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CLIMATE CHANGE, HUMAN HEALTH AND WELL-BEING IN YAKUTIA

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Resume. The study was designed as a community survey conducted face-to-face with an in-person interview. The 145 subjects living in 8 rural settlements were reviewed. Data presented show that in total the most impressive changes are registered for the following signs: thinner ice on rivers, water and ice in rivers more muddy, the number of sunny days greater, more difficult to predict good weather and beginning of spring, rivers and sea covered with ice later, hunting, fishing, gathering mushrooms and berries is not so successful and quantity of mosquitoes is greater than it has been 5 years ago. Everyday activities of hunters, fishermen and herders living in Yakutia have changed during the last 5 years due to climate change. People living in the central part of Yakutia are affected to a greater extent, which is associated with faster warming. Those changes are supposed to be the sources of the problems with long-term and short-term weather forecast, difficulties to travel along tundra and forest, reindeer grazing, problems with fishing, hunting, gathering mushrooms and berries. Tendencies of infant mortality and morbidity in the studied regions are not associated with climate change and though the morbidity in Yakutia has a tendency to grow both in adults' and in children's populations mostly due to increase in prevalence of the diseases of the respiratory, circulatory and digestive system, this fact can hardly be associated with climate change.

Key words: climate change; morbidity; regions of Yakutia; cross-sectional survey.

INTRODUCTION

The pattern of average ambient temperature along the timeline of millions of years is known to have the downward trend with fluctuations of incremental range [5]. This pattern rather supports the idea that the average temperature can be sometimes higher than it has been previously than the idea of long-term total global warming. It is known that the global trend for the average temperature curve during the last 120–140 years is upward (Fig. 1).

As it is well known, projected climate change-related exposures are likely to affect the health status of millions of people, particularly those with low adaptive capacity, through at least:

1. increases in malnutrition and consequent disorders, with implications for child growth and development;
2. increased deaths, disease and injury due to heatwaves, floods, storms, fires and droughts;
3. the increased burden of diarrhoeal disease;
4. the increased frequency of cardio-respiratory diseases due to higher concentrations of ground-level ozone related to climate change;
5. the altered spatial distribution of some infectious disease vectors.

OBJECTIVES OF THE STUDY

1. to reveal climate-dependent problems in everyday activities of people living in rural areas of Yakutia;
2. to analyze the demographic and health status tendencies possibly associated with climate change.

MATERIALS AND METHODS

The study was designed as a community survey conducted face-to-face with an in-person interview by a specialist of the Yakutsk Research Centre. Fig. 2 shows the places where the survey was performed. The total of 145 subjects living in 8 rural settlements (Mytaakh, Magaras, Kujerelyakh, Ert, Asyma, Orto-Surt, Tiksi, Andryushkino) were reviewed.

Of those 145 respondents 15 inhabit Bulunsky, 15 — Nizhnekolymsky and 130 — Gorny uluses. The settlements were situated in two different parts of Yakutia: in its central part and in the northern part.

To be enrolled into the research fishermen, hunters and herders had to meet the following inclusion criteria:

1. belong to any ethnic group,
2. be a male,
3. be a herder, fisherman or hunter,
4. be 18–65 years old,
5. be a resident of the same area for at least 5 years,
6. sign an informed consent,

The questionnaire consisted of twenty seven questions that the respondent had to answer in a set format. All questions are very simple and closed-ended. The respondent had to pick an answer from a given number of three options. While evaluating the difference of percents of respondents answered "yes" in the northern and central parts of Yakutia the third option — "don't know" — was used as a marker for exclusion of the respondent from calculations concerning this question, so the answers were considered to be dichotomous.

