水産学における学術論文のベンチマーク評価

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Scientific publications in fisheries science. Selection of target institutions for benchmark evaluation

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Abstract : A benchmark evaluation was carried out on scientific publications in fisheries science and related disciplines from the Japanese Fisheries Research Agency (FRA) and international research institutions. Data for the period 2000－2009 were obtained from the Web of Science. A total of 2,678 scientific papers were published by the FRA. Research institutions were classified according to their similarity to the FRA in published disciplines, and six international institutes were selected. Radar charts of the percentage of publications between 12 selected disciplines related to fisheries science were constructed for the six institutions and the FRA. The relationship between the number of publications and the Hirsch-index (h-index), estimated for six international institutions and five domestic fisheries universities, indicated a linear regression, and the performance of institutions could be compared by the relative position to the regression line.

Key words : h-index, bibliometrics, benchmark evaluation, institute evaluation

Introduction

Scientific evaluations, using metric indicators that include the number of scientific papers and the number of times cited, have been employed as indices of research activity and/or scientific achievements within/between countries and research institutions (Ueda and Kurata 1988, Tanaka 2001, King 2004). Data from online databases, such as Thomson Scientific's Web of Science (WOS), have been used in international comparative analyses (King 2004) and, in Japan, as guidelines in science and technology policy planning (NISTEP, 2005). Several indices have been proposed for the characterization of scientific output; for example, the Hirsch-index (h-index: the descending ranking number of the list of publications that corresponds to or equals the number of received citations per paper) (Hirsch 2005), and other more advanced derivative indices, such as the g-index (Egghe 2006), A-index, R-index, AR-index (Jin *et al.* 2007) and IQp (Antonakis and Lalive 2008). The h-index was shown to be biased in comparisons between researchers from different disciplines or different age groups (van Leeuwen 2008), although the h-index can be easily applied to the evaluation of individual researchers and organizations (Kinney 2007). Thus, when the h-index is used as an indicator of scientific achievement for benchmark analyses, the selection of target institutions is crucial.

There are few studies comparing scientific publishing activities among institutions in fisheries science and related disciplines (Dong and Zhang 2007). In addition, there is no appropriate methodology to assess or compare individual research institutions in different countries and universities studying fisheries science in Japan. In this paper, we propose an approach for selecting target institutions for benchmark analyses from the publication data of scientific journals and categorized disciplines acquired from the WOS. Preliminary benchmark tests were conducted on the Fisheries Research Agency (FRA), compared to selected international institutions and domestic

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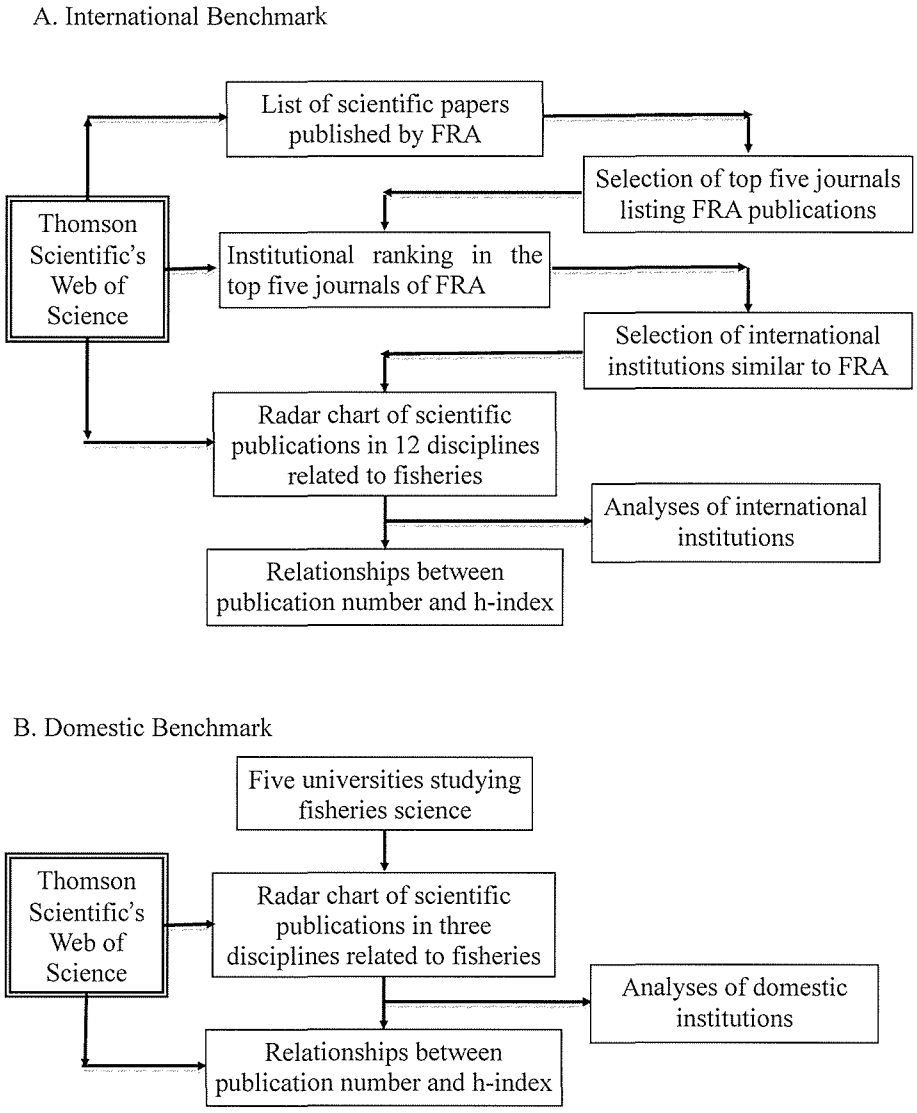

Fig. 1. Protocol for selecting target international institutions and benchmark testing (A). Domestic benchmark tests were conducted on five nominated universities studying fisheries science (B).

fisheries universities, by analyses of the relationships between the number of publications and h-index relating to fisheries science (Fig. 1). Recent changes in the scientific performance of the FRA were also compared to international institutes for an independent administrative institutions (IAI) evaluation.

