

Downloading Articles by Russian Researchers Using the Sci-Hub Resource

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Abstract—On the basis of the 28 million downloaded articles posted by J. Bohannon and A. Elbakyan on the Internet on the Sci-Hub resource for the period from September 1, 2015 to February 29, 2016, about 1.5 million articles downloaded by Russian researchers were identified. They were distributed by publishing houses of scientific periodicals, cities, and regions of Russia, from which the download took place. As an example, among the 521 cities in Russia, the largest downloads were observed by researchers from Moscow (731 100 articles), St. Petersburg (132 600), Novosibirsk (57 500), Kazan (55 100), and Tomsk (26 400). Comparisons are made with similar downloads of Ukrainian researchers.

Keywords: Sci-Hub, Elsevier, Springer, J. Bohannon, A. Elbakyan, Russia, pirated downloading of articles

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INTRODUCTION

After the Sci-Hub pirate resource was launched in September 2011, all publications about it were more emotional and journalistic in nature. This topic entered the scientific discourse after John Bohannon and Alexandra Elbakyan, founder of Sci-Hub, posted data on 28 million user requests in Sci-Hub for the period from September 1, 2015 to February 29, 2016 in the public domain [1]. This allowed all interested researchers from around the world to analyze the use of Sci-Hub in their own countries and in specific research areas.

John Bohannon found that this resource is used by scientists not only from developing and underdeveloped countries, where access to subscription journals is difficult, but also from developed countries (a quarter of the requests come from OECD countries), which have good access to subscription journals [1] and do not want to sacrifice their comfort by obtaining legal access to them in their scientific libraries, which is confirmed by the polls of Jacques Travis [2]: “17% of the respondents said that accessing the full text through Sci-Hub was easier than through legal channels.” He also found that 37% of the respondents were unable to legally access the articles they needed, and 23% chose Sci-Hub because they disagreed with the pricing of major commercial publishers of scientific periodicals.

All this was best described by Simon Oxenham in summarizing his interview with Alexandra Elbakyan with the catchy headline “Meet the Robin Hood of science” [3]: “The efficiency of the system is really quite astounding, working far better than the comparatively primitive modes of access given to researchers at top universities, tools that universities must fork out millions of pounds for every year.”

M. Parkill [4] selected the TOP 100 articles from [1] into the PlumX tool, and determined that most of them were published in 2015, that is, Sci-Hub users prefer to receive the latest articles. Moreover, a large number of articles were devoted to physics, technical sciences, and life sciences.

Z. Babutsidze [5] studied arrays of downloaded articles on economic topics [1] from TOP 5 economic journals: *American Economic Review*, *Quarterly Journal of Economics*, *Journal of Political Economy*, *Econometrica*, and *Review of Economic Studies*. He noted the small number of articles from these journals; requests for them come from underdeveloped countries.

G. Cabanac [6], using the same data, found that 36% of all articles are available on the Library Genesis (LibGen) open platform, which is paired with Sci-Hub. It was also noted that 68% of the articles from Elsevier, Springer, and Wiley are available on LibGen. At the same time, [7] gave a figure of 83% for articles from the same publishers.

D. Himmelstein et al. [8] found that Sci-Hub provides free access to more than 85% of the scientific articles from subscription journals, as well as to 97% of the articles from Elsevier, which, as we know, has repeatedly sued this pirated resource.

S. Nazarovets [9] used the data of [1] to obtain the distribution of articles downloaded by Ukrainian researchers by publishing houses and regions; he identified the main areas of knowledge that correspond to these articles (chemistry, physics, and astronomy accounted for 69% of the articles; medical and pharmaceutical sciences, 13%; life sciences, 12%; and social sciences, 6%) and the most common journals (*Journal of the American Chemical Society*, 6769 articles; *Organic Chemistry*, 6038; *Physical Review B*, 4325; and *Medicinal Chemistry*, 3712 articles).

In [10], using the access of the University Association for Contemporary European Studies (UACES) to European Studies journals, journals with IF (WoS) > 1 were selected. Their analysis together with the data on the download of articles from [1] revealed that readers are mainly interested in issues related to populism, extremism, and the economic crisis.

