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FIFTY YEARS OF RESEARCH IN THE COMMONWEALTH OF THE BAHAMAS: A QUANTITATIVE THEMATIC ANALYSIS OF SCHOLARLY OUTPUT

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Abstract: This study presents the first longitudinal bibliometric mapping of peer–reviewed research on The Bahamas, analyzing 12,113 Web of Science records (1975–2025) using CiteSpace v.6.4.R2. We identified 36 co–citation clusters (modularity Q = 0.7967; silhouette = 0.9231) and 28 keyword clusters (Q = 0.7523; silhouette = 0.8695), revealing 8 thematic trajectories over 5 decades. Early research (prior to 1990) focused on carbonate geology and sea–level dynamics across the northwestern Bahama Platform and Blake–Bahama Basin (Cluster#0, silhouette = 0.939). From the 1990s–mid–2000s, attention shifted to marine fisheries, *Aliger gigas,* coral reefs, and ecological resilience (Cluster #1, n = 203). In the late–2000s, oceanography, microbial ecology, and stromatolitic systems were most common (Cluster #4, silhouette = 0.982). Post–2010 research encompassed public health, climate impacts, and computational methods. Burst terms (terms showing rapid, time–bounded increases in usage rather than simply the most frequent terms) including "health" (24.39), "resilience" (19.82), and "impact" (31.21) indicate rising interdisciplinarity. Persistent underrepresentation of social–ecological systems, local knowledge, and climate–governance research shows the need for transdisciplinarity, local authorship, and alignment with national development frameworks. See Supplemental Figure **S1** for a graphical abstract summarizing the main findings of this study.

Key words: Bibliometric mapping, Caribbean studies, Climate vulnerability, Marine science, Scientometrics

Introduction

Documented and reviewed research can form the basis for national development in social, environmental, and public health policy. In small island developing states (SIDS) such as The Bahamas, scientific research that can document and understand the fragility of unique insular ecosystems are vital in guiding natural resource management. An accumulated history of research across disciplines informs policies to predict and mitigate future risks and vulnerabilities. Social science and historical research provide essential insights into culture, governance, livelihoods, community resilience, and societal values. The foundation of research is critical to building effective adaptations and strategies for an island, factors that are critical in a nation vulnerable to climate change and other global stressors.

The Bahamas is an archipelago over 1,200 km in length, with a distinctive carbonate geology of massive shallow (< 5 m) banks, creating a unique ecology on both the land and in the sea (Sealey and Logan 2019). The 6,000 m thick carbonate platform has accreted then eroded over millions of years to create separate bank systems and platforms. The Bahamas has served as the global center for understanding sedimentary processes, sea–level history and coral reef development (Sealey 2006). The country's marine ecosystems include not only the shallow banks, but deep erosional marine canyons and abutting abyssal plains (Peresypkin et al. 2003). Although The Bahamas has a low level of endemism in the Tropical Western Atlantic, there are unique populations and species assemblages creating remarkable biodiversity. The island geography of The Bahamas has impacted its history and culture, with low—lying islands supporting small human populations.

This linkage of geography, ecological and societal factors positions The Bahamas as a multifaceted natural laboratory for advancing both fundamental and applied research. Early scientific research in the region was shaped by colonial interests and international funding; thus, priorities were focused on topics of foreign interests rather than a national agenda. Prior to the 1990s, the research landscape was dominated by sedimentary geology as a training ground for petroleum geologists (Foos 1991, Whitaker and Smart 1997). The geology of The Bahamas represents processes that occurred during the Mesozoic in many locations around the globe but today, only occurs there. Privately funded marine research on spiny lobster (*Panulirus argus*), queen conch (*Alger gigas*), and Nassau Grouper (*Epinephelus striatus)*, referred to as the "holy trinity of Caribbean fisheries" were carried out by international researchers working at Bahamian field stations (e.g., the Caribbean Marine Research Centre, Gerace Research Centre, and Bimini Biological Station; Gruber et al. 1988, Colin 1992, Sandt and Stoner 1993, Rothfus 2008).

During this period, The Bahamas as a country had limited capacity to direct or coordinate research activities. It was only after the establishment of national environmental policy frameworks through international conventions that efforts to systematize and categorize scientific research began. In 1994, The Bahamas became one of the first SIDS to sign the United Nations Convention on Biological Diversity (CBD). Subsequently, research efforts began to align with stated national priorities and the core principles of the CBD (Bahamas Environment, Science and Technology Commission 1999, Sullivan—Sealey et al. 2002, Mumby et al. 2007, Lubin 2011, Anderson et al. 2018). Over the past 50 years, researchers worldwide have studied aspects of Bahamian geology, oceanography, ecology, climate, and human health. This growing body of research literature not only advances knowledge but also informs natural resource management and public health policies in The Bahamas and the wider Caribbean region.

Currently, the landscape of research focused on The Bahamas is characterized by interdisciplinary approaches, with an increased focus on climate—related challenges. There is still a lack of integration from local perspectives. However, despite the breadth of research conducted in The Bahamas, until now there has been no comprehensive quantitative assessment of the trends underlying this scholarly output. Understanding who is driving Bahamas—related research, how topics have evolved, and where collaborations are forming is valuable for contextualizing The Bahamas' place in the global scientific landscape.

In this study, we analyze all peer—reviewed literature published in English related to The Bahamas from 1975 to 2025 using bibliometric and network analysis tools. Mapping publications, collaborations, and research themes helps to reveal the trajectory of Bahamas—based research, how it has grown, which disciplines and issues have been most prominent, obvious data gaps, and how an international network of scientists has coalesced around the challenges and opportunities presented.

Materials and Methods

A structured methodological approach, i.e., Systematic Bibliometric Review, was employed to retrieve and analyze literature related to The Bahamas as per established methods (Booth 2016, Chen and Song 2019, Brunton et al. 2020). We first defined a broad search query to capture any scholarly work referencing The Bahamas. Specifically, we queried the Web of Science Core Collection for "baham"* in "All Fields" to ensure inclusion of any term beginning with "Baham" (thus covering "Bahamas", "Bahamian", "Bahama islands"). The Web of Science Core Collection was used as the sole data source due to its consistent metadata, robust citation indexing, and comprehensive coverage of peer—reviewed literature in English across the natural and applied sciences. While broader coverage could be achieved by incorporating other databases such as Scopus or PubMed, this study prioritized data uniformity, homogeneity, and citation integrity, all of which are essential for reliable co—citation, clustering, and burst detection in CiteSpace. The search yielded 12,113 documents spanning the publication years 1975 through June 2025. We then downloaded the full records of these documents, including bibliographic information, abstracts, keywords, author affiliations, and cited references, for scientometric analysis.

After data retrieval, CiteSpace (Version 6.4.R2) was used for network extraction and visualization. CiteSpace is a bibliometric software tool that allows for co—authorship, co—occurrence, and co—citation analysis with temporal slicing. In our analysis, we performed several steps, detailed below.

Collaboration Network Construction

We generated 3 collaboration networks – one each for countries, organizational affiliation entities, and authors. Nodes in these networks represent the respective entities, and links represent co—authorship of at least one paper. We applied thresholds in CiteSpace to focus on significant nodes and links (for visualization manageability). The software was set to include up to 137 country nodes, 1,050 organizational affiliation entity nodes, and 6,000 author nodes based on publication frequency and connectivity. These thresholds retain the most relevant contributors while pruning very isolated or low—output nodes. We calculated network metrics such as link counts and betweenness centrality for each node. The country collaboration network was used to identify major contributing countries and the extent of their international partnerships. The institutional or organizational affiliation entities network similarly highlighted leading research organizations/consortia and their global linkages. Institutional names were analyzed using the organizational affiliation entities exported from Web of Science/CiteSpace. These entities are not always equivalent in organizational scale: some refer to single universities, whereas others refer to multi—campus university systems, government agencies, or national research organizations. The author network exposed groups of researchers and key individuals in research collaborations based on The Bahamas.

Keyword Co—occurrence and Clustering

To map research themes, we extracted keywords from titles, abstracts, and author keywords (including Keywords Plus). Using CiteSpace's co—occurrence analysis, a keyword network of 1,068 nodes (keywords) was built. We then applied CiteSpace's clustering algorithm using a combination of log—likelihood ratio and latent semantic indexing for label extraction to analyze this network. The algorithm identified 85 distinct keyword clusters. Cluster labels are algorithmically generated from prominent terms and should be interpreted as descriptors rather than author—assigned categories. Cluster size indicates the number of contributing nodes or records, depending on the exported analysis. The silhouette score compares within—cluster cohesion with separation from the nearest neighboring cluster and ranges from −1 to 1; values approaching 1 indicate internally coherent, well—separated clusters, values near 0 indicate overlap, and negative values indicate possible misclassification (Rousseeuw 1987). "Mean year" is the arithmetic mean publication year of the items assigned to a cluster. These metrics describe cluster prominence, coherence and temporal concentration.

