

The Influence of Various Forms of Co-Authorship on the Scientific Productivity of Russian Scientists in the Field of Molecular Biology

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Received March 15, 2015

Abstract—This paper considers the influence of different forms of co-authorship as the main aspect of collaboration in science on the productivity of Russian scientists in the field of molecular biology. We attempt to confirm or refute assumptions about the impacts of different forms of co-authorship on improvement of the citation rates of publications, viz., the number of co-authoring scientists, the number of co-authoring organizations, and international co-authorship. Trends in the dynamics of proportional redistribution of articles and reviews as types of publications in document flows and the impacts of these processes on the citation levels of publications are analyzed. The information base of this study is the Web of Science Core Collection (Thomson Reuters).

Keywords: scientific collaboration, co-authorship, scientific productivity, citation levels, reviews, articles, bibliometrics, molecular biology, science in Russia

DOI: 10.3103/S0147688215030090

INTRODUCTION

Collaboration in science is of fundamental importance and is generally considered as a prerequisite for high-quality research. There are various forms of scientific collaboration, such as scientific forums, affiliate programs, and joint ventures. Due to such interactions, scientists have the opportunity to share knowledge, experience, and techniques for carrying out certain studies. In addition, the expansion of the audience makes it possible to control, adjust, and enrich the research results, which allows the development of scientific research in a spiral. Due to the facts that in recent years an increasing number of scientific areas are being connected with each other and that the quantity of multidisciplinary research is growing rapidly, the interaction of scientists and research groups is of particular importance. One cannot overestimate the economic benefits of collaboration, such as reducing the costs of the purchase of equipment, chemicals, and information technology.

The interaction of scientists can be considered at three levels: the micro-level means collaboration within a single scientific institution among scientists, laboratories, and groups; the meso-level means collaboration between research institutions; and the macro-level means collaboration with industry and among different regions [1]. It can be assumed that the broader scientific collaboration is, the higher the rate is of conveying information to other scientists.

However, there are several factors that have negative impacts as a result of collaboration in scientific

work. For example, in [2] it was stated that collaboration may entail temporary expenses in the joint formulation of research problems; cause difficulties in deciding on the division of labor when carrying out the research; and cause differences in the study results and their subsequent interpretation. In addition, collaboration can inhibit the promotion of young scientists, as their contribution to the research can be undervalued [3, 4].

Trends in co-authorship as a fact of collaboration in science in recent years are of great interest among specialists in the field of scientometrics [5–8]. In the early 20th century, co-authored works made up less than 10% of all publications, while at the end of the 20th century they accounted for more than 50% of all publications [9]. However, co-authorship can be an indicator of collaboration only in part because it does not reflect the full and accurate understanding of the nature and extent of scientific interactions [2].

Many publications have started to present information and statements about the correlation between the number of authors and subsequent citing of their articles. Thus, the authors of [2] wrote that scientific collaboration improves the quality of research, and this, in turn, leads to active citation of publications. Similar conclusions have been made by other authors [10–12]. However, this statement has been questioned by a number of authors [7, 13, 14].

The potential benefits of scientific collaboration may depend on the type of collaboration, the field of knowledge, and the participating countries. In [15] the

authors referred to the significant influence of international collaboration on the subsequent citation rates of articles. A similar statement was made in [16], where the author argued that international publications are cited more often than those of mono-national publications. Furthermore, the author estimated the “citation advantage” of collaboration with various countries in the fields of physics, chemistry, and mathematics. The benefits of collaboration with different countries have also been suggested in other publications [15–20]. In [21], the author concluded that international co-authorship in the field of carbon nanostructures significantly increases the citation rates of Russian publications and that articles that are authored only by Russian scientists were cited even less than the publications of a single author.

In [14], the authors noted only a slight benefit from collaboration from the standpoint of increased citation rates, which does not differ from other forms of collaboration (both domestic and international). The most interesting result of the study, according to the authors of [14], is the conclusion that collaboration increases the citation rates of articles in ecology in cases where more than two institutions participate in the preparation of the publication. Collaboration between departments within a single agency reduces the citation level. The authors attributed the decrease in the citation rates of publications with foreign participation to the general globalization of science.