According to the data of the same work [1], D. Androćec [11] studied publications in the field of computer science, which turned out to be 5.95% of the total number of publications, and cited the 20 most popular articles. The first five countries whose researchers downloaded articles on the sciences were India, Iran, China, United States, and Indonesia. Russia was in seventh place on this ranking list with 46659 articles.

B. Greshake [12] showed that, out of 62 million articles pirated through Sci-Hub, 80% are from nine publishers.

We present an overview of publications (with the exception of article [9]), for 2016–2017, based on the empirical basis of work [1]. However, in addition to the statistical analysis of articles downloaded from the Sci-Hub, research was conducted in parallel by surveys of users of this pirated resource. We only note work [13], which describes the results of the large-scale Early career researchers (ECRs) project, which motivated 106 young researchers from seven countries (Great Britain, Israel, Spain, China, Malaysia, Poland, and France) to use Sci-Hub. These researchers were interviewed annually for 3 years. It was shown that the popularity of Sci-Hub was growing: in 2016 this resource was used by 6% of the project participants, in 2018 it was used by 25%. It was most popular among young researchers in France. It was also shown that Sci-Hub is heavily blocked in China, but it has its own pirate resource 91lib.com. Even if university libraries are well stocked with subscriptions to scholarly periodicals, Sci-Hub is preferred for convenience over licensed access through the libraries. It is noted that the ResearchGate network was used by 75% of the project participants.

One of the most recent surveys of researchers and students about their dependence on Sci-Hub was published in early January 2021 on the Indian SpicyIP repository of blogs on intellectual property and innovation policy [14]. From December 22, 2020 to January 2, 2021, 212 respondents were interviewed, of which 140 (66%) strongly depended on Sci-Hub on a ten-point scale (8–10 points). Before the COVID-19 pandemic, 51.9% of respondents preferred to receive articles through their libraries (48.1% through Sci-Hub), while during the pandemic, this ratio changed in favor of Sci-Hub (164 respondents or 77.3% strongly depended on Sci-Hub to access paid resources).

In conclusion to our review, we note that the articles downloaded from Sci-Hub are cited 2.21 times more often than those not downloaded from this resource [15]. This review, including all articles identified through Google Scholar, has shown that there is no research into downloading pirated articles from Sci-Hub by Russian researchers. Here, we try to fill this gap.

MATERIALS AND METHODS

Data of work [1] consist of 6 files with the extension “*.tab;” files with the extension.tab; each of them reflects the requests of users for a certain period.

The files contain

- the date and time of the request;
- DOI identifier, which includes the code of the publisher and the code of a specific article in the journal, generated by the publisher;
- the user’s IP address;
- the name of the country;
- the city name;
- the geographic coordinates, latitude and longitude.

Along with the data of six files, a file of articles in the CSV format was downloaded, which contains

- the name of the publisher;
- publisher prefix;
- the date of the last save;
- the date of the last request.

To obtain the results, only requests from Russian IP addresses were selected. Using the PyCharm development environment and the Python programming language, the source files were processed and the results of the downloading of articles by Russian researchers were obtained.

When processing the source file of articles, it turned out that if the names of publishers are selected by prefix, the number of downloaded articles will be 1780431, which does not correspond to the number of downloaded articles by cities of Russia, equal 1521434. The discrepancy is due to duplicate publish-

ing lines in the original file. When a file with initial data on the number of downloaded articles is processed and the names of publications are found by prefixes, then the union of two frame dates is used, similar to join in SQL. Thus, duplicate lines are also counted and this results in an extra number of articles. After removing duplication, the number of articles with Russian IP-addresses was 1521434.

When processing the data, it was also noted that the total number of downloaded articles by country is not equal to the total number of downloaded articles by city. The reason lies in the source files: some of the data lines are missing the name of the city, instead of this N/A occurs. The number of lines with this value was counted; it was 29264. Thus, 1492170 lines were analyzed, which corresponds to the number of articles downloaded in Russia.

RESULTS AND DISCUSSION

We present the results of processing the data of [1] on the distribution of downloaded articles by publishing houses, cities, and regions of Russia.

Table 1 shows a ranked list of publishers with at least 900 downloads of these articles.