Citation Burst Detection

Burst detection was applied to keywords and cited references using CiteSpace's implementation of Kleinberg's algorithm (Kleinberg 2002, Chen and Song 2019). A burst is a statistically detected, rapid and time—bounded increase in the frequency of a term or citation relative to its surrounding baseline. Burst terms are therefore not necessarily the most frequent terms, and burst strength is not a measure of research quality or total long—term influence. Keyword bursts indicate periods of sharply increased term usage, while reference bursts indicate periods when particular publications received unusually concentrated attention in the research community. We specifically examined the top references with the strongest bursts. These "bursting" keywords and references are crucial for understanding what new topics or influential works have shaped the field at different times. The burst analysis was performed with default CiteSpace parameters, which detect bursts within the context of the dataset's timeline (in this case, annually from 1975 to 2025).

Co—citation Thematic Analysis

To complement keyword clustering, we conducted a co—citation analysis of references. This involves creating a network where nodes are cited references (papers, reports, etc.), and links indicate that 2 references are cited together by one of The Bahamas—related papers. Co—citation networks often reveal underlying research domains or paradigms. Given the large number of distinct references in our data (352,848 unique references), we applied CiteSpace's clustering on co—citations, which resulted in a high number of small clusters. We then focused on the 36 most significant thematic clusters identified from this co—citation network. These clusters correspond to major recurring themes or topic areas in the references, effectively capturing the evolution of research topics over time. For each such cluster, we noted its label, silhouette, and temporal attributes (e.g., many clusters have a "mean year" indicating when research in that cluster was most active). This thematic clustering provides a longitudinal perspective on how research themes have emerged, developed, or declined across the decades.

This study used descriptive bibliometric and network—analysis metrics generated by CiteSpace, including publication counts, record counts, cluster size, modularity Q, silhouette score, betweenness centrality, citation—burst strength and cluster mean year. These values are algorithm—derived indicators of publication volume, network structure, cluster coherence and temporal concentration, rather than inferential hypothesis tests. No ANOVA, t—tests, chi—square tests, regression models or other inferential statistical tests were performed; therefore, test statistics, degrees of freedom and p—values are not applicable. Where numerical results are reported, the relevant metric is named explicitly.

Results and Discussion

Temporal Trends

The number of digital publications of research on The Bahamas totaled 12,113 documents published from 1975 to June 2025. Annual publication counts rose from 21 in 1975 to a peak of 1,097 publications in 2004, followed by a decline and subsequent resurgence in publications after 2010 (Figure 1A). Digital research output has increased recently, reaching 844 publications in 2022, the second—highest yearly total. The publication record suggests an expansion then a broadening of Bahamas—based research into the early 2000s. A lull in the late 2000s may correspond with the global economic downturn. Research publications have had renewed growth in the past decade.

The early growth in publication output was partly associated with externally funded programs: for example, intensive investments in Bahamian carbonate geology to train sedimentary geologists in the 1970s followed by the establishment of dedicated field research centers in the early 1980's (Brown et al. 1992). The mid—2000s decline corresponds with the winding down of major initiatives such as the closing of the Perry Institute for Marine Science field station (formerly NOAA's Caribbean Marine Research Centre) on Lee Stocking Island in 2012. The post—2015 increase aligns with rising international interest in climate change, conservation, and sustainable development issues in island contexts, as well as increased post—graduate training for Bahamians through scholarships. The establishment of the advisory Bahamas Environment, Science, and Technology Commission (BEST) in the 1990s highlighted the need for educated Bahamians in science, environment, and education policies. Figure 1A illustrates this trajectory, showing the 2 major surges in research output in the 2000s. Evidently, scientific attention to and in The Bahamas has not been constant but rather punctuated by periods of rapid growth likely driven by the launch of major research programs or emerging global themes (e.g., coral reef declines and invasive species outbreaks). The recent uptick in publications confirms that The Bahamas remains a unique venue for a wide range of scientific investigations. Historical records suggest that the availability of mainly foreign research funding and logistical support (field stations, international collaborations) has influenced this publication trajectory.

Collaboration Patterns (Top Authors, Institutions, and Countries)

Research on The Bahamas is characterized by international dominance, involving researchers from 192 countries/regions (Figure 1B). The United States (USA) is the most prolific contributor, which is consistent with global trends. USA—based authors appear in 6,172 publications (~51% of all documents), which may be due to the proximity of the USA to The Bahamas, the past limitations of permitting regulation in The Bahamas, and availability of research dollars at US academic institutions. Bahamian researchers rank second in lead authorship with 1,381 publications, reflecting the remarkable increase in Bahamians with post—graduate degrees focusing their research in and on The Bahamas since independence in 1973. Other nations contributing researchers include Spain (880 publications) and England (UK; 859), followed by Canada (841), Germany

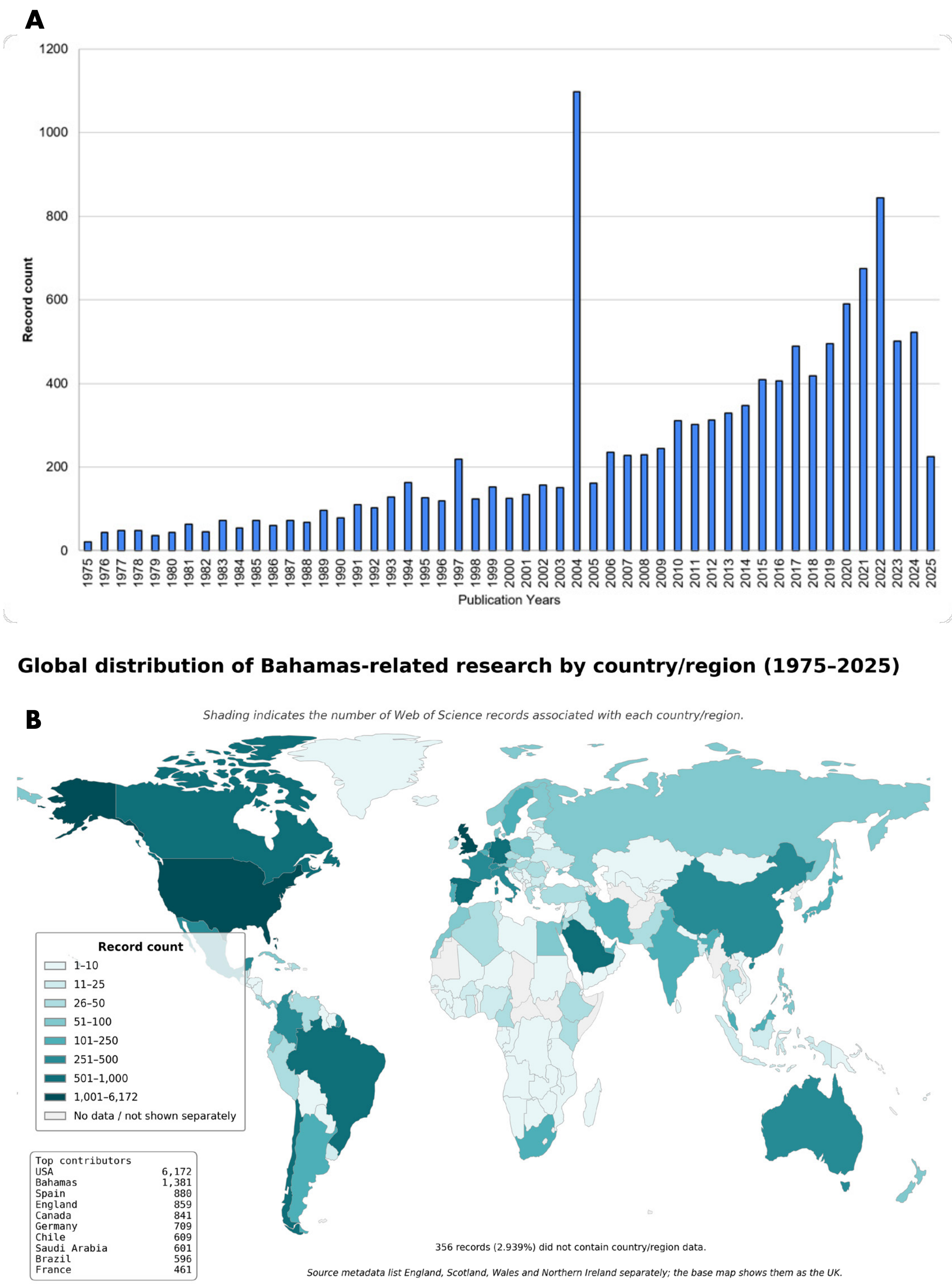

Figure 1. *Publication output and global distribution of Bahamas–based research, 1975–2025. A. Annual number of Web of Science publications related to The Bahamas from 1975 to June 2025. B. Global distribution of contributing countries/regions. Darker shading indicates a higher number of Bahamas–related records associated with each country/region, while the lightest unfilled category indicates no output detected in the dataset.*

(709), Chile (609), Saudi Arabia (601), Brazil (596), and France (461). These countries represent a mix of geographically proximate partners (e.g., the USA) and more distant nations with historical or thematic links to Bahamian science. For example, Spanish researchers have focused on marine geology, and UK researchers on ecology. This was somewhat serendipitous, with key individuals building a critical knowledge base and connection with The Bahamas. Notably, many smaller Caribbean neighbors (Jamaica, Cuba, Trinidad & Tobago) contribute modestly (dozens of papers each), indicating either regional interest and cooperation or available opportunities for funding at Bahamian institutions. This distribution reinforces a "core–periphery" structure in the collaboration network: large science producers in North America and Europe form a core that drives much of the output (often in partnership with Bahamian institutions), while smaller nations participate in targeted collaborations.