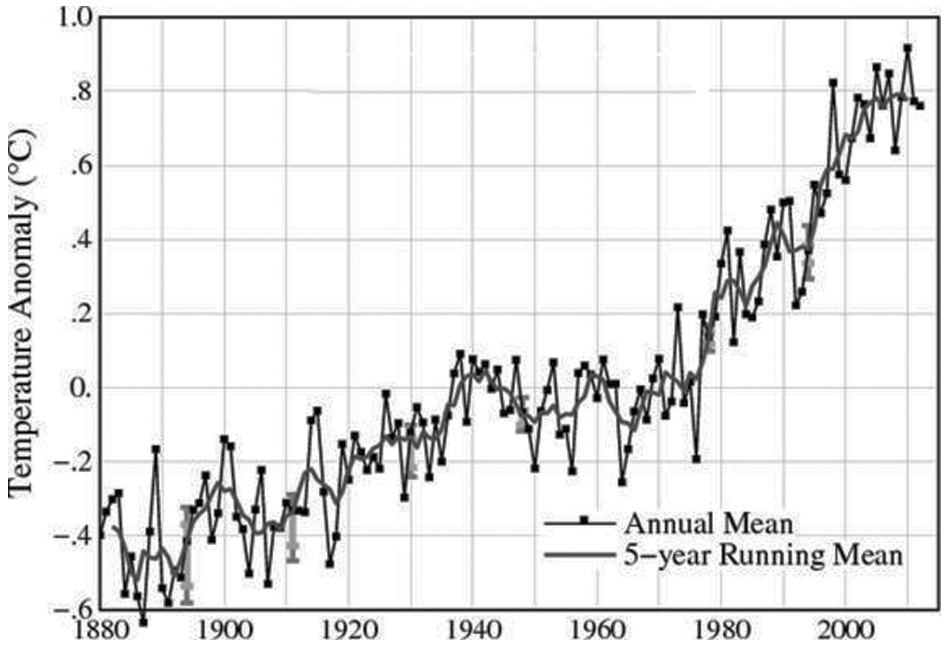

Fig. 1. Annual and five year global average temperature trend since 1880. IPCC, 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp. Published by the Intergovernmental Panel on Climate Change. Available from: http://www.ipcc.ch/graphics/syr/fig1-2.jpg (Accessed 25.09.2014)