Table 1 data were compared with similar results for Ukraine obtained by Sergei Nazarovets [9]. To do this, we combined data on Springer-Verlag and the Nature Publishing Group, receiving a total of 206153 articles, and data on Wiley Blackwell (Blackwell Publishing) and Wiley Blackwell (John Wiley & Sons), receiving a total of 120391 articles. For the five leading publishers with the largest number of their articles downloaded by Russian researchers, we get the following excess over the downloads of articles by Ukrainian researchers: Elsevier, 4.3; Springer Nature, 4.5; Wiley Blackwell, 4.2; American Chemical Society, 3.5; Institute of Electrical and Electronics Engineers, 6.0. The list of leading publishers whose articles were downloaded was approximately the same for researchers in both countries.

In the process of data processing, 521 cities and settlements were identified, while in the last 35 cities one download was observed for the entire 6-month period. Among them are cities that are well known: Tuapse, Derbent, Mozdok, Nazran, and Pizhma. Table 2 provides information on the top 100 cities.

Comparing the data in Table 2 with the data of [9], it can be seen that Moscow is 3.9 times ahead of Kiev in the downloading of articles, although Kiev has more downloaded articles per capita than Moscow (64 versus 60 per thousand people). The first cities in both countries are ahead of the second cities in terms of downloads by approximately the same number of times (5.1 and 5.2).

The slight difference in the downloading of articles for Moscow and St. Petersburg as regions (subjects) of the Russian Federation from the downloading for

them as cities is due to the fact that their regions include small cities, such as Lomonosov and Peterhof for the St. Petersburg region (Table 3).

In comparison with the Ukrainian situation [9], the third largest Ukrainian region in terms of the number of pirated downloads, the Kharkiv region [9], is inferior in this indicator, with the exception of the first two Russian cities, only to Moscow and Novosibirsk regions, as well as the Republic of Tatarstan.

CONCLUSIONS

On the basis of a large array of 28 million articles highlighted in [1] from the Sci-Hub resource, we identified publications pirated by Russian researchers. These publications are distributed among publishing houses, as well as cities and regions of Russia. Their first triplets looked like this: Elsevier, Springer-Verlag, American Chemical Society; Moscow, St. Petersburg, Novosibirsk; Moscow, St. Petersburg as subjects of the Russian Federation, and the Moscow region.

We plan to continue processing the data by defining the distribution of the selected articles by field of research, as well as by journal. It would be relevant, in our opinion, to select data from Sci-Hub at the present time, for example, from September 1, 2021 to February 29, 2022, in order to get exactly a 6-year time interval relative to previous samples. There will then be an understanding of what kind of scientific information Russian researchers need.

Here are a few general thoughts on this phenomenon and its relationship to the open access movement. Paper [12] concluded that, despite the growth of Open Access, illegal access to scientific articles is becoming more widespread. For the 6-month period considered above, the scientists of Madrid, Barcelona, and Valencia downloaded, respectively, 98143, 78535, and 26634 articles, while for the whole of 2017 they have downloaded 868322, 488101 and 215690 articles [16]. Thus, in terms of an annual period, the increase in pirate takings in these cities only a year later occurred by 4.4, 3.1, and 8.1 times. The same is occurring all over the world. Enthusiasts of the Open Access movement worked hard towards their goal, and 11–12 years after the launch of this movement, one single, but even greater, enthusiast instantly opened almost 100% access to scientific publications. This access can be called the Black Open Access Revolution. The young student of communist views brought all commercial publishers to their knees and caught government officials around the world by surprise. None of their lawsuits and no government bans are in force here. Publishers have not felt any losses yet, since those who could get it legally, as well as scientists from underdeveloped countries, whose scientific organizations do not have money to access their content, receive illegal content. But they will soon feel it when scientific libraries begin to eliminate subscriptions,

Table 1. The distribution by publisher of articles downloaded by Russian researchers from the resource Sci-Hub

