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Information Report on Biological Studies Conducted At the Semipalatinsk Nuclear Test Site

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Abstract: The objective of the present report was to investigate the environmental impact of the nuclear testes at Institute of Radiation Safety and Ecology (IRSE). On 1949, biological center will be opened in the city of Kurchatov to monitor the radiological situation at the former Semipalatinsk Test Site (STS). Report focused on reviewing data on the health and environmental impacts resulting from the testing at STS.

Key words: Kazakhstan · Semipalatinsk Test Site · Health effects

INTRODUCTION

The Institute of Radiation Safety and Ecology (IRSE) was established on the basis of research sub-units of Military Unit 52605 and National Nuclear Center subdivisions in 1993. On 1949, biological center will be opened in the city of Kurchatov to monitor the radiological situation at the former Semipalatinsk Test Site (STS). The center was created to conduct medicine-and-biological studies while nuclear testing at the STS. From not numerous data left at the Institute, it was determined that investigations of the Military Unit 52605 were directed on study and hygienic assessment of radiation situation caused by products of nuclear explosions carried out in 1949. The following subjects were studied: environmental, social, ecological, sanitary and hygienic conditions for the local public residing settlements situated within radioactive plume, particularities of their effect to dose burden, main factors effecting dose burden dynamics for the local public within the distribution area of radioactive explosion products, conditions and options for use water basins established at the Shagan River for agricultural and industrial purposes, present day radiation situation caused by underground nuclear testing and possible health risk for the public. The center was well-equipped; two-storied vivarium contained over 740 guinea-pigs, 400 rabbits, 500 white mice, 1500 white rats, 20 monkeys, open-air cages were for 114 dogs taken from local settlements, cows, horses and sheep were taken in addition.

While studying, ideas of nuclear weapon affecting factors upon biological objects were defined more exactly. The principle organizing and implementing stepwise medical measures while evacuating people affected by shock wave and other affecting factors of nuclear explosion were developed. Along with the institutions of the USSR Department of Defense, the Authorities of the 3[d] Central Administrative Board of the Public Health Ministry of the USSR, the personnel of the Institute of Biophysics and other leading medicine organizations participated actively to develop these principles. It was obtained experimental data on effect of radiation and fireballs to animals located outside, in open trenches, inside engineering structures and military vehicle. While experiments, it was revealed that dosed muscle work applied by animals inside did not affect course and result of radiation sickness. On the basis of obtained results, including data of pathologoantomic studies the main particularities of radiation sickness course, which were foundation for radiation sickness classification by burden significance, were determined. The occasions “death under ray”, when death occurs in the process of irradiation or soon after it, were highlighted as a special form. Pathologoantomic studies of dead animal corpses

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allowed, with more precision, corroborating sickness burden, death terms and radiation dose. These data were of great importance for developing domestic radiobiology and radiation medicine. On account of results obtained by the animal tests, the complex therapy method efficiency when treating acute radiation sickness and, in particular, combining protective means (radioprotectors) with medicine, was shown. Research works conducted at the center contributed fundamentally into study of ionizing radiation mechanisms and pathogenesis of radiation sickness. Thanks to this the information field of radiation biology and radiation medicine, as a scientific basis for resolving tasks to provide radiation safety, preventive measures, early diagnostics and treatment of radiation effects, preventive measures or reducing further consequences, was developed. Ivanov I.I., Krayevsky N.A., Lebedinsky A.V., Livanov M.N., Pigalev I.A., Tarusov B.N. and their colleagues were initiators of these fundamental studies.

Dus' V.I. [1] studied hygienic aspects and radiation situation assessment while nuclear testing at the Shagan River. This was "peace" excavation explosion of 1965, directed to create water basin. The crater 300 m in diameter and 200 m in depth was created by the explosion. As a result of this, excavated ground blocked the river up and, consequently, the water basin formed. The water basins formed were studied for radionuclide contamination directly by him during some years. The data on dynamics of radionuclide content, as well as decreasing of radiation level in water, soil, plants were provided with respect to years gone. It was provided hygienic description of radiation situation within the plume of underground nuclear test that included radiometry, dosimetry, sanitary-and-hygienic situation, plume's axis, thyroid gland condition, external and internal dose for the local public, radionuclide accumulation in chain "soil-animal-human", observation data on semi-periods of water basin cleaning at the Shagan River. Monthly and annually estimated dynamics gave data on soil contamination, as well as coefficient of radionuclide accumulation by plants. These data are still unique and used for comparative analysis.