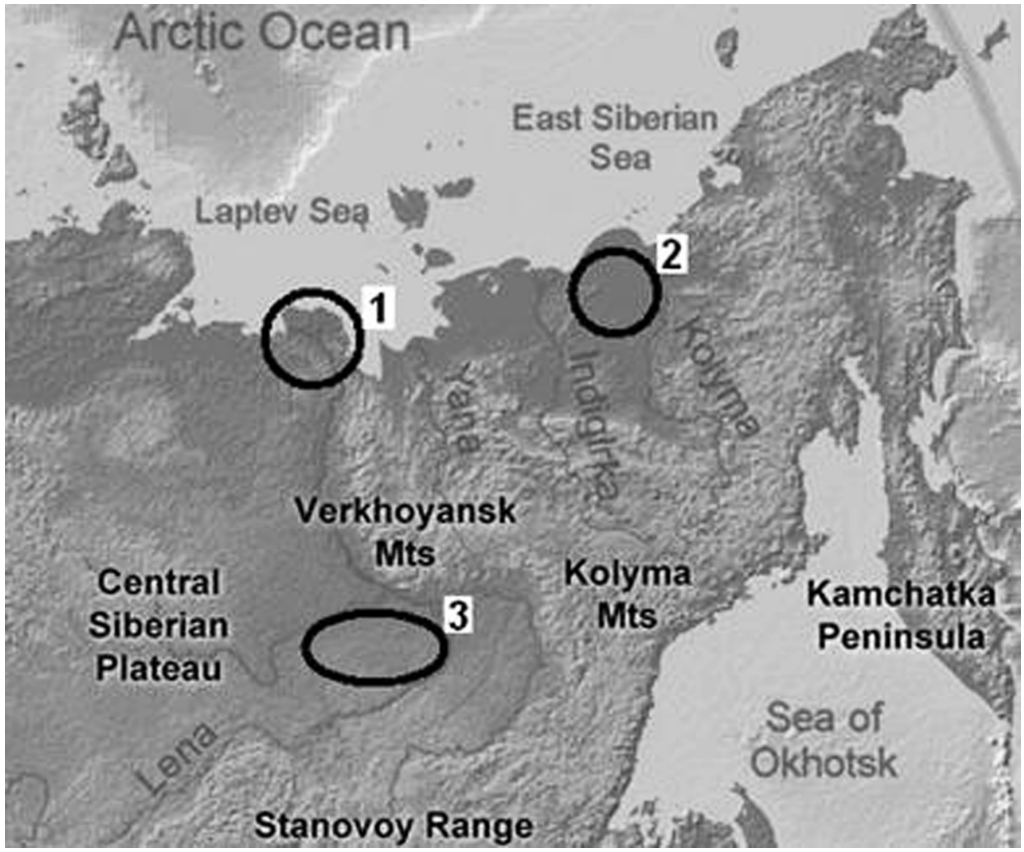

Fig. 2. Map of Eastern Siberia. Circumscribed are the areas in northern Bulunsky (1), Nizhnekolymsky (2) and central Gorny (3) uluses covered by the survey. IPCC, 2007: Physical map of Siberia, Eastern Russia. Available from: http://www.freeworldmaps.net/russia/siberia/map.html Accessed 25.09.2014

Table 1

Number of answers "yes", "no", don't know" given by 145 inhabitants of Bulunsky, Nizhnekolymsky (both northern) and Gorny (central) uluses of Yakutia

№	Question	Total N=145			North N=30			Center N=115		
		Yes	No	Don't know	Yes	No	Don't know	Yes	No	Don't know
	During past 5 years:									
1	Swamps appear to occupy more tundra and forest	18	26	101	2	19	9	16	7	92
2	Ice on rivers became thinner	70	28	47	20	8	2	50	20	45
3	Rivers became covered with ice longer	56	50	39	10	18	2	46	32	37
4	Water in rivers became more muddy	113	10	22	21	4	5	92	6	17
5	Ice on rivers became more muddy	99	22	24	13	11	6	86	11	18
6	The number of rainy days became greater	42	88	15	23	7	0	19	81	15
7	The number of sunny days became greater	83	45	17	15	15	0	68	30	17
8	Snowfall amount increased	12	125	8	0	30	0	12	95	8
9	Snowstorms became stronger and more frequent	21	44	80	2	21	7	19	23	73
10	Foggy weather became more frequent	32	67	46	14	13	3	18	54	43
11	It has become more difficult to predict a snowstorm	23	23	99	4	12	14	19	11	85
12	It has become more difficult to predict good weather	83	18	44	11	7	12	72	11	32
13	It has become more difficult to predict when spring will come	96	20	29	25	0	5	71	20	24
14	Rivers and sea became covered with ice later	67	22	56	23	4	3	44	18	53
15	Snow in winter became more crumbly	40	40	65	2	9	19	38	31	46
16	It has become more difficult to travel in tundra and forest because of more hummock on rivers	15	18	112	6	14	10	9	4	102
17	It has become more difficult to travel along tundra and forest because of more swamps	15	21	109	2	19	9	13	2	100
18	It has become more difficult to travel along tundra and forest because of unpredictable weather	25	16	104	12	10	8	13	6	96
19	You can catch fewer fish	102	18	25	20	10	0	82	8	25
20	You can hunt fewer birds	93	37	15	9	21	0	84	16	15
21	You can hunt fewer wild animals	82	25	38	10	15	5	72	10	33
22	You can gather less berries	105	26	14	6	21	3	99	5	11
23	You can gather less mushrooms	105	26	14	7	20	3	98	6	11
24	You see fewer lemmings	15	24	106	2	18	10	13	6	96
25	Reindeer grazing has become more complicated	31	23	91	2	19	9	29	4	82
26	Wild animals became lean	52	18	75	17	11	2	35	7	73
27	The amount of mosquitoes became more numerous in tundra and forest	89	41	15	26	3	1	63	38	14

To determine the significance of differences a two sided t-test for percents was used (Statistica for Windows *ver.* 6, StatSoft, AX204B521115F60, independent samples).

