Women pioneers of marine and freshwater sciences in Spain: IEO (1923-1969) and CSIC (1943-1969)

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WOMEN PIONEERS OF MARINE AND FRESHWATER SCIENCES IN SPAIN: IEO (1923-1969) and CSIC (1943-1969).

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SUMMARY

Along the period 1923-1969, 11 women scientists from the Spanish Institute of Oceanography (IEO) and 9 from the Spanish Council for Scientific Research (CSIC) publish inside the scientific journals produced from both institutions publishers, as sole authors or in collaboration with others 65 papers on marine and freshwater sciences (oceanography, plankton, fishery biology, bromatology, algology, etc.).

The studied scientific activity causal realm has been chronologically splitted into two periods: 1923-1945 (uniquely with IEO's journals) and 1946-1969 (with only the first written CSIC productions). A revision and quantification of both institutions women scientists published papers has been performed, and they have been classified by subject and valuated. The benchmark study carried on has shown a meaningful overall disminution both in the amount of articles and women researchers from IEO along the Sixties; this reduction was coincidental with the "emergence of the CSIC women researchers". The study has been complemented with the analysis and interpretation of the inter- and intra- institutional variation, mainly after a set of bibliographical citations extracted from the international database SCI (Science Citation Index).

Key words: Women in science, Marine sciences, Freshwater sciences, Oceanography, History of oceanography, Bibliometrics, Historiometrics, Spain, IEO, CSIC

1.- INTRODUCTION: THE INSTITUTIONAL FRAMEWORK.

In this paper we compare the activities performed by the women scientists inside the organisms created by the precursors of the modern aquatic sciences produced in Spain : Odón de Buen y del Cos (1863-1945) founder, in 1914, of the IEO, *Instituto Español de Oceanografía* [Spanish Institute of Oceanography]), and Francisco García del Cid (1897-1945) from both the IBA, *Instituto de Biología Aplicada* [Applied Biology Institute], and IIP, *Instituto de Investigaciones Pesqueras* [Fisheries Research Institute], respectively founded in 1943 and 1955. Several women pioneers in marine sciences along this period, perform research in the *Instituto de Edafología y Fisiología Vegetal* [Edaphology and Vegetal Physiology Institute] and in the *Museo Nacional de Ciencias Naturales* [Natural Sciences National Museum], both institutions under the umbrella of CSIC.

We can date the initial CSIC institutional participation in freshwater sciences after the creation of IBA (1943) and, in what concerns the marine sciences, as early as 1946 (occurrence of the first marine biology article inside the journal published by the *Instituto de Biología Aplicada* [Applied Biology Institute] and 1948 (the first appearance of a IBA member on a list of spanish experts in fishery research; inside the October 1949 ICES rapport is included a list of Spanish experts members from the IEO (35), *Dirección General de Pesca Maritima* [General Directorate of Maritime Fishery] (4), *Sociedad Oceanográfica de Guipúzcoa* [Guipuzcoa Oceanographic Society] (2), and the directors from the *Instituto Oceanográfico de la Marina* [Marine Hydrographic Institute] and from the *Instituto de Biología Aplicada* [Applied Biology Institute] ("Del Cid,F.G.", without specifying its scholar specialty)[1]). Afterwards a section on Marine Biology was created at IBA (1949), whose considerable development resulted in an independent organism, the IIP (1949), that enlarged its research area to the Atlantics the next year with the inauguration of the Vigo's lab and the subsequent Cádiz's lab (1955). This initial IIP, *Instituto de Investigaciones Pesqueras* [Fisheries Research Institute], was consolidated in the decade 1955-65 [2], and the first year was coincidental with the creation in Madrid of the *Junta Consultiva de la Investigación Científico-Pesquera* (JCICP) [Consultive Board of Scientific-Fishery Research] (1955[3]). This last Board coordinated the studies in the area performed by the *Dirección General de Pesca Maritima* (DGPM) [General Directorate of

[1] ICES, 1949, p.27.

[2] The 13 year-period 1952-65 resulted in the duplication of the staff at IIP, what resulted in 50 researchers. Guerra & Prego, 2003, p.164-165.

[3] This Board was required two years before by IEO, when it demanded the creation of a Regulatory Council for the Fishery, designed for the coordination of existent organisms and able to rule the general directives concerning the fisheries affairs.