By the moment the Institute was established the archive and equipment of the Military Unite 52605 had been exported and scientific officers had moved to Russia. The data on radiation situation throughout the Test Site were not available. Contaminated sites were not mapped. This fact showed that the above said was not included in research tasks of the Test Site's staff since the major purpose was to provide radiation protection directly at the place of testing. In connection with this, one of the principle tasks for the Institute of Radiation Safety and Ecology was to organize radiation survey assistance for all kinds of works performed at the STS, as well as render a guard services in the sphere of environmental protection and area use associated with atomic energy utilization. Since the STS data were classified at first and transferred to Russia then, all works to study radiation situation of the STS and radiation effect to human and biota were undertaken from the beginning. In addition, as a result of the Nuclear Test Ban Treaty, research target was switched to animal and plant natural populations inhabiting the area in the conditions of low chronic radiation doses, as well as reconstruction of radiation doses for the local public. The research into "direct" effect of dose rate was undertaken under laboratory conditions only.

Initial data obtained by the Institute's staff may be found in reports. Content of the reports includes a wide range of issues but they are interrelated, as plants and animal could not be studied without data on local radionuclide contamination. The last is associated with development of quantitative methods for radionuclides. Thus, on the basis of data available at the Institute, Smagulov S.G. [2] assessed radiation situation at the STS and adjacent areas, as well as nuclear testing consequences upon flora and fauna. This report presents data on developing and implanting measures for environmental protection at the contaminated areas, environmental restoration. In 1997, Seisebayev A.T. [3] continued developing measures for radiobioecological monitoring at the STS. Ecotypes and biological objects participating at external and internal dose formation- the surface layer of atmosphere, surface and underground water, soil, wild and domestic plants, animals and human -were main objects studied.

Artemyev O.I. *et al*. [4] investigated current radiation situation at the STS. They resurveyed 10 monitored sites within STS in scale 1: 200000 and conducted field radiometry and gamma-spectrometry, soil sampling. The data on radionuclide distribution within the sites studied and in the depth of soil profiles (up to 20sm) were obtained. The data obtained were compared with results of investigations conducted in 1994. The analysis result is evidence of radionuclide contamination level reduction at the sites monitored.

One of the Institute's research directions is to select new and effective radioprotectors and agents modifying effect of radioactivity. Thus, Karabalin B.K. [5] described chemical composition of 3 types of dog-rose and hawthorn growing in the Semipalatinsk region and, on this

bases, he developed medicament #52. In addition, for the same purposes, immunomodulator was extracted from thymus of karakul sheep. The therapeutic, endurable, maximum endurable and toxic dosage of the preparation for white rats, when intra-abdominal injecting, was determined. The preparation effect was controlled by the methods of hematolytic control, clinical observations and determination of physical parameters. The radiomodifying effect was observed in 80 male rats after irradiating by different level gamma-dose. Furthermore, Karabalin B.K. [6] extracted from plants phytopreparation containing biologically active compounds, as well as compounds having properties of immunomodulator. The preparation was tested for radiomodifying features while total gamma-irradiation in lethal dosage. For the test, white rates were used to study their clinical, physical state, blood composition after irradiation. While other series of tests, Karabalin B.K. [5, 6] and others tested both known and unknown preparations of vegetable nature CNC-8, CNC-52 as well as for the first time created - CNC -4, CNC -8, 52,53, 54. Besides, they used synthetic preparations of piperidine row - PP-13, PP -14, PP -15, PP -16. Inbreed white rats and male rats of conditional age and weight were used for the tests. A number of the preparations tested using laboratory animals and plants - CNC-8, CNC-52 and piperidine row - had radiomodifying features. While testing white mice, derivations of piperidine showed moderate radioprotective efficiency. While testing other biological objects- male rats, radioprotective features were not revealed in the same derivations of piperidine. Then, similar tests were continued by Kadyrova N.Zh. and Kairambayev S.K. [7]. They studied radiomodifying effect in 5 anew-synthesized preparations. Initial screening of radioprotective compounds was carried out under laboratory conditions using different test-objects. According to the coefficient of survival criterion for laboratory animals, it was revealed radioprotective effect of phosphatidelinositol while injecting male rates with the preparation in lethal dosage. The radiation effect can be better seen while irradiating animals by significant dose.