RESULTS

The results of the survey are presented in tables 1 and 2.

Data presented in table 1 show that in total the most impressive changes are registered for the following signs: thinner ice on rivers, water and ice in rivers more muddy, the number of sunny days greater, more difficult to predict good weather and beginning of spring, rivers and sea covered with ice later, hunting, fishing, gathering mushrooms and berries is not so successful and quantity of mosquitoes is greater than it has been 5 years ago.

Comparison of answers of the respondents living in the northern and in the central parts of Yakutia makes it possible to conclude that situation in the central part has a more strongly pronounced negative trend (Table 2). Significantly more often respondents' answers "yes" to questions №№ 1, 3, 5, 9, 11, 12, 15, 16, 17, 19, 20, 21, 22, 23, 24, 25, 26 in the central part of Yakutia being compared with greater number of "yes" in reply to only few questions (6, 10, 13, 27) in the northern part makes

Table 2

Difference between percent of answers "yes" for inhabitants of northern and central uluses of Yakutia

Question	Percent of answers "yes", dichotomized values		Importance of difference for "yes" between northern and central uluses, P
	northern uluses	central ulus	
Q1. Swamps appear to occupy more tundra and forest	10	70	0.00
Q2. Ice on rivers became thinner	71	71	1.00
Q3. Rivers became covered with ice longer	36	59	0.04
Q4. Water in rivers became more muddy	84	94	0.10
Q5. Ice on rivers became more muddy	54	89	0.00
Q6. The number of rainy days became greater	77	19	0.00
Q7. The number of sunny days became greater	50	69	0.06
Q8. Snowfall amount increased	0	11	0.06
Q9. Snowstorms became stronger and more frequent	9	45	0.00
Q10. Foggy weather became more frequent	52	25	0.01
Q11. It has become more difficult to predict a snowstorm	25	63	0.02
Q12. It has become more difficult to predict good weather	61	87	0.01
Q13. It has become more difficult to predict when spring will come	100	78	0.01
Q14. Rivers and sea became covered with ice later	85	71	0.16
Q15. Snow in winter became more crumbly	18	55	0.03
Q16. It has become more difficult to travel along tundra and forest because of more hummock on rivers	30	69	0.04
Q17. It has become more difficult to travel along tundra and forest because of more swamps	10	87	0.00
Q18. It has become more difficult to travel along tundra and forest because of unpredictable weather	55	68	0.40
Q19. You can catch fewer fish	67	91	0.00
Q20.You can hunt fewer birds	30	84	0.00
Q21. You can hunt fewer wild animals	40	88	0.00
Q.22. You can gather less berries	22	95	0.00
Q23. You can gather less mushrooms	26	94	0.00
Q24. You see fewer lemmings	10	68	0.00
Q25. Reindeer grazing has become more complicated	10	88	0.00
Q26. Wild animals became lean	61	83	0.04
Q27. The amount of mosquitoes became more numerous in tundra and in forest	90	62	0.01

us really believe in that the influence of climate change on human well-being is more profound in the center of Yakutia.

Trying to find links between climate change and human health and taking into account higher vulnerability of children than adults we compared mortality and morbidity of infants living in the uluses covered by the survey (Table. 3). High variability of data, which is obviously the result of influence of other factors (small population mostly), doesn't allow us to assert such a link.

Although the incidence of the diseases associated with climate change is going upward in Yakutia both for children (Table 4) and for adults, and the index of morbidity for population of Yakutia is getting higher during the last years (2010–1858.7, 2011–1863.3 per thousand), analysis of data for years 2011–2012 presented by the Federal Supervising Office for Protection of Consumers and Maintenance of Human Well-Being in the Republic of Sakha (Yakutia) and the Federal Center of Hygiene and Epidemiology in the Republic of Sakha (Yakutia) [6] shows that in terms of climate change-related exposures affecting the health status of people [2] the position of Gorny ulus was better than the positions of Nizhnekolymsky and Bulunsky uluses, particularly for infectious and parasite diseases, diseases of the circulatory system and the mortality index.