Maritime Fishery], the IEO and the IIP, throughout quarterly meetings of the directors with their technical assesors. [4]

The inter-institutional collaborations of the researchers were a fact from early date, e.g. the director of the IEO-Majorca laboratory (Miguel Massutí) wrote several articles for the journal '*Publicaciones del Instituto de Biología Aplicada*' and was one of the professors who taught the course "*Introducción a la Investigación Pesquera*" ('Introduction to Fishery Research', Blanes, 1949). Researchers from both institutions coincidate at the four "*Reuniones de Productividad y Pesquerías*" [Meetings on Productivity and Fisheries] along the period 1955-1965. Scholars initially granted by IIP or researchers first working in this Institute finish their research careers in IEO and vice versa (eg Bartolomé Andreu, one of the founding fathers of IIP, was initially a scholar granted by IEO-Santander).

2.- MATERIAL AND METHODS

We have afforded with the study of the women pioneers from IEO and CSIC through several phases:

2.1.- IDENTIFICATION OF THE WOMEN RESEARCHERS FROM BOTH INSTITUTIONS.

Starting from an exhaustive revision of the published articles inside their own institutional journals on oceanography [5] and freshwater research [6]. We have included in our analysis the research assistant Josefa Sanz Echeverría (1889-1952). She did not obtained any universitary degree although she performed numerous studies that were published in different evaluated scientific journals. She was the first spanish technical assistant in marine sciences research. All the publications of her carrer were focused on otolyths (the fishes' ear bones where are marked the growth rings of the individual). She began her studies at the *Estación de Biología Marina de Santander* [Santander Marine Biology Station] (1907-1915), before being transferred to the IEO, and she continued at the *Museo Nacional de Ciencias Naturales* (MNCN) [Natural Sciences National Museum] (Madrid). Nevertheless, along the years 1943 and 1950 this author transiently collaborated with IEO (Peces del Sáhara) [Fishes from the Sahara] and she published in its journals. Otherwise, the collection Science Citation Index (SCI) gathers several of her papers published by a journal outside her institution (see note 9). It is why in this paper we assimilate her scientific

[4] Guerra & Prego, 2003, p.120-121.
[5] Separately identified by institution as: IEO [*Boletín de Pescas* (1923), *Notas y* Resúmene*s* (1927/1947), *Boletín del IEO* (1948/1966), *Trabajos del IEO* (1957/1969) and *Publicaciones del IEO* (1956)] and CSIC [*Investigaciones Pesqueras* (1946/1968)].
[6] Articles corresponding to the CSIC journal *Publicaciones del Instituto de Biología Aplicada* (1946/1968).

production with CSIC, this way keeping her institutional and subject identity. The study is complemented with the analysis of the set of bibliographic citations towards these articles and extracted from the international database SCI (Science Citation Index) at the Web of Knowledge (WOK, ISI Thompson ©).

2.2.- PERIODIZATION.

Once established that the temporal plans of each institution are different, our analysis will be applied on three different scales (see Table 1): 1) The global period (years 1923-1969) for both institutions (taking into consideration all the papers published in the IEO and CSIC journals). 2) Subperiod 1923-45 (uniquely marine sciences contents) that will be featured by the absence of documents authored by women inside the IEO scientific production recorded by the SCI database along these years (77 papers). And 3) Subperiod 1946-69 (marine sciences and freshwater sciences).

2.3.- HISTORIOMETRICS.

In accordance with the identification of the "scientific career" by Nowakowska[7] the personal temporal horizon of each woman scientist will be determined by the overall institution plan where they develop their career. A benchmark approach to the scientific authorship patterns by institution for the period (1946-1969), is adopted. What means with the inception point from the starting date of publication for the women scientists coming from CSIC. And the inter- and intra- institutional variations of the women researchers careers are analysed from the set of bibliographic citations extracted from the SCI database. Three women authors were considered as exceptions: Josefa Sanz Echeverría (CSIC)[8], Dominica Montequí (IEO) and Josefina Pérez Mateos (CSIC). In both cases (Dr Dominica Montequí and Dr Josefina Pérez-Mateos) , the 6 cited sources (5 journals and the proceedings of a meeting) also belong to publications not produced at their institutes. It is why, in this specific case we will solely analyse the citations with a prosopographic criteria [López Piñero & Terrada, 1993, p.16] in what concerns the SCI database; without study or evaluation neither of the age of the references nor of the contents of the 6 items mentioned. [9]

3.- **RESULTS**

[7] Nowakowska, 1977, p.296. A scientific career is identified after a series of events like: solving a research problem, the obtention of a certain scientific degree, the reception of scientific awards, the fact of being a member of the editorial board of a journal or scientific committee, the referage of doctoral dissertations, the participation in a scientific congress, etc.