Materials and Methods

Selection of similar institutions to the FRA

The numbers of papers from the FRA published in scientific journals between 2000 and 2009 were obtained from the Thomson Scientific's Web of Science (WOS : http://scientific.thomson.com/products/wos/). Before accessing the data, a list of institution names, including abbreviations, was drawn up from both the names used in "Nippon Suisan Gakkaishi" (http://www.miyagi.kopas.co.jp/JSFS/jsfs-english/E-PUB/index.html) and from the names of Japanese institutions used in "Aquaculture" (http://www.elsevier.com/wps/find/journaldescription.cws_home/503302/description#description), because the registered institution abbreviations differ between journals in WOS (http://thomsonscientifi

c.jp/products/wos/search_tips/index9.shtml). The following fields tag was used after considering all names of FRA institutions:

AD=(FISHERIES RES AGCY OR TOHOKU NATL FISHERIES RES INST OR NATL RES INST FAR SEAS FISHERIES OR NATL RES INST FISHERIES SCI OR SEIKAI NATL FISHERIES RES INST OR JAPAN SEA NATL FISHERIES RES INST OR NATL RES INST AQUACULTURE OR NATL CTR STOCK ENHANCEMENT OR NATL RES INST FISHERIES ENGN OR NATL SALMON RESOURCES CTR OR FISHERY RES AGCY OR FRA OR HOKKAIDO NATL FISHERIES RES INST OR JAPAN SEA FARMING ASSOC OR JAPAN SEA NATL FISHERIES INST OR NALT RES INST FAR SEAS FISHERIES OR NATL RES INST FISHERIES & ENVIRONM INLAND SEA)

The result was refined by the Countries/ Territories name 'Japan'.

FRA publication data were classified by journal, then categorized into domestic (Japanese) and international journals according to the editorial society. The number of FRA publications in each journal was then counted and the top five international journals selected.

The top 30 institutions in the top five journals were listed in order of the number of publications from the WOS data and institutions listed in three or more of the five journals were selected as the candidate institutions for comparison to the FRA. Institutions showing a wide range of research activities and universities were excluded; those remaining were selected as the target institutions.

Feature analyses of FRA and other institutions

The number of the publications in the top 12 disciplines within the FRA (Fisheries, Marine & Freshwater Biology, Oceanography, Zoology, Biochemistry & Molecular Biology, Ecology, Veterinary Science, Biotechnology & Applied Microbiology, Genetics & Heredity, Microbiology, Physiology, Endocrinology & Metabolism) and the number in the same disciplines from the target institutions, as selected above, were obtained from WOS. The same publication might be nominated in several disciplines during the WOS sorting procedure and the total number of publications from each institution might differ from the sum of publications in all disciplines. The percentage of publications in the 12 disciplines per all publications was illustrated for the target institutions in radar charts for comparison with the FRA.

Benchmark investigation

An international benchmark test was conducted by plotting the number of publications and h-index of the target institutions and the FRA plot was compared to the estimated regression line.

Five domestic universities involved in fisheries science (Tokyo University, Hokkaido University, Tokyo University of Marine Science and Technology, National Fisheries University, and Kinki University) were also compared to the FRA using WOS data. Radar chart analyses to describe the university features were conducted for the three main FRA disciplines (Fisheries, Marine & Freshwater Biology, and Oceanography), as assessed in the previous analyses (see Results). The number of publications and h-index was investigated by regression analysis in comparison with the international institutions.

Recent changes in performance

Recent changes in the scientific performance of the target institutions and FRA were also compared. In Japan, IAIs are evaluated every year by their governing Ministries and the Commission on Policy Evaluation and Independent Administrative Agency Evaluation (http://www.soumu.go.jp/english/aeb / index.html). The Minister then reviews all IAI business after a mid-term objective period of 3 – 5 years. The performance of the FRA during the first and second mid-term periods (2001 – 2006 and 2006 – 2011 for data obtained during 2006 – 2009) was then compared in relation to the target international institutions. The three main FRA disciplines (Fisheries, Marine & Freshwater Biology and Oceanography) and the increase in FRA publications for these disciplines were compared with the six target institutions.

Table 1. List of publications in which the Fisheries Research Agency published papers during 2000 – 2009. The total number of publications from the FRA was 2,678 during 2000 – 2009.

