



Food and Agriculture
Organization of the
United Nations



IDENTIFICATION AND ANALYSIS OF MARINE FISHERIES RESEARCH

Case studies from selected countries
in the Fishery Committee for the
Eastern Central Atlantic (CECAF) area of competence



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PREPARATION OF THIS DOCUMENT

This document was prepared by the FAO Aquatic Sciences and Fisheries Abstracts (ASFA) Secretariat, Arame Keita (FAO Consultant), Daryl Superio from the Southeast Asian Fisheries Development Center (SEAFDEC) and the Fishery Committee for the Eastern Central Atlantic (CECAF) - PESCAO project team, with support from the EAF-Nansen Programme. Funding was provided by CECAF-PESCAO, with additional contributions from the FAO ASFA Secretariat.

ABSTRACT

During 2020, the ASFA Secretariat supported the CECAF-PESCAO project by compiling an inventory of marine fisheries research produced in nine countries (Benin, Côte d'Ivoire, Ghana, Guinea, Mauritania, Morocco, Nigeria, Senegal, Spain). A search methodology was agreed with the CECAF project team, with support from the EAF-Nansen Programme in order to identify relevant marine fisheries research. Further parameters, including publication date and author affiliation, were defined in order to conduct systematic and repeatable searches. In the first stage, online searches were conducted using four sources (ASFA database, Google Scholar, Web of Science and Scopus) resulting in 1 527 references being recorded on the inventory. The second stage involved searching local and nationally held collections (library catalogues, institutional websites or repositories) to identify further references. The second stage resulted in a further 884 unique references being identified. The results from these searches were then combined to produce an inventory of 2 411 unique references. A bibliometric analysis was then conducted on the inventory which revealed intensive publishing activity and strong collaboration across the region, however publishing in predatory journals and difficulty in locating grey literature on online sources were areas where further work is needed to ensure research produced in the area reaches a wide audience. A detailed analysis of research published by authors affiliated to Senegalese institutions was conducted which revealed a significant gender imbalance of authors (only 13 percent of authors identified in the study were female). Due to time constraints, it was not possible to expand this detailed analysis to other countries. Recommendations included in this report are to expand the inventory and analysis to other CECAF member countries and to take steps to ensure the grey literature produced by authors from the CECAF region is indexed by online sources.

Two versions of the research inventory are available to download: a simplified version can be downloaded here: <https://data.d4science.net/DAGA> and a version with full metadata can be downloaded here: <https://data.d4science.net/tvvn>.

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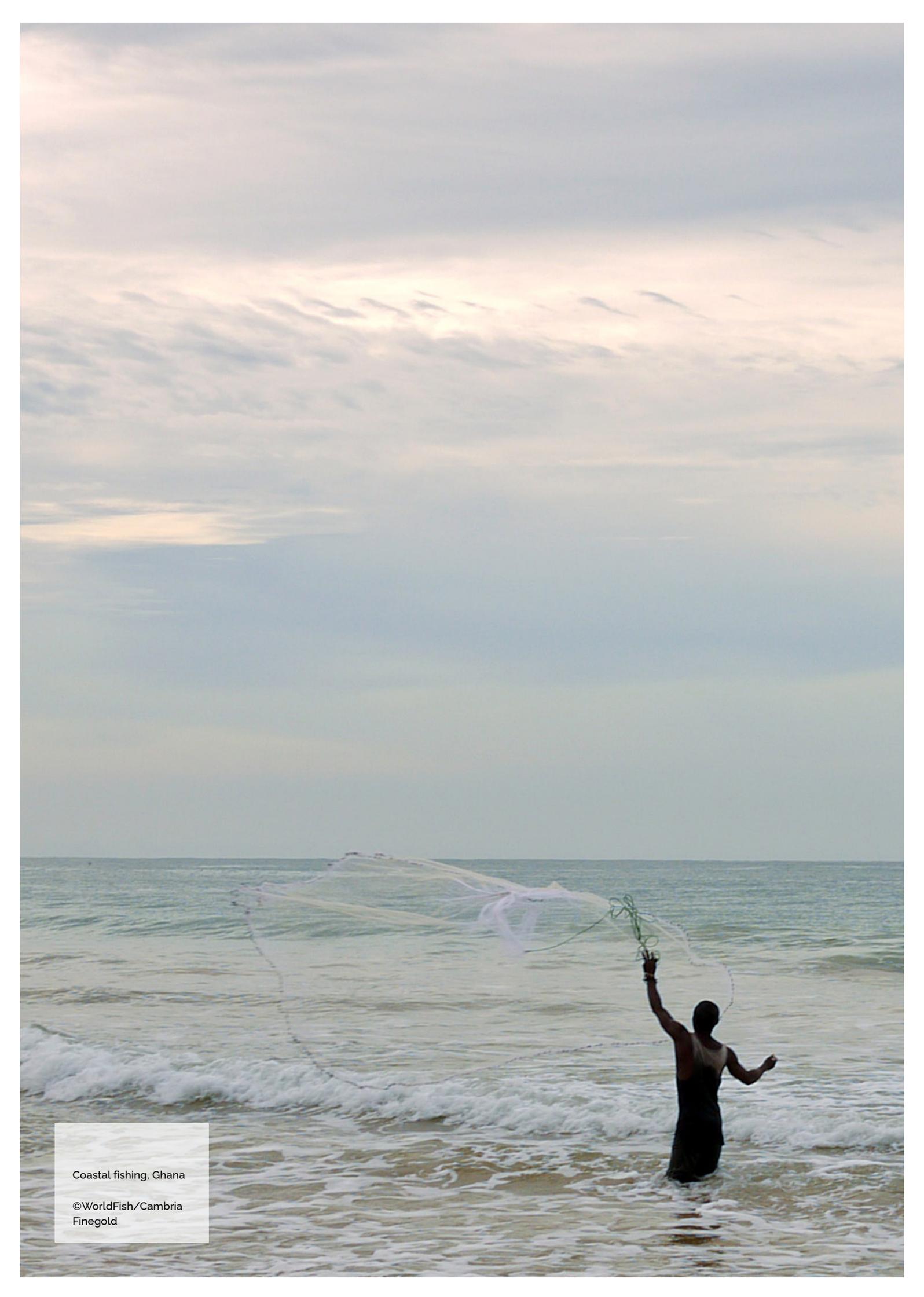
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ABBREVIATIONS AND ACRONYMS

ASFA	Aquatic Sciences and Fisheries Abstracts
CECAF	Fishery Committee for the Eastern Central Atlantic
CNHSB	Centre national des sciences halieutiques de Boussoura
CRO	Centre de recherche océanologique
DPM	Direction des pêches maritimes
GL	grey literature
IEO	Spanish Institute of Oceanography
IMROP	Institut mauritanien de recherches océanographiques et de pêches
INRH	Institut national de recherche halieutique
IRHOB	Institut de recherches halieutiques et océanologiques du Bénin
NIOMR	Nigerian Institute for Oceanography and Marine Research
SEAFDEC	Southeast Asian Fisheries Development Centre



Coastal fishing, Ghana

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1. BACKGROUND

The Fishery Committee for the Eastern Central Atlantic (CECAF) seeks to promote the sustainable utilization of the living marine resources across the Eastern Central Atlantic between Cape Spartel and the Congo River through informed development of fisheries management actions. ASFA participates in the CECAF-PESCAO project: "Improved Regional Fisheries Governance in Western Africa", specifically on Output 1.2: "Collaboration on data and information sharing procedures and research enhanced between relevant countries, sub-regional and regional organizations to harmonize data and knowledge." ASFA seeks to contribute to this output by producing an inventory of marine fisheries research in the CECAF region as recommended by the CECAF Scientific-Committee at its 22nd session. The concept for the work was developed jointly by the Marine and Inland Fisheries Branch¹ of the FAO Fisheries and Aquaculture Division, CECAF and ASFA, with support from the EAF-Nansen Programme. For practical reasons, it was agreed that the research inventory, initially, should focus on eight CECAF member countries where ASFA Partners were present and able to provide support. These countries are: Benin, Cote d'Ivoire, Ghana, Mauritania, Morocco, Nigeria, Senegal, and Spain. In addition, Guinea was also included when a contact was recommended by CECAF. ▼

¹ Now Fisheries Assessment and Management Team.

1.1

SUMMARY OF ACTIVITIES

Activities were undertaken in three stages:

- 1 _ Stage One: Searching online sources.** A search methodology was agreed with the CECAF and used to identify relevant research held on a number of online sources (ASFA, Scopus, Web of Science, Google Scholar). Online searching was conducted by Daryl Superio from September – December 2020 (See Appendix 1 for search strings used to search online resources). Stage One resulted in 1 527 references being recorded on the inventory.
- 2 _ Stage Two: Searching nationally held collections.** Nine consultants were recruited from the following countries: Benin, Côte d'Ivoire, Ghana, Guinea, Mauritania, Morocco, Nigeria, Senegal and Spain. Each consultant received training in the search methodology agreed in stage one and searched nationally held collections (libraries, institutional repositories and websites) to identify relevant research not captured in stage one. The ASFA Secretariat provided training to consultants and was responsible for quality control of the results recorded in the inventory (for full details of training sessions, see Appendix Two). Stage Two resulted in 950 references being added to the inventory, bringing the total to 2 477. These 2 477 references then underwent a final check for duplicates and irrelevant references, with 66 references being removed. This brought the total number of unique references recorded on the inventory to 2 411.
- 3 _ Stage Three: Bibliometric analysis of inventory.** Two analyses were produced. Firstly, the ASFA Secretariat analysed all references recorded in the inventory, providing a summary of publishing trends, keywords and document types. Secondly, Daryl Superio prepared an in-depth analysis of the research recorded during stage one for Senegal only.

This report presents the methodology and results of the bibliometric analyses and recommendations for future work. Appendix 1 provides the search strings that were used to identify relevant material; Appendix 2 provides information on the Activities and training undertaken to compile the research inventory; lastly, Appendix 3 is the methodology used to retrieve, clean and record data used in the in-depth bibliometric analysis. Due to time limitations, it was not possible to conduct this analysis for all references recorded in the inventory, however dependent on feedback, ASFA would be willing to expand this analysis.

1.2

PARTICIPANTS

In total, 12 individuals participated in ASFA's support to the CEEAF-PESCAO project:

- 1 _ **Maria Kalentsits** (FAO ASFA Secretariat) – delivery of training workshops, collaboration with Daryl Superio to develop a methodology for searching and bibliometric analysis, reporting. 48 days worked (funded by ASFA).
- 2 _ **Tamsin Vicary** (FAO ASFA Secretariat) – coordination of the project activities and reporting. 13 days worked (funded by ASFA).
- 3 _ **Daryl Superio** (The Southeast Asian Fisheries Development (SEAFDEC), Philippines) – gathered data from selected online sources and perform a bibliometric analysis.
- 4 _ **Arame Gaye Ndiaye Keita** (Direction des pêches maritimes (DPM, Senegal) – liaised with French-speaking participants and assisted with translation (training material, documents and reports); identified and recorded national research output and assist with the final report.
- 5 _ **Coffi Ferdinando Rock Gbedo** (Institut de recherches halieutiques et océanologiques du Bénin (IRHOB), Benin) – identified and recorded national research output and assist with the final report.
- 6 _ **Assémien Clément** (Centre de recherche océanologique (CRO), Côte d'Ivoire) – identified and recorded national research output and assist with the final report.
- 7 _ **Richard Yeboah** (Fisheries Commission, Ghana) – identified and recorded national research output and assist with the final report.
- 8 _ **Fodé Karim Kaba** (Centre national des sciences halieutiques de Boussoura (CNSHB), Guinea) – identified and recorded national research output and assist with the final report.
- 9 _ **Cheikh Ibrahima Sakho** (Institut Mauritanien de Recherches Océanographiques et de Pêches (IMROP), Mauritania) – identified and recorded national research output and assist with the final report.
- 10 _ **Bouchra Bazi** (Institut national de recherche halieutique (INRH), Morocco) – identified and recorded national research output and assist with the final report.
- 11 _ **Ibrahim Zakariyau** (Nigerian Institute for Oceanography and Marine Research (NIOMR), Nigeria) – identified and recorded national research output and assist with the final report.
- 12 _ **Uxia Tenreiro López** (Spanish Institute of Oceanography (IEO), Spain) – identified and recorded national research output and assist with the final report.



Fresh fish just landed
for sale on the beach,
Kayar, Senegal.

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Delaporte

2. METHODOLOGY FOR COMPILING AND ANALYSING THE RESEARCH INVENTORY

2.1

METHODOLOGY FOR COMPILING THE INVENTORY

The process for compiling the inventory involved a preparatory stage where the search methodology and scope of the inventory was agreed. The search methodology was then applied in two stages: firstly, four online sources were searched to identify relevant references; secondly, national consultants were recruited from nine countries to search nationally held collections, such as library collections, institutional holdings or national journals. Adopting a two-stage approach allowed for comparison between results available on major online sources and those held in national collections, allowing for a deeper understanding of research needs and publishing trends in the region.

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Preparatory Stage: Elaboration and testing of search methodology, including keyword identification and processing

The ASFA Secretariat, Marine and Inland Fisheries Branch of the FAO Fisheries Division, CECAF-PESCAO project team, with support from the EAF-Nansen Programme, agreed the below search criteria for identifying references to be recorded on the inventory:

- Documents must be published in the previous decade (i.e. between January 2010 – September 2020).
- Author of the publication must be affiliated with the institution located in one of the countries covered by the project (Benin, Côte d’Ivoire, Ghana, Guinea, Mauritania, Morocco, Nigeria, Senegal, Spain). In terms of Spain, it should be noted that only publications covering marine and fisheries research related to Canary Islands and West African marine region are included in the inventory.
- Documents must relate to one or more of below topics (CECAF keywords):
 - ▶ **marine fisheries** (including fisheries statistics, fishing fleet, fisheries monitoring);
 - ▶ **fishery biology** (including growth, reproduction, genetics, eggs and larvae, life cycle, morphometric and meristic, population dynamics, trophic ecology);
 - ▶ **fishery management** (including stock assessment, scientific advice for fishery management);
 - ▶ **marine and fishery policy**;
 - ▶ **ecosystem modelling**;
 - ▶ **gender and socioeconomic aspects** (if related to fisheries);
 - ▶ **climate change** (if related to fisheries);
 - ▶ **marine protected areas** (mpas) (if related to fisheries).
- Documents on aquaculture (both marine & freshwater aquaculture) should not be included in the inventory, unless the document describes the impact of aquaculture on wild marine fishes and marine fishery.
- Documents on freshwater fish biology, inland fisheries and other aspects relating to freshwater environment should not be included in the inventory.
- Documents on marine pollution, food technology, physical oceanography should not be included in the inventory.
- All types of documents can be included in the inventory, including: book; book chapter; conference; dataset; dissertation/thesis; journal article; report; review; working paper.

To avoid information losses, a broad search strategy was adopted when using online sources. This meant that some irrelevant references were returned in the search results and needed to be manually evaluated and excluded from the inventory where necessary. This ensured that relevant research was not overlooked.

An example of a broad search string used to identify research is provided below, for the full list of search strings used on each online resource, together with the terms used to identify relevant CECAF member countries, see Appendix 1.