[8] The SCI collection gathers three of her publications inside the *Boletín de la Real Sociedad Española de Historia Natural* [Natural History Spanish Royal Society Bulletin] (years 1931, 1941 and 1949).

[9] López Piñero & Terrada, 1993, p.16.

3.1. WOMEN AUTHORS FROM IEO.

We have identified 12 women researchers from this organism (IEO). Prior to 1936 we have found only four attendees to the Dr. Adrien Robert course (IEO, April 1925, see Figure 1): Emma Bardán Mateu (1898-1992), Mercedes García López (1904-1990), Gimena Quirós Fernández-Tello (fl. 1922-1931) and María Encarnación Sánchez Herrero (fl. 1932-1933). In the postwar period, specifically during the years 1941-1951, the women access to IEO is consolidated with 4 tenured scientists – assigned to the new Departments of Applied Chemistry (María Jesús del Val and Mª Dolores García Pineda), Chemical Physics (María Martín Retortillo) and Physical Oceanography (Mª Luisa González Sabariegos) – along with some others associated women researchers (Teresa Valls, Mª. Carmen Méndez Isla, Dominica Montequí and Ángeles Alvariño). In the course of this decade several between these young women researchers develop new lines of investigation, such as food biotechnology, development of new applications and treatments for the fishery subproducts and for the algae with a potential industrial exploitation.

3.2. WOMEN AUTHORS FROM CSIC (IBA, IIP and others).

The occurrence of the two first women researchers from CSIC inside the institutional journals, arrives in the middle of the Forties: for the oceanography with Josefa Sanz Echeverría[10] (from the *Museo Nacional de Ciencias Naturales*, MNCN [Natural Sciences National Museum]) and for the freshwater sciences with Montserrat Bassedas (from the *Instituto de Biología Aplicada*, IBA [Applied Biology Institute]). In the Fifties publications come from the sedimentologists Josefina Pérez Mateos and Julia Mª González Peña (both from the *Instituto de Edafología y Fisiología Vegetal* [Edaphology and Vegetal Physiology Institute]); and the zoologist Dolores Selga (IBA). At last, with the creation of the *Instituto de Investigaciones Pesqueras*, IIP [Fisheries Research Institute], from 1958: Maria López Capont, Josefina Castellví, Dolores Blasco and Tecla Riera will be engaged. The development areas of these individual scientific careers are the plankton, the primary production, the bacteriology and the parasitology.

3.3. THE FIRST GENERATIONS OF WOMEN OCEANOGHRAPHERS (IEO AND IIP).

1st GENERATION: year 1925 (IEO-Madrid): Encarnación Sánchez (Madrid, 1903-1934?), Mercedes García [11] (1904-1990), Gimena Quirós (fl. 1922-1931), and Emma Bardán (Madrid, 1898-1992). Ms.D. in Natural Sciences, Mercedes

[10] See notes 8 and 10.

García embarked in 1926 with Emma Bardán aboard the sailboat from the IEO-Laboratory at Málaga, *Príncipe Alberto de Mónaco*; this way both of them become the first Spanish women engaged as participants into an oceanographic campaign. She is the only woman researcher of whom we have not located any publication, surely because of her assignment to the Central Laboratories (Madrid), with a dedication on coordination and management works, and the same arrived to her companions Gimena Quirós and Emma Bardán, as they did not published any more after been transferred to IEO-Madrid. Emma Bardán develop all her career inside IEO (years 1925-1962), with her first participations into oceanographic campaigns in 1926 and 1928 and her first attendance to an international congress in 1949 to ICES. She published along 1927-52, and she was the most proliphic and interdisciplinary. After being transferred to IEO-Madrid she anonymously collaborated inside other authors' works who do acknowledge her collaboration.