Rank	Journals		Type	Number	%
1	Fisheries Science		Domestic	374	14.0
2	Nippon Suisan Gakkaishi		Domestic	297	11.1
3	Aquaculture		International	89	3.3
4	Fish Pathology		Domestic	88	3.3
5	Zoological Science		Domestic	80	3.0
6	Marine Ecology Progress Series		International	66	2.5
7	Journal of Oceanography		Domestic	65	2.4
8	Journal of Fish Biology		International	56	2.1
9	Fisheries Oceanography		Domestic	55	2.1
10	Ichthyological Research		Domestic	55	2.1
11	General and Comparative Endocrinology		Domestic	47	1.8
12	Fish Physiology & Biochemistry		International	40	1.5
13	Marine Biology		International	38	1.4
14	Comparative Biochemistry & Physiology - B Biochemistry & Molecular Biology		International	34	1.3
15	Fish & Shellfish Immunology		International	30	1.1
	More than 30 publications	Total		1,414	52.8
		Domestic		1,061	39.6
		International		353	13.2
	More than 10 publications	Total		2,026	75.7
		Domestic		1,111	41.5
		International		915	34.2

Results

Selection of similar institutions to the FRA

The total number of FRA publications was 2,678, which includes all publications that FRA researchers included in the author lists. The total number of times FRA publications were cited was 19,512, with an estimated h-index of 45 for the period 2000 – 2009. The journal list of 2,678 publications indicated that four domestic and one international journal were ranked in the top five (Table 1). These were Fisheries Science (The Japanese Society of Fisheries Science: 374), Nippon Suisan Gakkaishi (The Japanese Society of Fisheries Science: 297), Aquaculture (International Journals: 89), Fish Pathology (The Japanese Fish Disease Society: 88), and Zoological Science (The zoological Society of Japan: 80). The top five international journals were Aquaculture (89), Marine Ecology Progress Series (66), Journal of Fish Biology (56), Fish Physiology & Biochemistry (40), and Marine Biology (38) (Table 1). Fifteen journals published more than 30 papers and the number of papers in these journals was 1,414 (52.8% of all publications). Eight journals were domestic, including English journals and seven journals were international, and the number of publications was 1,061 (39.6%) and 353 (13.2%), respectively. Fifty-four journals published more than 10 papers and the total number of papers published in the 54 journals was 2,026 (75.7%). Eleven journals were domestic and 43 journals were international, and the number of

Table 2. Number of the scientific publications in the five major journals from the target institutions during 2000 – 2009.

Journal	Institutions						
	FRA	IFREMER	IMR	DFO	NOAA	INRA	CSIC
Aquaculture	89	190	109	53	26	122	93
Marine Ecology Progress Series	66	59	65	66	198	6	113
Journal of Fish Biology	56	20	41	65	49	27	38
Fish Physiology & Biochemistry	40	4	14	4	7	16	12
Marine Biology	38	23	2	18	25	0	59
Total	289	296	229	206	305	171	315

FRA (Fisheries Research Agency, Japan), IFREMER (Institut français de recherche pour l'exploitation de la mer, France), IMR (Institute of Marine Research, Norway), DFO (Fisheries & Oceans Canada, Canada), NOAA (National Oceanic and Atmospheric Administration, USA), INRA (Institut national de la recherche agronomique, France), CSIC (Consejo Superior de Investigaciones Científicas, Spain)

published papers was 1,111 (41.5%), and 915 (34.2%), respectively.

Seventeen institutions were listed in three journals or more of the top five FRA journals. Three institutions were listed within the top 30 places for the five journals. Those were CSIC (Consejo Superior de Investigaciones Científicas, Spain), University of Tasmania (Australia) and University of Washington (USA). Five institutions, IMR (Institute of Marine Research, Norway), NOAA (National Oceanic and Atmospheric Administration, USA), James Cook University (Australia), Bergen University (Norway), and Tokyo University (Japan) were listed in four of the five journals. Nine institutions – DFO (Fisheries & Oceans Canada, Canada), IFREMER (Institut francais de recherche pour l'exploitation de la mer, France), INRA (Institut national de la recherche agronomique, France), Chinese Academy of Science (China), Dalhousie University (Canada), Hokkaido University (Japan), Goteborg University (Sweden), University of Maryland (USA) and University of Queensland (Australia) – were listed in three of the five journals. All 17 institutions are involved in similar disciplines to the FRA; however, institutions with a wide scope of research and universities were excluded. Thus, five institutions (IMR, NOAA, DFO, IFREMER, INRA) and a high-ranking institution in all five journals (CSIC) were selected as the target institutions for comparison with the FRA.

The number of scientific publications in the five journals is listed in Table 2. These five international journals have the following features:

Aquaculture : 5,099 papers were published over 10 years (2000 – 2009). FRA contributed 89 papers – in 9th place; IFREMER was in first place with 190 papers, and the number of papers from Japan was 368.

Marine Ecology Progress Series : 5,049 papers were published and FRA contributed 66 papers during 2000 – 2009. FRA was in 18th place; NOAA was in first place with 156 papers. The number of papers from Japan was 278.

Journal of Fish Biology: 3,416 papers were published during 2000 – 2009 and FRA contributed 56 papers. FRA was in fourth place and UBC (the University of British Columbia, Canada) was in first place with 68 papers. The number of papers from Japan was 206.

Fish Physiology & Biochemistry : 731 papers were published over 10 years (2000 – 2009), with the

Table 3. Number of publications from seven institutions sorted by the 12 disciplines during 2000－2009. Abbreviations are as in Table 2.

	Institutions						
Disciplines	FRA	IFREMER	IMR	DFO	NOAA	INRA	CSIC
Fisheries	1,224	663	720	865	948	365	418
Marine & Freshwater Biology	627	1,004	1,033	1,026	1,468	451	1,625
Oceanography	367	682	576	579	1,379	40	841
Zoology	281	125	81	123	272	672	1,011
Biochemistry & Molecular Biology	205	184	83	49	76	3,097	5,090
Ecology	205	232	336	287	678	1,128	2,014
Veterinary Sciences	170	93	56	85	74	1,655	372
Biotechnology & Applied Microbiology	81	130	24	27	38	1,941	1,750
Genetics & Heredity	68	73	26	37	55	1,650	1,259
Microbiology	68	169	29	19	38	1,915	1,871
Physiology	67	50	35	21	21	466	312
Endocrinology & Metabolism	66	24	20	12	23	842	448

FRA contributing 40 papers. The FRA was in first place; the NIBB (National Institute for Basic Biology, Japan) was in second with 32 papers. The number of papers from Japan was 148.