*“All documents covering **Marine Fish** OR **Marine Fisheries** related aspects and published within last ten years (2010-2020) by the **authors affiliated with the national institution** in a particular CECAF country”*

Results were exported to an Excel spreadsheet (separate sheets were created for each country) and verified manually. References clearly not responding to the established criteria were removed from the lists.

The metadata fields recorded on the inventory are presented in [Table 1](#).

► **TABLE 1**
Description of metadata recorded on the inventory

METADATA FIELD	DESCRIPTION
Source database	This recorded the source the reference was identified on, limited to ASFA, Google Scholar, Scopus or Web of Science.
Title	The given title of the reference.
Year of publication	Year reference was published, limited to between 2010-2020.
Collaboration	This field recorded whether the reference involved collaboration between authors. For references that involved collaboration, it was recorded whether that collaboration was among west African countries and/or among countries outside west Africa.
Number of authors	Number of authors cited on the reference.
Country of first author	The country of the first author's affiliated institution was recorded.
Names of authors	The name of authors from west Africa and Spain was recorded.
Gender of authors	For Senegalese references only, the gender was recorded for all authors (whether from west Africa or Spain). For all other countries, gender of first author only was recorded.
Country and affiliation of authors from west Africa and Spain	For authors from west Africa or Spain, the affiliation and country was recorded.
Country of authors outside Africa or Spain	For authors who were affiliated to an institution outside of west Africa and/ Spain, the country of the institution was recorded.
Publication source title	Where given, the serial title of the publications was recorded.
Type (journal article, book, book chapter, report, thesis, etc.)	The document type was recorded.
Predatory journal (Yes/No)	When a journal article was published in a predatory journal, this was recorded.
Grey literature (Yes/No)	Whether a document was classified as grey literature or not was recorded.
Open access (Yes/No), if oa, link to the full text	The access rights, and where given the link, of the document was recorded to enable access to anyone using the inventory.
Link to the ASFA record	For publications located on the ASFA database, the link to the ASFA record was recorded.

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METADATA FIELD	DESCRIPTION
CECAF keywords	The CECAF Keyword the document most corresponded to was recorded on the inventory.
Taxonomic terms	Species names referred to in the publication were recorded.
ASFA keywords	Subject keywords from the ASFA thesaurus were recorded.
Author assigned keywords	Where author assigned keywords were given on the publication, these were recorded on the inventory.
Availability for digitization (Yes/No)	For print only publications, whether the document was available for digitization was recorded.

Once this preparatory stage was agreed, stage one of activities began, which involved searching online resources for relevant research to add to the research inventory.

Stage One: Recording of online resources on research inventory

Dates: September-February 2021

Objectives: 1) to identify and record relevant documents available online; 2) to prepare a spreadsheet helping National Consultants involved in the project to identify references.

Description: This work was performed by Daryl Superio (SEAFDEC) in collaboration with the ASFA Secretariat. The search strategy agreed in the preparatory stage was applied to online sources to identify relevant research.

In total, four major online sources (ASFA, Web of Science, Scopus, and Google Scholar) were searched for marine fisheries research output, published since 2010, by authors affiliated to institutions in nine CECAF countries (Benin, Côte d'Ivoire, Ghana, Guinea, Mauritania, Morocco, Nigeria, Senegal, and Spain). Relevant results were exported to an Excel spreadsheet.

A series of additional searches were performed to identify the gender and author affiliation of each author recorded on the inventory. Due to the time consuming nature of these searches, the decision was made to complete author affiliation and gender for authors of Senegal only. Providing the full metadata for one country (Senegal) enabled an in-depth bibliometric analysis to be performed which demonstrates the full capability of the inventory and could be extended to all results if more time becomes available.

Duplicate results were removed from the inventory resulting in 1 527 unique references being recorded on the inventory during stage one.

Stage Two: Nationally held collections

Dates: November–December 2020 (Introductory Session, four weekly workshops, Post-workshop meeting)

Objective: The objective of the Stage Two activities was to identify research (published and unpublished documents) held in national collections and record it on the research inventory. A series of online trainings was organised to ensure participants understood and could implement the search methodology. Participants searched nationally held collections, which could be located in libraries, institutional repositories or websites, as well as national journals and other sources likely to be overlooked by online databases and search engines. The trainings ensured participants had the practical skills to accurately search, identify and record research as well as providing a forum to ask questions, share information and network.

Description: In total, six online training workshops were organized by the FAO ASFA Secretariat, with support from Arame Gaye Ndiaye Keita and Daryl Superio. The course consisted of four 2-hour training sessions held weekly over a period of four weeks, in addition to preparatory and concluding meetings. Participants were given tasks which they were expected to complete between the sessions, with progress checked each week by the FAO ASFA Secretariat. Before submitting their inventories, participants were asked to verify all the records to ensure that they met the established criteria, and to ensure that all the required metadata was included (such as Title, Year of publication, Authors' affiliation, Gender, Source title, CEECAF keyword, Link to the full text when available, etc.). Once this was complete, each participant sent their inventory to the FAO ASFA Secretariat who provided a final quality control of work, with all inventories received and finalised by 15 December 2020.

Output

Each participant produced an Excel file of research identified as part of this project, summarising their findings in individual reports. A total of 950 references were identified in stage two and recorded in the inventory. The results were then compared with references identified in stage one, with 52 duplicates removed. A small number (14) of irrelevant records were also removed, which brought the final number of publications identified by participants to 884. Combined with the results from stage one, this brings the total number of unique references recorded on the inventory to 2 411.

Limitations

The training was originally planned to take place as a meeting in Dakar, Senegal. Due to the Coronavirus pandemic, the decision to move to virtual meetings was made in July 2020. Despite some connection issues and the difficulty of conducting training virtually, the format was effective and allowed the sessions to be spread over a longer time period rather than condensed into a five-day in-person meeting. Training on digitization was originally planned, however due to the small number of documents available in print only format, it was decided the time would be better spent on identifying and searching a larger number of sources.

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Due to the difficulty of recording the gender and affiliation of each author, participants instead provided this information for the first author only. Likewise, gender was not recorded for authors identified during the first stage, with the exception of authors affiliated to institutions in Senegal. This leaves 2 180 references with gender either not recorded at all, or only recorded for the first author. We estimate that it will require 68 working days to complete this information for all authors, based on average of three authors per article and five minutes to identify author gender.

Other limitations of the data recorded by participants are:

- 1 _ There was some confusion regarding the format of documents that participants were asked to report on as either digital or print only. All of the documents claimed by participants as available in print only need to be double-checked to ensure there is no digital version already available. This should be done prior to planning any digitisation projects.
- 2 _ Some articles published in commercial journals are available full-text on ResearchGate and links are provided by the participants in their inventories – to avoid copyright issues these should be replaced with links to the journal.

Problems encountered by participants

Participants were asked to report on any problems they encountered during their work. The below issues were raised:

- Intermittent internet connectivity and electricity problems - this meant participants struggled to attend the virtual meetings. To mitigate this, all meetings were recorded, with summaries and PowerPoint presentations sent to participants after the meeting.
- Travel restrictions and closure of services due to COVID-19 - this limited the number of institutional collections that could be searched.
- Insufficient time allotted – a number of participants reported that they struggled to complete the activities in the five days they were contracted for, and that a number of collections with relevant materials remained unsearched due to the limited time allotted.
- Work with Excel spreadsheet – although we provided a simple spreadsheet for participants to complete, in French and English, problems using and formatting the spreadsheet caused some issues.
- Administrative and technical issues related to accessing information stored in other institutions.
- Researchers refused to give access to their publications.
- Local strike and national elections.

All the participants provided positive feedback on their involvement in the project and have indicated their interest to be involved in future work.

2.2 METHODOLOGY FOR CONDUCTING THE BIBLIOMETRIC ANALYSIS

Stage 3: Bibliometric analysis

Dates: December 2020 – February 2021

Objective: to analyse the information gathered during first two stages by applying a bibliometric analysis. To provide recommendations based on the assessment and analysis of research coverage of CECAF priority areas in individual CECAF member countries.

Description: Two bibliometric analyses were conducted: (1) a summary bibliometric analysis of the research output in nine CECAF-PESCAO countries, and (2) an in-depth bibliometric analysis of the research output identified in stage one for Senegal only.

To conduct the summary bibliometric analysis, the full inventory was simplified to provide data on the following metadata fields: Title; Year of publication; Source title; Document type; URL; CECAF keyword, Country (of author affiliation) and whether the reference was identified during stage one or two. The reason for limiting the inventory to these metadata was to provide a full analysis of all references recorded on the inventory.

As gender and affiliation were only partially completed, this meant analysis could not be fairly completed for all references recorded on the inventory. Senegal is the only country for which author affiliation and gender was recorded in full which is why in-depth bibliometric analysis was limited to results from Senegal only.



One of the dried fish vendors in the local town food market in Oyo State, Nigeria.

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3. RESULTS OF THE BIBLIOMETRIC ANALYSES

3.1 SUMMARY BIBLIOMETRIC ANALYSIS

Publication volume

A total of 2 477 references were recorded on the inventory, however 52 references were found to be duplicates, and 14 were outside the subject scope, meaning the total number of unique references recorded on the inventory is 2 411.

During stage one, 1 527 (62 percent) documents identified by searching four online sources (ASFA, Scopus, Web of Science, and Google Scholar). During stage two, 950 (38 percent) documents were identified locally by national consultants. [Table 2](#) presents the number of references identified during stages one and two by country of author affiliation.

► **TABLE 2**

Number of documents identified during stage one and two, by country

COUNTRY	DOCUMENTS IDENTIFIED DURING STAGE ONE	DOCUMENTS IDENTIFIED DURING STAGE TWO	TOTAL NUMBER OF DOCUMENTS
Benin	58	32	90
Côte d'Ivoire	69	43	112
Ghana	206	89	295
Guinea	27	123	150
Mauritania	146	37	183
Morocco	208	99	307
Nigeria	255	103	358
Senegal	232	268	500
Spain	326	156	482
Total	1 527	950	2 477*

* The total number includes multiple records for publications co-authored by authors from more than one CECAF-PESCAO country and accordingly recorded in more than one country list. When these duplicate records were removed, the total number of unique references is 2 411.

The differences between countries in the total number of publications identified could be due to the following factors: research capacity in the country; accuracy and comprehensiveness of search methodology; accessibility of searching nationally held collections (problems accessing sites due to COVID-19 restrictions); or limited time allowed for document identification. However, the overall number of references identified was higher than expected at the start of the project which is testament to the commitment of project participants. Although direct comparisons between countries should be treated with caution (due to the variables listed above), the inventory indicates that Senegal, Spain and Nigeria have the highest research publication output, and that Benin, Côte d'Ivoire and Guinea have the lowest output.

Year of publication

Figure 1 shows the number of references recorded in the inventory. There was little fluctuation over the past 11 years with the lowest value (179 references) recorded for 2011 and the highest value (252 references) recorded for 2016. The cumulative average number of references is 218 per year. This lack of growth over time is in contrast to global research output, which has been shown to have grown 4 per cent annually over the past ten years (White, 2019). The lack of annual growth in the number of references recorded in the inventory could be due to inconsistencies in searching or recording references in the inventory, or due to the lack of growth of marine fisheries research output in the region. Further investigation is needed before conclusions can be made.

► FIGURE 1

Number of references by year of publication



* - publications In Print, Submitted, or "No Date" identified.

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Table 3 presents a breakdown of references by year of publication and country. The number of identified publications for any year/ country remains below 100, varying from the lowest value of 3 (2011/Benin) to the highest value 76 (2013/Senegal).

► **TABLE 3**

Number of references recorded on the inventory by year and country

YEAR OF PUBLICATION	NUMBER OF PUBLICATIONS PER COUNTRY								
	BENIN	CÔTE D'IVOIRE	GHANA	GUINEA	MAURITANIA	MOROCCO	NIGERIA	SENEGAL	SPAIN
2010	4	10	8	12	14	18	51	39	59
2011	3	6	16	9	13	22	44	23	45
2012	10	8	15	8	20	29	34	38	47
2013	11	6	23	5	14	16	29	76	40
2014	5	6	22	6	18	16	21	66	53
2015	10	9	34	15	17	35	21	44	35
2016	12	15	30	19	24	34	31	64	37
2017	11	18	33	19	30	45	32	25	39
2018	12	16	35	7	11	39	41	47	45
2019	7	8	32	18	12	29	35	48	44
2020	5	10	45	31	10	24	19	21	38
No date given	0	0	2	0	0	0	0	9	0
Total	90	112	295	149	183	307	358	500	482

* - publications In Print, Submitted, or No Date identified.

Document types

All references in the research inventory were assigned one of the following document types: Book, Book Chapter, Dissertation/Thesis, Journal article, Pamphlet, Poster, Preprint, Conference proceedings, Report, and Working paper. [Table 4](#) illustrates the distribution of references by document type collected during stage one (using online sources) and stage two (by National Consultants who searched nationally held collections).

► **TABLE 4**

Number of document types recorded during stages one and two

DOCUMENT TYPE	STAGE ONE (ONLINE SOURCES)	STAGE TWO (NATIONAL COLLECTIONS)	TOTAL
Book	57	40	97
Book chapter	48	23	71
Dissertation/Thesis	43	158	201
Journal article	1 150	314	1 464
Pamphlet	2	0	2
Poster	1	7	8
Preprint	3	0	3
Proceedings	137	79	216
Report	18	258	276
Working paper	5	68	73
Total	1 464	947	2 411

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Table 5 presents the number of references by Document Type and Country. For each of the focus countries, 'Journal Article' was the most frequent type of publication (from 90 percent of all Côte d'Ivoire publications down to 33 percent of all Guinea publications).

► **TABLE 5**
Number of document types recorded on the inventory by country

DOCUMENT TYPE	BENIN	CÔTE D'IVOIRE	GHANA	GUINEA	MAURITANIA	MOROCCO	NIGERIA	SENEGAL	SPAIN
Book	2	2	41	15	17	4	3	12	4
Book chapter	0	1	11	0	18	7	5	13	17
Dissertation/Thesis	12	6	31	31	17	16	8	69	11
Journal articles	53	101	169	50	86	225	234	260	342
Pamphlet	1	0	0	0	0	0	1	0	0
Poster	6	0	0	0	0	0	0	2	1
Preprint	1	0	2	0	0	0	0	0	0
Proceedings	7	1	8	7	31	25	72	63	8
Report	7	1	33	42	0	30	33	76	38
Working paper	1	0	0	5	14	0	2	5	61
Total	90	112	295	150	183	307	358	500	482

Grey literature (GL) is defined as research produced outside the control of commercial publishers and typically includes the following document types: Dissertations, Pamphlets, Posters, Preprints, Proceedings, Reports and Working Papers. Using these document types to identify references in the inventory as GL results in 779 documents (33 percent) being classified as GL. Figure 2 presents a distribution of identified GL by country, with the largest number of GL documents by volume identified for Senegal (215), followed by Spain (119), Nigeria (116). By percentage, Guinea (62 percent), Senegal (45 percent) and Benin (42 percent) had the highest shares of GL versus references for Journals or Books. As Benin and Guinea had the lowest and third lowest number of references recorded on the inventory, their high percentage of research published as GL could indicate difficulties in publishing results in academic journals however further work would be needed to eliminate inconsistently applied search methodology across countries as a factor.