2nd GENERATION: two were the more representative women researchers, and both coincidate in the birth year (1916) and in the date of their retirement from IEO 40 years after. The first one was the sister of an admiral and the second one of a medical doctor. Mª. Dolores García Pineda (Cádiz, 1916): Ph.D. in Pharmacy and in Biochemistry, she worked for IEO (1944/56), at several Universities and foreign laboratories (Ochoa's lab.) and, finally, she spent 25 years at the *Junta de Energía Nuclear* [Nuclear Energy Board] (JEN). Ángeles Alvariño (Ferrol, 1916-2005): worked for IEO and for the *Dirección General de Pesca Marítima* [General Directorate of Maritime Fishery] (DGPM) between the years 1951-1956, her first campaign was in 1953 (the 1st woman scientist aboard a british oceanographic ship), and she continued her professional career at prestigious oceanographic institutions from the USA, even in participating in congresses after her retirement.

3rd GENERATION: it can be featured by Josefina Castellví (Barcelona, 1935): in the Sixties she become the first woman oceanographer from CSIC, she was the director of the *Institut de Ciènces Marines* [Marine Science Institute] ICM – Barcelona (1994-95). She undertook 36 oceanographic campaigns and she was the first spanish scientist woman who investigated in Antartics, and her first international congress was in 1962 (CIESMM).

Figure 2 shows the temporal evolution (nº of women authors vs. Nº of published papers) of the set of women researchers from both institutions along the global considered period (1923-69). The intellectual development of the spanish women scientists is strictly symmetric to the decadence period 1936-39; it is why this temporal gap is not considered here with purposes of comparaison.

3.4.- WOMEN PIONEERS INTERINSTITUTIONAL RELATIONSHIP.

We have established that in the period 1943-58 three women researchers from CSIC do accept the offers coming from IEO focused on the analysis of samples from IEO campaigns. That resulted in the publication of five articles at the *Bol. IEO* [12]. These situation reflects a punctual and 'forced' interinstitutional collaboration, motivated by the absence of specialists (in the area of fishes' otolyths and marine sediments) in one of the institutions. By the inclusion of these women researchers in the reckoning we obtain a total of 16 women authors, what represents 18% of the scientific community that publish inside these journals in provenance from both institutions (IEO + CSIC).

4.-HISTORIOMETRICS: MEASURABLE ASPECTS OF THE BENCHMARKED SCIENTIFIC CAREERS IN BOTH INSTITUTIONS (CSIC / IEO, 1946-1969).

4.1.- INSTITUTIONAL RATIO Nº OF WOMEN / MEN AUTHORS AND WOMEN RESEARCHERS PRODUCTIVITY DIFFERENCES

At IEO women (♀♀) represented 20% of the publishing scientific community (ie, 11 ♀♀ / 54 ♂♂). A higher value than obtained from CSIC publications (13.8%; 5 ♀♀ / 36 ♂♂). Nevertheless, from 1960 a clear decrement of women participation coming from IEO laboratorios has been evidenced, a situation that we graphically represent with Figure 3. The IEO women authors published all the years between 1948 and 1958, and so could be named "continuants" (PRICE, 1986, p.206-226).

20% (27) of the 133 published articles inside the *Bol. IEO* along this period implied women participation. An annual decremental rhythm in the publication frequency is observed. Women authors from IEO show a continuous record of research publication along the decade 1948-1958. Afterwards, annual alternance occurs until 1962. And in the last 8 years women just emerge in only one year (1966). In absence of reposition, the genre dynamic occurrences in the Sixties are minimal for IEO. Either complete lifes at work in the research front have concluded, or juvenile pledges do not success anymore.