A great range of research was undertaken on making of an inventory of plants and animals of the STS with regard to nuclear tests. Thus, Sultanova B.M. [8, 9] and Seisebayev A.T. [10, 11] assessed biological consequences for natural plant and animal populations after nuclear testing. To assess current situation for vegetable cover, flora and flora and cenosis composition at the Technical Area of Balapan, three hundred and twenty (320) descriptions of phytocenosis were made. Seven (7) key sites were mapped (scale 1:1000); seven (7) ecological profiles were described; leveling of relief heaps of Balapan Lake was carried out. Two hundred and seventeen (217) leafs of herbarium were collected; flora list of vegetation was made. It was shown that one hundred and forty-eight (148) species of vascular plants of thirty-two (32) kinds and one hundred and ten (110) families grow at the Technical Area of Test Field. Two hundred and three (203) species of thirty-two (32) kinds and one hundred and thirty-nine (139) families were revealed at the area of the track of Balapan. Flora of the Degelen Mountain Massif includes three hundred and ninety-two (392) species of vascular plants of fifty-eight kinds and two hundred and thirty-eight families. In addition, Sultanova B.M. [8] studied tunnel liquidation effect to vegetation of the Degelen Granite Massif and concluded that tunnel demilitarization led to significant anthropogenic degradation of vegetation at sites adjacent to the tunnels and flood plains of radioactive streams. The processes of anthropogenic degradation caused transformation of species and cenotic composition of vegetable cover. Anthropogenic transformation of flora occurs in space and time simultaneously. Consequently, anthropogenic transformation coefficient differs at separate sites of the area covered with the vegetation. In 2004, Sultanova B.M. [9] continued work on assessing current situation for content, structure and particularities of vegetable cover restoration at the Degelen and Balapan. She determined and described species of water and riverside vegetation of the sites studied. In particular, vegetation in shallow water of the Aschiozek and Shagan rivers. In summary report, Seisebayev A.T. [3] and Ptitskaya L.D. [12] represented data on tunnel closure effect to flora and fauna at the Degelen Mounting Massif. The report shows that vegetable cover of the Degelen Mountain Massif was affected by significant anthropogenic transformation in break off zones, as well as artificial heaps and portal sites of the tunnels as a result of two hundred (200) underground nuclear tests.

The data on description of phytocenosis status and flora composition were provided; inventory of some vascular plants of the Degelen Mountain Massif was given. By the moment, two hundred (200) species of vascular plants, which divided into 38 kinds, were revealed. Brief information about flora of the area studied was given.

Alimbayev K.S. *et al*. [13] carried out geobotanical investigations including soil studies to plan steady use of the STS area in the region of Abai, Eastern Kazakhstan.

It was carried out ecological analysis of flora of the area studied, soil sampling, geobotanical investigations, topographical mapping, standard-method base to transfer the area for national economy purposes. In 2000, Polevik V.V. [14] jointly with Sultanova B. studied flora composition and vegetable cover of the STS and adjacent areas. Consequently, they made a list of species and studied vegetable cover of the STS.

Akhmetov M.A. [15] generalized the information available and the information obtained from IRSE on the most contaminated technical areas of the STS- Test Field. As the result of 5 year work, contaminated sites studied were mapped in scale 1:50000. Improved method for Cs-137 determination in water was prepared. A method of experimental study for Pu content in plant samples was developed. The Institute initiated monitoring of streams and contaminated portals of the Degelen Mountain Massif.

Karabalin B.K., *et al*., [6] for the first time undertook effort to use biotechnological method for cleaning soil and water contaminated with radionuclides at the STS. For the purpose, seeds of cultivated corn (*amaranth*) were sowed in contaminated sites. It was shown that above ground parts of the corn actively accumulated radionuclides. This kind was suggested to be used for decontamination of local sites at the STS.