Marine Biology : 2,769 papers were published over 10 years (2000－2009) and the FRA contributed 38 papers. The FRA was in sixth place; in first place was the Alfred Wegener Institute for Polar and Marine Research (Germany) with 70 papers. The number of papers from Japan was 206.

Analyses of FRA and other institutions

The number of scientific publications from the FRA and the six target institutions, sorted by discipline, was obtained from the WOS and shown in Table 3. For each discipline, the FRA was ranked as follows among the target institutions: Fisheries (1st), Marine & Freshwater Biology (6th), Oceanography (6th), Zoology (3rd), Biochemistry & Molecular Biology (3rd), Ecology (7th), Veterinary Science (3rd), Biotechnology & Applied Microbiology (4th), Genetics & Heredity (4th), Microbiology (4th), Physiology (3rd), and Endocrinology & Metabolism (3rd).

For the FRA, the percentages of publications for the 12 disciplines were as follows (Fig. 2): Fisheries (45.7%), Marine & Freshwater Biology (23.4%), Oceanography (13.7%), Zoology (10.5%), Biochemistry & Molecular Biology (7.7%), Ecology (7.7%), Veterinary Science (6.4%), Biotechnology & Applied Microbiology (3.0%), Genetics & Heredity (2.5%), Microbiology (2.5%), Physiology (2.5%) and Endocrinology & Metabolism (2.5%). Institutions with a high percentage of publications (30% or more) in Fisheries and Marine & Freshwater Biology were FRA, IMR and DFO, and IMR and DFO, respectively. Three institutions, NOAA, INRA and CSIC, showed no prominent discipline (less than 30%). The analysis of each institution, including FRA, is described as follows:

FRA: Almost 50% of publications were related to Fisheries; <30% were published in other disciplines: Marine & Freshwater Biology, Oceanography, and Zoology. The FRA was a major institution in the field of Applied Fisheries,

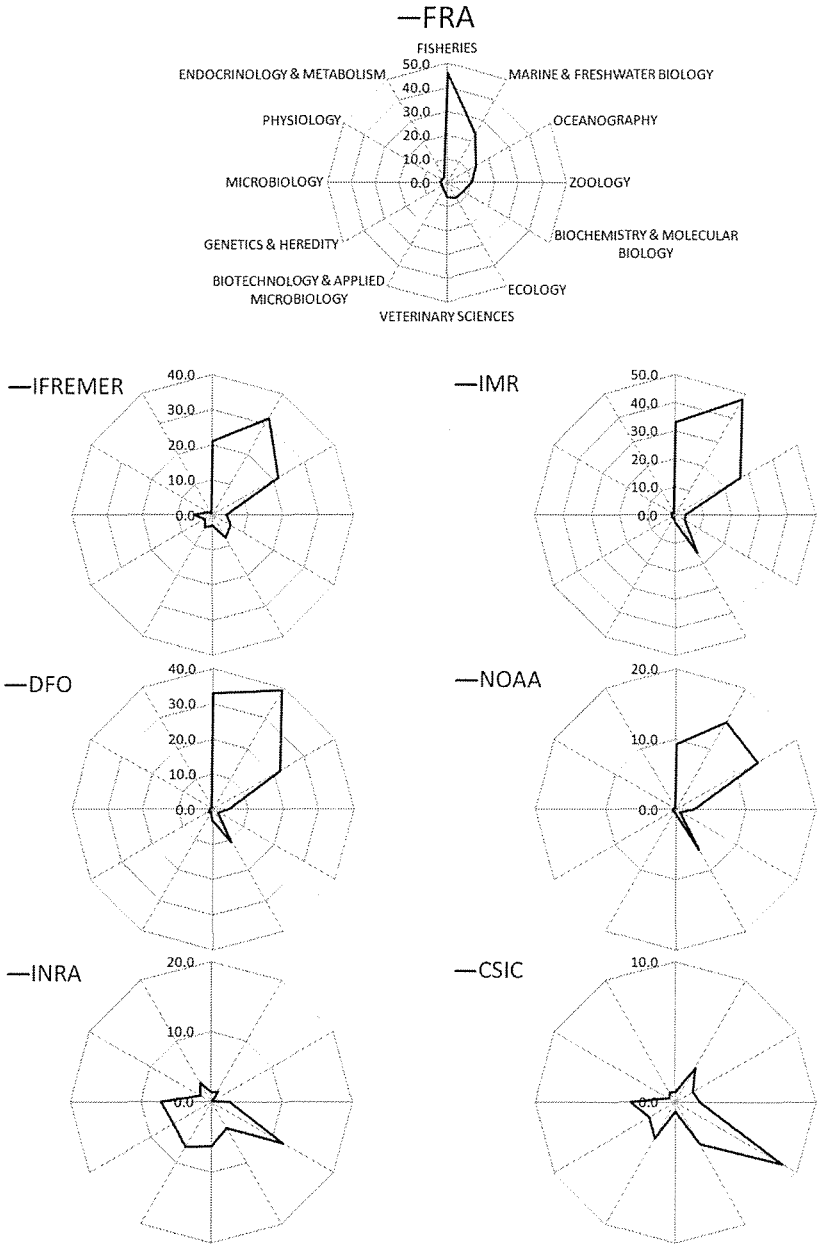

Fig. 2. Radar charts of the percentage of publications in 12 disciplines related to fisheries from seven institutions. Abbreviations of the seven institutions are shown in Table 2.

ranking first out of seven institutions in Fisheries.