As a form of scientific collaboration, co-authorship is studied by many researchers, but Russian publications in biology have not been studied sufficiently in this context. Our study aims to examine different models of scientific co-authorship of Russian researchers in the field of biology and, in this regard, the following issues are considered:

- the question of whether there is a pronounced interaction between the number of co-authors in the scientific publications of Russian scientists in the field of biology and their level of citation;

- the question of whether there is a positive correlation between the number of Russian institutions whose employees were the authors of publications in biology and their citation rates;

- the question of whether co-authorship with colleagues from other countries has any impact on the citation rate;

- the question of whether there is a relationship between the proportional dynamics of articles and reviews (as types of publications) and their citation rates.

METHODS

A search for Russian publications in molecular biology was carried out in the databases of Thomson Reuters: Web of Science Core Collection (WOS), namely: Science Citation Index Expanded (SCI-

EXPANDED) from 1980 to the present and Conference Proceedings Citation Index – Science (CPCI-S) from 1990 to the present (as of October 9–15, 2014). We analyzed publications for the 2004–2013 period whose “address” field contained Russia.

Publications were identified in a predetermined sequence. First, for each year of study, we loaded publications for which an author’s address was listed as Russia. To avoid duplication, the identified records were filtered for several areas of knowledge (we used the field *research areas*): *biochemistry*, *molecular biology*, *biophysics*, and *cell biology*. In order to better understand the currently existing trends, the publications were divided into arrays with foreign participation and without foreign participation. Each co-authored publication was taken into account once for each country (in cases of foreign participation) and each scientific organization (in cases without foreign participation). If the author was affiliated with two or more Russian scientific organizations or with both Russian and foreign scientific organizations, these publications were taken into account for each designated organization or country. In the latter case, the publication was considered as having foreign participation. If the addresses of the authors indicated departments or laboratories of the same research institution, such publications were considered as having been carried out by one organization. The exceptions were research institutes at universities (especially at major universities). In these cases, the university and the affiliated research institute were considered as two different scientific institutions.

To determine how actively the publications of Russian scientists in the field of molecular biology are cited, we analyzed arrays of publications whose citation levels are equal to or greater than the worldwide average rates separately. Here, we also studied the publications that were carried out with foreign participation and without it separately. We focused on the differences in the numbers of reviews and articles as different types of publications. Publications whose cards stated “Review” and “Review: Book Chapter” were classified as reviews; papers with “Article” and “Article; Proceedings Paper”¹ were classified as articles.

In determining the level of citation, we used the methodology that was described in detail in [22, 23]. The average citation rate of publications for each year of the study period was divided by the average figure in “biology and biochemistry” for a certain year according to the Essential Science Indicators database (Thomson Reuters), as of October 15, 2014, and presented in relative terms (%).

The publications that had a single author but whose address bar listed some other countries in addition to

¹ We mean exactly this specification of the publication type. Publications that were attributed to the “Proceedings Papers” type were not taken into account in this case.

Table 1. The dynamics of the publication activities of Russian scientists in molecular biology for the 2004–2013 period

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Publications without foreign participation										
Number of publications	1112	1027	1173	1114	1028	1002	1097	1074	1037	1519
The proportion in the total array of Russian publications in molecular biology, %	63	61	66	64	63	65	65	65	62	68
The proportion of reviews in the array of publications without foreign participation, %	6	7	6	6	9	8	10	10	12	7
The proportion of articles in the array of publications without foreign participation, %	61	64	53	66	64	67	65	65	65	46
Publications with foreign participation										
Number of publications	649	661	619	634	605	546	587	577	632	723
The proportion in the total array of Russian publications in molecular biology, %	37	39	34	36	37	35	35	35	38	32
The proportion of reviews in the array of publications with foreign participation, %	3	4	4	6	5	6	6	5	9	7
The proportion of articles in the array of publications with foreign participation, %	84	81	82	81	83	82	76	78	77	67

Russia were considered as having foreign participation. The number of countries (except for Russia) that were listed in the address of the author of the publication was taken into account. Similarly in the cases of domestic co-authorship, if the author's address listed more than one organization, this publication was taken into account as being carried out with the participation of other organizations.

RESULTS

For the 2004–2013 period, the data on 17 416 Russian publications in molecular biology that are presented in the WOS were collected and processed. Of these, 11 183 were publications without foreign participation and 6233 had foreign participation.

In order to have an overview of the status and trends of the publication activities of Russian scientists in the field of molecular biology, let us consider the overall dynamic characteristics of the document flow in this field for the 2004–2013 period.