Bekonov A.B. *et al*., [16] conducted reconnaissance survey of animal populations and communities inhabiting surface and water of the Shagan River basin. Species of small rodents and hydrobionts inhabiting the area were determined and described. It was determined a complex of factors that the most accurately show adaptive degree and character for population inhabiting under conditions of sites exposed to contamination.

It was revealed that hundred and twelve (112) species of *Rotifera* and one hundred (100) species of toxons of the lower *Crustacea* by hydrobilogical studies in animal plankton composition. For the first time, new forty-five (45) species of *Crustacea* and thirty-nine (39) species of *Rotifera* were shown for the Semipalatinsk region. According to information values of animal plankton totality, ecological situation in water basins of the Test Site is, to some extent, favourable at present. Structure of the community is in satisfactory state, provides normal existence and reproduction of mass species and sufficient water self-cleaning level at almost all sites. Exclusion is the Shagan Water-basin and Uzynbulak Stream where unstable and misbalanced states of animal plankton community may be observed.

The hydrobiological studies included hydrobiont diversity determinations, hydrobiont number estimation and calculation of phyto- and animal plankton biomass. These data were used to determine water quality. Water plant and animal communities of the Shagan were studied in more detail. The upper points with the stream of Shagan Lake within the area studied are characterized as clean or moderate contaminated. Phyto- and zoobenthos are the most representative here. Phytoplankton includes 24 species of algae. Diatomaceous algae- nineteen species- are a basis of plant community. Sample indexes- 1.76- 2.01, III class of water quality. It was observed thirteen (13) taxons of animals in zoobenthos sample, such as: lavae, hammarus, molluscs, bugs, leeches, lavae of two-winded. A quite high taxonomic diversity is evidence of stability of the ecosystem. The water at these points is assessed to be of II class - pure. Phytoplankton within the area studied is scanty. It was observed from two (2) to eight (8) taxons in samples. It was found 7 animal taxons in zooplankton samples. The number and biomass are low - 0.23 thousand specimens/m^3 and 12.35 mg/m^3. The diversity is extremely low downstream the Shagan River (~20 km upper Lake). Water quality class is IV.

According to hydrobilogical values, the water of Shagan Lake and “Atomic Lake” is assessed, as a whole, to be of IV class of water quality - moderate contaminated. Downward “Atomic Lake” the Shagan River practically dries up and is represented by separate reaches. On the whole, water quality of the river with stream from “Atomic Lake” is, according to hydrobilogical values, of IV class, moderate contaminated. The Aschisu River is the biggest inflow of the Shagan River. This is a water basin with a very low stream velocity. Compared all data of all values, water quality of the Aschisu was of IV class (moderate contaminated). Level of water mineralization and small depth rather affect degradation of hydrobiocenosis diversity than radiation factor.

Water basins of the STS were examined for fish diversity. Quite poor fish diversity at the STS was revealed by ichthyologic investigations, as follows: six (6) species in the Shagan and one (1) species in Uzunbulak Stream. By years of the studies, it is observed percentage decrease of rheophylne species in ichthyofauna. Ichthyocenosis of the fish species studied of the Shagan River is quite balanced according to biological values (fatness, rate of increase). An only exclusion is tench as among one of its populations there was observed dwarfish form. It was registered increasing of stochastic

component in populations of dace, loach and, minnow, mostly at the decreasing of genetic component of unsteadiness by a number of bilateral features. In fact, solely increasing of stochastic component of unsteadiness at the decreasing of its genetic component is an only evidence of negative effect likelihood of the STS activity for fish populations of the Shagan.

In his report, Karabalin B.K. [6] provides data on study of radionuclide content in soil, plants animal cytology. To determine agrochemical parameters and physic-and-chemical properties of soil, it was carried out soil sampling at the STS technical areas. It was studied radionuclide migration from soil to plant. Genetic and cytogenetic studies, were conducted haematologic investigations, haematologic analysis of animals inhabiting areas adjacent to "Atomic Lake", Technical Areas (Balapan, Test Field), winter huts - Chagan, Taktaigul, Kyzyl-Kuduk, Tulpar. People residing the settlement of "Chaganky", located within radioactive plume, were entered into questionnaires.