Concerning CSIC, we witness the initial phases of the scientific authority accumulation of 2 (among the 8 women scientists) of the nowadays marine sciences research leaders. Like in any process of selective internal disequilibrium the system will kept them in positions which they outgrow (NOWAKOWSKA, 1977, p.326). The set of women authors in freshwater and

[12] These women authors were Josefa Sanz Echevarría (1943, 1950) from the *Museo Nacional de Ciencias Naturales* MNCN [Natural Sciences National Museum], and two from the *Instituto de Edafología* [Institute of Edaphology]: Josefina Pérez Mateos (1952, 1958) and Julia González Peña (1958).

marine sciences afford with some 10% of the articles published in the CSIC journals, when considering the publication years in which they occur. Otherwise, the events concerning the freshwater research appear between 1946 and 1953, and the women authors work mostly alone, without collaborators in 80% of the items. While the oceanography is a consequence of a posterior cycle (on the years 1950-1967), and these women researchers do publish in 7 of these 17 years. Particularly two of these women authors, confirmed into the research front in those years, will be highly prolific (Dolores Blasco and Josefina Castellví).

Starting from an equal number of women authors in IEO and CSIC (9), The femenine interinstitutional comparison shows how the scientists from IEO have written 64% of the total of papers with women authorship coming from both institutions (see Table 1). Also the exploration of the SCI database confirms the greater mean productivity of the women researchers from IEO vs. CSIC (the number is twofold: 4/2); both groups with a similar citations number (see Table 2).

4.2.- OCEANOGRAPHIC vs. FRESHWATER RESEARCH

The freshwater research is uniquely in correspondance with CSIC activity, and with the articles published by the *Instituto de Biología Aplicada* [Applied Biology Institute] (journal, *P Inst Biol Apl*), from 1946. At CSIC, the participation of the women in freshwater investigations affords with 9% of the authors when considering the (non recurrent) years at which they actually publish. The participation of CSIC women in oceanography (1950-1967) do not answer to the usual concept of periodicity, because of the presence of several publication gaps (see Figure 3). They afford with 7% of the total scientific authorship in oceanography at CSIC (limiting the authors reckoning to the years in which genre occurrences happen to appear).

4.3.- IEO AND CSIC: INSTITUTIONAL ECHO (Table 3).

The corporate identity, in regard to the women oceanographers activity, is concentrated in the case of CSIC but it is disseminated when working with the data of IEO. When explaining this configuration from the correlation coefficient it shows a value of $r= 0.71$ ($t=6.53$, +25 freedom degrees). What suggests that there is no discrepancy concerning the quantity of observations. Therefore the image thus generated is comparable in terms of methods applicability and exposed results. The extension of the acknowledgments is longest when dealing with IEO, on the contrary when CSIC is concerned the recognition context fits much more in the general plan of the institution. Actually, as the variance value shows ($\sigma^2 = 18.41$), CSIC women are much acknowledged by its own

institution than those from IEO ($\sigma^2 = 1.25$). (In fact, in the case of IEO, the SCI database does not recognise any citation received by the IEO women oceanographers issued from the own IEO; just a limited 92% self-recognition exists when focusing on the bibliographical references employed by the women authors in their own papers.)

4.4.- IEO AND CSIC: NATIONAL/INTERNATIONAL RETURNS. (Table 4)

The scientific production of IEO is located in 21 countries, while for CSIC just in 10 countries. Significant distinct statistical means identify the two groups, 2.3 for IEO, and 5.8 concerning CSIC. Nevertheless, the harmonic means are not so different (IEO – 1.41, CSIC – 1.23). So, it could be said that although the use of the scientific results is two-times more concentrated in Spain when scrutinizing the case of CSIC, the predictions made after them pay attention to similar creativity criteria (ZUSNE, 1976).

4.5.- IEO AND CSIC: THEMATIC ANALOGY. (Table 5)

We assume that no *a priori* information is available on the data generation processs. We employ a non-parametric test, the Mann-Whitney test, searching to determine if the analogy or difference between the thematic contents provided by the women researchers in freshwater sciences and oceanography, coming from both institutions (IEO and CSIC), is or not attributable to mere chance.
Onlyone condition is required, the rank distribution of the citation production , extracted from SCI, and received by the articles contributed by the women from IEO and CSIC, between 1944 and 1969. The acceptance region for the test, with a 5% confidence level, is $(51, +\infty)$. The statistics value obtained is $U = 73$. As a consequence and from a thematic point of view. So, from a thematic point of view, it must be accepted that the scientific production from the two institutions do not statistically differ, in what concerns the women researchers contribution.

4.6.- IEO AND CSIC: COMMUNICATION AND COLLABORATION IMAGES.