According to the data that are presented in Table 1, we see that publications with foreign participation and without it during 2004–2012 occurred in a 35(40)% to 65(60)% ratio. However, in 2013 the proportion of publications with foreign participation dropped to 32%. Perhaps in the near future these data will be corrected. Therefore, in our view, it is too early to talk

about a downward trend in the proportion of publications with foreign participation. However, the growth rate figures are some evidence of a downward trend of foreign participation in Russian publications in molecular biology. Thus, although the average growth rate of arrays of publications with foreign participation was positive, its value was only 1%. At the same time, more active growth was observed in publications without foreign participation, where the average growth rate was 4%.

It is interesting that in recent years there has been a tendency towards an increase in the number of reviews with foreign participation at an especially accelerated pace: the average growth rate during the study period was 9%. In the case of reviews without foreign participation the increase was 5%. Against this background, there is a negative dynamics in scientific papers (as a type of publication) in the total array. Thus, the average growth rate of articles with foreign participation decreased by an average of 2%, while the average growth rate without foreign participation was zero.

Let us consider the impact of the increase in the number of reviews on the dynamics of citing arrays of publications in molecular biology with both foreign participation and without it for the period of 2004–2013 (Figs. 1–4).

Since 2008, there has been an increase in the proportion of reviews without foreign participation in the

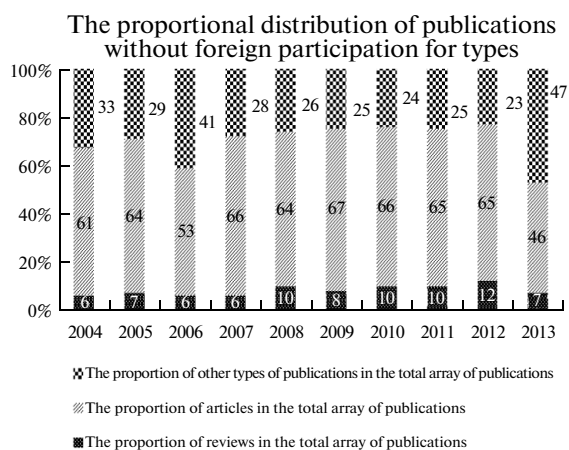


Fig. 1. The proportional distribution for types of publications without foreign participation.

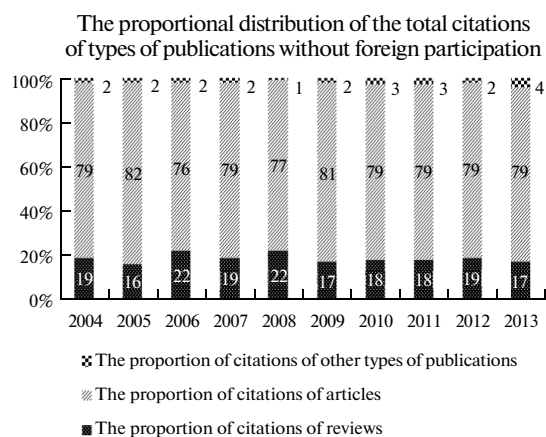


Fig. 2. The proportional distribution of total citations of various types of publications without foreign participation.

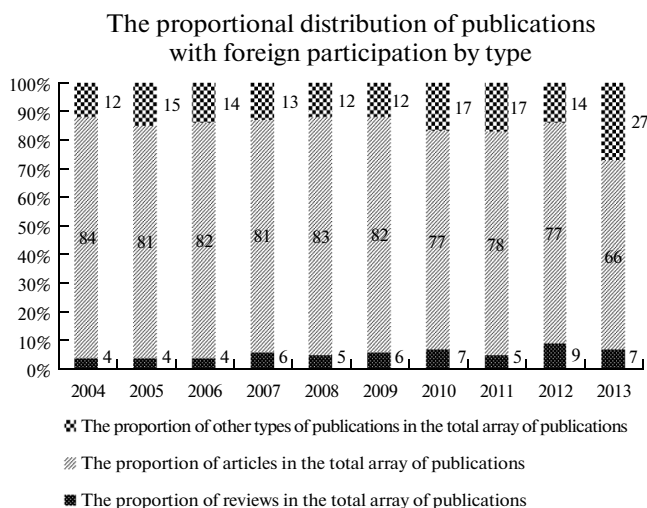


Fig. 3. The proportional distribution of publications with foreign participation by type.