Ptitskaya L.D. [17] presented data on content and distribution of radionuclides in chain "soil-plant" for different kinds of soil-vegetable cover. These studies were continued by Kadyrova N.Zh. *et al*. [18-20]. They performed a detailed studied of anthropogenic radionuclide distribution in ecosystems "soil-plant" of various landscapes of the STS area. Some dominant species of zonal vegetation growing on light-chestnut soils of the Balapan (*Festuca valesiaca, Stipa sareptana, Artemisia gracilescens*), which are main fodder component for desert-steppe pasture of the region, were subjected to comparison analysis. The soil of the sites selected at the areas "Degelen" and "Balapan" hardly differed by humus horizon thickness and mechanical composition. The accumulation coefficient (C_A) of anthropogenic radionuclides was determined for the species studied. It was revealed that the most expressed migration process of ^{137}Cs è ^{90}Sr was for meadow-sweet (C_A of ^{137}Cs - 0.18, C_A of ^{90}Sr - 0.47) at the area of "Degelen". The most radionuclide accumulation value in the area of "Balapan" was observed for wormwood (C_A of ^{137}Cs - 0.59, C_A of ^{90}Sr - 0.98). C_A of $^{239,240}Pu$ is equally low for all plants selected and varies from 0.002 to 0.22. Above the ground mass of all studied plants accumulates ^{90}Sr more than other radionuclides. It may be explained by its significant biotropability, as well as it differs by greater mobility in the soil-solution system. Analysis of C_A in dominant plants at sites with different kind of soil shows inverse dependence of the coefficient on humus content which absorbs and firmly retains the radionuclide. Values of C_A accordingly increase in cases of low humus content in soil. They also studied regularities of radionuclide migration from lower soil to plants under conditions of varied contamination level. It was demonstrated that specific activity of above ground part of plants increases approx as much as specific activity of ^{137}Cs in soil correspondingly. Thus, it may be seen constant relationship between radionuclide accumulation level by plants and content of the radionuclide in soils. Tuleubayev B.A. *et al*. [21] issued, on the basis of investigations of the Radiobilogy Department, the Methodical Handbook "For Methodology of Radionuclide Migration Study in Chain "Soil-Plant". The handbook presents theoretical aspects of research on study of radionuclide migration features in chain "soil-plant" depending on physic-and-chemical and mechanical properties of soil, as well as biological particularities of lower-and-pasture plants with regard to land use conditions at the former STS.

Akhmetov M.A. [15, 22] summarized data on radiometric and radiobiological investigations of portal areas of the Degelen tunnels, as well as water basins of the areas Balapan and Degelen. The study described species diversity of fish, mesonic animal plankton and lavae of chyronomides inhabiting the Shagan River, current status of vegetable cover of the Degelen Mountain Massif and species diversity of vertebrates. The likelihood of biorecultivation and rehabilitation of vegetation in destroyed portals of closed tunnels was shown by sowing and planting. It was described particularities of natural plant restoration at portal sites of closed tunnels.

Khromov (2002) studied fauna of the STS vertebrates. He made fauna review of this animal group. While studying species composition and number of vertebrates, defined 4 classes: amphibia (2 species), reptile (4 species), birds (61 species) and mammal (21 species). The properties of ornithofauna - at the STS were determined; there are fourteen (14) species of sandpiper, rare species - Haliacetus albicilla, Syrrhaptes paradoxus, Anthropoides virgo, Cygnus musicus. Small rodents dominate among mammal species. Matmuratov S.A. (2002) characterized species diversity and seasonal changeability in number and density of small rodents at the STS. It was determined species and seasonal regularities in forming hematological values in forest mice and vole mice. In addition, he provided results of fauna study of *Rotifera* and lower *Crustacea*, as well as

ichthyologic data on changeableness of loaches from the STS water basins in comparison with control fish populations from the river of Ayaguz. It was revealed population of tench with furcated tail. Matmuratov S.A. suggests that biodiversity status of small rodents within the STS and adjacent areas should be determined by species-indicators.

Ptitskaya L.D. [23] presented data on area survey of central and east part of the area Balapan, as well as complex radioecological investigation of the region of Atomic Lake and the Shagan River. Water monitoring was conducted at Degelen; the stream-beds of Karabulak, Baitles, Takhtakushuk flowing outside the Mountain Massif, as well day surface zones of the massif in the region of explosion epicenter, were investigated. The data on analysis of morphobiological values, cytogenetic effects in dominant plants of indicator species, as well as studying species diversity of water, surface animals and water invertebrates inhabiting the STS and control sites, were given.

