresholds, surveys performed without estimating sightability were assigned a constant sightability correction factor (SCF) of 1.21 (early winter: October–December) or 1.25 (late winter: February–April).

Winter season	Unit	Survey name	Year	Survey area (mi^2)	No. units surveyed	Total units in survey area	% Surveyed	Estimated observable moose (SE)		% Error as proportion of the mean ($\alpha = 0.10$)	SCF used for total	Estimated total moose density (moose/mi^2)
Early	12	12 Northwest	2006	2,702	89	449	19.8	2,317	(253)	18	1.21	1.07
Early	12	12 Northwest	2008	2,702	92	449	20.5	3,225	(353)	18	1.21	1.44
Early	12	Tetlin NWR	2001	2,954	80	482	16.6	1,443	(175)	20	1.21	0.59
Early	12	Tetlin NWR	2003	2,954	80	482	16.6	1,317	(152)	19	1.21	0.54
Early	12	Tetlin NWR	2008	2,954	80	482	16.6	1,843	(218)	20	1.21	0.75
Early	19D	19D East	2001	4,195	218	695	31.4	2,148	(339)	26	1.19	0.61
Early	19D	19D East	2004	4,195	99	695	14.2	2,163	(249)	19	1.27	0.37
Early	19D	19D East	2008	4,195	89	695	12.8	3,071	(298)	16	1.27	0.52
Early	19D	19D EMMA[†]	2001	528	87	87	100.0	440	(0)	0	1.19	0.99
Early	19D	19D EMMA[†]	2003	528	45	87	51.7	424	(48)	19	1.35	1.09
Early	19D	19D EMMA[*]	2004	528	87	87	100.0	531	(0)	0	1.27	1.28
Early	19D	19D EMMA[†]	2005	528	87	87	100.0	479	(0)	0	1.3	1.18
Early	19D	19D EMMA[†]	2006	528	87	87	100.0	591	(0)	0	1.17	1.31
Early	19D	19D EMMA[†]	2007	528	87	87	100.0	662	(0)	0	1.33	1.67
Early	19D	19D EMMA[*]	2008	528	43	87	49.4	599	(62)	17	1.27	1.44
Early	19D	19D EMMA[*]	2009	528	44	87	50.6	654	(55)	14	1.27	1.57
Early	20A	20A[*]	1999	5,747	86	987	8.7	11,205	(954)	14	1.21	2.36
Early	20A	20A[*]	2000	5,747	114	987	11.6	10,557	(1,155)	18	1.21	2.22
Early	20A	20A[*]	2001	5,747	78	987	7.9	11,511	(1,050)	15	1.21	2.42
Early	20A	20A[*]	2003	5,747	112	987	11.3	14,684	(1,161)	13	1.21	3.09
Early	20A	20A[*]	2004	5,747	129	987	13.1	13,566	(1,237)	15	1.21	2.86
Early	20A	20A[*]	2005	5,747	123	987	12.5	13,348	(1,217)	15	1.21	2.81
Early	20A	20A[*]	2006	5,747	115	987	11.7	12,773	(1,243)	16	1.21	2.69
Early	20A	20A[*]	2008	5,747	158	987	16.0	10,361	(693)	11	1.21	2.18
Early	20A	20A[*]	2009	5,747	116	987	11.8	12,956	(945)	12	1.21	2.73
Early	20B	20B[§]	2001	9,196	138	1,628	8.5	10,261	(1,061)	17	1.2	1.34
Early	20B	20B[§]	2003	9,196	60	1,628	3.7	13,400	(1,874)	23	1.2	1.75
Early	20B	20B[§]	2004	9,196	73	1,628	4.5	13,810	(2,352)	28	1.2	1.80
Early	20B	20B[§]	2006	9,196	127	1,628	7.8	13,321	(1,701)	21	1.2	1.74