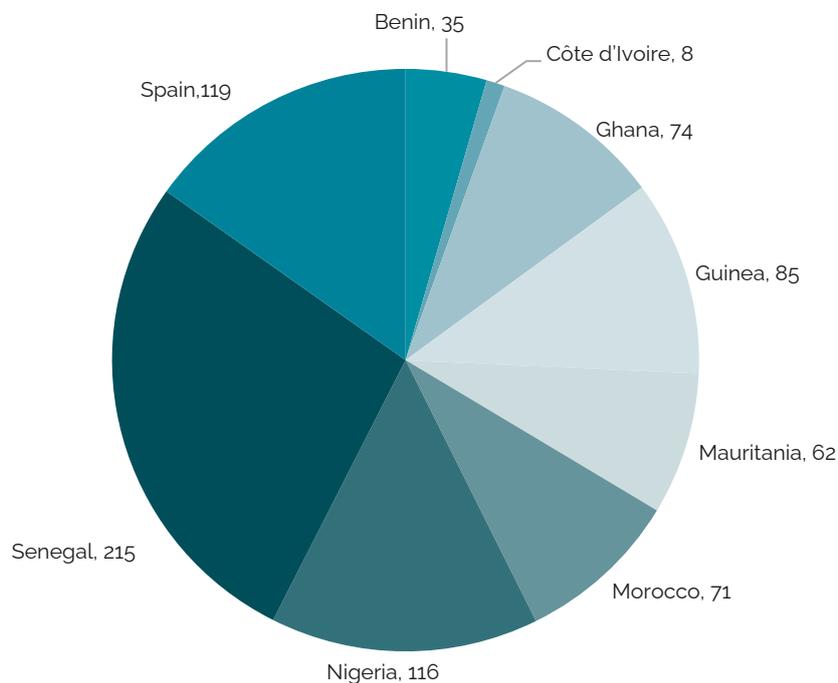
When looking only at GL, 73 percent of references recorded on the inventory came from searching national collections and only 27 percent from online sources. For reports, the difference is even greater (93 percent found searching national collections; 7 percent found searching online sources). Reports by fisheries institutions can be vital sources of information for managing marine fisheries, reporting findings on areas such as fishery statistics, marine environment issues

and policy and legislation aspects directly affecting fishers and fishing communities. Similarly, dissertations and theses are underutilized sources of information not often findable using online sources; in this inventory 79 percent of dissertations and theses were located searching national collections versus 21 percent searching online sources. Dissertations can be on important emerging topics and can be the first or only source of information on a particular geographic area or scientific topic. In addition, dissertations and theses have undergone intensive review and supervision and are authored by the next generation of researchers and policy makers. Research has confirmed publication bias exists against researchers in developing countries (FAO, 2009), meaning the information contained in these GL documents is less likely to be accepted into commercial journals as opposed to dissertations and theses from developed countries.

Reports, dissertations and theses and other GL document types should not be overlooked due to their difficulty to find using online sources alone. The results collected during stage two indicate that library collections and librarians continue to play an important role in managing GL and in ensuring these documents are sustainably stored and properly catalogued, however further work is needed to ensure these documents are searchable online. Efforts must be made to improve the accessibility of marine fisheries GL produced in the region. Uploading references identified during stage two of this project to an online database such as OpenASFA is recommended in order to increase discoverability.

► **FIGURE 2**

Number of grey literature documents in the inventory by country



CECAF keywords

All references included in the inventory were assigned one of nine keywords as described in the [Table 6](#). Fishery biology was the most frequently assigned keyword (41 percent). Fishery biology covered the biology and ecology of marine and brackishwater animals and organisms other than fish. Marine fisheries was the second most selected keyword (17 percent) with fishery management

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the third most likely to be selected (16 percent). The remaining keywords were each selected for ten percent or less of the references in the inventory.

► **TABLE 6**

Keywords assigned to references in the research inventory

	NUMBER OF REFERENCES (FREQUENCY)	NUMBER OF REFERENCES (PERCENTAGE)
Marine fisheries (incl. fisheries statistics, fishing fleet, fisheries monitoring)	419	17
Fishery biology (incl. growth, reproduction, genetics, eggs and larvae, life cycle, morphometric and meristic, population dynamics, trophic ecology)	978	41
Fishery management (incl. Stock assessment, Scientific advice for Fisheries Management)	393	16
Marine & Fishery policy	95	4
Ecosystem modelling	63	3
Gender and Socioeconomic aspects (in relation to marine fisheries)	234	10
Climate change (in relation to marine fisheries)	102	4
Marine Protected Areas (MPAs) (if relates to fisheries)	127	5

Drawing conclusions from the number of times keywords were selected is difficult due to some keywords having a broader scope than others; for example, fishery biology is a wider topic than ecosystem modelling and therefore it is unsurprising that more references referred to fishery biology than ecosystem modelling. It should also be noted that the “Ecosystem modelling” keyword, was often incorrectly assigned to publications covering other aspects related to ecosystem, such as Ecosystem services, Ecosystem approach, etc. Uploading references from the inventory to an online database will enable a full set of keywords to be added which would enable more accurate and insightful analysis.

Most popular journals for publication

Table 7 displays the number of journal article references recorded in the inventory for different Journal Titles (as identified from the “Source Title” Column of the inventory). Many of these journals are considered high-impact² journals in the fisheries field, while others are of national importance. Having such a wide spectrum of publishing sources in the region increases the visibility and impact of the research at both global and national levels.

² The impact factor (IF) of a journal is a description of the influence the journal has in academic or university research circles. It is a measure of how often the average research article in a journal has been cited or used in other research in any particular year [The Oxford Review Encyclopedia of Terms].

▶ TABLE 7

Number of journal article references recorded by journal title

RANK	JOURNAL TITLE	IMPACT FACTOR (IF)*	NO OF ARTICLES
1	Marine Policy	3.22	40
2	Fisheries Research	2.147	28
3	International Journal of Fisheries and Aquatic Studies**	N/A	26
4	African Journal of Marine Science	0.733	22
5	Scientia Marina	1.172	22
6	Collective volume of scientific papers. ICCAT	N/A	22
7	Nigerian Journal of Fisheries	N/A	21
8	Ocean & Coastal Management	2.482	19
9	Cybium	0.534	17
10	Bulletin du Centre Halieutique de Boussoura (Guinea)	N/A	16
11	AACL Bioflux	N/A	16
12	Journal of Fish Biology	1.495	16
13	International Journal of Biological and Chemical Sciences**	N/A	14
14	Journal of Marine Systems	2.528	14
15	Regional Studies in Marine Science	1.183	14
16	Estuarine, Coastal and Shelf Science	2.333	14
17	ICES Journal of Marine Science	3.188	13
18	PLOS One	2.740	13
19	European Scientific Journal		13
20	Acta Ichthyologica et Piscatoria (Poland)	0.629	12
21	Fiche Technique & Document de vulgarisation du Centre de Recherches Océanologique Abidjan (Côte d'Ivoire)	N/A	12
22	Bulletin du Centre de Rogbanè (Guinea)	N/A	11
23	Journal of Ichthyology	N/A	11
24	Marine Ecology Progress Series	2.326	10
25	International Journal of Advanced Research**	N/A	10

* The Impact Factor is based on the 2020 Clarivate Analytics Journal Citation Report.

** Predatory journals and publishers are entities that prioritize self-interest at the expense of scholarship and are characterized by false or misleading information, deviation from best editorial and publication practices, a lack of transparency, and/or the use of aggressive and indiscriminate solicitation practices." In: Grudniewicz, A., Moher D., Cobey K.D. 2019. Predatory Journals: no definition, no defence. Nature, 11 December 2019. <https://www.nature.com/articles/d41586-019-03759-y>.

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It should be noted that three out of 25 journals listed in [Table 7](#) are considered “predatory” **. These are:

- International Journal of Fisheries and Aquatic Studies - Third most popular journal to publish in, according to the inventory. The inventory includes 26 papers published in this journal, of which:
 - ▶ five (co)authored by Benin affiliated authors (B012, B037, B040, B044, B047);
 - ▶ three (co)authored by Ghana affiliated authors (GH183, GH291, GH316);
 - ▶ eight (co)authored by Nigeria affiliated authors (N051, N085, N086, N168, N201, N210, N254, N349);
 - ▶ eight (co)authored by Senegal affiliated authors (SE011, SE026, SE067, SE110, SE179, SE181, SE187, SE461); and
 - ▶ one co-authored by Senegal and Mauritania affiliated authors (xMUL/SE091/MA1432).

- International Journal of Biological and Chemical Sciences – Thirteenth most popular journal title to publish in, according to the inventory. The inventory includes 14 references to articles published in this journal, of which:
 - ▶ five (co)authored by Benin affiliated authors (B025, B042, B048);
 - ▶ seven (co)authored by Côte d'Ivoire affiliated authors (C041, C054, C062, C065, C091, C102, C103); and
 - ▶ four (co)authored by Nigeria affiliated authors (N083, N103, N227).

- International Journal of Advanced Research –Twenty-fifth most popular journal title to publish in, according to the inventory. The inventory includes ten papers published in this journal, of which:
 - ▶ six (co)authored by Morocco affiliated authors (MO018, MO224, MO225, MO228, MO236, MO237);
 - ▶ three (co)authored by Senegal affiliated authors (SE103, SE189, SE334); and
 - ▶ one (co)authored by Mauritania affiliated author (MA092).

Reasons for publishing in “predatory” journals need further analysis involving co-authorship patterns, national publishing policies and other aspects. Ways of informing researchers in the region about the risks of publishing in predatory journals should be explored and support provided to ensure authors are able to publish in accredited journals.

[Table 8](#) ranks top popular journals for publication per country (as identified from the “Source Title” Column of the inventory). The table provides an insight into the publication sources which were chosen most frequently for publishing in the nine participating countries. It should be noted that in case of co-authored publications, a decision on what journal to submit the article to, may have been taken by co-authors located in a non-CECAF country.

► TABLE 8

Journal titles by country

	TITLE	NUMBER OF ARTICLES	IMPACT FACTOR (2018)	PEER REVIEWED?	OPEN ACCESS?	COUNTRY OF PUBLICATION	TYPE
Benin							
1	Vestnik of Astrakhan State Technical University. Series: Fishing Industry	6		Yes	Yes	Russian Federation	University Journal
2	International Journal of Fisheries and Aquatic Studies	5		Unknown	Yes	India	Predatory journal
3	International Journal of Biological and Chemical Sciences	3		No	Yes	Cameroon	Predatory journal
4	African Journal of Aquatic Science	3	0.750	Yes	Partial OA		Primary journal
Côte d'Ivoire							
1	Collective Volume of Scientific Papers. ICCAT	14		Partial	Yes	Spain	ICCAT's scientific papers
2	Fiche Technique & Document de vulgarisation du Centre de Recherches Océanologique, Abidjan	12		Unknown	Parcial (Some available on OceanDocs)	Côte d'Ivoire	CRO's papers
3	International Journal of Biological and Chemical Sciences	8		No	Yes	Cameroon	Predatory Journal
4	European Scientific Journal	7		Yes	Yes		Primary journal
5	Journal of Applied Biosciences	4		No	Yes	Cameroon	Primary journal

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	TITLE	NUMBER OF ARTICLES	IMPACT FACTOR (2018)	PEER REVIEWED?	OPEN ACCESS?	COUNTRY OF PUBLICATION	TYPE
Ghana							
1	Marine Policy	10	2.865	Yes	No		Primary journal
2	West African Journal of Applied Ecology	4		No	Yes	Cameroon	Primary journal
3	International Journal of Fisheries and Aquatic Research	4		Unknown	Yes	India	Primary journal
4	Sustainability	4	2.592	Yes	Yes	Switzerland	Primary journal
Guinea							
1	Bulletin du Centre Halieutique de Bousoura	16		Unknown	No (not available online)	Guinea	CNSHB Bulletin
2	Bulletin du Centre de Rogbané	11		Unknown	No (not available online)	Guinea	Bulletin
3	Le Bulletin de l'Environnement: revue semestrielle de recherche en environnement	5		Unknown	Yes	Guinea	Bulletin
Mauritania							
1	ICES Journal of Marine Science	4	3.367	Yes	No	Denmark	Primary journal
2	Journal of Ichthyology	8		Yes	No	Russian Federation	Primary journal
3	Marine Policy	4	2.865	Yes	No		Primary journal
4	PLOS One	3	2.776	Yes	Yes		Primary journal
5	Fisheries Research	3	2.343	Yes	No		Primary journal

	TITLE	NUMBER OF ARTICLES	IMPACT FACTOR (2018)	PEER REVIEWED?	OPEN ACCESS?	COUNTRY OF PUBLICATION	TYPE
Morocco							
1	AACL Bioflux	9		Yes	Yes	Romania	Society journal
2	Bulletin de la Société zoologique de France	8		Unknown	Yes	France	Society bulletin
3	Cybium	6	0.812	Unknown	No	France	Primary journal
4	Egyptian Journal of Aquatic Biology & Fisheries	5		Yes	Yes	Egypt	Primary journal
5	International Journal of Advanced Research	5		No	Yes	India	Predatory journal
Nigeria							
1	Nigerian Journal of Fisheries	21		Unknown	Yes	Nigeria	Primary journal
2	International Journal of Fisheries and Aquatic Studies	8		Unknown	Yes	India	Predatory journal
3.	Journal of Fisheries and Aquatic Science	8			Yes	Pakistan	Primary journal
4.	Asian Journal of Agricultural Sciences	3		Yes	Yes		Primary journal
5	African Journal of Biotechnology	3		Yes	yes		Primary journal

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	TITLE	NUMBER OF ARTICLES	IMPACT FACTOR (2018)	PEER REVIEWED?	OPEN ACCESS?	COUNTRY OF PUBLICATION	TYPE
Senegal							
1	African Journal of Marine Science	10	0.991	Yes	No		Primary journal
2	Marine Policy	8	2.865	Yes	No		Primary journal
3	International Journal of Fisheries and Aquatic Studies	8		Unknown	Yes	India	Predatory journal
4	Estuarine, Coastal and Shelf Science	6	2.611	Yes	No		Primary journal
5	Ocean & Coastal Management	6	2.595	Yes	No		Primary journal
Spain							
1	Scientia Marina (Barcelona)	18	1.252			Spain	
2	Marine Policy	17	2.865	Yes	No		Primary journal
3	Fisheries Research	17	2.343	Yes	No		Primary journal
4	ICES Journal of Marine Science	8	3.367	Yes	No	Denmark	Primary journal
5	Journal of Marine Systems	8	2.539	Yes	No		Primary journal
6	Journal of Fish Biology	8	2.038	Yes	No	United Kingdom	Primary journal
7	Ocean & Coastal Management	8	2.595	Yes	No		Primary journal

Publications recorded by more than one CECAF member country

A total of 52 (two percent) publications were recorded multiple times in the inventory as they featured authors from more than one CECAF member country considered in this study. For example, the below reference was recorded four times, once each by consultants from Guinea, Mauritania, Morocco and Senegal. For the accuracy of analysis, it was assigned as a cross regional publication, duplicate entries were removed, and it was given a new reference number (xMUL/GU012/MA054/MO146/SE207/). Marked with an asterisk are the authors from Guinea, Mauritania, Morocco and Senegal:

Shin, Y-J., Shannon, L. J., Bundy, A., Coll, M., Aydin, K., Bez, N., Blanchard, J. L., Borges, M. F., Diallo, I.*, Diaz, E., Heymans, J. J., Hill, L., Johannesen, E., Jouffre, D., Kifani, S.*, Labrosse, P.*, Link, J. S., Mackinson, S., Masski, H.*, Möllmann, C., Neira, S., Ojaveer, H., Ould Mohammed Abdallahi, K.*, Perry, I., Thiao, D.*, Yemane, D., and Cury, P. M. 2010. Using indicators for evaluating, comparing, and communicating the ecological status of exploited marine ecosystems. 2. Setting the scene. – *ICES Journal of Marine Science*, 67: 692–716, <https://doi.org/10.1093/icesjms/fsp294>

Of the 52 publications with co-authors from the region, over half (31) had a co-author from Senegal. This shows a high level of collaboration by authors from Senegal with other authors from countries included in this study. The results for co-authors from other countries are as follows: 23 from Mauritania; 14 from Guinea; 14 from Morocco; six from Benin; six from Ghana; four from Nigeria; and three from Côte d'Ivoire. By type of publication, 41 publications are Journal Articles, seven- Proceedings, two- Books, one- Book Chapter, and one- Working Paper.