Aidosova S.S. [24] studied plant structure features in the conditions of radioactive contamination. She determined anatomic-and-morphological structure of surface and ground organs of dominant plant species, various living forms of natural phytocenosis at the STS and adjacent areas. Anatomic-and-morphological characteristics of two dominant plants - *Stipa capillata L*. and *Festuca valesiaca Gaudin* collected at the areas of Balapan and Degelen were given. It was revealed that, in plans of contaminated area, height of stem, length and width of leaf plates increased; in interior and exterior structure of stem and leaf increased the following: epidermis thickness, sclerenchyma ring thickness, mesophyll, diameter of xylem vessels and area of conducting tufts.

More detailed investigations on radiation effect on biota and human were conducted for chromosomes. Seisebayev *et al*. [10] studied genetic effects induced by chronic radiation of low doses in some animal species. Karyotypes were determined and showed significant increasing of cytogenetic abnormality level in cells of genitals, as well as somatic cells, in two (2) species of small rodents inhabiting contaminated areas. For the first time, natural populations of chironomidaes were investigated at water basins of the tract Balapan. It was carried out cytotaxonic identification of some chironimidae species and determined spectrum and frequency of disk inversion sequences for each of chromosome shoulder. The data obtained are evidence of genetic abnormalities in animals due to radiation effects at individually studied sites of the STS area.

Seisebayev A.T. [3] assessed biological consequences of nuclear tests for natural plant and animal populations. He determined radioecological situation in habitat of animals and singled out chironomid populations inhabiting water basins located in the region of radionuclide contamination. It was conducted cytotaxonic identification of the species and determined spectrum and frequency of disk inversion sequences for two (2) species: *Camptochironomus setivalva* and *Glyptotendipes salinus*.

For the first time, Seisebayev A.T., *et al*. [11] provided results on monitoring investigations of natural plant and animal populations of experimental sites of the STS in the proceedings of International Conference "BIORAD-2001" held in Syktyvkar. It was studied species composition and made inventory of vertebrates inhabiting the STS. It was shown that males Allagtaga major and Tellus erythrogenus inhabiting Balapan had significant number of abnormal spermatozoa that was 2-8 times more than control level. The number of metaphase cells with polyploidy and aneuploid range of chromosomes, as well as structural abnormalities of chromosomes, in the form of single and pair fragments and dicentrics, was two-four (2-4) times more than control level in marrow cells of small rodents and domestic sheep.

Shenal S., *et al*., [25] carried out radiation dose reconstruction using marrow cells and spermatozoa of animals. It was shown that two (2) groups of exposed to radiations animals had no morphometric differences in marrow cells. At the same time, there is a statistically reliable difference between both groups in number of abnormalities of spermatozoa heads. It was observed, for marrow cells, non-linear dose dependence at the range from 0.15 mcSv/h (within control) to 11.2 mcSv/h for low radiation doses. The conclusion was that chronic internal and external radiation effects quality of male cells. Modifications of ploidy may be used as indicator of genome instability caused by radionuclide toxicity. Non-linear dependence of chromosome aberrations in marrow cells could be explained by direct effect of chronic beta- and gamma-radiation, or combined effect of alpha-rays, or little quantity of Pu.

Aidarkhanova G.S. [26] carried out ecological assessment of underground nuclear test effect to environment of the mountain massif Deglen. Small rodents

inhabiting area adjacent to the STS were used for radiobiological investigations. The study of dominant animals (forest mouse) showed utmost diversity according to a number of morphological features. Using metaphase cells, it was also shown that percent of chromosome aberrations of various types was up to 6.74. Mostly, small rodents inhabiting contaminated areas had increased level of erythrocytes in blood.

Kadyrova N.Zh., *et al*. [7, 18] investigated adaptation properties of wild plants growing in places of nuclear tests - technical areas "Balapan" and "Degelen". They showed that long-term radiation causes genetic alterations. It was determined increasing in number of cells with chromosome aberrations and shown that younger plant forms of phylogenetic row were more stable to ionizing radiation than evolutionally older forms. This is the evidence of the fact that plants adapt in the process of evolution to ionizing radiation. A great number of factors for anthropogenic abnormalities of vegetation cover were revealed at the area of Balapan. It was shown that radiation educed chromosome aberrations, in particular structural and ethylamine - genetic mutations.