IFREMER : The total number of publications from IFREMER was 3,398, with a total of 35,781 citations. The average number of times cited was 10.53 and the h-index was 57. This institution is categorized as basic biology because Marine & Freshwater Biology was ranked third out of the total number of publications in the 12 disciplines (3,429 publications). The study of Marine & Freshwater Biology is supported by that of Oceanography and Fisheries.

IMR : The total number of publications from the IMR was 1,348 with a total times cited of 13,663. In the results, the average times cited was 10.14 and the h-index was 44. This institution majored in Oceanography and Ecology, in contrast to the IFREMER, although the characteristics of this institution were similar to the IFREMER because

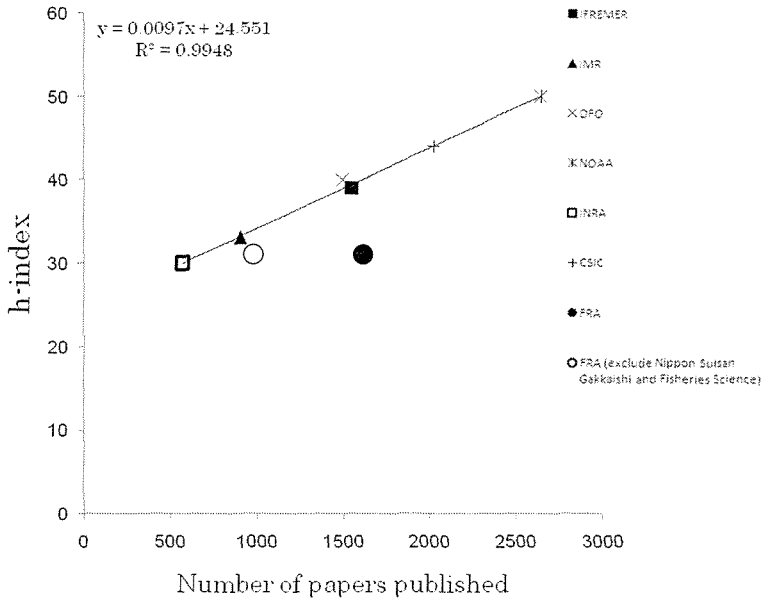

Fig. 3. Number of papers published and h-index in three major disciplines from seven institutions (FRA, IFREMER, IMR, DFO, NOAA, INRA, CSIC) during 2001 – 2009. A regression curve was estimated for six target international institutions. The FRA data are shown as a black circle for all publications and as a white circle with two Japanese journals exclude.

the stem discipline was Marine & Freshwater Biology with the support of both Oceanography and Fisheries. These differences might be related to the higher ratio of Fisheries than that in the IFREMER.

DFO : Total number of publications of the IMR was 2,629 and total number of times cited was 29,317. Thus, the average times cited was 11.15 and the h-index was 56. This institution was ranked in the middle, between FRA and IMR, because the percentage of Fisheries papers was highest in the international target institutions and the chart was similar to IMR. It differed from the FRA in that the percentage in Ecology was high and that in other disciplines, such as Biochemistry & Molecular Biology, was low.

NOAA : The shape of the radar chart was similar to both IFREMER and IMR, although the percentage of all Fisheries-related disciplines was low due to their broad coverage of disciplines. The NOAA published 3,954 reports in the field of Meteorology/Atmospheric Science of a total of 10,233 publications during 2000 – 2009. It differed from the FRA in that the proportion in Ecology was high but low in areas such as Biochemistry & Molecular Biology.

INRA : The total number of publications from the INRA was 28,740 owing to its broad coverage of disciplines. The highest number of publications was in Plant Sciences (3,420). Therefore, the percentages were low in all 12 disciplines, although the percentage in Biochemistry & Molecular Biology was high.

CSIC: The total number of publications from CSIC was 58,407, with the highest number (5,090) in Biochemistry & Molecular Biology. Although Biochemistry & Molecular Biology had the highest number, the percentage was low (8.7%) due to the broad coverage of disciplines. The percentage of papers in Fisheries was 0.72%.

Benchmark investigation

The relationship between the number of publications and h-index in the three main three disciplines for the FRA and six target institutions showed a positive correlation, an increase in the h-index indicated an increase in the number of