The literature reflects much of the communication difficulties and perhaps it maximize them (HOADLEY & KETTENRING, 1990). Our purpose here is the exploration of the communication degree between the women authors of IEO and CSIC, by examining the role played by information and experience in both senses. These relationships are exposed through the reference sources from the opposite institution retrievable after the studied articles.

The image from CSIC publications id much dependent from its main journal 'Investigación Pesquera'. Its foundation, in 1955 (MARRASÉ & ABELLÓ, 2005), is far from being able to catalize a long term collaboration with the IEO publications, that disposed (already in 1932) of statistical bibliography results.; signed by Fernando de Buén (DE BUÉN, 1932). The 36 articles published by the women, inside the journals published by IEO use 707 bibliographical references, and just 11 (the 1.5%) were directed to the publicationsof CSIC. Retrospectively, the communication is also limited in contrary sense, in the case of the IEO publishers. And from the 202 bibliographical references utilized by the 18 publications of women authors from CSIC, 12 (6 %) are directed to the journals by IEO. Therefore, the retrospective possibilities for the design of the scientific developments reconstruction are limited in terms of interbreeding.

The mean number of previous publications on which each article is based approaches the value of 13. Because from the science generated by IEO 19.32 items are referred as a mean term, and 11.22 from CSIC. And the geometric mean, rating both, is 14.8. This is a structure that Price (NALIMOV, 1981, p.154) qualified, in a pintoresque mood, as a thirteen degree sexual system.

CONCLUSIONS

The IEO women researchers, with a little quantity of single-authored papers, were the most prolific and they have shown a greater mean productivity, both beside the men from their own Institute and beside the women of CSIC. These dominant situation seems assumed in the international scene, because the influence of the publications authored by the women from IEO reached two-fold the number of countries than the items published by women scholars from CSIC.

Nevertheless, the communication between women coming from both spanish institutions was very little, and the CSIC women were much more acknowledged by their own institution than those from IEO. To those patterns must be added the subject and creativity analogies. Thus, from CSIC and IEO were generated contents without differences and were formulated predictions which paid attention to similar criteria of creativity . Doubtless, these questions are linked to each institution corporative identity, to the international dissemination flow of their research results and to the degree of communication between both institutions.

Otherwise, although we have underlined that along the 1941-51 decade the women access to IEO was consolidated, with an amount of 8 women researchers, from this last year until 1969 no new women author is recruited.The opposite situation is the scenario for CSIC, where gradually 7 new women were aggregated after 1952. Important changes began its development in Spain from 1952, with indicators like the disappearance of rationing stamps and the entrance of Spain in UNESCO (1952), the CSIC institutions incremented until 141, the first spanish women ever being appointed as an universitary full professor was in 1953, in 1954 the women were some 15% of the universitary students, the enaction of the Law for the Women Rights (1961), etc. This apparent coincidence with a new socio-political situation will reach its highest point in 1964 with the creation by the *Comisión Asesora de Investigación Científica y Técnica (CAICYT)* [Assessment Commission on the Scientific and Technical Research] of an specific budget of 100 millions pesetas[13]. This fact could be considered as the theoretical origin of the nowadays management system called *Plan Nacional de I+D* [R&D National Plan], which for the last 2002-04 period has estimated some 26% of proposals leadered by women Ph D. At IEO, the women researchers attains nowadays a higher porcentage (32%), that results insufficient if considering the growth recorded between 1932 (17 %) and 1948-49 (25 %).

Particularly in what concerns marine sciences, in spite of the described independent development between IEO and IIP (CSIC) (in absence of a state policy aiming to equilibrate them), it is surprising to verify that the present situation is quite similar between IEO and the CSIC-Marine. Both organisms equitatively distribute themselves through 20 existent territorial marine centres and they equally dispose of a global manpower of 1000 workers.

[13] Portela, 1991, pp.38-39.

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Table 1. **Quantitative approach to the articles and to the women authors by periods after the papers inside the institutional journals.**

PERIODS	**1923-1945**	**1946-1969**	**1923-1969**
IEO (Nº / %)	***14 / 93,3 %***	***32 / 64 %***	***= 46 / 71 %***
" Nº Women Authors	***6***	***9 (5 new)***	***11***
CSIC (Nº / %)	**1 / 6,7 %**	**18 / 36 %**	**= 19 / 29 %**
" Nº Women Authors	1	***9 (8 new)***	**= 9**
TOTALES			
Nº Articles	15 art.	50 art.	**= 65 art.**
Nº Women Authors	7	***18 (13 new)***	**20**

Table 2. **Women authors from both institutions and their citation records for the period 1946-1969, extracted from the database SCI** (Note: the non-institutional journals are included, it is why the number of articles is different from the pointed out at Table I).