Authors [10] conducted cytogenetic investigation of natural chironomidae populations (Diptera, Chironomidae) inhabiting water basins located at the STS and adjacent areas. It was made cytophotomaps of polytene chromosomes of salivary gland for four (4) species. For the first time, before unknown species of *Chironomus degilenicum* family was described. It was conducted detailed quantitative and qualitative analysis of chromosome polymorphism, determined spectrum and frequency of disk sequences and their genotype combinations, revealed structural alterations of polytene chromosomes in some kinds of chironomidae, found unique sequences of chromosome disks and defined increase of frequency of structural chromosome mutations in mitotic cells of imaginal disks in natural chironomidae populations. Bakhtin M.M., Seisebayev A.T. *et al*., [10] also studied karyotype and chromosome polymorphism in three (3) populations of òàêææå Camtochironomus tentans (from diptera type, chironomidae family) inhabiting Degelen. For the first time, it was found unique inverse sequences of chromosome disks (p/ten B5, p/ten D3, p/ten CK, p/ten FK) and revealed a number of homozygous (p/ten c1.1; p/ten B2.2) and heterozygous (p/ten B1.5; p//ten D1.2; p/ten B1.3; p/ten F1.3; p/ten F1.κ) inversions that were specific for the area and presence of which could be connected with adaptation mechanism to the conditions of radioactive contamination of the environment. Seisebayev A.T., *et al.* [10] found that chironomidaes (Diptera, chironomidae) could be used as possible bioindicators for ecological status of water basins. They provided materials confirming likelihood of chironomidae use in the form of indication criterion when lake classification. It was determined that number and existence of some species may be index for assessment of ecological status of water basins. Results of cytotaxonic analysis allowed revelation of chironomidae species diversity character in water basins of the STS.

Sarsenbayev K.N., *et al*. [27, 28] studied consequences of nuclear tests at the Semipalatinsk Test Site with regard to physiological, biochemical and genetic properties of dominant plant of the deserted steppes - Stipa capillaceous. It was revealed that low chronic doses of ionizing radiation effect activity of antioxidant enzymes (superoxidedismutases, glutationreductases, catalases, peroxidases and Gl-6P-DH) in test (cultivated from seeds of plants grooving in the conditions of radiation) and control plants. This reduces radiation effect to plants and provides their radioresistance. By testing plants and enzymes, it was proved that this property is transmitted from generation to generation. By the example of 36 populations of ковыля волвидного growing at the STS, it was shown that radiation level effected component composition of heroxidase, esterase, acid phosphotase and soluble proteins. New components in spectrum of enzymes and soluble proteins were found. This may be result of genetic or post-transmission alterations of protein data due to exposure to chronic radiation. The PCR analysis of genome DNA of 4 Stipa capillaceous populations growing at different level of radiation was conducted. Significant differences between populations according to composition of amplicons were shown. The level of divergence between them was determined. The data provided by Sarsenbayev K.N. [27, 28] is evidence of the fact that growing of feather grass in the conditions of chronic radiation during forty (40) years led to appearance of new genotypes having effective enzyme antioxidant system, as well as genes coding them. This decreases number of plant aberrations due to radiation effect.

Thus, since the Institute was established, a wide range of investigations on radiobiology had been conducted. In parallel with developing methods of radionuclide analysis, it was carried out large-scale area surveys. On this basis, the following was made:

- A full list of vessel plant species,
- A full list of vertebrate species and
- A list of lower animals and plants.

Chromosome structure of animals and plants, radionuclide transfer in system - soil-plant-animal, radioprotectors, phytoremediation and component composition of proteins, enzymes and amplicons of DNA were studied. In spite of progresses achieved, it should be taken into consideration that fragmentation of the studies and absence of reliable evidences that plants and animals have genetic alterations while living at the contaminated areas. Uniqueness of the object - natural populations under permanent effect of low radiation doses - allows assumption that genetic aberrations in biota may be revealed using molecular-and-genetic methods of study.

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