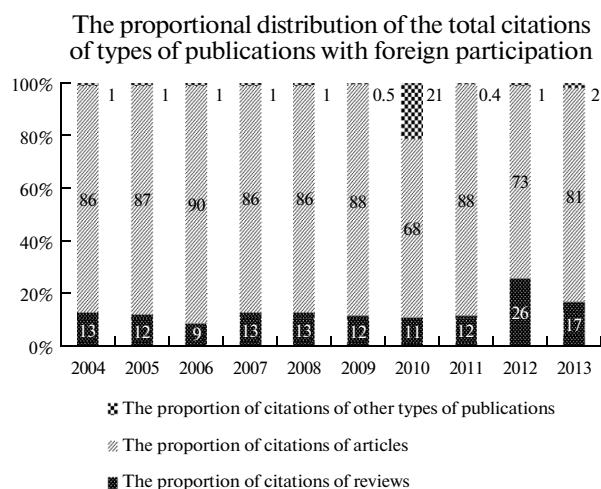


Fig. 4. The proportional distribution of the total citations of various types of publications with foreign participation.

arrays of publications in molecular biology during the study period (Fig. 1). The proportion of articles remained, in general, at about the same level, but a sharp decline occurred in 2013, which occurred as well in the case of reviews. Correction of the data for that year will probably occur, since at the time of the information collection all publications may not have been reflected in the WOS database.

Figure 2 shows that the proportions of the citations for reviews and articles without foreign participation remained virtually unchanged over the study period. Despite the fact that the proportion of reviews has increased since 2008, the proportion of citations of reviews has declined starting from 2009. Therefore, in the case of publications without foreign participation the hypothesis that a positive influence occurs for the impact of the growth of the number of reviews on the increase of the total citation rate was not confirmed.

Let us now consider this process based on the example of publications with foreign participation.

Figure 3 shows that in the period of 2004–2006 the proportion of reviews in arrays of publications with foreign participation remained the same (4%), while since 2007 it has grown gradually. However, it is difficult to say whether this is a trend or not, since in some years (2008 and 2011) the proportion of reviews decreased after some growth and was 5%.

Figure 4 shows that along with the increase in the proportion of reviews with foreign participation among other types of publications there was some increase in the proportion of citations that were related to reviews. In this case, we can assume that the increase in the proportion of reviews among other types of publications has a positive effect on the total

Table 2. The dynamics of the arrays of Russian publications in molecular biology with citation levels equal to or greater than worldwide average values for the 2004–2013 period

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Publications without foreign participation with citation equal to or greater than the worldwide average values										
Number of publications	38	37	43	33	61	46	49	66	81	137
The proportion in the total array without foreign participation, %	3	4	4	3	6	5	5	6	8	9
Average number of authors per publication	5	4	4	5	6	5	6	5	9	5
Maximum number of authors in publications	12	10	12	12	33	27	22	17	19	28
Average number of organizations per publication	1.7	1.6	1.7	1.6	1.7	2	2	2	2	2
Average citation per publication	57	50	51	44	40	33	24	18	9.3	3
The proportion of reviews in the array of highly cited publications without foreign participation, %	32	16	35	30	23	33	26	20	25	18
The proportion of articles in the array of highly cited publications without foreign participation, %	66	84	65	67	77	74	73	77	75	80
Publications with foreign participation with citation rates equal to or greater than the worldwide average values										
Number of publications	160	146	149	158	152	138	154	149	195	283
The proportion in the total array with foreign participation, %	25	22	24	25	25	25	26	26	31	39
Average number of authors per publication	7	8	7	8	7	10	8	12	16	8
Maximum number of authors in publications	42	42	43	25	33	137	70	179	1268	44
Average number of countries per publication	1.6	1.7	1.7	1.8	1.9	2.1	1.9	2.5	2.5	1.7
Average citation per publication	70	98	59	67	46	42	44	21	17	5
The proportion of reviews in the array of highly cited publications with foreign participation, %	8	10	8	12	11	11	12	9	16	12
The proportion of articles in the array of highly cited publications with foreign participation, %	92	89	92	87	88	89	88	91	83	87

citation rates of arrays of publications with foreign participation.

Based on the data that are presented in Figs. 1–4, it can be concluded that the hypothesis that there is a positive impact due to an increase in the proportion of reviews among other types of publications on the growth of aggregate citation was confirmed only in the case of publications with foreign participation.

To understand how studies by Russian authors in the field of molecular biology are valued and to define the processes that affect the ranking of their publications, we analyzed arrays of articles with a citation

level that is equal to or greater than the global average figures separately.