No.	Publisher	Number of downloads from Sci-Hub	No.	Publisher	Number of downloads from Sci-Hub	No.	Publisher	Number of downloads from Sci-Hub	No.	Publisher	Number of downloads from Sci-Hub	No.	Publisher	Number of downloads from Sci-Hub
1	Elsevier	453245	22	Elsevier – Academic Press	6974	43	S. Karger AG	2847	64	The Endocrine Society	1392			
2	Springer-Verlag	147419	23	Informa UK (Informa Healthcare)	6284	44	Turpion	2793	65	Cambridge University Press (Materials Research Society)	1383			
3	American Chemical Society	141852	24	Trans Tech Publications	6256	45	The royal society	2496	66	Nature Publishing Group - Macmillan Publishers	1308			
4	Wiley Blackwell (John Wiley & Sons)	87034	25	American Institute of Aeronautics and Astronautics	6190	46	American Society for Biochemistry and Molecular Biology	2393	67	Springer – Adis	1222			
5	Institute of Electrical and Electronics Engineers	83948	26	Annual Reviews	5373	47	Elsevier – WB Saunders	2336	68	Emerald (MCB UP)	1202			
6	Nature Publishing Group	58734	27	Proceedings of the National Academy of Sciences	5219	48	Ovid Technologies Wolters Kluwer – American Heart Association	2249	69	American Physiological Society	1199			
7	The Royal Society of Chemistry	48529	28	Mary Ann Liebert	4914	49	Brill Academic Publishers	2159	70	The University of Chicago Press	1180			
8	American Physiological Society	41296	29	World Scientific	4475	50	New England Journal of Medicine	2146	71	American Association of Physics Teachers	1173			
9	Informa UK (Taylor & Francis)	35307	30	The Electrochemical Society	4342	51	Informa UK (Ashley Publications)	2029	72	Acoustical Society of America	1150			
10	Wiley Blackwell (Blackwell Publishing)	33357	31	Canadian Science Publishing	4317	52	American Vacuum Society	2026	73	American Scientific Publishers	1130			
11	American Institute of Physics	29234	32	Thieme Publishing Group	4161	53	Society for Industrial and Applied Mathematics	2010	74	Oldenbourg Wissenschaftsverlag	1125			

Table 1. (Contd.)

No.	Publisher	Number of downloads from Sci-Hub	No.	Publisher	Number of downloads from Sci-Hub	No.	Publisher	Number of downloads from Sci-Hub	No.	Publisher	Number of downloads from Sci-Hub
12	The Optical Society	25691	33	International Union of Crystallography	4131	54	Springer (Biomed Central Ltd.)	1876	75	CSIRO Publishing	1121
13	JSTOR	19636	34	BMJ	3934	55	Ovid Technologies (Wolters Kluwer) – Lippincott Williams & Wilkins	1744	76	American Society of Civil Engineers	1104
14	IOP Publishing	18863	35	Japan Society of Applied Physics	3680	56	ASME International	1674	77	Informa UK (Marcel Dekker)	1093
15	Pleiades Publishing	18742	36	Institution of Electrical Engineers	3641	57	Future Medicine	1664	78	Woodhead Publishing	1088
16	SPIE - International Society for Optical Engineering	15306	37	Cambridge University Press	3612	58	Bentham Science	1635	79	Ovid Technologies (Wolters Kluwer) - American Academy of Neurology	1077
17	Oxford University Press	14703	38	American Society for Microbiology	3566	59	Maney Publishing	1631	80	Geological Society of London	1048
18	American Association for the Advancement of Science (AAAS)	12045	39	Association for Computing Machinery	3530	60	Allerton Press	1630	81	Society for Neuroscience	1022
19	SAGE Publications	10890	40	American Medical Association	3237	61	Informa Healthcare (Expert Reviews, LTD)	1510	82	Muse - Johns Hopkins University Press	916
20	Springer (Kluwer Academic Publishers)	7442	41	American Geophysical Union	3146	62	Cold Spring Harbor Laboratory Press	1508	83	Springer-Verlag	915
21	Walter de Gruyter GmbH	7210	42	Wiley Blackwell (Blackwell Publishing)	3011	63	American Association for Cancer Research	1451	84	Geological Society of America	908

Table 2. The distribution of pirated articles by Russian researchers in the Top 100 cities of Russia