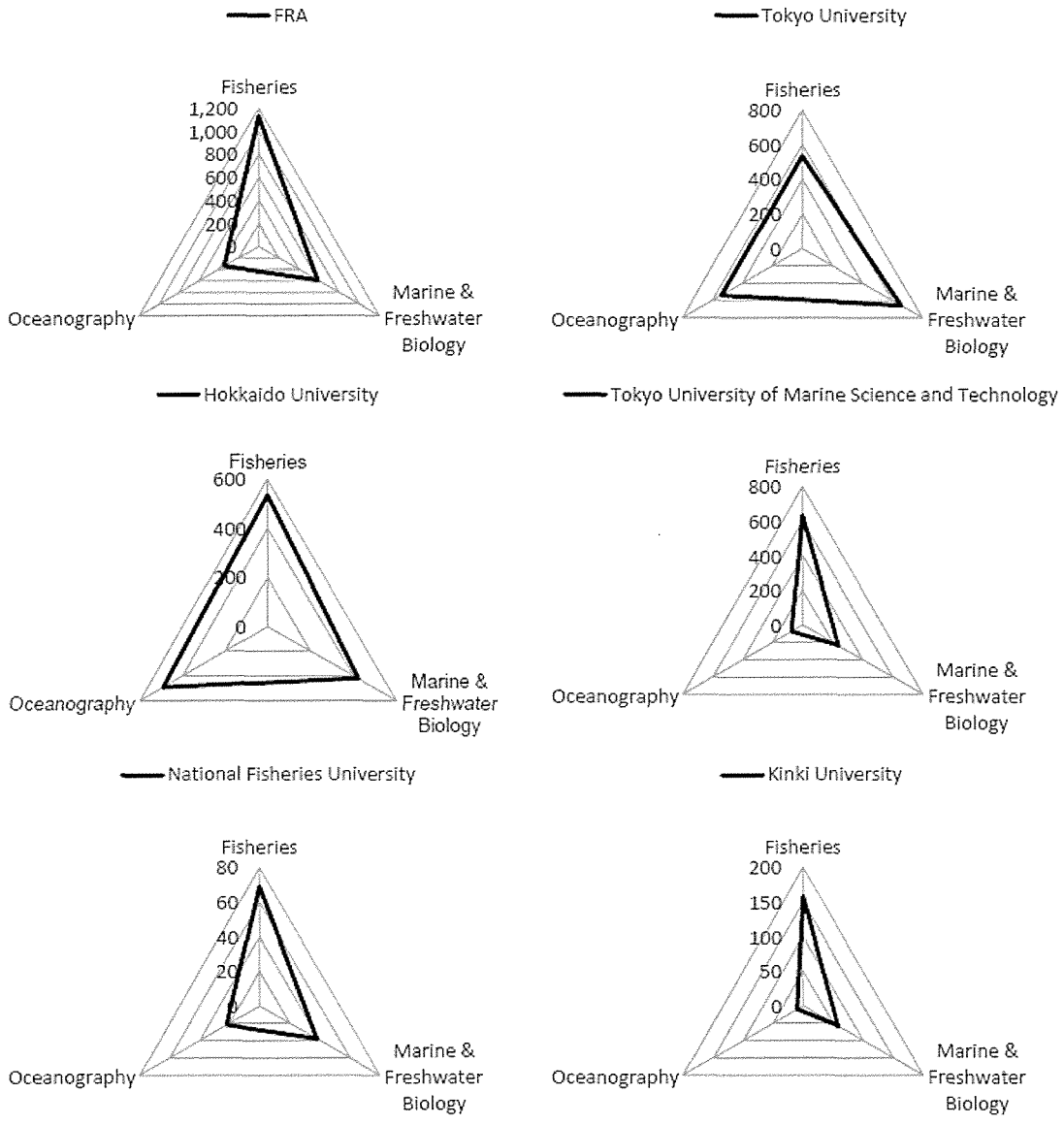

Fig. 4 Radar charts of the three major disciplines (Fisheries, Marine & Freshwater Biology and Oceanography) at Japanese institutions (FRA, Tokyo University, Hokkaido University, Tokyo University of Marine Science and Technology, National Fisheries University, Kinki University).

papers (Fig. 3). From the regression line, the FRA was at a lower position compared to other institutions. The difference, however, was not significant from this positive correlation in the number of papers and h-index when two domestic journals (Nippon Suisan Gakkaishi and Fisheries Science) were excluded from the FRA data.

Radar chart analyses of the number of publications from five domestic universities involved in fisheries science (Tokyo University, Hokkaido University, Tokyo University of Marine Science and Technology, National Fisheries University, and Kinki University) were conducted on the three major FRA disciplines (Fisheries, Marine & Freshwater Biology and Oceanography). (Fig. 4) Although it was difficult to extract accurate statistics due to the broad range of disciplines studied by several universities, the features of the five universities are described as follows:

Tokyo University : The number of publications from Tokyo University was almost equal in the three disciplines, although the number in Marine

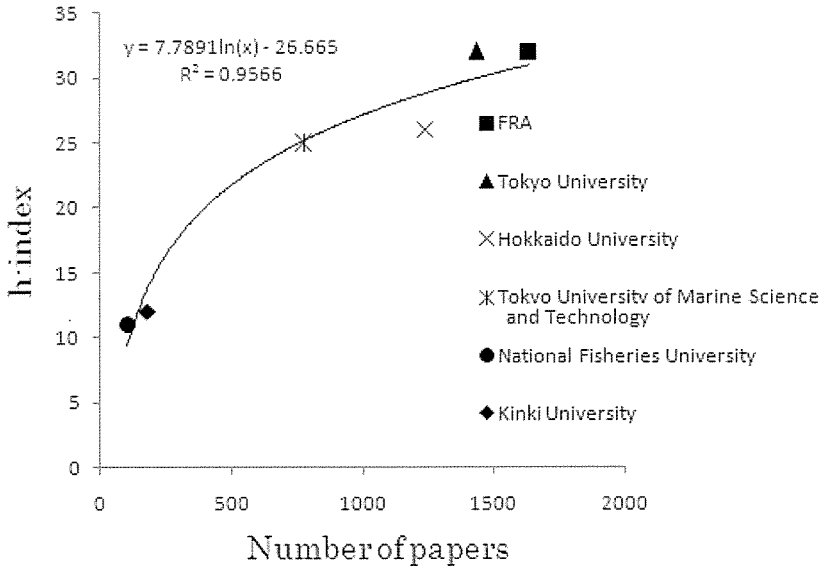

Fig. 5. Number of papers published and h-index in the three major disciplines from six Japanese institutions, as in Fig. 4, during 2001－2009. A regression curve was estimated at all institutions.