As can be seen from Table 2, the number of publications with a citation level that is equal to or greater than the average was increasing during the analyzed period. This trend was observed in the publication flow both with and without foreign participation. The average growth rate of publications without foreign participation was higher than with it, viz., 15 and 7%, respectively. The proportion of highly ranked publications in the general array without foreign participation grew considerably, viz., from 3% in 2004 to 9% in 2013; however, it was still markedly inferior to publica-

tions with foreign participation (25% in 2004 and 39% in 2013). Interesting issues are observed in the dynamics of the proportional distribution of reviews and articles (as types of publications) with foreign participation and without it in the arrays of publications whose citation levels are equal to or greater than the worldwide average values. Thus, over the study period there was a decrease in the proportion of reviews without foreign participation (from nearly 30% in 2004–2008 to 24% in 2009–2013) against the background of an increasing proportion of articles (from 72% in 2004–2008 to 76% in 2009–2013). In the case of publications with foreign participation the situation is reversed: an increase occurred in the proportion of reviews (from 10% in 2004–2008 to 12% in 2009–2013) and a decrease occurred in the proportion of articles (from 90% in 2004–2008 to 88% in 2009–2013). Given the fact of the increase in the proportion of publications with good citation rates and the simultaneous decrease in the proportion of reviews without foreign participation, we can conclude that in the case of publications in molecular biology without foreign participation the common opinion that reviews are better cited than articles was not confirmed. At the same time, in the case of publications with foreign participation the opposite situation occurs: there is a positive relationship between the increase in the proportion of reviews among other types of publications and an increase in the citation levels; that is, in this context the assertion that reviews are better cited than articles is only true for the cases with foreign participation.

Continuing to analyze the arrays of publications with citation levels that are equal to or greater than the worldwide average values, it can be assumed that the improvement of citation levels is affected by an increase in the number of co-authors and organizations that participated in the research. Thus, while in 2004–2008 the average number of authors per publication without foreign participation ranged from four to six, in the 2009–2013 period it varied from five and nine, respectively. As for the arrays of publications with foreign participation, an increase in the average number of co-authors also occurred: from 7 to 8 authors in 2004–2008 and from 8 to 16 in 2009–2013. However, these are average figures. If we look at concrete examples, we will see that publications with a very large number of co-authors began to occur in the 2009–2013 period. In 2008, the leading work among the publications that were authored only by Russian scientists had 33 co-authors and a citation rate equal to 88. At the same time, the maximum citation rate for this year belonged to a review by one author (a citation rate of 95) and an article by 11 authors (a citation rate of 94). In 2012, this time with the participation of foreign colleagues, there was a publication (review) with the collaboration of 1268 scientists with the maximum citation rate among the publications in the same year, 544. Thus, we see that the number of co-authors does not always affect the citation rate.

Let us return to the consideration of the entire array of Russian publications in molecular biology during the study period and try to estimate the impact of international collaboration on the scientific productivity of Russian scientists by answering the following questions. Which countries are the main partners of Russian scientists in the field of molecular biology? How does collaboration with these countries affect citation rates, so one can talk about the degree of influence of a publication? What are the *h*-indices of the arrays of publications that are carried out in co-authorship with the main partner countries? Is there an increase in the number of partner countries and, if so, does this process have a positive impact on the citation rates of publications?

The data on the collaboration of Russian scientists with the main countries of co-authors in molecular biology are presented in Table 3. During the study period the number of countries whose scientists collaborated with Russian scientists increased. While in 2004 the number of such countries was 50, in 2012 it was 73. The undisputed leaders in terms of the number of joint publications are the United States and Germany, where the former was involved in an average of 35% of all of the joint works and the latter 18%. The average rate of growth in the number of joint publications with participation of the United States over the 2004–2013 period was 4% while for Germany it was 3%. The leader in terms of the growth rate of joint publications was China: the average growth rate during the study period was 18%. In this connection it is necessary to make a clarification: in 2004 the papers that were co-authored by scientists of this country were only 1% of the total array of publications with foreign participation, while in 2010 and subsequent years it was 5–6%.

Let us now consider the issue of determining the countries for which co-authorship was most effective in terms of the citation rates. For this, we analyzed an array of only those publications whose citation levels were equal to or greater than the worldwide average. We see that the largest proportion of these publications were due to the United States (48% of the entire array of highly ranked publications); the average growth rate of such publications during the study period was 7%. The same growth rate was observed in joint publications with Germany (7%). Satisfactory growth rates were observed in co-authorships with the United Kingdom (10%) and France (9%). However, the highest average growth rate was observed in publications with China (20%), although in absolute terms these publications are still not numerous (16 publications in 2013). When analyzing the data in Table 3, one should consider the fact that citation in molecular biology reaches its peak in the third year after the publication of the article [3, 24]; thus, the total figures for the data of 2011–2013 should be seen as speculative.