Most of the journal articles with co-authors from the region are published in academic journals with high impact factor, whereas one article is published in a so called “predatory journal”** (no. 22) (Table 9).

► TABLE 9

Number of journal articles by authors affiliated to more than one CECAF member country by journal title

	JOURNAL TITLE	NO OF PUBL.	JOURNAL TITLE	NO OF PUBL.
1.	Acta Biotheoretica	1	22. International Journal of Fisheries and Aquatic Studies	1
2.	Acta Ichthyologica et Piscatoria	1	23. Journal of Coastal Research	1
3.	African Journal of Marine Science	1	24. Journal of Fish Biology	1
4.	Agricultural Sciences	1	25. Journal of Fisheries & Livestock Production	1
5.	Aquaculture, Aquarium, Conservation & Legislation – Int. J. Bioflux Soc.	1	26. Journal of Marine Systems	2
6.	Aquatic Conservation	1	27. JMBA (United Kingdom)	1
7.	Aquatic Living Resources	1	28. Journal of Vertebrate Biology	1
8.	Deep Sea Research Part II: Topical Studies in Oceanography	1	29. Marine Policy	3
9.	Ecological Indicators	1	30. Maritime Studies	1
10.	Ecosystem Services	1	31. Ocean & Coastal Management	1
11.	Environmental and Water Sciences, Public Health & Territorial Intelligence Journal	1	32. Ocean Science	1

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	JOURNAL TITLE	NO OF PUBL.		JOURNAL TITLE	NO OF PUBL.
12.	Environmental Development	1	33.	Parasitology Research	1
13.	Fish and Fisheries	1	34.	Progress in Oceanography	2
14.	Fisheries Oceanography; Oxford	2	35.	Revue d'Ecologie	
15.	Fisheries Research	1	36.	Vestnik of Astrakhan State Technical University (Russian Federation)	1
16.	Frontiers in Marine Science	1	37.	Vieraea	1
17.	Global Change Biology	1	38.	Zoosystema	1
18.	ICES Journal of Marine Science	2			

The results of an in-depth bibliometric analysis of references identified using online sources for authors affiliated to an institution in Senegal is presented below. Due to time constraints, data related to author affiliation and gender was only recorded in full for references from Senegal which is why the in-depth analysis only covers these results. In-depth analysis could be extended if further time is allocated to allow the recording of affiliation and gender of all authors.

3.2 IN-DEPTH BIBLIOMETRIC ANALYSIS OF MARINE FISHERIES RESEARCH IN SENEGAL, 2010-2020

Summary

An in-depth bibliometric analysis was conducted to assess the publications on marine fisheries in Senegal, published from 2010 to 2020. A total of 231 relevant publications were identified and analysed. The analysis covered the annual production of marine fisheries publications. Specifically, it presented the quantity of the research output of fishery research and academic institutions and of individual authors. The results also showed the authors' collaborative research activities and provided information on the subjects and types of publications. The authors' publishing behaviour in predatory journals, grey literature, and open-access or free-access sources were also presented. The results also provided some information on the involvement of women in marine fisheries research.

I. Introduction

The fisheries sector has contributed 17 percent of the total animal protein supply to global food, human nutrition, and livelihood (Bennett *et al.*, 2018). Specifically, the fisheries sector in Senegal, a coastal nation in West Africa, has significantly contributed to its economy (FAO, 2021a) by contributing four percent to the country's overall gross domestic product and provided jobs to 17 percent of the total Senegalese workforce (The World Bank, 2016). Fish is one of the essential components of the Senegalese diet and has constituted almost 75 percent of their protein intake (SRFC, 2016). However, several factors such as overfishing, illegal fishing, habitat destruction, biodiversity loss, pollution, and climate change have threatened fisheries' sustainability over the years (Burgess *et al.*, 2013; Lu *et al.*, 2018). For instance, overfishing has caused the continuous

decline of fisheries resources in Senegal (Diedhiou & Yang, 2018). Lam et al. (2012) projected that in 2050, fisheries' annual landed value in West Africa would decrease up to 21 percent due to climate change. The decrease will significantly affect West African nations' economies and food security, further increasing their vulnerability to the impacts of climate change (Lam et al., 2012). Thus, science-based management strategies and effective policy systems to protect and ensure fishery resources' sustainability are imperative.

In cognizance of the importance of the fisheries sector in West Africa, the Fishery Committee for the Eastern Central Atlantic (CECAF) is working on the improvement of the governance of marine resources in the Region by “using knowledge-based advice by strengthening management processes to contribute to sustainable fisheries, food security, and sustainable livelihoods” (FAO, 2021b). One of the initiatives it has undertaken to achieve this goal was a comprehensive inventory of research activities in CECAF. The inventory was accomplished in collaboration with Aquatic Sciences and Fisheries Abstracts (ASFA) Secretariat. The inventory covered nine CECAF member countries, such as Benin, Côte d'Ivoire, Ghana, Guinea, Mauritania, Morocco, Nigeria, Senegal, and Spain. Two approaches were undertaken to accomplish the inventory: a) online searches using proprietary databases and Google Scholar; and b) identification of nationally held collections by fishery information experts from the countries mentioned above. The output was a comprehensive list of marine fisheries publications that are available online and/or are held locally from nine CECAF member countries. The inventory provided detailed information on authorship, collaboration, and subject coverage, aside from the bibliographic information. Moreover, it also provided information on open access or free access publishing, grey literature, and predatory journal publishing. To aid the accessibility of open access or free access publications, the link to full text is also provided in the inventory.

To better understand the marine fisheries researchers' publishing activities in the countries named above, bibliometric analyses were performed to the curated marine fisheries-related publications for each country. One was a general bibliometric analysis for all the countries, and the other a detailed analysis of Senegalese publications. Presented in this paper is the result of a bibliometric analysis of Senegalese publications.

Bibliometric analysis is commonly used to quantitatively evaluate the research productivity of an individual or a group of researchers, institutions, or countries in a particular discipline (Sweileh, 2020). It has been used in various fields such as economics (Bonilla et al., 2015), engineering (Cancino et al., 2017), medicine (Falagas et al., 2006), physics (Kim, 2001), and social science and humanities (Tripathi et al., 2018) to name a few. Bibliometrics has also been used to evaluate research trends and impacts on fisheries sciences and aquaculture, such as the studies of Asknes and Browman (2016) and Jaric et al. (2012) that analysed research activities in the fisheries, and of Natale et al. (2012) that provided information on the research areas and research fronts in aquaculture. Hiruy et al. (2019) have measured the impacts of research-for-development projects on fisheries and aquaculture of an international organization in Southeast Asia and the Pacific using bibliometrics. Furthermore, bibliometrics has also been used to evaluate research activities on the fisheries or culture of specific species such as shrimp (Teixeira et al., 2020) and oyster (Guo, 2014). The results of bibliometric analysis explicate and describe research trends, assess academic performance and impact, discover social networks, and have been used as one of the bases for determining research directions and development (Anderson, 2017; Iftikhar et al., 2019).

Given the extensive use of bibliometrics as a tool in describing research trends and measuring research impacts, it is the most appropriate methodology to achieve the project's goal of assessing the research coverage of the CECAF priority areas in individual West African CECAF countries. Bibliometric analysis was employed to evaluate systematically local and international researchers' publication productivity on Senegal's marine fisheries from 2010 to 2020. Specifically, the analysis covered subjects, publication productivity, collaborative activities among the researchers and institutions within and outside the country, publication type, and publishing activities on predatory journals, grey literature, and open-access or free access literature. The most productive individual researchers and institutions in terms of the number of publications were also identified. The analysis also provides information on the Senegalese women's involvement in marine fisheries research through authorship.

II. Methodology

a. Database used and search query

The analysis includes the data on marine fisheries research in Senegal that was retrieved from three proprietary databases (Aquatic Sciences and Fisheries Abstracts (ASFA), Scopus, and Web of Science (WoS)) and a search engine that specializes in scientific information (Google Scholar). The data gathered by Scopus and WoS covered academic journal articles. The data from ASFA, an aquatic science-specific database, covered almost all types of publications, including scholarly journals, book chapters, conference proceedings, and grey literature such as reports, manuals and translations. However, due to quality control, these proprietary databases do not index all literature, particularly those published by "predatory" and local publishers, and grey literature such as local conference proceedings, theses and dissertations, project and activity reports, manuals, and pamphlets to name a few. The inventory included data from Google Scholar to ensure that it covered most of the literature on marine fisheries in Senegal. Data from Google Scholar was retrieved using Harzing's Publish or Perish Software (Harzing, 2007). A broader search query was used in each database to cover most of the relevant literature. Shown in [Table 10](#) are the search strings used for each of the databases. The keywords lagoon* and estuar* were intentionally included in the search string to include publications covering both brackishwater and marine environments. To ensure that titles covering marine and freshwater or brackishwater environments and the relationships between marine fisheries and aquaculture are also included, no search term exclusion (e.g., AND NOT (freshwater or brackish*); AND NOT aquacultur*) was identified. All related publications were included in the analysis regardless of type.

► TABLE 10

Search string used to identify relevant research on four online sources by Senegalese authors

DATABASE	SEARCH STRING
ASFA	noft(fish*) AND noft(marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar*) AND af(Senegal)
Scopus	(TITLE-ABS-KEY (fish* AND (marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar*))) AND AFFILCOUNTRY (Senegal)
WOS	AD=(Senegal) + TS=(fish* AND (marine OR sea OR ocean* OR bay OR lagoon OR estuar*))
Google Scholar (used Harzing's Publish or Perish Software)	All of the words: Fish* AND Senegal Any of the words: marine coast* ocean* bay* lagoon* sea* estuar*

The retrieved data from each database were exported to Microsoft Excel for manual data cleaning. Publications' relevance was determined based on eight specific marine fisheries-related topics of interest to CECAF (see Figure C2(d)). Since broader search strings were used to retrieve most related publications, many non-relevant items were also retrieved. These included publications on marine pollution impacts on fishery resources, bioaccumulation, fishery products, brackishwater fisheries and fishery resources, tuna fisheries, and aquaculture-related publications. Also, marine fisheries-related publications that contained passing mention of Senegal in the abstract or list of cited references were also excluded from the study. On the other hand, publications about the interaction between aquaculture and fisheries were included. Non-relevant items were eliminated from the list. The cleaned data from four databases were combined, duplicates deleted and presented in a standardized spreadsheet containing the metadata required by CECAF (see Figure 3). All the relevant titles were retrieved or accessed individually to record the: a) publication information (i.e., year of publication, the title of the source, and link when the publication is open-access or free access); b) author information (i.e., author's name and gender, affiliation, and country); c) collaboration (country and affiliation of the collaborating authors); d) publishing behaviour (predatory journal, grey literature, and open-access publishing); and e) subject coverage (i.e., CECAF keywords, taxonomic terms and author(s)-assigned keywords). See Appendix 3 for the detailed data retrieval and recording processes.

Academic social networking sites such as ResearchGate, Academia, LinkedIn, and Google Scholar were used to confirm the author's full name when the names were in initials only. Likewise, the aforementioned networking sites were also used to verify the author's gender. Additionally, the authors' Twitter, Instagram, or Facebook accounts, and Google search were also used to confirm the author's gender whenever the aforementioned academic networking sites cannot provide such information.

Quantitative analyses were performed to present the results. Frequency and percentages were used to describe the data.

► **FIGURE 3**
Standardized spreadsheet for metadata coding and analysis

Pub. No.	Source DB	Article Title	Year of Publication	Collaboration			No. of Author from W. Africa	% of Total	Gender of Author (Self as identified in reference)	With Female Author Co-Editor	Country and Affiliation of Authors from West Africa and Spain (List all West African Countries - One country/affiliation in each cell)			Country	No. of Author from Senegal	% of Total	Affiliation - Research Agency	Country of Author's residence	Journal Title	Type	Predatory (0-5 stars)	Link
				Senegal Only	Among W. African Countries and Spain Only	Among W. African, Spanish and Spanish-African (Senegal or African)					Country	No. of Author from Senegal	% of Total									
01	ASFA IV	A review of indicators for sustainable fishery resources: Senegalese Fisheries	2002	No	No	Yes	2	Senegal	Clifford Neale	1	100%	Male	No	Senegal	1	100%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	France	Marine Resource Economics	JA	No	No
02	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
03	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
04	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
05	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
06	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
07	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
08	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
09	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
10	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
11	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
12	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
13	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
14	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
15	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
16	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
17	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
18	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
19	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No
20	ASFA IV	ASFA IV	2008	No	Yes	Yes	6	USA	Clifford Neale	2	33%	Male	No	Senegal	1	16%	Centre de Recherche Océanographique et Pêchère de Dakar-Thiaroye	USA	Fish and Fisheries	JA	No	No

III. Results and discussion

a. Volume, types of publication, and publishing behaviour

A total of 231 relevant titles about marine fishes and marine fisheries in Senegal were identified using the four databases. A considerable proportion (39.4 percent) of the titles were unique in Google Scholar only. Although lesser than that of Google Scholar, ASFA, Scopus, and Web of Science also covered unique titles. While the remaining proportions (60.6 percent) were indexed either in one of the three databases or in two, three, or four databases. Detailed analysis of the titles retrieved from the databases suggests that most of the titles indexed in the three proprietary databases were titles published by commercial publishers. Most of these were also available in Google Scholar. In comparison, the unique titles from Google Scholar were published either in academic journals by academic institutions, independent and or predatory publishers, or in conference proceedings or other forms of grey literature published locally. These titles were often uploaded or recorded online through institutional repositories or academic networking sites such as ResearchGate and Academia and various document sharing platforms such as docplayer.net, technodocbox.com, semanticcholar.org, among others. The results support previous studies' findings on the comprehensiveness of Google Scholar's coverage compared to other proprietary databases (Gantman and Dabós, 2018; Harzing and Alakangas, 2016). Google Scholar covers 98 to 100 percent of scholarly journals (Chen, 2003) and various types of publications from commercial publishers and aggregators, including grey literature from government agencies, academic institutions, professional societies, and the like (Yang and Meho, 2006). Google Scholar makes scholarly and grey literature discoverable regardless of quality.