No.	City	Number of downloads from Sci-Hub	Region code	No.	City	Number of downloads from Sci-Hub	Region code	No.	City	Number of downloads from Sci-Hub	Region code	No.	City	Number of downloads from Sci-Hub	Region code
1	Moscow	731134	77	26	Omsk	6934	55	51	Kirov	2214	43	76	October	1214	2
2	St. Petersburg	132623	78	27	Solnechnoe	6776	50	52	Vladimir	2174	33	77	Novocheboksarsk	1169	21
3	Novosibirsk	57508	54	28	Belgorod	6070	31	53	Dubna	2163	40	78	Pillar**	1125	50
4	Kazan	55138	16	29	Cher-nogolovka	6034	50	54	Lipetsk	2108	48	79	Oryol	1102	57
5	Tomsk	26412	70	30	Kaliningrad	5964	39	55	Tyumen	2050	72	80	Volobuevo*	1095	46
6	Nizhny Novgorod	25508	52	31	Stavropol	4795	26	56	Makhachkala	2012	5	81	Volkhonsk-chino*	1086	68
7	Yekaterinburg	22024	66	32	Obrninsk	4314	40	57	Odintsovo	1994	50	82	Cheboksary	1069	21
8	Korolev	20589	50	33	Izhevsk	4205	18	58	Saransk	1967	13	83	Reutov	1054	50
9	Samara	19401	63	34	Peterhof	3457	78	59	Podolsk	1935	50	84	Chkalovsk	937	52
10	Voronezh	18962	36	35	Astrakhan	3384	30	60	Chekhov	1924	50	85	Kuban*	906	23
11	Velikiy Novgorod	17723	53	36	Pushkino	3125	50	61	Kursk	1880	46	86	Vidnoe	878	50
12	Irkutsk	16752	38	37	Fryazino	3040	50	62	Ulyanovsk	1796	73	87	Penza	877	58
13	Saratov	16678	64	38	Gatchina	2935	47	63	Lyubertsy	1792	50	88	Snezhinsk	839	74
14	Rostov	15260	76	39	Kaluga	2892	40	64	Lomonosov	1740	78	89	Protvino	819	50
15	Perm	14740	59	40	Berdsk	2860	54	65	Dmitrov	1723	50	90	Krasnogorsk	781	50
16	Krasnoyarsk	14576	24	41	Ryazan	2837	62	66	Tambov	1712	68	91	Kirovsk	779	51
17	Chelyabinsk	13209	74	42	Mytishchi	2732	50	67	Yakutsk	1658	14	92	Sergiev Posad	772	50
18	Ivanovo	11643	37	43	Petrozavodsk	2695	10	68	Bryansk	1634	32	93	Surgut	764	86
19	Ufa	10905	2	44	Khabarovsk	2507	27	69	Taganrog	1472	61	94	Smolensk	761	67
20	Volgograd	10798	34	45	Tula	2409	71	70	Yoshkar-Ola	1453	12	95	Vladikavkaz	745	15
21	Krasnodar	10071	23	46	Zhukovsky	2392	50	71	Nakhodka	1354	25	96	Lobnya	744	50
22	Vladivostok	9794	25	47	Tver	2365	69	72	Apatity	1347	51	97	Balashikha	717	50
23	Syktvykar	9693	11	48	Barnaul	2351	22	73	Magnitogorsk	1344	74	98	Dzerzhinsky	714	50
24	Kemerovo	7200	42	49	Tolyatti	2293	63	74	Ivanovskoe*	1270	50	99	Domodedovo	706	50
25	Yaroslavl	7172	76	50	Arkhangelsk	2230	29	75	Sarov	1264	52	100	Lytkarino	681	50

*, Rural community, **, village.

Table 3. The distribution of pirated articles by Russian researchers by regions of Russia