The country co–authorship network (Figure 2) shows the central role of a few key nations, particularly those from the Global North with current or former colonies in the Carib-

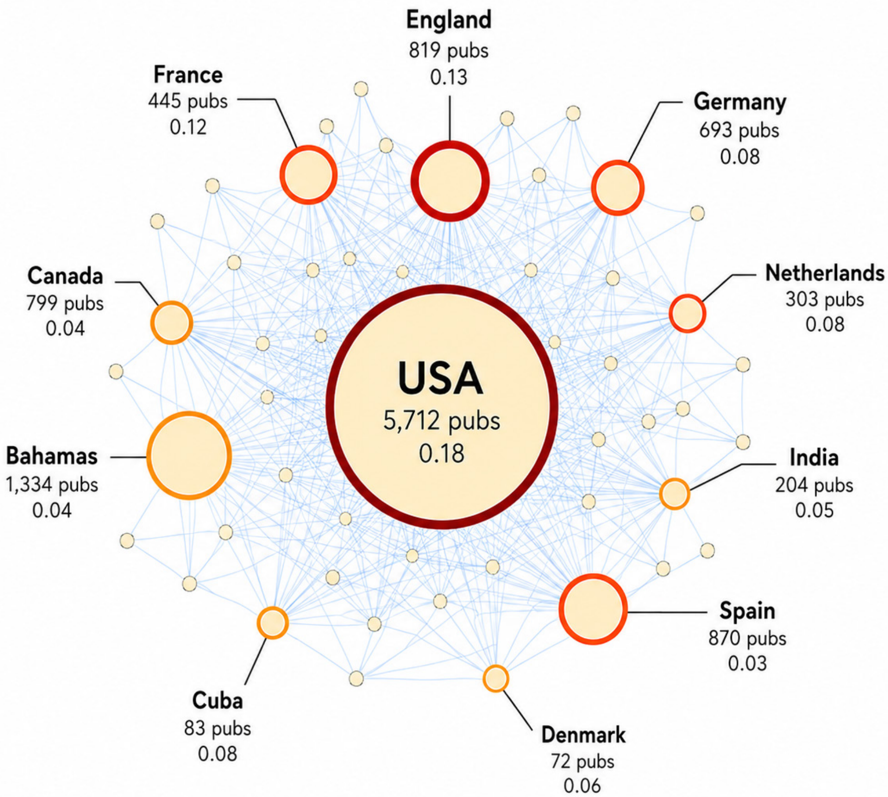

Figure 2. *International collaboration network of countries in Bahamas–based research. Each of the 264 nodes (circle) represents a country or region, and links (blue lines) represent co–authorship ties between countries. Node size is proportional to the number of Bahamas–related publications associated with that country, while outline color and thickness indicate betweenness centrality. Darker colors and thicker lines indicate greater centrality. Countries with higher betweenness centrality (bottom number) occupy stronger bridging positions in the collaboration network, connecting otherwise less–linked research communities.*

bean. In bibliometric network analysis, centrality refers to the relative importance or influence of a node, such as an author, institution, country or keyword, within a network (Brandes 2001). Different centrality measures capture different aspects of this influence. Betweenness centrality specifically measures the extent to which a node lies on the shortest paths between other nodes in the network (Brandes 2001, Ausiello et al. 2013). A node with high betweenness centrality therefore acts as a bridge connecting otherwise separate clusters, indicating its potential role in linking different research communities, themes or knowledge domains. The United States is at the network's hub, with the highest betweenness centrality (0.18). The United Kingdom and France also exhibit disproportionately high betweenness centrality values (0.13 and 0.12, respectively), despite their smaller publication counts, indicating that they frequently act as bridges between scientists in other countries. For example, UK–based researchers often partner with Bahamian and North American colleagues on coral reef studies, linking those groups. Similarly, France's collaborations in marine geology and climate science connect European and Caribbean institutions. Interestingly, countries with moderate publication output can also have relatively high betweenness centrality. Cuba, for instance, has a centrality value of about 0.08, placing it among the higher–tier bridging countries despite having only 83 publications. This suggests that Cuban researchers may play a role in facilitating regional collaborations, for example through co–authorship with USA and European teams on Gulf Stream ecology. In contrast, The Bahamas, despite being the second–largest contributor by publication volume, has a low betweenness centrality value of about 0.04. This suggests that Bahamian researchers often collaborate through bilateral partnerships, most commonly with the USA or UK, rather than serving as intermediaries between third–party countries. The overall network density is relatively low, but there are tightly connected subgroups. For example, one strongly interconnected group links countries from the Global North, including the USA, Canada, UK, Germany and Spain, while another links the USA with Latin American countries, such as through USA–Brazil co–authored studies on fisheries and hurricanes. These patterns emphasize that international collaboration is a defining feature of Bahamas–based research, particularly between affluent research nations and local partners. They also highlight how access to funding and infrastructure shapes collaboration patterns, as USA–based institutions have historically provided platforms, including vessels, laboratories and research funding, which enabled scientists from multiple countries to conduct work in The Bahamas.

Among Web of Science organizational affiliation entities (Figure 3), the University of Miami (UM) occupies the highest–centrality position with 595 publications and an extensive web of co–authorship links spanning the globe. This reflects UM's long–term involvement in Bahamian marine and geoscience (e.g., the Rosenstiel School of Marine and Atmospheric Sciences' (RSMAS) work on coral reefs and carbonate platforms since the 1970s). Indeed, UM's Comparative Sedimentology Laboratory was the center of Bahamian carbonate research funded by both private industry and the US government in the 1970s–1980s (Brown et al. 1992), establish-

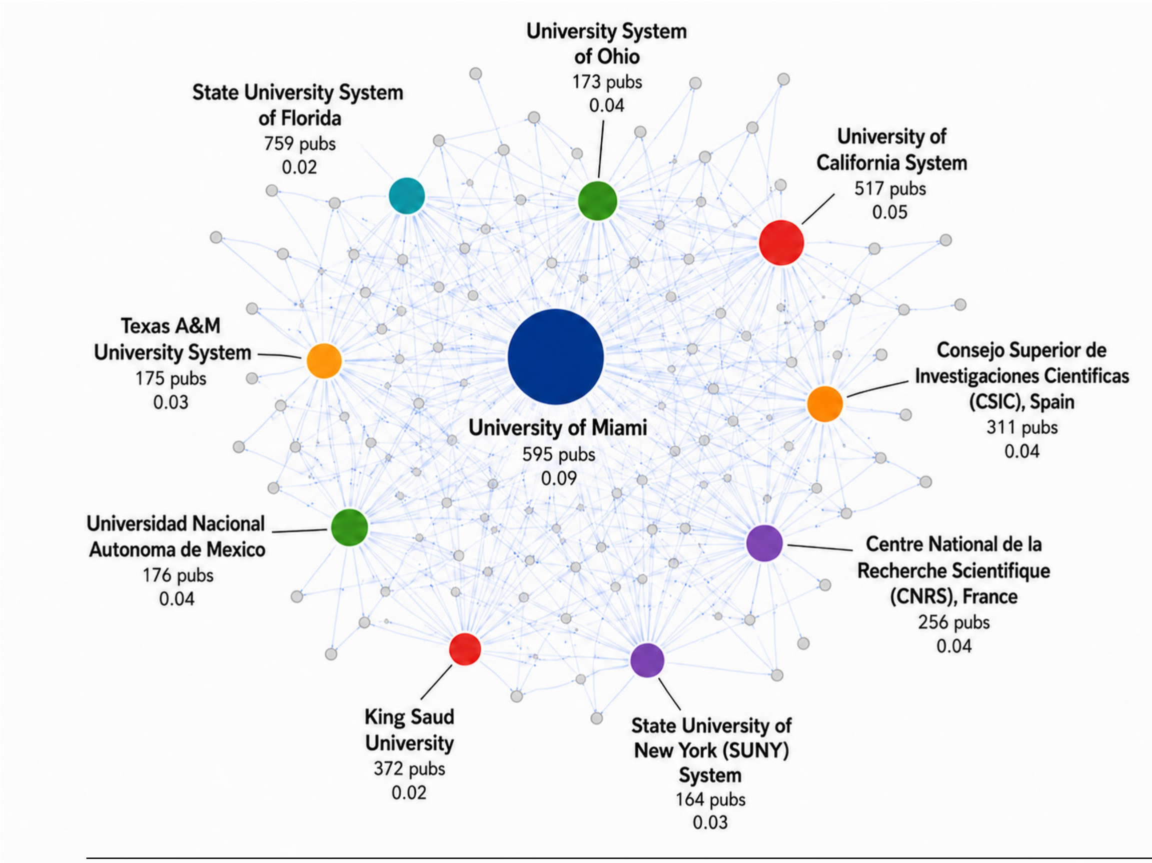

Figure 3. *Collaboration network of organizational affiliation entities in Bahamas–based research. Each node (circle) represents a Web of Science organizational affiliation entity, which may correspond to a single university, a multi–campus university system, a government agency, or a national research organization. Links (blue lines) represent co–authorship ties between organizational entities. Node size indicate betweenness centrality (centrality values indicated below pubs), color is just for illustrative purposes. Because Web of Science indexes some affiliations at system or umbrella–organization level, nodes should be interpreted as bibliometric affiliation entities rather than directly comparable single institutions. CSIC is Spain's national research council and CNRS is France's national research organization.*