SCI: PERIOD (1946-1969)	**IEO (9 WOMEN AUTHORS) [mean values]**	**CSIC (9 WOMEN AUTHORS) [mean values]**	**TOTAL**
Nº PAPERS	**36 [4]**	**18 [2]**	**54**
Nº CITATIONS	**58 [6,4]**	**70 [7,7]**	**128**

Table 3. **Institutional acknowledgement of the women researchers work.**

	IEO	CSIC
Observations number relevance *Correlation coefficient*	r= 0.71	
Own institution acknowledgement *Variante*	$\sigma^2 = 1.25$	$\sigma^2 = 18.41$

Table 4. **Destination and creativity of the scientific production of the women from IEO and CSIC.**

Organization	Nº of countries	Mean destination (X)	Creativity (Harmonic mean)
IEO	21	2.3	1.41
CSIC	10	5.8	1.23

Table 5. **Mann-Whitney test for the thematic analogy between the scientific productions of the women from IEO and CSIC.**

Women researchers scientific production	U statistics	Acceptance Region	Meaningful statistical difference between the research contents
CSIC vs. IEO	73	$(51, +\infty)$	The contents do not differ

Table 6. **IEO-CSIC communication**

Organization	Nº of articles	Nº of references	Mean value	Ref. to the other organization	Percentage (%)
IEO	36	707	19.63	11	1.5
CSIC	18	202	11.22	12	6

Figure 1. **Dr. Adrien Robert (April 1925) course with the participation of four oceanographers from IEO (from the left to the right: Encarnación Sánchez, Mercedes García, Emma Bardán and Gimena Quirós).**

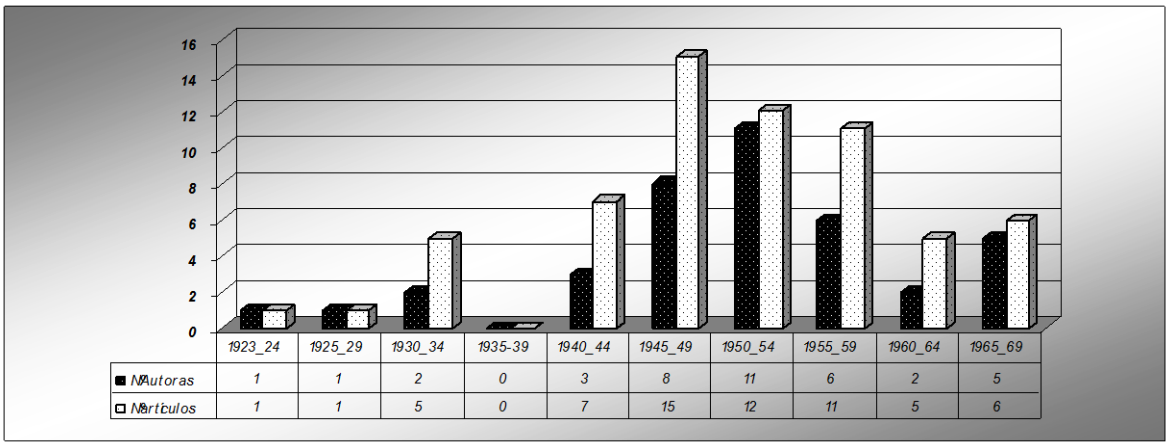

Figure 2. **Temporal evolution (quinquenniums) of the number of women authors vs number of articles published by the set of women researchers from both institutions: IEO (1923-69) and CSIC (1946-69).**

Figure 3. **Women / Men in freshwater and marine sciences IEO vs CSIC publications, between 1946 and 1949.**

MARINE AND FRESHWATER RESEARCH (IEO/CSIC, 1946-1969)

% WOMEN/ MEN in the publications (*Bol.IEO* , *P. Inst. Biol. Apl* ., I*nv. Pesq* .)