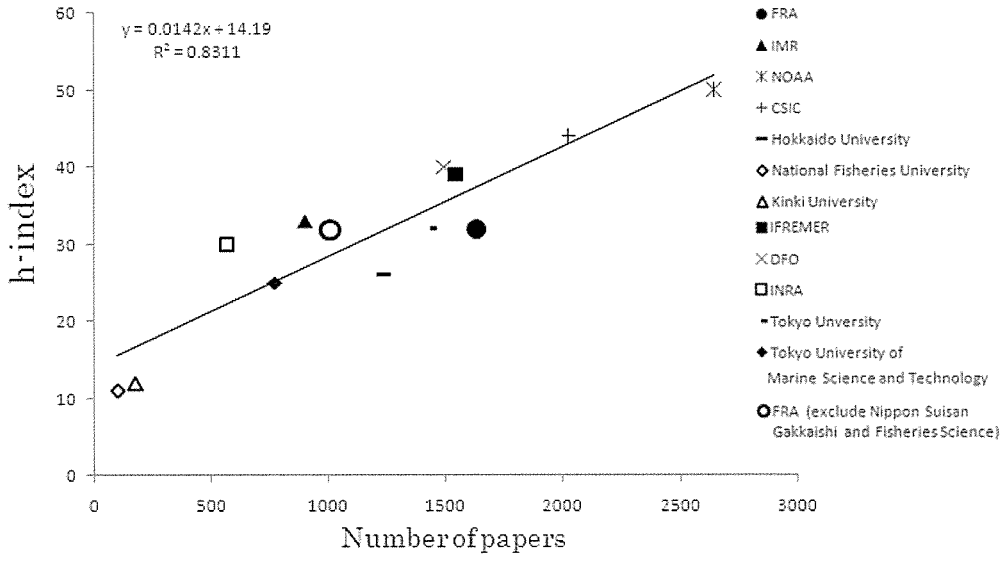

Fig. 6. Number of papers published and h-index in the three major disciplines at all institutions during 2001－2009. A regression curve was estimated at all institutions.

& Freshwater Biology was slightly higher.

Hokkaido University : The number of publications from Hokkaido University was almost equal in the three disciplines, although the number in Marine & Freshwater Biology was lower than the others.

Tokyo University of Marine Science and Technology : Fisheries was the main discipline in the Tokyo University of Marine Science and Technology; the number of publications in Marine & Freshwater Biology and Oceanography was low.

National Fisheries University : National Fisheries University had a similar pattern to the Tokyo University of Marine Science and Technology.

Table 4. Changes in the number of papers published in three major disciplines (Fisheries, Marine & Freshwater Biology, Oceanography) from seven institutions (FRA, IFREMER, IMR, DFO, NOAA, INRA, CSIC) during the periods 2001–2006 and 2006–2009.

Institution	Period, ratio	Fisheries	Marine & Freshwater Biology	Oceanography	Total
FRA	2001–2009	1,130	589	344	1,631
	A (2001–2006)	727	359	236	1,039
	B (2006–2009)	542	301	145	787
	B:A (per year)	1.12	1.26	0.92	1.14
IFREMER	2001–2009	636	974	680	1,543
	A (2001–2006)	384	557	376	891
	B (2006–2009)	328	533	382	838
	B:A (per year)	1.28	1.44	1.52	1.41
IMR	2001–2009	582	627	342	903
	A (2001–2006)	345	353	172	510
	B (2006–2009)	332	349	205	508
	B:A (per year)	1.44	1.48	1.79	1.49
DFO	2001–2009	775	939	533	1492
	A (2001–2006)	509	596	301	936
	B (2006–2009)	332	431	289	698
	B:A (per year)	0.98	1.09	1.44	1.12
NOAA	2001–2009	861	1371	1,297	2,644
	A (2001–2006)	502	744	760	1521
	B (2006–2009)	452	784	677	1421
	B:A (per year)	1.35	1.58	1.34	1.4
INRA	2001–2009	364	450	40	569
	A (2001–2006)	228	278	27	360
	B (2006–2009)	170	225	18	273
	B:A (per year)	1.12	1.21	1	1.14
CSIC	2001–2009	385	1,515	790	2,024
	A (2001–2006)	240	898	437	1,180
	B (2006–2009)	198	823	437	1,104
	B:A (per year)	1.24	1.38	1.5	1.4

Fisheries was the main discipline; the number of publications in Marine & Freshwater Biology and Oceanography was low.

Kinki University : Kinki University also had a similar pattern to the Tokyo University of Marine Science and Technology, although few publications were published in Oceanography.

Tokyo University and Hokkaido University showed a similar pattern with almost equal numbers in the three disciplines. Meanwhile, the FRA and National Fisheries University showed a similar

tendency, although they differed in the number of papers published. Tokyo University of Marine Science and Technology was similar to Kinki University due to the low number of publications in Oceanography.

The relationship between the number of publications and the h-index indicated a positive correlation between the five domestic universities and the FRA, although the relationship was logarithmic (Fig. 5).

Japanese and International institutions showed a positive correlation, with an increase in the h-index with increasing number of papers published (Figure 6). When two journals (Nippon Suisan Gakkaishi and Fisheries Science) were excluded from the FRA data, eliminating the influence of domestic journals, all the institutions, including the FRA, could be plotted on the regression curve.