Table 3

Infant mortality and morbidity in uluses, covered by the survey, and in Yakutia in total [3]

Index	Region	Years				
		2005	2006	2007	2008	2009
Infant mortality per 1000 of live births	Bulunsky	17.9	16.7	7.5	8.0	17.1
	Nizhnekolymsky	–	56.8	11.8	25.6	
	Gorny	9.1	34.1	4.1	9.7	5.3
	Yakutia in total	11.3	10.5	10.7	9.7	9.2
Infant morbidity per 1000 of children	Bulunsky	2018.5	2015.2	1728.6	1575.8	936.2
	Nizhnekolymsky	2164.4	1523.8	1000.0	3725.0	3639.5
	Gorny	2400.9	3209.6	2497.8	2495.7	2694.0
	Yakutia in total	2730.9	2566.4	2384.9	2490.5	2633.4

Table 4

Incidence of selected diseases in children aged 0 – 14 years in Yakutia in terms of the International Statistical Classification of Diseases and Related Health Problems 10th Revision [1]

Class ICD 10 (version: 2010)	Per 1000 of children				
	2005	2006	2007	2008	2009
Certain infectious and parasitic diseases (A00-B99)	63.5	70.7	65.6	73.4	75.9
Diseases of the circulatory system (I00-I99)	5.6	5.6	5.6	6.9	6.1
Diseases of the respiratory system (J00-J99)	954.2	1101.0	1167.1	1294.3	1398.3
Diseases of the digestive system (K00-K93)	127.7	139.5	154.7	157.4	170.0
Total	1612.4	1796.9	1904.4	2051.6	2192.8

DISCUSSION

The results of the survey confirm the pattern of the surface air temperature changes over the period 1970–2004, drawn from a subset of about 29,000 data series from 577 studies, where the central and southern uluses of Yakutia belong to areas with greater temperature changes (+1–2 °C) than the northern uluses (0.2–1.0 °C) (see Fig. 3, marked with a polygon).

It is known that the northern uluses of Yakutia are inhabited by Natives in greater extent.