ing The Bahamas as a natural laboratory for sedimentology. Several other high–ranking nodes represent broader systems or umbrella organizations, including the State University System of Florida (aggregated 759 publications), the University of California System (517 publications across its campuses), Consejo Superior de Investigaciones Cientificas (CSIC) in Spain, and Centre National de la Recherche Scientifique (CNRS) in France. These nodes should therefore be interpreted as collaboration hubs at the affiliation–entity level rather than as directly comparable single institutions. The high centrality shown by the University of California system and the State University System of Florida demonstrate that multiple USA academic centers contribute heavily, likely using California and Florida's geography and ecology to contrast and compare to The Bahamas. Outside the USA, notable nodes (some of which are not shown in Figure 3, to improve legibility) are King Saud University in Saudi Arabia (372 publications), Brazil's Universidade Estadual de Campinas (UNICAMP, 320 publications), Spain's CSIC, (311), and France's CNRS (256). These illustrate how specific international institutions have become key contributors, often due to key individuals, focused interests, or exchange programs (e.g., UNICAMP's tropical ecology projects in partnership with Bahamian parks and CSIC's marine geology expeditions).

Local Bahamian institutions play a smaller role: for example, the University of The Bahamas (officially renamed from "College of The Bahamas" in 2016) has roughly 203 publications (previously as the College of The Bahamas from 1975 to 2016 producing about 131 publications). Bahamian government agencies and NGOs occasionally appear as co–author affiliations as well, with contributions from the Bahamas National Trust (BNT) and Department of Marine Resources (DMR), in survey and policy–oriented studies post–2000. Other important collaborating institutions and agencies, some of which are not individually labelled in Figure 3, include the University of Florida (261 publications) and NOAA (232) which form part of the Florida–Caribbean research nexus, the University of North Carolina (240) connects via marine science projects, and the University of Cambridge and University of Oxford (each contributing to Bahamian ecology and paleoclimatology) occupy influential trans–Atlantic positions. European research centers such as Germany's Universität Tübingen (known for carbonate research) and the University of Exeter (coral reef conservation) link to the network via collaborative initiatives. The institutional collaboration map shows that a handful of top–tier research universities with access to research funding and resources (mostly in the USA and Europe), serve as hubs partnering with numerous smaller or Bahamian national institutions, thereby structurally reinforcing global–national research integration. Resources from outside of the country (from laboratories or ships to funding) have been critical in enabling diverse research in The Bahamas.

Finally, at the individual author level, an enormous co–authorship network of 38,784 authors was identified, fragmented into many clusters by discipline or project. Several highly productive, all male contributors and their collaborative groupings stand out, reflecting historic norms. The top contributors to Bahamas–focused literature include scientists who have dedicated substantial parts of their careers to Bahamian research. In marine science and ecology, Samuel H. Gruber (72 publications) is prominent for decades of shark biology research at Bimini, as are Steven J. Cooke (71) for fisheries science and Peter K. Swart (68) for carbonate chemistry and reef studies. In geology, pioneers like Robert N. Ginsburg (40+ publications), Albert C. Neumann (34), and Wolfgang Schlager (27) are notable for foundational studies of Bahamian Pleistocene geology; cave and karst researchers John E. Mylroie and John L. Carew have each contributed 50 publications centered on Bahamian karst landscapes. Ecologist Thomas W. Schoener (51 publications) and his collaborator David W. Spiller form another influential pair, known for island biogeography experiments in The Bahamas. These prolific authors cluster into thematic communities: for instance, Ginsburg, Eberli, Neumann, and colleagues form a tight—knit group on carbonate platforms and sea—level history (often co—authoring across institutions, including UM and the University of Tübingen). Gruber's name anchors a cluster of shark and marine conservation researchers spanning the U.S., The Bahamas, and the UK (including his mentees and collaborators such as Dean Grubbs, Demian Chapman, and others from the Bimini Biological Field Station). Schoener and Spiller link with other ecologists (e.g., Jonathan B. Losos) focusing on lizard and food—web dynamics on Bahamian islets.

The author network is thus divided into sub—networks that mirror disciplinary lines, yet a few individuals act as bridges between fields. For example, Peter K. Swart collaborates with both geologists (on carbonate diagenesis) and biologists (on coral isotope ecology), giving him a modest but noteworthy betweenness centrality in connecting geology and marine biology communities (Swart et al. 2014). Another example is Kathleen Sullivan—Sealey, whose work spans ecology, environmental management, and sustainable development, linking academic research with policy and thus connecting ecological scientists to social scientists and government agencies. In summary, while no single researcher dominates Bahamian science, a cadre of domain experts has driven productivity in their niches, often through long—term field programs and mentorship lineages. Their collaboration patterns reflect how research initiatives in The Bahamas have often grown around key individuals and facilities, demonstrating the importance of sustained programs and leadership in producing high—impact research, as well as the role of field stations in nurturing expert communities.

Overview of Cluster Structure

The analysis generated by CiteSpace automatically yielded and named 2 types of clusters: 28 keyword clusters and 36 thematic clusters (Supplemental Material S1, S2). The 36 thematic clusters delineated the intellectual landscape of Bahamas—based research from 1975 to 2025. These clusters had a modularity Q score of 0.7967. Modularity shows how clearly a network separates into different groups. A high modularity score means that the research topics form clear clusters, rather than being randomly mixed together. The mean silhouette value was 0.9231. Silhouette values show how well the items within each cluster fit together. A high silhouette value means that the publications within each cluster are closely related to one another and are clearly different from publications in other clusters. The largest thematic clusters by size include Cluster #0 "northwestern Bahama Platform" (n = 234 documents), Cluster #1 "Queen Conch" (n = 203), and Cluster #2 "Blake—Bahama Basin" (n = 189). Each thematic cluster is labelled by an algorithmically derived term; for example, Cluster #0 is labelled "northwestern Bahama platform", reflecting the fact that geology research was highly skewed geographically because of the funding source and use of research vessels from the University of Miami. Cluster #1 is labelled "queen conch", reflecting the fisheries literature.

In addition to these thematic clusters, the keyword co—occurrence network yielded 28 well—defined keyword clusters, of which 18 are shown in Figure 4. These keyword clusters represent patterns in the terms that frequently

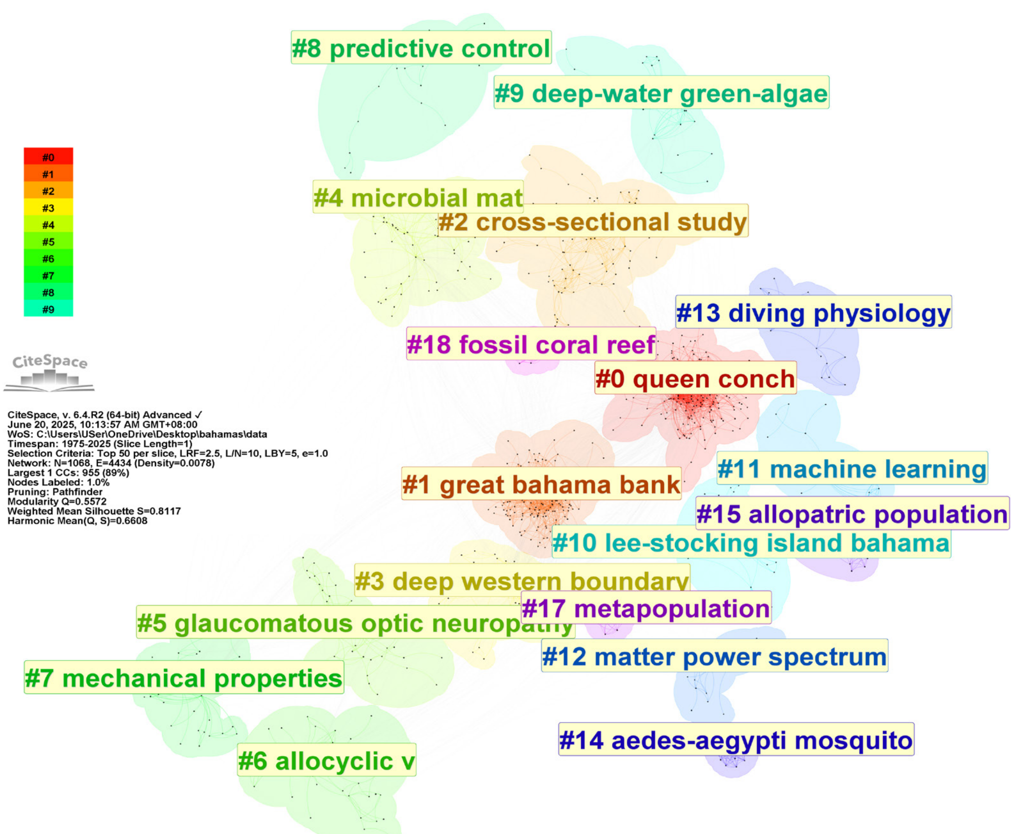

Figure 4. *Keyword co—occurrence clusters in Bahamas—based research, 1975–2025. The keyword co—occurrence network shows groups of terms that frequently appeared together across the dataset. Eighteen selected clusters are labeled. Colored regions distinguish algorithmically generated cluster regions generated by CiteSpace and do not encode importance. The visualization reports modularity Q = 0.5572 and mean silhouette S = 0.8117.*