Region	Urban population in 2016	Number of downloads from Sci-Hub	Downloads per capita	Region	Urban population in 2016	Number of downloads from Sci-Hub	Downloads per capita
Moscow	12232428	731555	0.0598	Tver oblast	980532	2638	0.0027
St. Petersburg	5282000	138327	0.0262	Tyumen oblast	1220828	2586	0.0021
Moscow oblast	6064591	75039	0.0124	Khabarovsk krai	1094393	2569	0.0023
Novosibirsk oblast	2193420	60712	0.0277	Kostroma oblast	465912	2466	0.0053
Republic of Tatarstan	2975910	56050	0.0188	Kirov oblast	985796	2337	0.0024
Nizhny Novgorod oblast	2582160	28128	0.0109	Altai krai	43834	2384	0.0544
Tomsk oblast	780117	26862	0.0344	Chuvash Republic	766320	2238	0.0029
Sverdlovsk oblast	3662334	23306	0.0064	Lipetsk oblast	742152	2116	0.0029
Samara oblast	2565603	21791	0.0085	Republic of Dagestan	1371942	2103	0.0015
Voronezh oblast	1487395	19327	0.0130	The Republic of Mordovia	505000	2031	0.0040
Novgorod oblast	434004	17723	0.0408	Ulyanovsk oblast	939750	1822	0.0019
Irkutsk oblast	1900701	17464	0.0092	Sakha Republic (Yakutia)	630765	1687	0.0027
Rostov oblast	4231000	17383	0.0041	Bryansk oblast	855921	1651	0.0019
Saratov oblast	1871645	17249	0.0092	Mari El Republic	450730	1460	0.0032
Chelyabinsk oblast	2892652	16372	0.0057	Oryol oblast	503585	1105	0.0022
Krasnoyarsk krai	2374750	15423	0.0065	Penza oblast	916586	950	0.0010
Perm krai	1992424	15066	0.0076	Smolensk oblast	687113	877	0.0013
Republic of Bashkortostan	2517473	12526	0.0050	Khanty-Mansi Autonomous Okrug	1519258	876	0.0006
Krasnodar krai	3041766	12489	0.0041	Republic of North Ossetia – Alania	451326	746	0.0017
Ivanovo oblast	832722	12296	0.0148	Vologda oblast	854848	730	0.0009
Primorsky krai	1482633	11621	0.0078	Orenburg oblast	1194000	623	0.0005

Table 3. (Contd.)

Region	Urban population in 2016	Number of downloads from Sci-Hub	Downloads per capita	Region	Urban population in 2016	Number of downloads from Sci-Hub	Downloads per capita
Volograd oblast	1 946 680	11 338	0.0058	Amur oblast	539 746	473	0.0009
Kaluga oblast	770 640	10 525	0.0137	Chukotka Autonomous District	35 000	468	0.0134
Komi Republic	663 000	10 216	0.0154	Republic of Khakassia	371 067	433	0.0012
Kemerovo oblast	2 324 322	7 585	0.0033	Kamchatka krai	245 700	430	0.0018
Yaroslavl oblast	1 038 407	7 531	0.0073	Kurgan oblast	527 772	425	0.0008
Omsk oblast	1 432 398	7 084	0.0049	Kostroma oblast	465 912	338	0.0007
Belgorod oblast	1 045 169	6 853	0.0066	Republic of Bashkortostan	2 517 473	304	0.0001
Kaliningrad oblast	767 108	6 029	0.0079	Zabaykalsky krai	733 720	267	0.0004
Stavropol krai	1 637 536	5 400	0.0033	Kabardino-Balkar Republic	452 052	232	0.0005
Leningrad oblast	1 154 048	4 803	0.0042	Republic of Adygea	214 742	189	0.0009
Udmurt Republic	996 669	4 219	0.0042	Karachay-Cherkess Republic	198 982	144	0.0007
Astrakhan oblast	677 635	3 393	0.0050	Pskov oblast	453 894	116	0.0003
Murmansk oblast	699 468	3 076	0.0044	Tyva Republic	172 356	73	0.0004
Kursk oblast	760 271	3 014	0.0040	Republic of Kalmykia	125 934	46	0.0004
Vladimir oblast	1 085 590	2 982	0.0027	Republic of Buryatia	579 576	32	0.0001
Tambov oblast	629 200	2 906	0.0046	Magadan oblast	139 722	28	0.0002
Ryazan oblast	808 059	2 858	0.0035	Sakhalin oblast	398 366	22	0.00006
Republic of Karelia	424 479	2 849	0.0067	Yamalo-Nenets Autonomous District	448 632	13	0.00003
Tula oblast	1 121 252	2 730	0.0024	Republic of Ingushetia	82 044	1	0.00001

which will become unnecessary. This will serve well for the legal Open Access movement, because it will accelerate the transition of commercial subscription magazine publishers to the open access model; they will go bankrupt otherwise. When this happens, then the Sci-Hub pirate project will die out by itself, as Alexandra Elbakyan herself wrote.

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