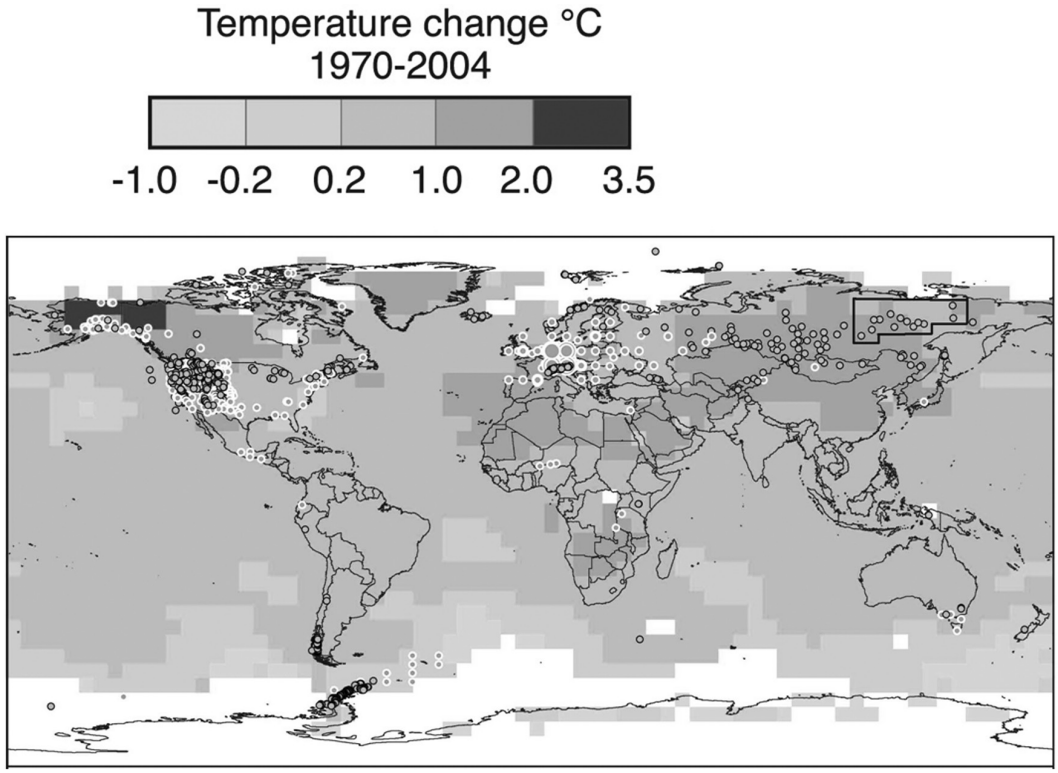

Fig. 3. Surface air temperature changes over the period 1970–2004. A subset of about 29 000 data series was selected from about 80 000 data series from 577 studies [4]. The polygon shows the points related to Yakutia

The prevalence of diseases among the Natives is high, especially for digestive diseases, diseases of the genitourinary system, of the circulatory system, of the respiratory system [3], which fact supposes existing climate change-related exposures affecting the health status. Our results can be interpreted as not supporting this hypothesis.

CONCLUSIONS

1. Everyday activities of hunters, fishermen and herders living in Yakutia have changed during the last 5 years due to climate change. People living in the central part of Yakutia are affected to a greater extent, which is associated with faster warming. Those changes are supposed to be the sources of the problems with long-term and short-term weather forecast, difficulties to travel along tundra and forest, reindeer grazing, problems with fishing, hunting, gathering mushrooms and berries.
2. Tendencies of infant mortality and morbidity in the studied regions are not associated with climate change and though the morbidity in Yakutia has a tendency to grow both in adults' and in children's populations mostly due to increase in prevalence of the diseases of the respiratory, circulatory and digestive system, this fact can hardly be associated with climate change.

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ИЗМЕНЕНИЕ КЛИМАТА, ЗДОРОВЬЕ И БЛАГОПОЛУЧИЕ ЧЕЛОВЕКА В ЯКУТИИ

Шадрин В.П., Бурцева Т.Е., Аврусин С.Л., Солодкова И.В.

◆ **Resume.** Исследование проведено на материале социологического опроса, проведенного путем очного собеседования специалистом научно-исследовательского центра Якутска. Были опрошены в общей сложности 145 субъектов, проживающих в 8 сельских поселениях. Представленные данные показывают, что в общей сложности самые впечатляющие изменения зарегистрированы для следующих признаков: тоньше лед на реках, вода и лед в реках более мутные, количество солнечных дней больше, труднее предсказать хорошую погоду и начало весенних паводков, реки и моря покрываются льдом позже, охота, рыбалка, сбор грибов и ягод проходит не так успешно и количество комаров больше, чем это было 5 лет назад. Установлено, что повседневная деятельность охотников, рыбаков и пастухов, живущих в Якутии, изменилась в течение последних 5 лет в связи с изменением климата. Люди, живущие в центральной части Якутии, страдают в большей степени, что связано с более быстрым потеплением. Эти изменения, как предполагается, приводят к проблемам с прогнозом погоды в краткосрочной и долгосрочной перспективе, трудностями путешествий вдоль тундры и леса, с выпасом оленей, проблем с рыбалкой, охотой, сбором грибов и ягод. Тенденции младенческой смертности и заболеваемости в исследуемых регионах не связаны с изменением климата, и хотя заболеваемость в Якутии имеет тенденцию к росту как во взрослых, так и в детских популяциях в основном за счет увеличения распространенности заболеваний органов дыхания, кровообращения и пищеварительной системы, этот факт вряд ли может быть связан с изменением климата.

◆ **Key words:** изменение климата; заболеваемость; регионы Якутии; анкетирование.

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