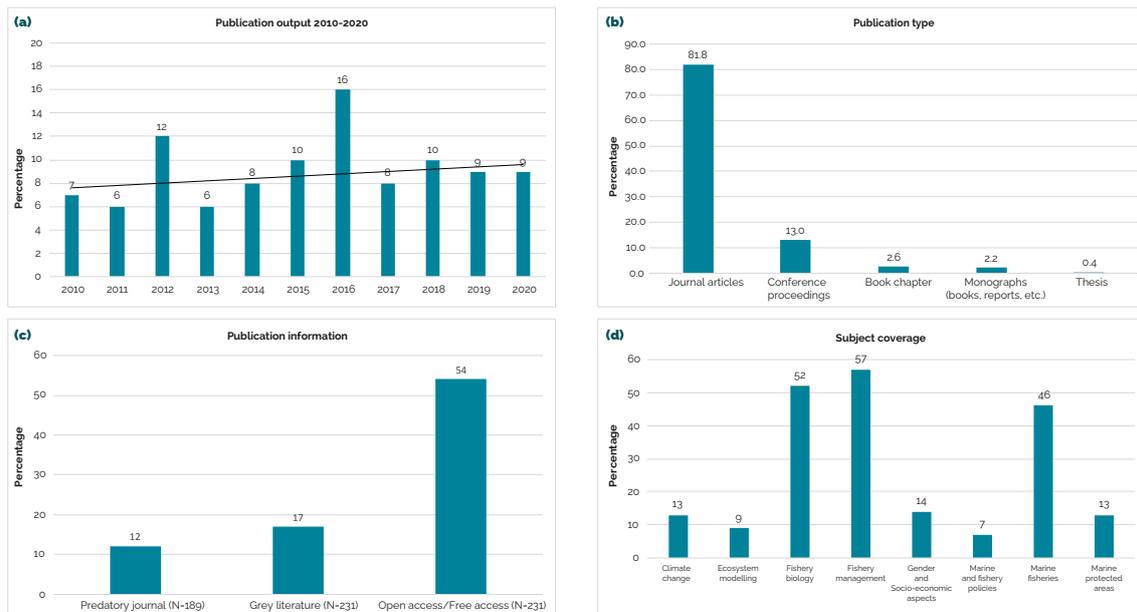
Based on the gathered data, there is an increasing publishing trend about Senegal's marine fisheries for the period 2010 to 2020 [Figure 4\(a\)](#). The spike of research output in 2016 (F=36 (16 percent)) was mainly due to the extended abstract of the *Second International Conference AWA "ICAWA 2015" – Ecosystem approach to the management of fisheries and the marine environment in West African waters*. On average, there are at least 21 publications produced annually throughout 2010-2020. [Figure 4\(b\)](#) presents that eight in every ten (81.8 percent) titles were published as journal articles, and the remaining proportions were published as conference proceedings (13 percent), book chapters (2.6 percent), monographs (2.2 percent), or theses (0.4 percent).

Moreover, as shown in [Table 11](#), seven of the top ten sources were published in high-impact academic journals and considered the leading journals in aquatic science based on the 2019 Journal Citation Reports (Clarivate Analytics, 2020). However, of the 189 titles published in the journals, 23 titles (12 percent) were published by predatory publishers [Figure 4\(c\)](#). Predatory journals and publishers "are characterized by false or misleading information, deviation from best editorial and publication practices, a lack of transparency, and/or the use of aggressive and indiscriminate solicitation practices" (Grudniewicz *et al.*, 2019). Predatory publishers are primarily interested in making a profit without paying much attention to peer review processes (Beall, 2015), making the quality of published papers questionable. Beall's List of potential predatory journals and publishers (Beall, 2021) was used to verify if the journals or the publishers were predatory. Predatory journals pose threats not just to scientists and researchers but most especially to students, policymakers, managers, and fishery stakeholders who are at risk of interpreting predatory journals as high-quality scientific journals (Clements *et al.*, 2018). Mills and Inouye (2020) found that publishing to predatory journals was motivated by certain factors. For example, academic institutions provide monetary incentives and promotion to their faculty members who have met a certain number of publications to build their research capacity and attract grants from funding agencies. In some countries, the publication is a requirement for graduation for doctoral and master's degrees.

Due to these requirements and stringent criteria imposed by Western peer-reviewed academic journals, researchers opted to publish their research in predatory journals (Mills and Inouye, 2020; Wallace and Timothy, 2016). In addition, young and inexperienced researchers from developing countries are often the victims of predatory publishers (Xia *et al.*, 2014).

► **FIGURE 4**

Volume of publication, publication type, publication information, and subject coverage



The 231 titles were published from 133 sources. **Figure 4(c)** shows that the majority (54 percent) of the titles were published open-access or free-access. Open-access publications include journal articles from commercial publishers and predatory publishers published in gold open-access. Free access publications were mostly grey literature such as reports, conference proceedings, preprints, and theses. The remaining titles were pay-per-view articles published by commercial publishers. Almost two in every 10 (17 percent) of the total publications were grey literature. As shown in **Table 11**, the top source of publications was the series of *ICAWA proceedings (extended book of abstract)*. *ICAWA proceedings* is an example of grey literature. Grey literature are publications produced outside the control of commercial publishers (Vicary and Pettman, 2020). Scientists in developing countries would opt to publish their research in the form of grey literature due to stringent criteria of the editorial board of Western peer-reviewed journals. Particularly in Africa, it is estimated that up to 70 percent of fisheries research were published as grey literature (FAO, 2009).

► **TABLE 11**
Ranking of sources (N=133)

TITLE	IF*	F	%
ICAWA proceedings (extended book of abstract)	NA	14	6.1
International Journal of Fisheries**	NA	9	3.9
African Journal of Marine Science*	0.733	7	3.0
Marine Policy*	3.228	7	3.0
Science and management of small pelagics (proceedings)	NA	6	2.6
Estuarine, Coastal and Shelf Science*	2.333	5	2.2
Fisheries Oceanography*	2.198	5	2.2
Fisheries Research*	2.147	5	2.2
Journal of Fish Biology*	1.497	5	2.2
Ocean & Coastal Management*	2.482	5	2.2

* IF = Impact Factor. Journal Citation Reports (Clarivate Analytics, 2020)

** predatory journal listed in Beall's List of Potential Predatory Journals or Publishers (<https://beallslist.net/>)

b. Subject coverage

Based on the scientific names' appearance in the titles and the documents' abstracts, 168 marine species were commonly studied in the country (Table 12). Various species of *Sardinella* and other pelagic fishes were the most frequently studied marine fishery resources. This could be associated with the fact that, from 2010 to 2018, pelagic fishes, particularly sardines, herrings, and anchovies, constitute the majority of Senegal's total annual capture fisheries production (FAO, 2020a; FAO, 2020b). As shown in Figure 4(d), the majority of the documents were about fisheries management (57 percent) and biology (e.g., growth, reproduction, genetics, life cycle, morphometrics and meristics, population dynamics, habitat, and trophic ecology) (52 percent) of these were on fishes. Moreover, a considerable proportion of the documents were about Senegal's marine fisheries (46 percent). Smaller distributions were on gender and socioeconomic aspects of fisheries, climate change, marine protected areas, ecosystem modelling, and fishery policies.

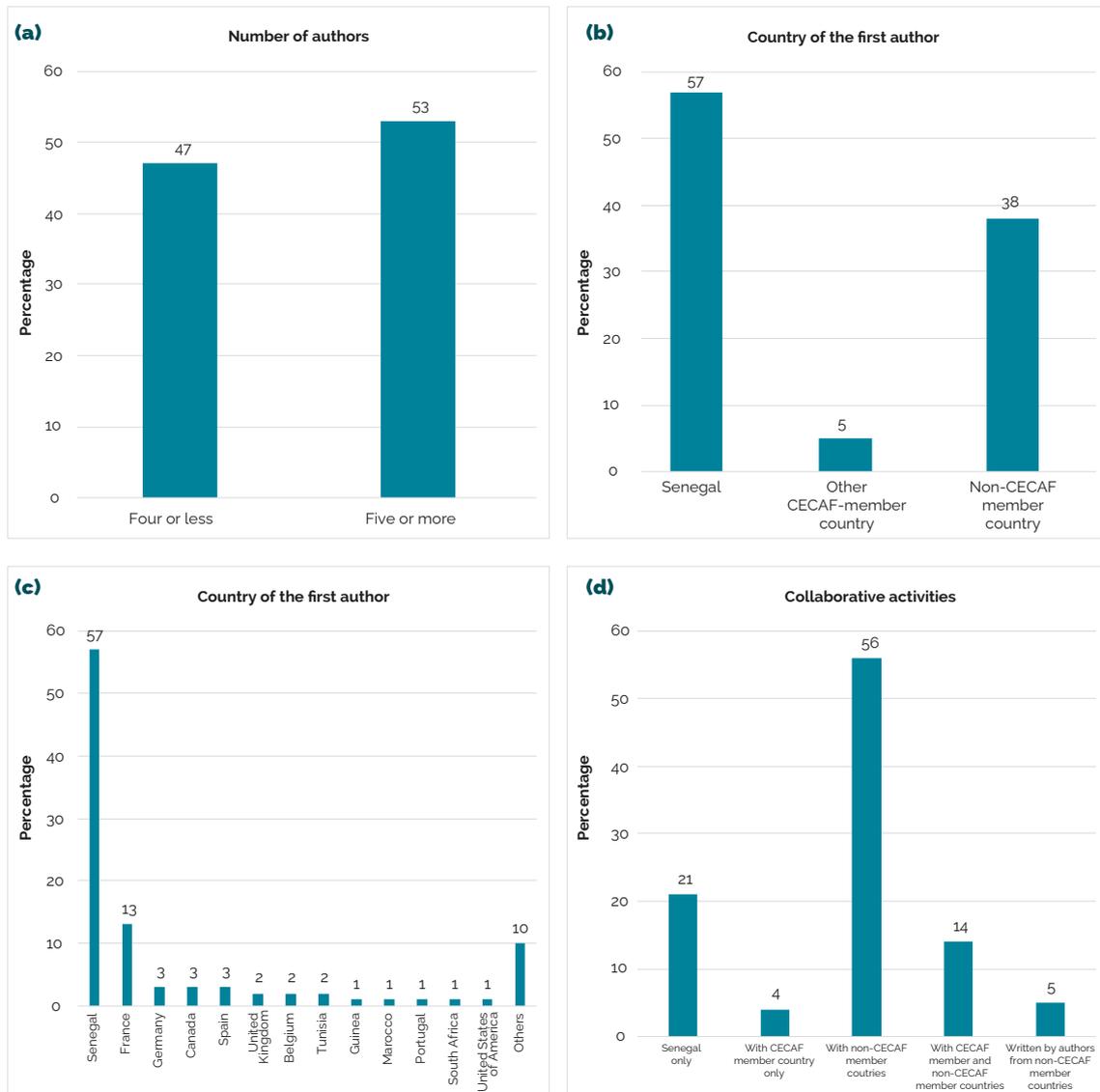
► **TABLE 12**
Ranking of most studied species (N=168)

SPECIES	F	%
<i>Sardinella aurita</i>	24	14.5
<i>Sardinella maderensis</i>	13	7.9
<i>Ethmalosa fimbriata</i>	12	7.3
<i>Sardina pilchardus</i>	6	3.6
<i>Epinephelus aeneus</i>	5	3.0
<i>Mugil cephalus</i>	5	3.0
<i>Octopus vulgaris</i>	5	3.0
<i>Cheilopogon pinnatibarbatus</i>	3	1.8
<i>Coryphaena hippurus</i>	3	1.8
<i>Engraulis encrasicolus</i>	3	1.8
<i>Sarpa salpa</i>	3	1.8
<i>Trachurus trachurus</i>	3	1.8

To visualize the commonly used keywords from the title of the publications, an open-source software WordClouds.com (<https://www.wordclouds.com/>), was used. The frequency of use is shown by word size. The bigger the word, the more frequent it appeared in the title. **Figure 5(a)** visualizes the results of all the keywords from the title. It broadly depicts the main topics discussed in the publications: marine fishes and fisheries in Senegal, West Africa. To further visualize the topics commonly discussed in the publications, geographic keywords such as Senegal, West, Africa, African, and the like were excluded. The word cloud in **Figure 5(b)** depicts the specific topics discussed in the publications: marine fisheries, MPAs, fishery management, fish parasites, pelagic fish species, particularly *Sardinella*, and climate change, among others. The word cloud supports the subject coverage of the publications presented in **Figure 4(d)** and the most commonly studied species shown in **Table 12**.

► FIGURE 6

Authorship and collaborative activity of researchers from Senegal



As shown in Figure 6(d), the majority (56 percent) of the publications was an output of Senegalese researchers' collaborative works with researchers outside West Africa. A more significant proportion of which was with French researchers (32.6 percent), while considerable proportions were collaborations with British (7.5 percent), American (6.8 percent), and German (6.8 percent) researchers (Table 13). The result suggests that Senegalese authors collaborate more with authors from France than with authors from other countries. Particularly researchers from Institute de Recherche pour le développement (IRD) and other academic institutions in France. The result confirms Dodsworth's (2019) findings, stating that African researchers based in countries that were former French colonies collaborate more often with researchers from France than with other countries. Researchers' collaborative behaviour from Senegal to researchers from France is one of the observable relationships between the two countries shaped by historical impacts (Dodsworth, 2019).

► **TABLE 13**

Ranking of most productive non-CECAF countries collaborating with Senegalese authors or doing research about marine fisheries in Senegal

COUNTRY	F	%
France	105	32.6
United Kingdom	24	7.5
United States of America	22	6.8
Germany	22	6.8
Canada	15	4.7
Portugal	11	3.4
South Africa	10	3.1
Norway	10	3.1
Tunisia	9	2.8
Italy	9	2.8

On the other hand, only a small proportion (five percent) of the publications were an output of collaborations with researchers from West African countries, and only two in every ten (21 percent) were outputs of partnerships with researchers within Senegal or an output of an individual Senegalese researcher only. Regarding collaboration with researchers from CECAF member countries, Senegalese researchers collaborated with researchers from Spain more often than other researchers based on countries in Africa ([Table 14](#)). The result supports Dodsworth (2019), stating that African researchers tend to develop collaborations with researchers from Western countries more often than researchers from other African countries.