Winter season	Unit	Survey name	Year	Survey area (mi^2)	No. units surveyed	Total units in survey area	% Surveyed	Estimated observable moose (SE)	% Error as proportion of the mean ($\alpha = 0.10$)	SCF used for total	Estimated total moose density (moose/mi^2)
Early	20B	20B[§]	2008	9,196	127	1,628	7.8	14,838 (1,444)	16	1.2	1.94
Early	20B	FMA	2008	315	56	56	100.0	417 (0)	0	1.2	1.59
Early	20D	20D North	1999	3,174	96	540	17.8	2,395 (197)	14	1.21	0.91
Early	20D	20D North	2004	3,174	60	540	11.1	1,929 (295)	25	1.21	0.74
Early	20D	20D South	1998	1,890	40	319	12.5	3,630 (667)	30	1.21	2.32
Early	20D	20D South	2000	1,890	38	320	11.9	3,932 (417)	17	1.21	2.52
Early	20D	20D South	2001	1,890	39	320	12.2	3,435 (481)	23	1.21	2.20
Early	20D	20D South	2003	1,890	47	320	14.7	5,493 (954)	29	1.21	3.52
Early	20D	20D South	2005	1,890	59	320	18.4	5,553 (632)	19	1.21	3.56
Early	20D	20D South	2006	1,890	51	320	15.9	7,243 (963)	22	1.21	4.64
Early	20D	20D South	2008	1,890	59	320	18.4	5,006 (639)	21	1.21	3.20
Early	20D	20D South	2009	1,890	60	320	18.8	4,633 (467)	17	1.21	2.97
Early	20E	20E Central	2004	2,178	53	366	14.5	802 (92)	19	1.21	0.45
Early	20E	20E Central	2005	2,178	62	366	16.9	1,097 (126)	19	1.21	0.61
Early	20E	20E Central	2006	2,178	80	366	21.9	979 (113)	19	1.21	0.54
Early	20E	20E Central	2007	2,178	80	366	21.9	1,348 (180)	22	1.21	0.75
Early	20E	20E Central	2008	2,178	80	366	21.9	1,162 (113)	16	1.21	0.65
Early	20E	20E Central	2009	2,178	80	366	21.9	1,471 (134)	15	1.21	0.82
Early	20E	20E West	2004	2,452	55	419	13.1	1,435 (192)	22	1.21	0.71
Early	20E	20E West	2005	2,452	80	419	19.1	1,801 (186)	17	1.21	0.89
Early	20E	20E West	2006	2,452	80	419	19.1	2,399 (277)	19	1.21	1.18
Early	20E	20E West	2007	2,452	82	419	19.6	2,098 (229)	18	1.21	1.04
Early	20E	20E West	2008	2,452	81	419	19.3	2,040 (186)	15	1.21	1.01
Early	20E	20E West	2009	2,452	82	419	19.6	2,445 (237)	16	1.21	1.21
Early	21D	21D Total	2001	5,526	291	986	29.5	8,924 (706)	13	1.21	1.95
Early	21D	21D Total	2004	5,527	452	986	45.8	7,967 (176)	4	1.21	1.61
Early	24B	Kanuti NWR	1999	2,714	108	507	21.3	1,003 (128)	21	1.21	0.45
Early	24B	Kanuti NWR	2004	2,710	103	507	20.3	842 (145)	29	1.21	0.38
Early	24B	Kanuti NWR	2005	2,710	82	507	16.2	1,025 (270)	43	1.21	0.46
Early	24B	Kanuti NWR	2007	2,715	150	508	29.5	588 (76)	21	1.21	0.26
Early	24B	Kanuti NWR	2008	2,715	80	508	15.7	872 (121)	23	1.21	0.39
Early	25C	25C	1997	4,643	110	699	15.7	2,270 (207)	15	1.21	0.59
Early	25C	25C	2007	4,643	104	699	14.9	3,019 (440)	24	1.21	0.79
Early	25D	25DE	1999	2,936	102	553	18.4	829 (100)	20	1.21	0.34