Recent changes in performance

The performance of the seven institutions during the first and second mid-term period (we used the period 2006-2009, as data for the full 2006-2010 mid-term are not yet compiled) was compared by the number of papers published per year (Table 4). For all institutions, the number of publications per year increased, with IMR in particular showing a 1.5-fold increase. During the period 2001 – 2006, FRA was ranked in first place in the discipline of Fisheries, 5th place in Marine & Freshwater Biology and sixth place in Oceanography (Table 4). However, the rankings in Marine & Freshwater Biology and Oceanography dropped to sixth and seventh place, respectively, during 2006 – 2009, although Fisheries was still ranked in first place.

Discussion

Data on the publications emanating of scientific institutions, accessed via the internet, are valuable in selecting target institutions for benchmark testing; however, the results are highly dependent on the database. Between 1999 and 2008, the WOS recorded 2,537 publications from the FRA, while the Council for Science and Technology Policy (CSTP) reported the number as 2,348 (CSTP 2009). In 2008, the CSTP reported 3,827 as the number of citations, but our research indicated 4,056. These differences could be due to the source database: the CSTP used the "ISI National Citation Report for Japan 1999 – 2008 (NCR-J)", which may differ in institution names, including abbreviations. For example, the number of publications from the FRA was 2,348 during 1999 – 2008, when "JAPAN SEA FARMING ASSOC", "NATL CTR STOCK ENHANCEMENT", "NATL SALMON RESOURCES CTR" and "FISHERY RES AGCY" were excluded from the field tags that we used. Related to this issue, other databases, such as Scopus, are becoming increasingly active (LaGuardia 2005, Meho and Rogers 2008) and the number of journals collected in these databases have been increasing. Therefore, reliability should increase with an increase in data.

Analysis revealed that the seven target institutions could be divided into three categories: (1) major institution in Fisheries (FRA), (2) major institution in Marine & Freshwater Biology (IFREMER, IMR, DFC, NOAA), and (3) major institution in Marine & Freshwater Biology but not in Fisheries (INRA, CSIC). FRA excelled in the three major disciplines (Fisheries, Marine & Freshwater Biology and Oceanography) and was ranked at the first place in Fisheries. INRA and CSIC are integrated research institutions that publish a large number of papers not only in Fisheries but also in a broad range of disciplines. These two institutions are included for comparison by restricting the disciplines to 12 or three categories, as same for the FRA. Overseas universities were also excluded from the comparison; however, these universities could be used in future comparisons with the FRA due to their active publishing activity in Fisheries.

The relationship between the number of papers and h-index indicated that the h-index of the FRA was lower than other institutions but, when Nippon Suisan Gakkaishi and Fisheries Science were excluded, the h-index was similar to other organizations. This means that the research achievements of Japanese institutions, including the FRA, and overseas institutions were almost equal. However, these findings also suggested that domestic journals are rarely cited by international institutions; a fact that should be considered

when international and Japanese institutions are compared. This discrepancy should be resolved at an institutional level by encouraging submissions to international journals, while opening discussions on language, the number of journals and the evaluation of papers collected in databases (Archambault *et al.* 2006, Stergiou and Tsikliras 2006).

Differences in the number of researchers and the budget of these institutions should be considered in international benchmarking, although the difficulties for obtaining information on the number of researchers (not total staff numbers) and scientific funding. Nevertheless, the number of publications per researcher or per amount of scientific funding should be standardized in future studies. Furthermore, institutions including the FRA have several missions other than scientific publications, those are the promotion of domestic fisheries industry and the technical assistance for prefectures in Japan. Therefore, the other multidimensional indices for the benchmark evaluation should be searched in future analyses.

Temporal analyses revealed the shift of strategic focus of science in institutions and/or the results of reorganization of institutions. In this context, the recent reorganization of the FRA might reflect in the decrease of publications in Oceanography and in the increase in Marine & Freshwater Biology (Table 4). Therefore, this analysis is considered useful not only in the assessment of the achievement of mid-term policy of FRA but also in the planning of the policy, and should be conducted at 3 – 5-year intervals for mid-term policy planning and evaluation.

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和文要旨

水産学における学術論文のベンチマーク評価 ーベンチマーク評価のための対象機関の選定ー

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我が国における第３期科学技術基本計画（平成18年３月28日閣議決定）ならびに現在検討中の第４期科学技術基本計画においては，国際ベンチマークの必要性が強く謳われているが，我が国の水産研究機関ではこれまで国際ベンチマーク調査の報告はない。そこで水産総合研究センターを含む各国の水産関係機関の特徴を把握し，ベンチマーク評価を行うために学術文献データベースを用いた調査を実施した。Web of Scienceにより水研センターの2000～2009年の発表論文数を調べ，水研センターにおける論文数上位５国際誌を用いて，各機関における順位と論文数を基に比較対象機関を選定した。さらに水研センターの研究分野別論文数から，上位12分野について比較対象機関における各分野の割合から各機関の特徴を比較した。上位３分野（水産学，海洋・淡水生物学，海洋学）について論文数とh-indexの関係を比較することで，各機関の特徴を抽出した。水研センターの2000～2009年の発表論文数は2,678報であった。論文数上位５国際誌による比較から，IFREMER（フランス海洋開発研究所），IMR（ノルウェー海洋研究所），DFO（カナダ漁業海洋省），NOAA（アメリカ海洋大気局），INRA（フランス国立農学研究所），CSIC（スペイン国立研究協議会）が水研センターとの比較可能機関として選ばれたが，これらの機関と比較すると，水研センターの論文は水産学に集中していた。論文数とh-indexとの関係はばらつきのある正相関を示しており，プロットの位置から見ると水研センターは標準的なパフォーマンスを示していた。