► **TABLE 14**

Ranking of most productive CECAF countries collaborating with Senegalese authors or doing research about marine fisheries in Senegal

COUNTRY	F	%
Spain	30	4.1
Morocco	19	2.6
Guinea	17	2.3
Mauritania	14	1.9
Gambia	7	1.0
Liberia	5	0.7
Mali	3	0.4
Benin	2	0.3
Cabo Verde	2	0.3
Côte d'Ivoire	1	0.1
Ghana	1	0.1
Guinea Bissau	1	0.1
Nigeria	1	0.1
Sierra Leone	1	0.1

d. Authors' affiliation and gender

A total of 264 authors from West African member countries were involved in the publication of 219 titles included in the study. On average, productivity is 2.76 publications per author from West Africa. The authors with the highest number of publications are Patrice Brehmer with 38 (17.4 percent) publications, Modou Thiaw with 24 (eleven percent) publications, and Massal Fall with 22 (10.1 percent) publications (Table 15). Patrice Brehmer is a French researcher and has conducted research with various Senegalese research institutions.

► **TABLE 15**
Ranking of most productive authors from Senegal (N=729)

NAME	F	%
Patrice Brehmer	38	17.4
Modou Thiaw	24	11.0
Massal Fall	22	10.1
Djiga Thiao	20	9.2
Malick Diouf	16	7.3
Papa Ibnou Ndiaye	15	6.9
Didier Jouffre	14	6.4
Omar Thiom Thiaw	13	6.0
Timothée Brochier	13	6.0
Hamet Diaw Diadhiou	12	5.5
Youssouph Diatta	12	5.5

Moreover, when grouped according to the number of times an institution was named as the affiliation of an author, the top institutions ([Table 16](#)) were Université Cheikh Anta Diop de Dakar (UCAD) with 257 (32.5 percent) mentions; Centre de recherches océanographiques de Dakar-Thiaroye (ISRA/CRODT) with 210 (26.6 percent) mentions; and Institut de recherche pour le développement (IRD) with 99 (12.5 percent) mentions. Interestingly, four institutions from other CECAF member countries outside Senegal were included in top institutions. These were the Institut national de recherche halieutique (INRH) from Morocco, Centre national des sciences halieutiques de Boussoura (CNSHB) from Guinea, Institut mauritanien de recherches océanographique et des pêches (IMROP) from Mauritania, and Universitat de Barcelona from Spain. These results confirm Senegalese authors' collaborative research activities with fellow Senegalese researchers inside and outside their research institutions and among researchers within CECAF. Furthermore, the result also shows that several Senegalese researchers were affiliated with more than one institution.

► TABLE 16

Ranking of most productive institutions based on the output of authors (N=790)

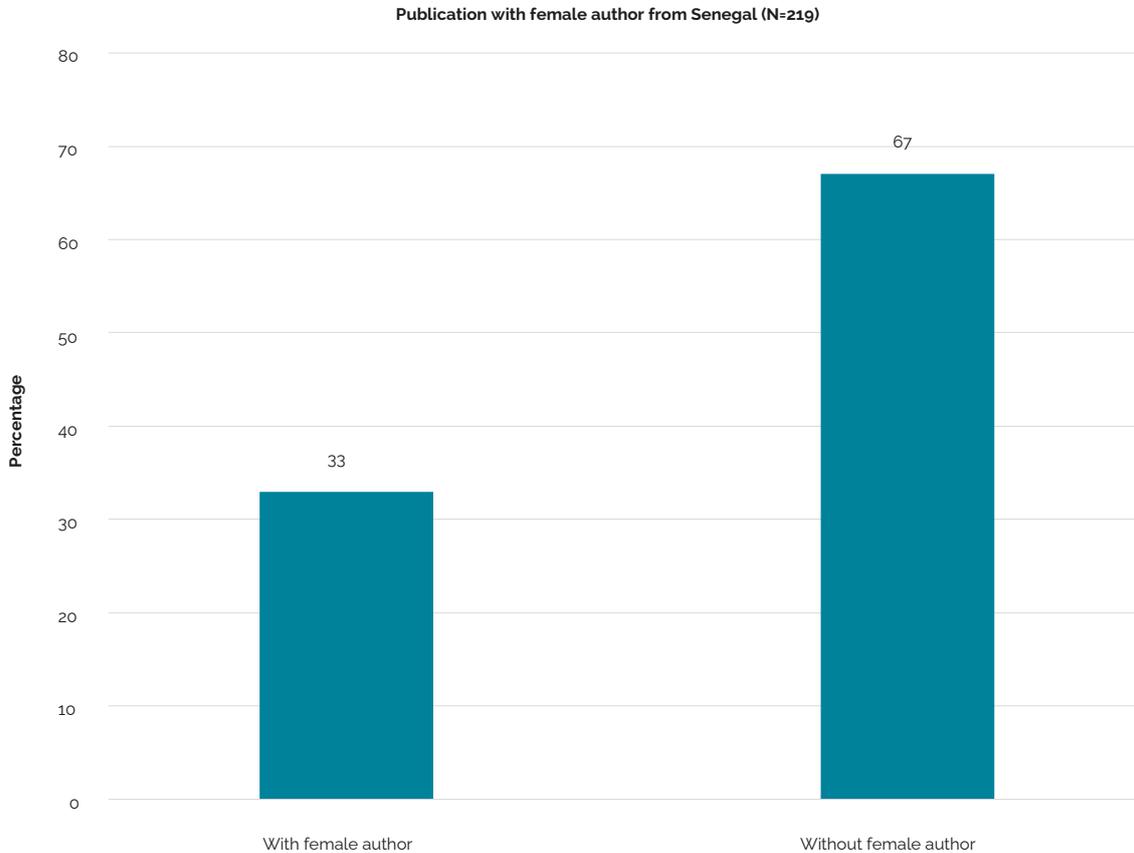
INSTITUTION	F	%
Université Cheikh Anta Diop de Dakar (UCAD)*	257	32.5
Centre de recherches océanographiques de Dakar-Thiaroye (ISRA/CRODT)*	210	26.6
Institut de recherche pour le développement (IRD)*	99	12.5
Institut national de recherche halieutique (INRH) (Morocco)	14	1.8
Centre national des sciences halieutiques de Boussoura (CNSHB) (Guinea)	13	1.6
Institut fondamental d'Afrique Noir Cheikh Anta Diop*	12	1.5
Université Gaston Berger (UGB)*	12	1.5
Institut mauritanien de recherches océanographique et des pêches (IMROP) (Mauritania)	11	1.4
Universitat de Barcelona (Spain)	11	1.4
Direction des aires marines communautaires protégées, Ministère de l'environnement	9	1.1
Institut Universitaire de pêche et d'aquaculture (IUPA)*	9	1.1

* Senegalese Institutions

Women constitute nearly half of the global fishery workforce (The World Bank, 2012), primarily in fishery post-harvest activities. In Africa, specifically in Senegal, nine in every 10 post-harvest workforce are women (Harper *et al.*, 2017). However, despite their valuable contribution, women lacked profile and recognition in fisheries and aquaculture (Williams, 2012) and fisheries research and development (Williams, 2016). Although women's career transition from education to research is faster than men, their career progress ends with lower salary and position (Williams, 2012).

Publication is one of the primary requirements for tenure and promotion in academic and research institutions, in which case women were found to be in the most unfavourable situation. This study revealed that only one-third (33 percent) of the 219 publications involved female Senegalese authors, while the remaining two-thirds (67 percent) involved male authors only (Figure 7). The percentage is even lower when the total number of authors was considered. Only 13 percent of the 729 authors were female authors from Senegal. This trend of authorship among fishery publications in Senegal is not an isolated case among fisheries and aquaculture research. It is as well an observable fact in other disciplines such as academicians (Cooper *et al.*, 2019), managers (Nielsen, 2017), and physicians (Lyons *et al.*, 2020).

► **FIGURE 7**
Number of publications with/without female author from Senegal



IV. Conclusions and recommendations

In summary, the results show that Senegalese marine fisheries researchers were communicating their research results in various avenues and formats. Although the majority of which were published in high-impact publications by academic publishers, still a considerable proportion was published in predatory journals. These publications are freely available online but were not indexed in databases such as ASFA, Scopus, and WoS that most academicians, researchers, scientists, and policymakers worldwide used. Further, publications in predatory journals have increased the information gap in Senegal's marine fisheries since they are less discoverable to their intended users. It also compromised marine fisheries research because the information they have disseminated has not undergone quality control or proper peer review. Despite these negative implications of publishing in predatory journals, many Senegalese researchers still fell into the ploy of predatory publisher. To better understand the decision of Senegalese researchers in publishing predatory journals, further investigation is warranted.

Although the publications have covered all of the priority subject areas, some have fewer publications, such as climate change, ecosystem modelling and gender and socioeconomic aspects of fisheries. Considering their impacts on fisheries, these topics could also be given attention by the country's fishery governing agencies and by academic and research institutions. If ever these topics were already being addressed, the research results or the projects that were undertaken should be communicated and made accessible to the stakeholders.

Generally, Senegalese authors tend to collaborate more often than not to accomplish their research projects and in publishing their results. They collaborate either with their fellow Senegalese researchers or with researchers outside the country. Preferably, they would collaborate with researchers outside West Africa, particularly with French researchers. Collaboration may determine publishing behaviour, thus further investigation is recommended.

Similar to the case of fisheries research in most countries, the gender gap in fisheries research in Senegal is evident as men dominated the authorship of the publications. This finding reflects the fact that women's contribution to the development of the fishery sector is less recognized, thus this must be given attention.

Overall, by presenting strengths, weaknesses, and research gaps in marine fisheries research in Senegal, the bibliometric analysis has shown a clear picture of the current state of marine fisheries research in the country. The results will guide national, regional, and international agencies in managing fisheries and aquatic resources in the country and in ensuring its sustainability for generations to come.

Moreover, to better understand Senegal's position in terms of marine fisheries research in the West African context, a full bibliometric analysis of the other West African countries' publications is recommended. The analysis would provide a clear picture of the status of marine fisheries research in the Region.



Small-scale fisheries,
Ghana, Africa.

©WorldFish/David Mills

4. CONCLUSIONS OF THE BIBLIOMETRIC ANALYSIS

The results of the analysis reveal intensive publishing activity by national research units and individual researchers in all nine countries from the period covered by the inventory (January 2010 – September 2020). Journal Articles were the most common document type published by authors from the region, with a number of high impact factor journals among the most published in sources, indicating strong research expertise of authors affiliated to institutions in the region. However, despite global research output growing by four percent annually over the past 11 years, the research inventory does not indicate a similar growth, with the number of references per year of publication not increasing but rather fluctuating. Further work is needed to understand why this is the case as it may be due to the methodology used to record data on the inventory or due to publishing patterns not increasing in the CECAF region at the same rate as they have globally.

When looking specifically at grey literature references recorded on the inventory, 77 percent of references were identified by searching nationally held collections, indicating that these documents are either missing or overlooked by online sources. It is recommended that steps are taken to improve their online accessibility, including digitising print only materials and creating database records for all references.

Creating records on a database such as OpenASFA, apart from the benefits relating to improved accessibility of the identified documents, would form the basis for a rigorous and comprehensive analysis of the volume of research output on specific topics of interest to CECAF, based on assigned subject, geographic and taxonomic keywords. This would create a more accurate level of detail than the inventory provides in Excel format, where only one keyword is listed.

In terms of publishing patterns in focus countries, the analysis revealed that a significant number of articles are published in so called “predatory journals.” This indicates authors from the region struggle to have their research accepted for publication in accredited journals, which could be for one of several reasons: inexperience in publishing practices; publishing bias on the part of the journals; cost of publishing in accredited or Open Access journals. Journal articles co-authored by authors from more than one country in the region were more likely to publish in academic journals with a high impact factor rather than in predatory journals. Cooperation across the region can therefore be seen as a factor in improving access to research in impactful journals and should be encouraged.

In order to produce a more detailed analysis of national, regional and international co-authorship further work on the inventory is required that has not been possible in the time permitted. This work could also be extended to include analysis of gender of authors in the CECAF region.



Woman selling fish in Nigeria fish market.

©WorldFish/Nhuong Tran

5. RECOMMENDATIONS FOR FURTHER WORK

In this section, several areas of further work are recommended that will build on progress made to record and disseminate marine fisheries research in the region. ▼

**Identification and analysis of marine fisheries research:
Case studies from selected countries in the fishery committee for the
Eastern Central Atlantic (CECAF) area of competence**

Online database of records – Several limitations were encountered when working with Excel, formatting issues limited the analysis that could be performed and made it difficult to add multiple keywords and authors to each reference. To increase the accuracy and utility of references collected on the inventory, we recommend creating an online database of records using the OpenASFA platform. OpenASFA is an online portal to create, store and export bibliographic records. Records on OpenASFA have detailed metadata which includes multiple subject, geographic and taxonomic keywords, in addition to recording multiple authors and their affiliation. Once recorded on OpenASFA, records can be displayed on CECAF webpages, with search configured to allow filtering on geographic, taxonomic or subject keywords. The ASFA Secretariat will prepare a proposal for this work and discuss with CECAF.

One of the responsibilities of ASFA National Partners is to create records on OpenASFA for relevant research in their country. As ASFA has National Partners in eight of the countries which participated in this project, OpenASFA will provide a continually updated source of marine fisheries research published in the region.

From OpenASFA, records can be exported to use in other systems or websites, for example we are connecting records to display on relevant FAO Fisheries webpages, as well as exporting the records to the commercial publisher ProQuest. Recruitment of new institutions in the CECAF region to the ASFA partnership would ensure records from a wider geographic area are included on OpenASFA. The ASFA Secretariat hopes to use the success of this project to attract more institutions from the region to join the ASFA Partnership.

As a first step, the ASFA Secretariat has created 100 OpenASFA records from references collected in the inventory. These records help to demonstrate the value of OpenASFA over Excel and will help to provide a time/ cost estimate for completing records for remaining all references recorded on the inventory. As this project has demonstrated the volume of research being produced in the region that is not easily available via online sources, OpenASFA could play an important role in improving the accessibility of research, particularly grey literature, produced in the region, providing benefits to the region beyond the end of the CECAF-PESCAO project.

Expansion to other CECAF member countries – having completed activities for nine CECAF member countries, the ASFA Secretariat, Daryl Superio and Arame Gaye Ndiaye Keita would be willing to complete a similar exercise in CECAF member countries not included in this study. Due to the difficulties and limitations of working in Excel, if expansion to other countries were to proceed, we would recommend creating records on OpenASFA rather than Excel.

Detailed bibliometric analysis – Appendix 3 provides in-depth bibliometric analysis for references recorded during stage one (online sources) for authors affiliated to institutions in Senegal. This analysis could be expanded to cover the remaining eight countries and references identified during stage two. A considerable amount of time would be required to record the gender and affiliation of all authors in the inventory, however doing so would provide analysis on author cooperation and gender on a country and regional level.

Training and promotional materials – the ASFA Secretariat will work with its partners in the CECAF region to produce a manual to assist searching of online resources, helping to improve

access to research. As requested by national consultants, we will also produce infographics highlighting their work and promoting their institution's research publications and involvement in the project.

Digitisation - Although only a small number of references identified by participants are available in print format only, digitisation and upload to an Open Access repository of these resources is still recommended. These print-only resources could be digitised and uploaded to OpenASFA to ensure access to full text of all records created.