Winter season	Unit	Survey name	Year	Survey area (mi^2)	No. units surveyed	Total units in survey area	% Surveyed	Estimated observable moose (SE)	% Error as proportion of the mean ($\alpha = 0.10$)	SCF used for total	Estimated total moose density (moose/mi^2)
Early	25D	25DE	2000	2,936	111	553	20.1	726 (110)	25	1.21	0.30
Early	25D	25DE	2001	2,936	114	553	20.6	514 (84)	27	1.21	0.21
Early	25D	25DE	2004	2,936	113	553	20.4	733 (75)	17	1.21	0.30
Early	25D	25DE	2005	2,936	121	553	21.9	1,008 (122)	20	1.21	0.42
Early	25D	25DE	2006	2,936	117	553	21.2	799 (82)	17	1.21	0.33
Early	25D	25DE	2007	2,936	110	553	19.9	585 (81)	23	1.21	0.24
Early	25D	25DW	1999	2,269	93	421	22.1	862 (99)	19	1.21	0.46
Early	25D	25DW	2000	2,269	92	421	21.9	670 (97)	24	1.21	0.36
Early	25D	25DW	2001	2,269	100	421	23.8	668 (97)	24	1.21	0.36
Early	25D	25DW	2004	2,269	93	421	22.1	511 (77)	25	1.21	0.27
Early	25D	25DW	2006	2,269	97	421	23.0	417 (53)	21	1.21	0.22
Early	25D	25DW	2008	2,269	174	421	41.3	490 (38)	13	1.21	0.26
Early	25D	BMA	2008	536	62	100	62.0	182 (16)	15	1.21	0.41
Early	25D	BMA	2009	536	50	100	50.0	221 (21)	16	1.21	0.50
Early	25D	BMA Ctrl	2008	533	51	100	51.0	76 (11)	25	1.21	0.17
Late	19A	19A East	2008	3,874	75	607	12.4	1,703 (290)	28	1.25	0.55
Late	19A	19A West	2006	3,444	94	539	17.4	1,329 (121)	15	1.25	0.48
Late	19A	19A West	2010	3,444	147	539	27.3	1,130 (103)	15	1.25	0.41
Late	19A	S Kuskokwim	2005	7,156	161	1,121	14.4	1,953 (190)	16	1.25	0.34
Late	21E	21E East	2000	5,070	100	822	12.2	8,394 (1,327)	26	1.25	2.07
Late	21E	21E East	2005	5,070	150	822	18.2	4,673 (483)	17	1.25	1.15
Late	21E	21E East	2009	5,070	150	822	18.2	6,218 (642)	17	1.25	1.53
Late	25D	25DE	2004	2,936	113	553	20.4	382 (46)	20	1.21	0.16
Late	25D	25DW	1999	2,269	96	421	22.8	735 (76)	17	1.21	0.39
Late	25D	25DW	2003	2,269	85	421	20.2	508 (89)	29	1.21	0.27
Late	25D	25DW	2004	2,269	91	421	21.6	632 (76)	20	1.21	0.34

[†] Survey- specific SCF estimated using radio collar sightability trials during the survey.

* Area-specific composite SCF estimated using radio collar sightability trials averaged over multiple years.

[§] Alternative SCF chosen by the management biologist.

Table 2. GSPE information summarized for GSPE survey areas in Interior Alaska conducted from 1997 through 2010. Survey areas are divided into small (<1,000 mi^2) and large (>1,000 mi^2), early (October–December) and late (February–April) winter.

Winter season	Survey size category	Unit	Survey area	No. of surveys	Survey area (mi^2)	Mean SCF-corrected moose density	Min and max no. units surveyed	Mean % SUs surveyed	Mean % error as proportion of the GSPE estimate (α = 0.10)	Recent search intensity (yr)
Early	Small	19D	19D EMMA	8	528	1.3	43–87	81	6	7.2 (2008)
		20B	FMA	1	315	1.6	56	100	0	8.3 (2008)
		25D	BMA	2	536	0.5	50–62	56	16	7.5 (2009)
		25D	BMA Ctrl	1	533	0.2	51	51	25	7.2 (2008)
	Large	12	12 Northwest	2	2,702	1.3	89–92	20	18	5.6 (2008)
		12	Tetlin NWR	3	2,954	0.6	80–80	17	20	6.2 (2008)
		19D	19D East	3	4,195	0.5	89–218	19	20	6.9 (2008)
		20A	20A	9	5,747	2.6	78–158	12	14	7.9 (2008)
		20B	20B	5	9,196	1.7	60–138	6	21	8.3 (2008)
		20D	20D North	2	3,174	0.8	60–96	14	19	7.3 (2004)
		20D	20D South	8	1,890	3.1	38–60	15	22	8.4 (2009)
		20E	20E Central	6	2,178	0.6	53–80	20	18	6.5 (2008)
		20E	20E West	6	2,452	1.0	55–82	18	18	6.5 (2008)
		21D	21D Total	2	5,527	1.8	291–452	38	8	4.8 (2004)
		24B	Kanuti NWR	5	2,715	0.4	80–150	21	27	6.6 (2008)
		25C	25C	2	4,643	0.7	104–110	15	20	6.4 (2007)
		25D	25DE	7	2,936	0.3	102–121	20	21	7.2 (2007)
		25D	25DW	6	2,269	0.3	92–174	26	21	5.8 (2008)
Late	Large	19A	19A East	1	3,874	0.5	75	12	28	6.0 (2008)
		19A	19A West	2	3,444	0.4	94–147	22	15	5.2 (2010)
		19A	S of Kuskokwim	1	7,156	0.3	161	14	16	NA
		25D	25DE	1	2,936	0.2	113	20	20	4.9 (2004)
		25D	25DW	3	2,269	0.3	85–96	22	22	6.5 (2008)
		21E	21E East	3	5,070	1.6	100–150	16	20	6.2 (2005)