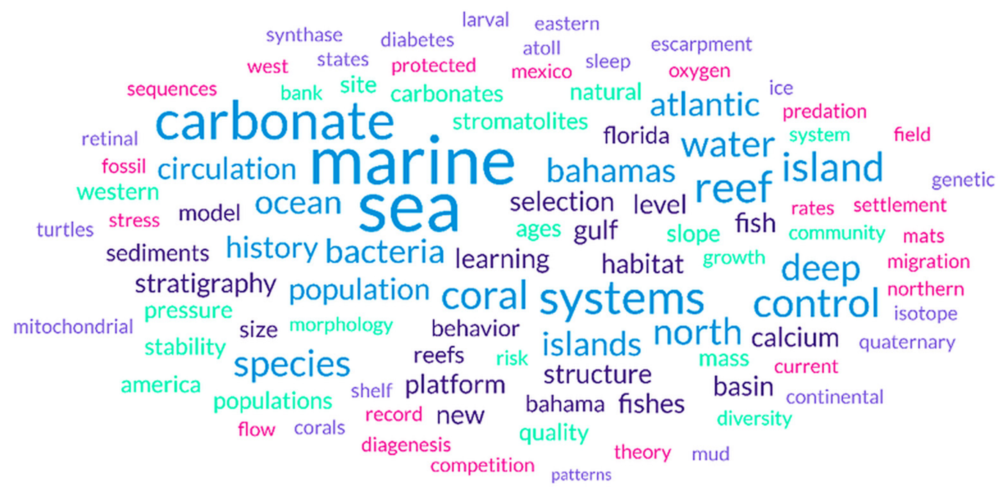

Figure 5. *Top 100 keywords in Bahamas–based research. Word cloud showing the 100 most frequent keywords identified in the keyword analysis. Font size is proportional to keyword frequency. Colors are decorative and have no analytical meaning. "Marine", "carbon", "water", "island", "coral" and "coral systems" are among the most prominent terms.*

appear together across Bahamas–based research, rather than document–level research themes. The keyword network exhibited a modularity Q of 0.7523 and a mean silhouette value of 0.8695, indicating a coherent and well–structured clustering pattern. Examples of these keyword clusters include high–frequency terms such as #0 "queen conch", #1 "Great Bahama Bank", and #13 "diving physiology", which show both disciplinary focus and the diversity of research topics. In contrast to Figure 4, which represents these keyword clusters, Figure 5 highlights the top 100 keywords in a word cloud, with terms such as "marine", "sea", "carbonate", "bacteria" and "coral" among the most prominent across the dataset.

To improve interpretability, the 28 algorithm–derived keyword clusters (See Supplemental Material S1) and the 36 algorithm–derived thematic clusters (See Supplemental Material S2), which were all automatically produced by CiteSpace/network analysis, were manually grouped into 8 broader meta–themes, based on shared subject matter, dominant keywords, cited literature and citation trajectories. These meta–themes are ranked according to their overall prominence in the dataset, primarily the number of publications and citations represented within the contributing clusters. The 8 meta–themes were Marine fisheries, conservation and resource management; Carbonate geology and sea–level science; Public health and epidemiology; Oceanography and climate dynamics; Microbial ecology and stromatolites; Ophthalmology and vision science; Sedimentary processes and ecological connections; and Biodiversity and taxonomic research.

Marine Fisheries, Conservation and Resource Management

The marine fisheries, conservation and resource management meta–theme includes Cluster #0 "queen conch" (21 nodes, silhouette 0.939, mean year 1994) as its largest contributing cluster, but it is not limited to queen conch research. Rather, this meta–theme captures the wider development of fisheries science, conservation planning and resource management in Bahamas–based research. It traces how early resource inventories evolved into broader conservation and spatial–management approaches, including studies on Queen conch (*Aliger gigas*), Nassau Grouper (*Epinephelus striatus*), Caribbean spiny lobster (*Panulirus argus*), Indo–Pacific Lionfish (*Pterois volitans*), marine protected areas and fisheries policy (Ray 1995, Stoner 1997, 1998a, 1998b, Sherman et al. 2018). Although ecosystem–based management is increasingly recommended for Bahamian marine systems, the published record suggests that implementation remains partial. In this context, ecosystem–based management is used to refer to management approaches that consider species interactions, habitats, ecosystem processes and human pressures together, rather than managing single stocks in isolation. These single–species studies broadened into community ecology and marine protected area evaluations, with keywords "community" (162 citations) and "management" (147 citations) showing strong citation bursts and indicating growing attention to ecosystem–based frameworks. Policy reforms such as the Nassau Grouper winter fishing ban, stricter export quotas, and the 2011 national shark sanctuary were influenced by research from field stations at Lee Stocking Island, Cape Eleuthera Institute and Bimini Biological Field Station (SharkLab); the closure of the Perry Institute for Marine Science field station in 2012 and subsequent growth of new facilities highlight shifting logistics. The cluster includes a high–sigma research front (#1) on Indo–Pacific Lionfish that stimulated local removal programs and adaptive management (Albins and Hixon 2008, Barbour et al. 2010, Benkwitt 2015). A combination of conservation projects since the year 2012 has led to the expansion of The Bahamas National Protected Area System (BNPAS) from ~758,684 hectares to ~7.5 million hectares as of 2021 (National Implementation Strategy Programme 2013[1], Bahamas Protected Areas Fund 2021). Despite growing Bahamian leadership, advanced stock assessments, genetic analyses and climate–driven models still depend on foreign laboratories, emphasizing the need for continued partnerships and national funding, as well as fuller integration of climate–change adaptation, resilience and social science into marine resource manage-

[1]National Implementation Strategy Programme Partnership. 2013. Annex I:40th Anniversary of The Bahamas proposal for The Expansion of the Protected Area System of the Commonwealth of The Bahamas. Proposal submitted to the Ministry of the Environment and Housing, Nassau, The Bahamas. 34 p.

ment (McCleave et al. 1994, Sherman et al. 2020, 2025).

Carbonate Geology and Sea-Level Science

Carbonate geology and sea—level science are represented by 2 overlapping clusters: #0 (high—energy shoals, 234 publications, silhouette 0.90, mean year 1976) and #1 (Great Bahama bank, 186 publications, silhouette 0.69, mean year 1996), that together illustrate how the Bahama Banks became the benchmark for carbonate platform evolution. Early work in the 1970s mapped high—energy ooid shoals, cross—bank channels and drowned Pleistocene reefs, demonstrating that the archipelago provides modern analogues of ancient carbonate systems (Hine and Neumann 1977, Mullins and Lynts 1977). Through the 1980s and 1990s, foreign—led teams drilled cores, deployed seismic surveys and applied U–Th dating to reconstruct glacio—eustatic cycles, refine diagenetic models and test allocyclic versus autocyclic deposition (Budd 1990, Chen et al. 1991, Osleger 1991, Henderson et al. 2006, Reijmer 2002). The UM's sedimentology lab and long—running field courses at the Gerace Research Centre provided practical training and logistics. By the late 1990s the Bahamas Drilling Project and Ocean Drilling Program cores supported sequence—stratigraphic models that linked Bahamian data to global climate oscillations, while small clusters on "Atlantic oscillation", "high sea level", "predictive control" and "uranium isotope fractionation" signaled new geochemical proxy development (Tissot et al. 2018, Seo 2024). Bahamian geoscientists have begun applying these techniques to Holocene sea—level history and hurricane reconstructions, but most geochronology and isotope analyses remain outsourced; investment in domestic laboratories and collaborative networks is essential.