A number of recommendations for future work were mentioned by National Consultants in their reports. These included repeating the exercise in 2021 to identify more research. Ideas for an in-person meeting were proposed and building on the network formed during this activity was recommended. If the project is extended to other CECAF member countries in 2021, time and thought should be given to creating a formal network of information professionals to assist the long-term capture of marine fisheries research.

Other recommendations included:

- Expanding the search criteria to inland waters and aquaculture.
- Expanding the search criteria to cover pre-2010 material. Historic material is less likely to be digital and so is more at risk of being lost as it ages.
- Produce a bibliography based on the research inventory
- Promotional materials should be made available to participants so that they can promote the value of this project at their institutions. FAO ASFA Secretariat will produce infographics for each country highlighting the research identified as part of this project.

References

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- Grudniewicz, A., Moher D., Cobey K.D.** 2019. *Predatory Journals: no definition, no defence*. Nature, 11 December 2019. (<https://www.nature.com/articles/d41586-019-03759-y>)
- White, K.** 2019. *Publications Output: U.S. Trends and International Comparisons* [online]. [Cited 9 March 2021]. (<https://nces.gov/pubs/nsb20206/>)

Appendix 1

SEARCH STRINGS USED TO SEARCH ONLINE SOURCES

The below tables show the search strings used to search four online sources (ASFA, Google Scholar, Scopus and Web of Science) in order to identify relevant research. The search strings can be pasted into the search bars of these online sources to repeat the searches and identify further research published after the completion of this project. For any assistance with searching, please email: Maria.Kalentsits@fao.org ▼

ASFA database

► TABLE A1

Search strings used to identify relevant material on the ASFA database

COUNTRY	SEARCH STRING
Benin	noft(fish*) AND noft(marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*") AND af(Benin)
Côte d'Ivoire	noft(fish*) AND noft(marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*") AND af("C?te d?Ivoire" OR "Ivory Coast")
Ghana	noft(fish*) AND noft(marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*") AND af(Ghana)
Guinea	noft(fish*) AND noft(marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*") AND af(Guinea)
Mauritania	noft(fish*) AND noft(marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*") AND af(Mauritania)
Morocco	noft(fish*) AND noft(marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*") AND af(Morocco)
Nigeria	noft(fish*) AND noft(marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*") AND af(Nigeria)
Senegal	noft(fish*) AND noft(marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*") AND af(Senegal)
Spain-Canary	noft(fish* AND Canary) AND noft(marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*") AND af(Spain)
Spain-West* Africa	noft(fish* AND "West* Africa") AND noft(marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*") AND af(Spain)

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Scopus database

► TABLE A2

Search strings used to identify relevant material on the Scopus database

COUNTRY	SEARCH STRING
Benin	(TITLE-ABS-KEY (fish* AND (marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*"))) AND AFFILCOUNTRY (benin) AND NOT AFFILCOUNTRY (nigeria)
Côte d'Ivoire	(TITLE-ABS-KEY (fish* AND (marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*"))) AND AFFILCOUNTRY (c?te AND *ivoire) OR AFFILCOUNTRY (ivory AND coast)
Ghana	(TITLE-ABS-KEY (fish* AND (marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*"))) AND AFFILCOUNTRY (Ghana)
Guinea	(TITLE-ABS-KEY (fish* AND (marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*"))) AND AFFILCOUNTRY (guinea) AND NOT AFFILCOUNTRY (bissau OR papua OR equatorial)
Mauritania	(TITLE-ABS-KEY (fish* AND (marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*"))) AND AFFILCOUNTRY (Mauritania)
Morocco	(TITLE-ABS-KEY (fish* AND (marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*"))) AND AFFILCOUNTRY (morocco)
Nigeria	(TITLE-ABS-KEY (fish* AND (marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*"))) AND AFFILCOUNTRY (nigeria)
Senegal	(TITLE-ABS-KEY (fish* AND (marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*"))) AND AFFILCOUNTRY (senegal)
Spain-Canary	(TITLE-ABS-KEY ((fish* AND "Canary Is*") AND (marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*"))) AND AFFILCOUNTRY (spain)
Spain-West* Africa	(TITLE-ABS-KEY ((fish* AND "West* Africa*") AND (marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar* OR "eco* model*" OR "eco* approach*"))) AND AFFILCOUNTRY (spain)

Web of Science (WOS)

► TABLE A3

Search strings used to identify relevant material on Web of Science

COUNTRY	SEARCH STRING
Benin	AD=(Benin NOT Nigeria) – to exclude Benin as Nigeria's State + TS=(fish* AND (marine OR sea OR ocean* OR bay OR lagoon OR estuar*)) AD=(Benin NOT Nigeria) AND TS=(fish* AND Fleet) AD=(Benin NOT Nigeria) + TS=(fish* AND ("ecosystem modelling" OR "ecosystem approach")) Year: 2010-2020
Côte d'Ivoire	AD=((Ivory Coast) OR Côte d'Ivoire) + TS=(fish* AND (marine OR sea OR ocean* OR bay OR lagoon OR estuar*)) AD=((Ivory Coast) OR Côte d'Ivoire)) AND TS=(fish* AND Fleet) AD=((Ivory Coast) OR Côte d'Ivoire) + TS=(fish* AND ("ecosystem modelling" OR "ecosystem approach")) AD=((Ivory Coast) OR (C?te d'Ivoire) OR (C?te Ivoire)) + TS=(fish* AND (marine OR sea OR ocean* OR bay OR lagoon OR estuar* OR "ecosystem modelling" OR "ecosystem approach")) Year: 2010-2020
Ghana	AD=(Ghana) + TS=(fish* AND (marine OR sea OR ocean* OR bay OR lagoon OR estuar*)) AD=(Ghana) AND TS=(fish* AND Fleet) AD=(Ghana) + TS=(fish* AND ("ecosystem modelling" OR "ecosystem approach")) Year: 2010-2020
Guinea	AD=(Guinea NOT Equatorial NOT Papua NOT Bissau) + TS=(fish* AND (marine OR sea OR ocean* OR bay OR lagoon OR estuar*)) AD=(Guinea NOT Equatorial NOT Papua NOT Bissau) AND TS=(fish* AND Fleet) AD=(Guinea NOT Equatorial NOT Papua NOT Bissau) + TS=(fish* AND ("ecosystem modelling" OR "ecosystem approach")) Year: 2010-2020
Mauritania	AD=(Mauritania) + TS=(fish* AND (marine OR sea OR ocean* OR bay OR lagoon OR estuar*)) AD=(Mauritania) AND TS=(fish* AND fleet) AD=(Mauritania) + TS=(fish* AND ("ecosystem modelling" OR "ecosystem approach")) Year: 2010-2020
Morocco	AD=(Morocco) + TS=(fish* AND (marine OR sea OR ocean* OR bay OR lagoon OR estuar*)) AD=(Morocco) AND TS=(fish* AND fleet) AD=(Morocco) + TS=(fish* AND ("ecosystem modelling" OR "ecosystem approach")) Year: 2010-2020
Nigeria	AD=(Nigeria) + TS=(fish* AND (marine OR sea OR ocean* OR bay OR lagoon OR estuar*)) AD=(Nigeria) AND TS=(fish* AND fleet) AD=(Nigeria) + TS=(fish* AND ("ecosystem modelling" OR "ecosystem approach")) Year: 2010-2020
Senegal	AD=(Senegal) + TS=(fish* AND (marine OR sea OR ocean* OR bay OR lagoon OR estuar*)) AD=(Senegal) AND TS=(fish* AND Fleet) AD=(Senegal) + TS=(fish* AND ("ecosystem modelling" OR "ecosystem approach")) Year: 2010-2020
Spain-Canary	AD=(Spain) + TS=(fish* AND (marine OR sea OR ocean* OR bay OR lagoon OR estuar*) AND (Canary OR "West* Africa")) AD=(Spain) AND TS=((fish* AND Fleet) AND (Canary OR "West* Africa")) AD=(Spain) AND TS=(fish* AND ("ecosystem modelling" OR "ecosystem approach") AND (Canary OR "West* Africa")) Year: 2010-2020

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Google Scholar

► TABLE A4

Search strings used to identify relevant material on Google Scholar

COUNTRY	SEARCH STRING
Benin	All of the words: Fish* AND Benin Any of the words: marine coast* ocean* bay* lagoon* sea* estuar* "eco* model*" "eco* approach*" None of the words: "Benin City" Year: 2010-
Côte d'Ivoire	All of the words: Fish* AND "Ivory Coast" OR "Côte d'Ivoire" Any of the words: marine coast* ocean* bay* lagoon* sea* estuar* "eco* model*" "eco* approach*" Year: 2010-
Ghana	All of the words: Fish* AND Ghana Any of the words: marine coast* ocean* bay* lagoon* sea* estuar* "eco* model*" "eco* approach*" Year: 2010-
Guinea	All of the words: Fish* AND Guinea Any of the words: marine coast* ocean* bay* lagoon* sea* estuar* "eco* model*" "eco* approach*" None of the words: "Papua New Guinea" OR "Guinea Bissau" Year: 2010- All of the words: (Peche* OR Poisson*) AND Guinea Year: 2010-
Mauritania	All of the words: Fish* AND Mauritania Any of the words: marine coast* ocean* bay* lagoon* sea* estuar* "eco* model*" "eco* approach*" Year: 2010-
Morocco	All of the words: Fish* AND Morocco Any of the words: marine coast* ocean* bay* lagoon* sea* estuar* "eco* model*" "eco* approach*" Year: 2010-
Nigeria	All of the words: Fish* AND Nigeria Any of the words: marine coast* ocean* bay* lagoon* sea* estuar* "eco* model*" "eco* approach*" Year: 2010-
Senegal	All of the words: Fish* AND Senegal Any of the words: marine coast* ocean* bay* lagoon* sea* estuar* "eco* model*" "eco* approach*" Year: 2010-
Spain- Canary	All of the words: Fish* AND Spain AND Canary Any of the words: marine coast* ocean* bay* lagoon* sea* estuar* "eco* model*" "eco* approach*" Year: 2010-
Spain- West* Africa	All of the words: Fish* AND Spain AND "West* Africa" Any of the words: marine coast* ocean* bay* lagoon* sea* estuar* "eco* model*" "eco* approach*" Year: 2010-

Appendix 2

ACTIVITY REPORT

The following section reports on activities which took place during stages one and two (September 2020 – February 2021) as part of ASFA's support to the CECAF-PESCAO project.

The below table gives the dates, description and links to any recordings of the meetings that took place between November and December. ▼

► **TABLE B1****Details of training sessions given to project participants**

Introductory Session 3 Nov 2020	Introduction to the project (activities, timelines, roles, etc.); Participants introduce themselves; Q&A Meeting Recording available here Access Passcode: Fi!+NJYg
Homework 3-9 Nov 2020	Participants complete online survey asking about work situation and library holdings in advance of the ASFA-PESCAO workshops by 6 Nov. Results of the survey are available to view online here
Workshop 1 10 Nov 2020	Methodology for identification and recording of institutional research output not available online, including overview of agreed search strategies and keywords; Spreadsheet to record institutional results; Q&A Meeting Recording available here Access Passcode: Qajo`!6V
Homework 10-16 Nov 2020	Participants were given two tasks: (1) contact authors in their institution and/or perform searches on institution's collections (library catalogue/physical collections) and (2) record results on the spreadsheet following agreed methodology.
Workshop 2 17 Nov 2020	Updates by participants on work done. Methodology for identification and recording of national research output (institutions; serial publications/ monographs/ grey literature) Meeting Recording available here Access Passcode: =VbKr50T
Homework 17-23 Nov 2020	Participants were given four tasks: Identify relevant institutions in their country; Identify where research is held or recorded (library, websites, repositories, etc.); Identify relevant publications; Compile list of relevant research and send to the ASFA Secretariat
Workshop 3 24 Nov 2020	Updates by participants on work done. Further recommendations and discussion to identify issues that require more attention; Meeting Recording available here Access Passcode: g&sSYVU4
Homework 24-30 Nov 2020	Participants were given three tasks: Continue searching library, collections, websites, repositories, etc.; Contact authors in their country (either from the list provided or from their own list); Compile list of relevant research and send to the ASFA Secretariat.
Workshop 4 1 Dec 2020	Updates by participants on work done. Instructions on tidying-up the spreadsheet and filling in the final report template; Meeting Recording available here Access Passcode: y.3W0Z&%
Homework 1-7 Dec 2020	Participants fill in the report template and send it to the ASFA Secretariat along with the verified spreadsheet;
Post-workshop meeting 8 Dec 2020	Summary of national reports submitted by the project participants; Discussion on identified research area strengths and gaps; Feedback by participants and recommendations for further work; Activities planned for 2021. Meeting Recording available here Access Passcode: D20nj.ZU

METHODOLOGY - DATA RETRIEVAL, CLEANING, AND RECORDING FOR IN-DEPTH BIBLIOMETRIC ANALYSIS

► **TABLE C1**

Search strings used to identify research by Senegalese authors

DATABASE	SEARCH STRING
Aquatic Sciences and Fisheries Abstracts (ASFA)	noft(fish*) AND noft(marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar*) AND af(Senegal)
Scopus	(TITLE-ABS-KEY (fish* AND (marine OR coast* OR ocean* OR bay* OR lagoon* OR sea* OR estuar*))) AND AFFILCOUNTRY (Senegal)
WOS	AD=(Senegal) + TS=(fish* AND (marine OR sea OR ocean* OR bay OR lagoon OR estuar*))
Google Scholar (used Harzing's Publish or Perish Software)	All of the words: Fish* AND Senegal Any of the words: marine coast* ocean* bay* lagoon* sea* estuar*

1. The data were retrieved from the following databases using the agreed search strings in Table C1, a) ASFA; b) Scopus; c) Web of Science (WoS); and d) Google Scholar:
- keywords *lagoon** and *estuar** were intentionally included in the search string to include publications covering both brackishwater and marine environments;
 - search term exclusion was not identified (e.g., AND NOT (freshwater or brackish*); AND NOT aquacultur*) to include titles covering marine and freshwater or brackishwater environments and the relationships between marine fisheries and aquaculture;
 - screenshots of data retrieval from Scopus (Figure C1); and Google Scholar using Harzing's Publish or Perish Software (Figure C2).

► **FIGURE C1**
Data retrieval from Scopus

Scopus

165 document results

(TITLE-ABS-KEY (fish* AND (marine OR coast* OR bay* OR lagoon* OR sea* OR estuar*))) AND AFFILCOUNTRY (senegal)) AND PUBYEAR > 2009 AND PUBYEAR < 2021

Search Sources Lists SOV

Search within results...