Table 3. International collaboration. The dynamics of publication activities with the main partner countries

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of partner countries	50	47	53	58	59	58	64	65	73	62
The proportion of joint publications in the total array with foreign participation, %										
United States	28	31	32	33	37	37	38	36	37	37
Germany	15	17	19	13	20	19	18	19	19	18
United Kingdom	8	11	9	13	9	9	8	12	11	11
France	8	8	9	8	10	9	7	11	10	11
Sweden	6	6	5	4	6	7	6	6	7	5
China	1	1	2	1	3	2	5	5	6	5
The proportions of publications with citation levels equal to or greater than the worldwide average in the array of highly ranked publications, %										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
United States	41	49	52	51	54	50	47	48	48	43
Germany	17	24	19	20	28	24	23	21	26	18
United Kingdom	11	14	11	15	12	10	12	17	15	15
France	7	9	12	7	15	11	11	19	15	10
Sweden	7	10	4	4	5	8	10	11	10	6
China	2	0	2	0.6	0	1	3	7	6	6

In recent years, the *h*-index gained special popularity in bibliometrics. In our case, this indicator is very demonstrative, as it allows one to compare certain arrays of publications within the same scientific field, molecular biology, over a specified time interval (2004–2013).

We determined the *h*-index for several information flows, viz., the entire array of Russian publications with foreign participation in molecular biology for 2004–2013 and six separate information flows that were generated via co-authorship with authors from the main partner countries (Table 4). Thus, we determined the *h*-indexes for seven arrays of publications. In cases where co-authors were scientists from several

countries, these works were taken into account in the arrays that relate to each of these countries.

The data given in Table 4 show that 91 joint publications with participation of the United States over a 10-year period (2004–2013) were cited 91 or more times, for Germany the figure was 60 times or more, for the United Kingdom, 51 or more times, etc. Separately, it was determined that the *h*-index of the entire array of publications that were carried out with international co-authorship, including with partner countries outside of the six leaders, over the study period in the field of molecular biology was equal to 108.

Thus, the participation of the leading countries in the joint publications that are taken into account by the *h*-index is distributed as follows: 67% of the works were carried out in collaboration with scientists from the United States, 22% from Germany, 11% from the United Kingdom, 8% from France, 7% from Sweden, and from 2% China. These data indicate that the greatest contribution to the value of the *h*-index of the entire array of publications with foreign participation in molecular biology during the study period was provided by co-authorship with scientists from the United States. Based on these data we can conclude that publications co-authored by American scientists have the most stable high citation rate compared to those written with scientists from other partner countries.

Let us now take a closer look at the impact of the number of co-authors on the citation rates of publica-

Table 4. *H*-index of arrays of joint publications in molecular biology with the main partner countries for the 2004–2013 period

Country	<i>h</i> -index of arrays of publications
United States	91
Germany	60
United Kingdom	51
France	46
Sweden	40
China	21

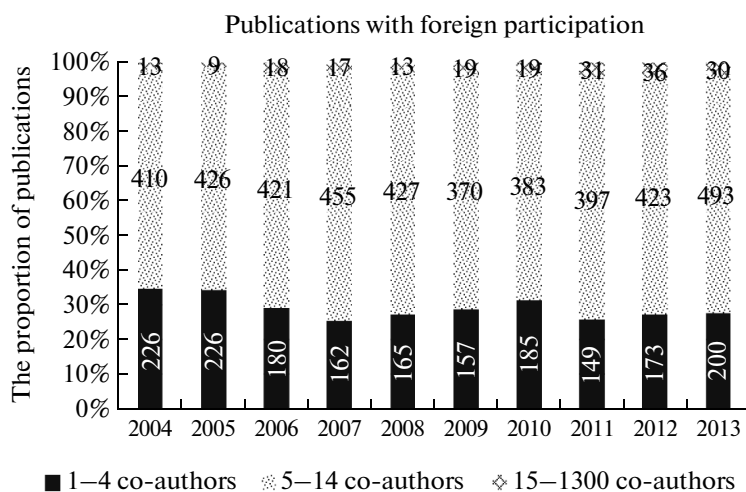


Fig. 5. The dynamics of the proportional distribution of publications with foreign participation with different numbers of co-authors.