Public Health and Epidemiology

The public health and epidemiology meta—theme include Cluster #2, labelled "cross—sectional" by the algorithm, with 99 publications, a silhouette value of 0.854 and a mean year of 2004. Here, "cross—sectional" should be understood as an algorithmically generated cluster label reflecting the frequent use of population—based and prevalence—oriented study designs, rather than as the sole subject of the cluster. The broader meta—theme documents a transition from infectious—disease surveillance to a wider suite of chronic—disease, genetic and computational health investigations. During the 1980s–1990s, Bahamian clinicians and international collaborators measured HIV and human T—cell lymphotropic virus prevalence, described opportunistic infections and co—infections, and characterized risk factors in pregnant women and high—risk groups (Harrington et al. 1991). These studies galvanized the National AIDS Programme and prompted the Zonta Club of Nassau to establish the AIDS Foundation of The Bahamas, which delivers education, prevention, and support. After 2000, the research focus shifted to non—communicable diseases such as obesity, diabetes, hypertension, and cancers, coinciding with the introduction of National Health Insurance. High—frequency keywords such as "risk", "prevalence", "women" and "health" reflect this expansion, while the advent of the #11 "machine learning" cluster illustrates growing interest in predictive analytics and precision medicine. Recent studies document a striking ~23% prevalence of BRCA1 mutations in Bahamian women with breast cancer and identify genetic variants linked to diabetes and metabolic syndrome (Trottier et al. 2016, Fielding 2022[2]). Emerging clusters on "*Aedes aegypti* mosquito" and "diving physiology" demonstrate attention to vector—borne disease and occupational health (Klowden and Chambers 1991). Local capacity has improved through the Princess Margaret Hospital research unit and community clinics, yet genomic sequencing, data curation and machine learning remain reliant on foreign partners, underscoring the need for national funding and cross—sector collaborations.

Oceanography and Climate Dynamics

Oceanographic research in The Bahamas is organized into clusters #3 (deep western boundary current; 79 publications, silhouette 0.843, mean year 1990) and #2 (Blake–Bahama Basin; 189 publications, silhouette 0.992, mean year 1985), complemented by smaller groups focused on "deep—water green—algae" and "predictive control". In the late 1970s and 1980s, foreign oceanographers deployed moorings, floats and shipboard measurements to reveal how the Florida Current, Antilles Current and deep western boundary current interact with the Bahama Banks and channel flows (McCleave et al. 1994, Miller et al. 1994). Large programs such as the Subtropical Atlantic Climate Studies (STACS), World Ocean Circulation Experiment and CLIMODE were supported by NOAA, NSF and the U.S. Navy; instrumentation staging occurred at the AUTEC base on Andros and the Rosenstiel School of Marine and Atmospheric Science (RSMAS). These efforts linked hydrodynamics to larval dispersal of eels and reef fishes and set the stage for research on mesoscale eddies, internal tides and stratification (Hamilton et al. 2005, Pujiana et al. 2023, Volkov et al. 2024, Seo 2024, Kough 2024). As climate change emerged as a central concern, scientists analyzed tide—gauge and satellite altimeter records to examine sea—level rise, North Atlantic oscillation variability, ENSO teleconnections and hurricane impacts. These studies link coral bleaching, mangrove die—back and fisheries productivity. Field stations on Lee Stocking Island, San Salvador, Eleuthera, Andros and Bimini host long—term moorings and time—series, while new acoustic Doppler and biogeochemical sensors installed in 2019–2020 extend these records. Although Bahamian participation is increasing, high—resolution modelling and autonomous platforms remain expensive; maintaining momentum will require partnership with international observatories and the development of national oceanographic infrastructure.

Microbial Ecology and Stromatolites

The microbial ecology and stromatolite cluster (#4 microbial mat; silhouette 0.779, mean year 2002) highlights how Bahamian stromatolites shifted perceptions of early life. While

[2]Fielding, W.J. 2022. Shifting attitudes towards COVID-19 in The Bahamas: 2020–2022. Unpublished manuscript, University of The Bahamas, Nassau, The Bahamas. 6 p. Available from ResearchGate https://www.researchgate.net/publication/364167526_Shifting_Attitudes_Towards_COVID-19_in_The_Bahamas (viewed on 7/21/2026).

microbial mats had been noted in earlier geological surveys, interest surged after interdisciplinary teams discovered extensive living stromatolite fields at Highborne Cay, Lee Stocking Island and Stocking Harbour in the late 1990s (Reid et al. 2000, Dupraz and Visscher 2005, Visscher et al. 2005, Dupraz et al. 2009, Baumgartner et al. 2009). These studies combined microbial ecology, sedimentology, geochemistry and remote sensing to show how cyanobacteria, sulphate–reducing bacteria and carbonate precipitation build laminated structures analogous to Archean fossils. High citation bursts for keywords "diversity", "carbon", "precipitation" and "biofilm" reflect the impact. Funding from NASA's Exobiology program, NOAA, and the Bahamian government, along with support from the Gerace Research Centre, Lee Stocking Island laboratories and the Exuma Cays Land and Sea Park, enabled field experiments and drew in Earthwatch citizen scientists. Later work applied metagenomics, microelectrode profiling and isotope fractionation to assess microbial diversity, biogeochemical cycling and resilience to sea–level and salinity changes (Wu et al. 2021). Recent analyses emphasize hypersaline ponds and blue holes as natural laboratories for astrobiology and climate research, linking microbial processes to carbon sequestration and informing reef restoration strategies (Puckett et al. 2011). Despite strong citation metrics, sequencing and geochemical facilities remain predominantly overseas. Strengthening national laboratories and training will empower Bahamian scientists to lead this frontier.

Ophthalmology and Vision Science

The ophthalmology and vision science cluster (#5 glaucomatous optic neuropathy; 43 publications, silhouette 0.979, mean year 1999) represents a small but influential domain centered on glaucoma. The high prevalence of primary open–angle glaucoma and familial predisposition among Afro–Caribbean populations stimulated collaborations between Nassau clinicians and researchers at the Bascom Palmer Eye Institute and other international centers in the late 1990s (Hayreh 1999). Early studies evaluated optic nerve perfusion, intra–ocular pressure, nitric–oxide signaling and vascular dysregulation and were collated in a special issue of the journal *Survey of Ophthalmology* that emphasized genetics, neuroprotection and early intervention (Chai and Goldberg 1999, Goldberg and Chai 1999, Haefliger et al. 1999). The Princess Margaret Hospital Eye Clinic, the Bahamas Ophthalmology Society and mobile outreach programs provide screening and treatment across the islands, while scholarships and partnerships have supported Bahamian trainees abroad. Later investigations explored gene polymorphisms, family pedigrees, and outcomes of trabeculectomy and drainage implants, with Bahamian ophthalmologists increasingly leading the research. Although the cluster is small, its papers are highly cited, reflecting both scientific merit and the global relevance of Afro–Caribbean eye health. Looking ahead, tele–ophthalmology, artificial–intelligence–assisted diagnostics and integration with public health programs could enhance surveillance and care. National investment in ophthalmic research and data registries would enable local clinicians to translate research into improved outcomes.

Sedimentary Processes and Ecological Connections

The sedimentary processes and ecological connections cluster (#6 allocyclic vs. 'autocyclic'; 36 publications, silhouette 0.883, mean year 1998) bridges carbonate sedimentology, marine ecology and biogeochemistry to examine how environmental drivers shape the Great Bahama Bank. Debates over allocyclic versus autocyclic controls on platform evolution emphasized the roles of storms, tides, sea–level change and biological productivity (Hine and Neumann 1977, Mullins and Lynts 1977, Kendrick 1991, Osleger 1991, Ray 1995). Subsequent work integrated studies of seagrass and macroalgae productivity, carbonate budget models, nutrient cycling and trophic linkages, revealing how seagrass beds, mangroves and tidal creeks mediate sediment export and support fisheries (Hearty et al. 2002, Pujiana et al. 2023). Field courses and research at the Gerace Research Centre, Bimini Biological Field Station, Forfar Field Station and Cape Eleuthera Institute facilitated hands–on learning for Bahamian and international students. The moderate size of this cluster reflects limited funding for integrative coastal science and the challenge of coordinating cross–disciplinary projects. Establishing national coastal observatories and sedimentology laboratories, and supporting collaborative networks, would enhance understanding of sediment–ecosystem interactions and inform sustainable coastal development.