Refine results

Limit to Exclude

Open Access

All Open Access (58) >

Gold (16) >

Hybrid Gold (8) >

Bronze (10) >

Green (50) >

Learn more

Year

2020 (16) >

2019 (21) >

2018 (15) >

2017 (14) >

2016 (20) >

2015 (15) >

2014 (13) >

Documents Secondary documents Patents

Analyze search results Show all abstracts Sort on: Date (newest)

All CSV export Download View citation overview View cited by Save to list

Document title	Authors	Year	Source	Cited by
Effects of cooperation and different characteristics of Marine Protected Areas in a simulated small-scale fishery	Owusu, K.A., Acevedo-Trejos, E., Fall, M.M., Merico, A.	2020	Ecological Complexity 44,100876	0
Insects as feed: Gendered knowledge attitudes and practices among poultry and Pond Fish farmers in Kenya	Waithangi, E., Afegnon, D.H., King'ori, S., Nakimbugwe, D., Fiaboe, K.K.M.	2020	NJAS - Wageningen Journal of Life Sciences 92,100312	0
Fishers' perceptions and attitudes toward weather and climate information services for climate change adaptation in senegal	Diouf, N.S., Ouedraogo, L., Zeugnoné, R.B., Niang, M.	2020	Sustainability (Switzerland) 12(2),9465, pp. 1-16	0
Analysis of fractional fishery model with reserve area in the context of time-fractional order derivative	Mansal, F., Sene, N.	2020	Chaos, Solitons and Fractals 140,110700	5

► **FIGURE C2**
Data retrieval from Google Scholar

Google Scholar query

Query: fish* AND Senegal, marine coas*

Source: Google Scholar

Papers: 297 Cited: 1262 Cited by: 85 g h: 139 h: 49 h: 4.45 h: 137

Query date: 3/5/2021 Cache date: 3/5/2021

How to search with Google Scholar

Author: Publisher/Journal: Title words: Year: 2010 2020 Linkup: ISSN: Clear All: Convert: Cite: New

Any of the words: fish* AND Senegal

Any of the words: marine coast* ocean* bay* lagoon* sea* estuar*

Any of the words: marine coast* ocean* bay* lagoon* sea* estuar*

The phrase:

Rank	Cited	Year	Author	Title	Year	Publication	Publisher	Type
1	671	2004	J Bole, C LAMM	Egg and sperm quality in fish	2010	General and comparative ...	Elsevier	
2	531	2021*	CC Mylonas, A Fou...	Broodstock management and hormonal mon...	2010	General and comparative ...	Elsevier	
3	453	2013*	M Angeles Esteban	An overview of the immunological defenses L...	2012	International Scholarly Pa...	downloads.hindawi.com	PDF
4	431	2019	JW Blount, BR Cap...	Marine natural products	2015	Natural Product ...	pubs.rsc.org	HTML
5	399	2021*	A Fadhil, K Sopha...	Review of safer dyes for agricultural and ma...	2010	... and sustainable energy ...	Elsevier	
6	385	2020*	M Bourgo, G Mee...	Impact of climate change on marine ecosyst...	2014	Nature Climate ...	nature.com	
7	381	2014*	J Adams, M Migan...	Current knowledge on the metabolism of L...	2010	General and comparative ...	Elsevier	
8	379	2014*	JW Blount, BR Cap...	Marine natural products	2014	Natural product ...	pubs.rsc.org	HTML
9	378	2020*	AGI Tacor, MB H...	Demand and supply of feed ingredients for fa...	2011	FAO Fisheries and ...	search.proquest.com	
10	373	2018*	B Phang, JM Fru...	How does fishing alter marine populations an...	2010	Journal of Marine ...	Elsevier	
11	363	2019*	AGI Tacor, MB M...	Fish nutrition: importance of aquatic foods in ...	2013	Reviews in Fisheries Science	Taylor & Francis	
12	359	2014*	F Guedes, A Labes...	Chemical interactions between marine macro...	2010	Marine ecology progress ...	int-res.com	
13	342	2019*	SM Garcia, AA Res...	Food security and marine capture fisheries L...	2010	... Transactions of the Roy...	royalsocietypublishing.org	
14	299	2022*	JW Tucker Jr	Marine fish culture	2012		books.google.com	BOOK
15	277	2013*	J Flanagan, M V...	Feeding behaviour and digestive physiology L...	2013	Reviews in ...	Wiley Online Library	
16	269	2018*	K Hamm, M Vitor...	Fish larval nutrition and feed formulation: In...	2013	Reviews in ...	Wiley Online Library	
17	265	2016*	J Bellas, J Menten...	Ingestion of microplastics by demersal fish fr...	2016	Marine pollution ...	Elsevier	
18	244	2019*	JN Ouedraogo	Review of methods for fish stock assessment	2013		FAO	
19	240	2010*	RR Reeves, K McCl...	Marine mammal bycatch in gillnet and other ...	2013	Endangered Species Rese...	int-res.com	
20	223	2019*	H Kawasaka, C ...	The potential role of small fish species in imp...	2011	Public health nutrition	cambridge.org	
21	219	2019*	H Sigaud, A Desr...	Current knowledge on the photosensitization...	2010	Journal of Fish Biology	Wiley Online Library	
22	218	2012*	C Baylouni, E Ghis...	Statistical anomalies in mixed L. complanat...	2013	Reviews in ...	Wiley Online Library	
23	206	2016*	S Gallar	Senegal an African nation between Islam and...	2020		books.google.com	BOOK
24	199	2019*	AJ Dyck, VR Soma...	Economic impact of ocean fish populations L...	2010	Journal of Bioeconomics	Springer	
25	195	2019*	UT Gononson, W...	Food security implications of global marine c...	2010	Journal of ...	Springer	
26	181	2014*	YJ Shin, UJ Shanno...	Using indicators for evaluating, comparing, a...	2010	... Journal of Marine ...	academic.oup.com	
27	180	2019*	IC Olowu, A Fec...	Alkylols in marine algae	2010	Marine Drugs	mdpi.com	
28	180	2016*	S Cooke, D Havel, L...	Mitigating climate change through restaurati...	2011		openknowledge.waikato.ac	
29	172	2019*	HA Hoggar, T Lem...	Marine Algae in Pharmaceutical Science, Vol 2	2019		books.google.com	BOOK
30	165	2019*	C Fernandez, L Fer...	Nitrogen fixation in denitrified marine waters	2011	PLoS one	journal.plos.org	HTML
31	163	2019*	AGA Olowu, RG Al...	Heavy metal contamination in sediments and...	2013	Ecotoxicology and environ...	Elsevier	
32	161	2016*	JM Gonzalez-Moran...	A global estimate of benefits from ecosystem...	2010	Journal of Bioeconomics	Springer	
33	160	2017*	D Kijts	Physiological mechanisms used by fish to co...	2015	Journal of Experimental Bi...	pub.biologists.org	

2. Retrieved data were exported to Microsoft Excel.

4 _ Combined data from the four databases and deleted the duplicates (Figure C10).

► FIGURE C5

Excel file containing the combined relevant titles during the first stage of data cleaning

Source Database	Title
Scopus	A comparison of the fish assemblages on natural and artificial reefs off Sal Island (Cape Verde)
Google Scholar	A critical review of the European Union West African fisheries agreements
Scopus	A critical review of the European Union West African fisheries agreements
Google Scholar	A focus on Senegal
Scopus	A focus on Senegal
Google Scholar	A global estimate of benefits from ecosystem-based marine recreation: potential impacts and implications for management
Scopus	A global estimate of benefits from ecosystem-based marine recreation: potential impacts and implications for management
Google Scholar	A Method for Measuring Fishing Effort by Small-scale Fish Aggregating Device (FAD) Fishers from the Commonwealth of Dominica
Scopus	A Method for Measuring Fishing Effort by Small-scale Fish Aggregating Device (FAD) Fishers from the Commonwealth of Dominica
Google Scholar	A modelling approach to assess the impact of land mining on marine biodiversity: Assessment in coastal catchments experiencing catastrophic events (SW Brazil)
Scopus	A modelling approach to assess the impact of land mining on marine biodiversity: Assessment in coastal catchments experiencing catastrophic events (SW Brazil)
Google Scholar	A multi-agent ecosystem model for studying changes in a tropical estuarine fish assemblage within a marine protected area
Scopus	A multi-agent ecosystem model for studying changes in a tropical estuarine fish assemblage within a marine protected area
WOS	A multi-agent ecosystem model for studying changes in a tropical estuarine fish assemblage within a marine protected area
Google Scholar	A multimetric index approach using fisheries data to assess fish assemblage structure in relation to salinity gradient in a tropical West African estuary
Scopus	A multimetric index approach using fisheries data to assess fish assemblage structure in relation to salinity gradient in a tropical West African estuary
WOS	A multimetric index approach using fisheries data to assess fish assemblage structure in relation to salinity gradient in a tropical West African estuary
ASFA	A multimetric index approach using fisheries data to assess fish assemblage structure in relation to salinity gradient in a tropical West African estuary
Google Scholar	A New Approach to Estimation of the Length—Weight Relationship of <i>Pollachis pollachius</i> (Gmelin, 1789) on the Atlantic Coast of Galicia (Northwest Spain): Some ...
Scopus	A New Approach to Estimation of the Length—Weight Relationship of <i>Pollachis pollachius</i> (Gmelin, 1789) on the Atlantic Coast of Galicia (Northwest Spain): Some ...
Google Scholar	A new record of Cephalopods teneipis in the Mediterranean Sea, with considerations on the Sicily channel as a biogeographical crossroad of exotic fish
Scopus	A new record of Cephalopods teneipis in the Mediterranean Sea, with considerations on the Sicily channel as a biogeographical crossroad of exotic fish
Google Scholar	A new record of the parasitic copepod, <i>Lernanthropus indicus</i> (Pillai, 1967)(Copepoda: Lernanthropidae) from carangid fishes in north-west Arabian Gulf, Iraq
Scopus	A new record of the parasitic copepod, <i>Lernanthropus indicus</i> (Pillai, 1967)(Copepoda: Lernanthropidae) from carangid fishes in north-west Arabian Gulf, Iraq
Scopus	A new species of <i>Prohatschekia</i> Nunes-Rulvo, 1954 (Siphonostomatoida: Hatschekidae) from the scorpaenid fish, <i>Scorpaena neglecta</i> Temminck & Schlegel ...
Google Scholar	A new species of <i>Prohatschekia</i> Nunes-Rulvo, 1954 (Siphonostomatoida: Hatschekidae) from the scorpaenid fish, <i>Scorpaena neglecta</i> Temminck & Schlegel ...
Scopus	A new species of <i>Prohatschekia</i> Nunes-Rulvo, 1954 (Siphonostomatoida: Hatschekidae) from the scorpaenid fish, <i>Scorpaena neglecta</i> Temminck & Schlegel ...
Google Scholar	A perception-based participatory monitoring and evaluation approach to foster effective co-management of the marine protected areas in Northwest Africa
Scopus	A perception-based participatory monitoring and evaluation approach to foster effective co-management of the marine protected areas in Northwest Africa
WOS	A perception-based participatory monitoring and evaluation approach to foster effective co-management of the marine protected areas in Northwest Africa
Google Scholar	A phylogeny of <i>Cichlidogyrus</i> spp.(Monogenea, Dactylogyridae) clarifies a host-switch between fish families and reveals an adaptive component to ...
Scopus	A phylogeny of <i>Cichlidogyrus</i> spp.(Monogenea, Dactylogyridae) clarifies a host-switch between fish families and reveals an adaptive component to ...
Google Scholar	A preliminary genetic map in <i>Solea senegalensis</i> (Pleuronectiformes, Soleidae) using BAC-FISH and next-generation sequencing

5 _ Cleaned data were copied to a standard spreadsheet containing the metadata required by CECAF (Figure C6). The following are the metadata contained in the spreadsheet:

- Source database
- Title of the article
- Year of publication
- Collaboration
- Number of author(s) from West Africa (including Spain)
- Number of author(s) from Senegal
- Country of the first author
- Name of authors from West Africa (including Spain)
- Gender of authors
- Country and affiliation of authors from West Africa (including Spain)
- Country of authors outside West Africa (except Spain)
- Title of the source (journal, magazine, books, etc.)
- Type of publication (journal article, book, book chapter, conference proceedings, etc.)
- Data if the source is predatory or not (reference: Beall's list of potential predatory journals and publishers)
- Data if the source is grey literature or not
- Data if the publication is open access or free access
- Link to fulltext for open access or free access article
- Link to record in ASFA database if the article is indexed in ASFA
- Taxonomic terms
- PESCAO keywords
- ASFA keywords
- Author assigned keywords

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► **FIGURE C6**
Standard spreadsheet containing all the metadata

6 _ Titles were retrieved or accessed individually and the metadata were recorded in the spreadsheet (Figure C7).

► **FIGURE C7**
Metadata recording

7 _ Completed spreadsheet (Figure C8) is processed for bibliometric analysis.

► **FIGURE C8**
Completed spreadsheet showing research inventory

The image shows a screenshot of a Microsoft Excel spreadsheet titled "Completed spreadsheet showing research inventory". The spreadsheet contains a table with the following columns:

- Art. No.
- Source ID
- Article Title (English)
- Year of Publication
- Collaborative
- Number of Authors
- Country of First Author
- Name of Authors
- No. of Author from V Africa
- % of Total
- Gender of Author (as indicated by author's partner)
- With Friends Author Co.
- Country and Affiliations of Authors from West Africa and Uganda (List all West African Countries. One exemplification for each cell)
- Country of Author's Home and Train (List all Countries from which you are working in each cell)
- Source Title
- Type
- Productivity (in Deal's Unit)

The table contains multiple rows of data, each representing a research article. The data includes details such as the article's title, author names, their affiliations, and the countries they are from. The spreadsheet is displayed in a standard Excel interface with various toolbars and a ribbon at the top.

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IDENTIFICATION AND ANALYSIS OF MARINE FISHERIES RESEARCH

Case studies from selected countries in the fishery committee for the Eastern Central Atlantic (CECAF) area of competence

During 2020, the ASFA Secretariat supported the CECAF-PESCAO project by compiling an inventory of marine fisheries research produced in nine countries (Benin, Côte d'Ivoire, Ghana, Guinea, Mauritania, Morocco, Nigeria, Senegal, Spain). A search methodology was agreed with the CECAF project team, with support from the EAF-Nansen Programme in order to identify relevant marine fisheries research. Further parameters, including publication date and author affiliation, were defined in order to conduct systematic and repeatable searches. In the first stage, online searches were conducted using four sources (ASFA database, Google Scholar, Web of Science and Scopus) resulting in 1 527 references being recorded on the inventory. The second stage involved searching local and nationally held collections (library catalogues, institutional websites or repositories) to identify further references. The second stage resulted in a further 884 unique references being identified. The results from these searches were then combined to produce an inventory of 2 411 unique references. A bibliometric analysis was then conducted on the inventory which revealed intensive publishing activity and strong collaboration across the region, however publishing in predatory journals and difficulty in locating grey literature on online sources were areas where further work is needed to ensure research produced in the area reaches a wide audience. A detailed analysis of research published by authors affiliated to Senegalese institutions was conducted which revealed a significant gender imbalance of authors (only 13 percent of authors identified in the study were female). Due to time constraints, it was not possible to expand this detailed analysis to other countries. Recommendations included in this report are to expand the inventory and analysis to other CECAF member countries and to take steps to ensure the grey literature produced by authors from the CECAF region is indexed by online sources.

Two versions of the research inventory are available to download: a simplified version can be downloaded here: <https://data.d4science.net/DAGA> and a version with full metadata can be downloaded here: <https://data.d4science.net/tvvn>.

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