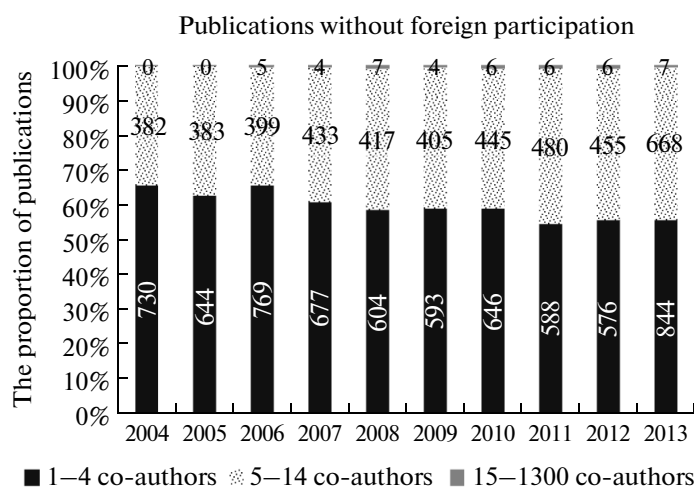


Fig. 6. The dynamics of the proportional distribution of publications without foreign participation with different numbers of co-authors.

tions. We have already noted that some publications with very good citation indicators did not have a large number of co-authors and, on the contrary, some papers with a large number of authors had very low citation rates, which does not confirm the hypothesis about the positive impact of the number of co-authors on the subsequent citation rate. To confirm or refute this idea, we investigated the arrays of publications with foreign participation and without it in the dynamics for the 2004–2013 period according to the following scheme: from 1 to 4 co-authors, from 5 to 14 co-authors, and from 15 to 1300 co-authors (Figs. 5 and 6). The division into these groups was due to the fact that publications without foreign participation often have 1–4 co-authors (60% of the array), while publications with foreign participation have from 5 to 14 co-authors (67%). In addition, in order to focus

attention on publications with a very large number of authors, they were placed in a separate group, viz., from 15 to 1300 co-authors.

We see that in the case of international publications during the study period there was a redistribution of publications towards an increase in the number of co-authors (Fig. 5). A similar process occurred in publications without foreign participation (Fig. 6).

In recent years, positive dynamics have occurred in the citation of publications and an increase in the number of publications whose citation was equal to or greater than the worldwide average. This occurred against the increase in the number of co-authors (see Figs. 5 and 6; Table 2, the data on the average number of authors per highly cited publication with and without foreign participation). Thus, this supports the idea that there is a relationship between these processes.

Table 5. The dynamics of average citation per publication with the participation of different numbers of co-authors

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Publications with foreign participation										
1–4 co-authors	26	23	19	17	19	13	12	7	5	2
5–14 co-authors	23	28	22	21	15	14	15	7	5	2.1
15–1300 co-authors	52	208	30	102	41	50	38	20	35	4.2
Publications without foreign participation										
1–4 co-authors	5	5	4	4	5	3	2	2	1	0.3
5–14 co-authors	6	6	5	5	5	4	4	3	2	0.4
15–1300 co-authors	0	0	1	1	45	36	5	4	2	2

Therefore, let us consider the dynamics of the average citation rate of publications in molecular biology based on the number of co-authors (Table 5).

The data given in Table 5 partially confirm the assumption of a positive interaction between the number of co-authors and the average citation rate. However, the small number of articles that have 15 or more co-authors is not sufficient to indicate an unconditional positive impact of the number of co-authors on the citation rate. The data for the two main groups of publications, viz., from 1 to 4 and from 5 to 14 co-authors, are more revealing. Here we see a small difference in the average citation of publications between these two groups in the arrays both with foreign participation and without it. Therefore, in this context, there is no explicit positive impact of the number of co-authors on the citation rate.

We will look deeper at the Russian domestic inter-institutional collaboration and attempt to reveal the

relationship between the number of co-authoring organizations and the citation levels of publications (Fig. 7).

According to the data shown in Fig. 7, it can be seen that in recent years there has been a redistribution of the proportions of publications towards an increase in the number of co-authoring organizations. Thus, while in 2004 the major proportion (73%) was due to the publications that were carried out within the same organization, in 2012 this proportion was already 52%. Tracing the dynamics of the number of co-authoring organizations on average, per publication, it was found that between 2004 and 2008 there were seven such organizations, while in the period from 2009 to 2013 the figure was ten.