Biodiversity and Taxonomic Research

The biodiversity and taxonomic research meta–theme (see Figure 6 and Supplemental Table S1) encompasses several sub–clusters, including #10 "Lee–Stocking Island Bahamas", #11 "invasive lionfish" and #18 "fossil coral reef". Although Lee Stocking Island is mentioned in several other clusters, it is included here because according to our manual analyses, we see that Cluster #10 includes studies that function primarily as a field–site cluster linking species inventories, reef–fish recruitment, coral assemblages, molluscan records and wider biodiversity observations. In this context, Lee Stocking Island is not treated as a separate subject area, but as a major research location through which biodiversity and taxonomic studies were repeatedly organized. This cluster therefore reflects the role of long–term field stations and accessible marine research infrastructure in shaping Bahamas–based biodiversity research. Together, these clusters mark a shift from descriptive species inventories to conservation science. Early surveys documented population dynamics, life histories and habitat preferences of queen conch, Nassau Grouper and reef fishes, alongside records of endemic and regionally significant species such as the Bahama parrot (*Amazona leucocephala bahamensis*), Bahamian rock iguana (*Cyclura* spp.), West Indian flamingo (*Phoenicopterus ruber*), Kirtland's warbler (*Setophaga kirtlandii*), Bahamian hutia (*Geocapromys ingrahami*), Smalltooth Sawfish (*Pristis pectinata*) and sea turtles (families Cheloniidae and Dermochelyidae) (Haney and McDonald 1998, Stoner 1998a,b, Greenstein and Pandolfi 1998a,b). The invasion of Indo–Pacific Lionfish triggered a new research front on predator ecology, population control and community effects (Albins and Hixon 2008, Mor-

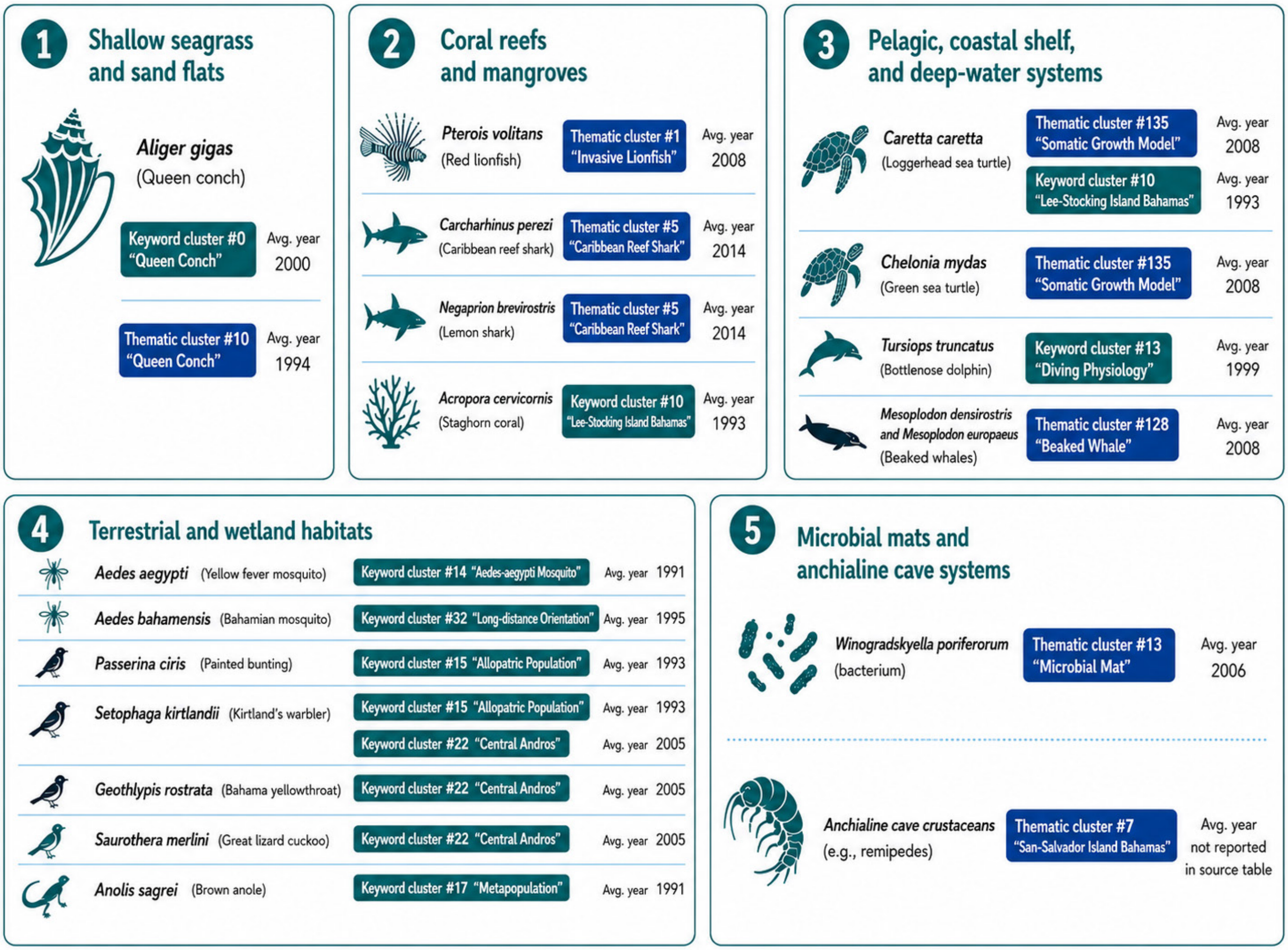

Figure 6. *Representative taxa associated with habitat–linked research clusters in Bahamas–based scholarship. Representative taxa are grouped into 5 broad habitat categories to provide a visual synthesis of species and organism groups identified across bibliometric clusters. The numbers 1–5 identify organizational groups only and do not indicate rank or importance. Blue labels indicate thematic clusters derived from cited–reference clustering, while teal labels indicate keyword clusters derived from keyword co–occurrence analysis. "Avg. year" refers to the mean publication year of items within the associated cluster. The figure summarizes prominent taxa and organism groups represented in the cluster analysis and is not intended as a complete species inventory.*

ris and Akins 2009, Benkwitt 2015, Pujiana et al. 2023, Sherman et al. 2025). The invasive–lionfish cluster appears at first to represent a narrow marine–ecology problem, but it is better understood as a cross–sector issue linking biodiversity loss, fisheries, food systems, tourism, governance, ecological security and public engagement. Subsequent studies examined sharks, turtles, dolphins and manatees; investigated avian metapopulation dynamics, and explored allopatric speciation, vertebrate assemblages preserved in karst cave and reef palaeobiodiversity (Björndal et al. 2000, Steadman et al. 2007, Guttridge et al. 2009, Caballero et al. 2012, Brown et al. 2017). Conservation is supported by protected areas, no–take zones, and community–based initiatives led by the Bahamas National Trust, local NGOs and the Government of The Bahamas. Although Bahamian scientists now lead many projects, access to genetic sequencing, remote–sensing imagery and underwater vehicles remains limited, pointing to the need for sustained funding, south–north partnerships and long–term ecological monitoring.

Others

As seen above, natural and health sciences dominate the dataset, while social sciences, humanities and interdisciplinary studies appear at lower volume within several keyword clusters, including Keyword Cluster #2 "Cross–sectional Study", Keyword Cluster #6 "Allocyclic vs. 'Autocyclic'", and Keyword Cluster #0 "Queen Conch". Keyword Cluster #6 "Allocyclic vs 'Autocyclic'" shows foundational population and community work, including Berggren et al.'s (1974) population genetics analysis in *Social Biology*, Agyei's (1976) demographic thesis's (1975) *Story of The Bahamas*, and anthropological insights on cultural practices and health behaviors (Appel 1977, *Medical Anthropology Newsletter*). Keyword Cluster #2 "Cross–sectional

Study" intersects women's health, epidemiology and community engagement, and includes studies such as Harrington et al. (1991) in Journal of Acquired Immune Deficiency Syndromes (JAIDS). Arts and humanities occur mainly through historical texts, with Albury (1975) bridging governance and identity. Education and pedagogy lack distinct keyword clusters or burst keywords (Supplemental Table S2), although outreach surfaces indirectly in the public health literature.

Citation bursts were interpreted as indicators of rapid, time–bounded increases in scholarly attention, rather than as measures of overall quality, total citation impact, or long–term foundational importance. A burst may signal an emerging research front, a period of intensified interest, or a shift associated with funding, field–site access, environmental events, policy attention, or methodological change; however, older studies with steady long–term citation patterns may be equally or more foundational even if they do not appear as burst references (Kleinberg 2002, Chen and Song 2019). For this reason, the citation–burst results (Supplemental Table S3) are used here as evidence of changing attention over time, not as a ranking of the most important publications in Bahamas–based research; this is particularly important for interpreting governance and policy research, which is often embedded within environmental and marine–resource studies rather than appearing as a separate, high–volume cluster. In the keyword cluster analysis, Keyword Cluster #0, "Queen Conch", includes research linked to marine conservation, MPA governance, fisheries management and ecological monitoring, including studies such as Kough et al. (2017), Kellner et al. (2010) and Lamb and Johnson (2010). The top bursting keyword, "impact" (strength 31.21 in 2020–2025; see Supplementary Tables S4 and S5), likely reflects growing links between science, policy and the socioeconomic effects of climate change. This interpretation is consistent with the broader policy context following The Bahamas' accession to the Convention on Biological Diversity in 1993 and the establishment of the BEST Commission in 1995, after which policy–oriented outputs such as the National Biodiversity Strategy and Action Plan emerged (Wells–Moultrie 2006). Although such governance and policy documents do not form a large standalone keyword or thematic cluster, they are important for understanding changes in the institutional context of Bahamas–based research. Overall, the visibility of different themes in the scholarly record appears to have been shaped not only by research interest, but also by funding availability, field infrastructure, institutional capacity and the extent to which policy–relevant work entered the indexed academic literature. Furthermore, since the analysis used only Web of Science and English–language records, it may underrepresent locally published, regional, non–indexed and non–English scholarship. Future comparisons with Scopus, PubMed and regional databases would test cross–platform robustness.