Does the increase in the intensity of Russian inter-institutional collaboration affect the increase in the “weight” of scientific publications in terms of their citation rates? Let us consider the dynamics of the average citation of publications carried out with the participation of a different number of organizations (Fig. 8).

According to the data shown in Fig. 8, we see that an increase in the number of co-authoring organizations causes an increase in the average citation rates of publications. Thus, we can talk about the positive impact of intense inter-institutional collaboration on the subsequent citation rates of publications.

CONCLUSIONS

This study showed that in recent years growth has occurred in the number of authors of publications. However, the results do not confirm the hypothesis of a marked positive relationship between the number of co-authors for the scientific publications of Russian scientists in the field of molecular biology and their citation levels. However, the impact of increasing the number of co-authoring organizations in Russian publications is quite different. Here we see an undoubted positive effect of active inter-institutional scientific collaboration on the citation rate.

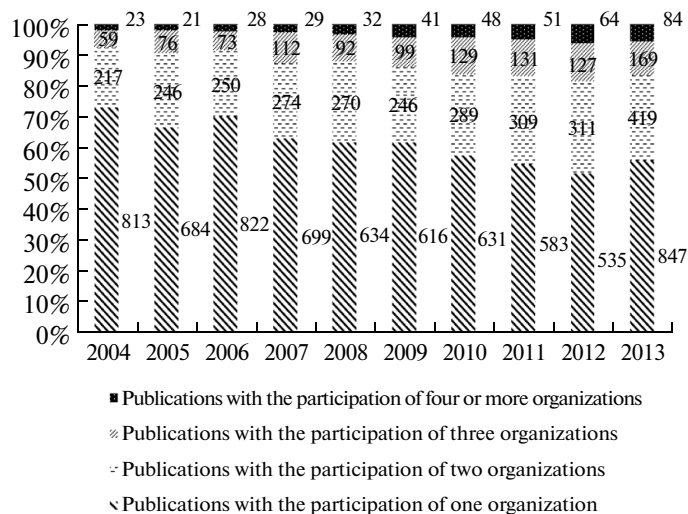


Fig. 7. The dynamics of publications in molecular biology of Russian authors without foreign participation carried out with the participation of different numbers of co-authoring organizations for the 2004–2013 period.

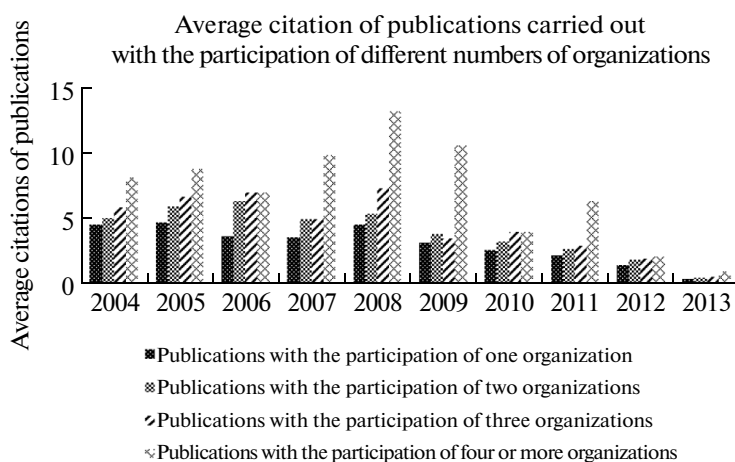


Fig. 8. The dynamics of the average citation of publications without foreign participation that were carried out with the participation of different numbers of organizations.

In recent years, a definite decrease in the intensity of international collaboration has been observed, as shown by the 1% rate of growth in the number of publications with foreign participation during the study period. The main scientific partners of Russian scientists who work in the field of molecular biology are scientists from the United States and Germany. During the study period, authors from the United States participated on average in about one-third of all joint publications; co-authorship with scientists from this country was the most effective in terms of the citation rate: joint publications with the participation of authors from the United States accounted for almost half of the entire array of highly ranked Russian international publications in molecular biology.

There is a trend towards growth of the number of reviews, which is especially notable for those with foreign participation. Against this background, we see negative dynamics in the number of scientific articles (as a type of publication) in the total array. However, one can say that an increase in the number of reviews positively affects the citation rate only in the case of works that are carried out with foreign participation.

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Translated by K. Lazarev