Finally, synthesizing across themes over 50 years of research, an interesting conclusion emerged (See Table 1, Figure 7, and Supplemental Table S4). Based on what has been published, clusters of importance have often been serendipitous and externally driven, producing rich knowledge but leaving nationally important areas such as groundwater resources, agriculture and renewable energy underrepresented. These areas are highlighted not only because they appear weakly represented in the bibliometric record, but also because they align with national priorities identified in The Bahamas' National Development Plan: Vision 2040, including environmental resilience, food security, sustainable resource management and economic diversification. As funder priorities shift, clusters waxed or waned

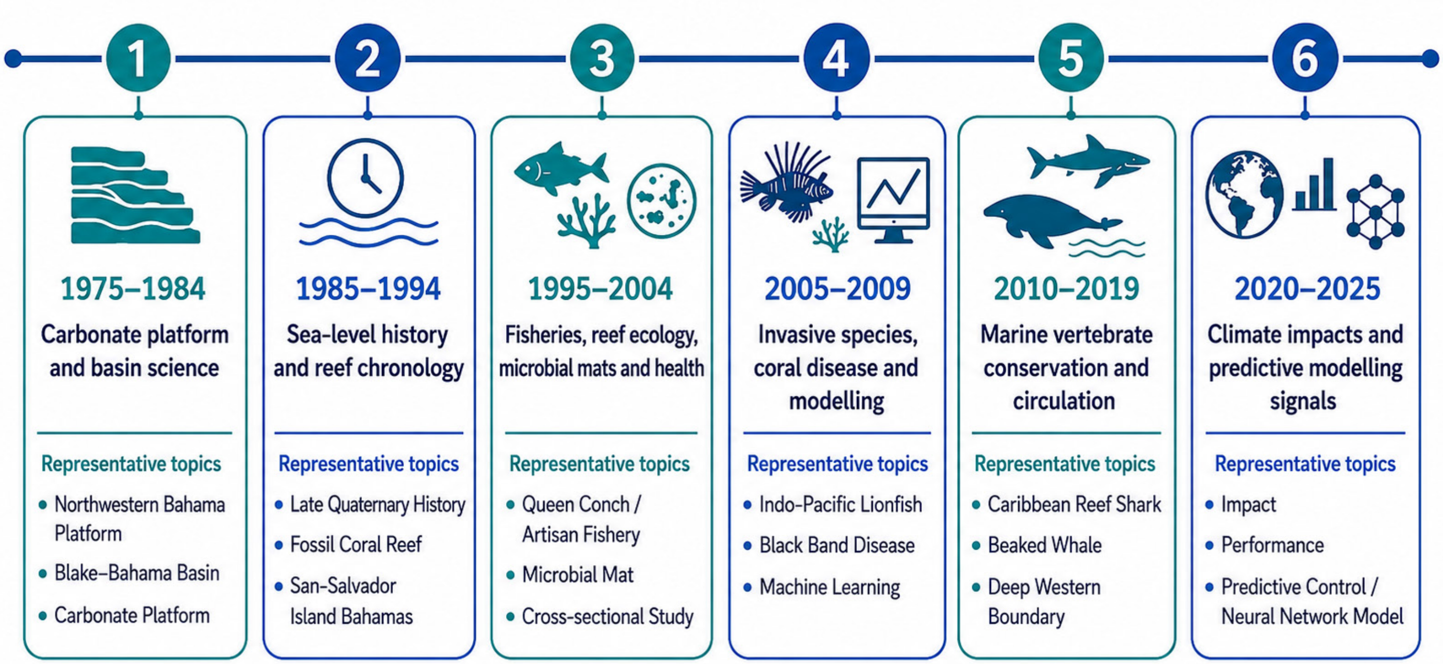

Figure 7. *Temporal evolution of dominant research themes in Bahamas–based scholarship, 1975–2025. Timeline summarizing the main research themes and representative cluster topics across 5 decades of Bahamas–related scholarship. The figure synthesizes broad temporal shifts identified from thematic clusters, keyword clusters, burst terms and network indicators.*

TABLE 1. *Evidence-to-action synthesis of major Bahamas-based research areas. Research areas were derived from the manual synthesis of CiteSpace keyword and thematic clusters. The table summarizes the main bibliometric pattern, gaps in data, recommended next steps, and likely professionals/agencies/organizations that could fully realize goals in each area.*

Research area	What did the analysis show?	What gap remains?	What should be done?	Who should act?
Marine fisheries and conservation	Strong applied theme led by "Queen Conch" research, with links to lionfish, MPAs, management and climate-change terms. Cluster #0: size = 203, silhouette = 0.665, mean year = 2000.	Fisheries research is strong, but it is not fully connected to livelihoods, value chains, local monitoring or national data stewardship.	Link ecological monitoring with catch data, bioeconomic models, household surveys and fisher knowledge. Rebuild long-term monitoring through field stations and Bahamian training.	Department of Marine Resources, Department of Environmental Planning and Protection (DEPP), Bahamas National Trust, NGOs, fishers' cooperatives and field stations.
Carbonate geology and sea-level science	Long-standing research strength centered on the Thematic cluster #0 "northwestern Bahama Platform" (size=234; silhouette=0.939, mean year= 1976), Thematic cluster #2 "Blake–Bahama Basin" (size = 189; silhouette= 0.992, mean year= 1985) and Great Bahama Bank. Key clusters show high coherence and early dominance.	Foundational geology is globally visible, but weakly linked to current reef condition, coastal exposure, groundwater risk and climate adaptation.	Reuse legacy cores, ODP data and carbonate-platform records for sea-level risk, blue carbon, coastal protection and reef-health monitoring.	Coastal engineers, geologists, disaster-risk planners, marine spatial-planning teams and climate-adaptation units.
Oceanography and climate dynamics	Important Atlantic-circulation theme centered on the "Deep Western Boundary" cluster. Cluster size = 79, silhouette = 0.843, mean year = 1997.	Physical oceanography is not sufficiently linked to fisheries, reef health, biological monitoring or nationally owned long-term time series.	Rebuild monitoring of the Florida Current, passages, tide gauges and coastal circulation, and connect these data to climate-risk dashboards.	Meteorological services, climate units, fisheries scientists, marine spatial planners and regional ocean-observing networks.
Public health and epidemiology	Growing post-2000 theme, with strong visibility of cross-sectional studies, health, risk and disease-related terms. Cluster size = 99, silhouette = 0.854, mean year = 2004.	Island-specific risk, equity, climate exposure, vector ecology and long-term non-communicable disease (NCD) tracking remain underdeveloped.	Build Small Island Developing States-specific health observatories linking infectious disease, NCDs, climate exposure, vector ecology and equity-stratified data.	Ministry of Health, Pan American Health Organization (PAHO), The Caribbean Public Health Agency (CARPHA), University of The Bahamas, public-health researchers and community health services.
Microbial ecology and stromatolites	Smaller but internationally important theme centered on microbial mats, stromatolites, carbonate precipitation and lagoon ecology. Cluster size = 68, silhouette = 0.779, mean year= 2002.	Local genomic, metabolomic, bioinformatics and analytical capacity remain limited.	Fund local metagenomics, environmental 'omics and bioinformatics pipelines, and protect key microbial-mat and stromatolite sites.	Marine ecologists, astrobiology researchers, University of The Bahamas, conservation agencies and field stations.
Ophthalmology and vision science	Small, coherent research pulse centered on glaucoma and Afro-Caribbean eye health. Cluster size = 43, silhouette = 0.979, mean year = 1999.	Weak links to social determinants, access to care, environmental exposure and long-term population health.	Develop Afro-Caribbean eye-health cohorts combining genetics, screening, affordability, ultraviolet exposure, climate stress and access to care.	Ministry of Health, ophthalmology units, World Health Organization (WHO) Caribbean networks, University of The Bahamas and public-health planners.
Sedimentary processes and ecological connections	Interdisciplinary theme linking carbonate sedimentology, seagrass systems, trophic ecology and environmental change. Cluster size = 36, silhouette = 0.883, mean year = 1998.	Few sedimentary records are translated into coastal-risk, storm-risk or marine spatial-planning decisions.	Develop sediment–reef chronologies for sea-level, storm and coastal-risk reconstruction, and add these to planning and protected-area risk layers.	Park managers, United Nations Educational, Scientific and Cultural Organization (UNESCO)-linked Programmes, coastal planners, climate scientists, field stations and MPA authorities.
Biodiversity and taxonomic research	Fragmented but coherent small clusters around birds, island taxa and allopatric populations. "Central Andros birds": size = 6, silhouette = 1.0, mean year= 1995; "allopatric population": size = 10, silhouette = 0.985, mean year= 1993.	Species inventories are not well connected through genetics, DNA barcoding, citizen science or national biodiversity databases.	Expand inventories using DNA barcoding, metabarcoding, community science and national data infrastructure. Prioritize Bahamian taxonomists and student training.	Bahamas National Trust, Department of Environmental Planning and Protection (DEPP), Global Biodiversity Information Facility (GBIF) partners, University of The Bahamas, NGOs, schools and community scientists.

accordingly. Aligning research with national needs will require stronger local capacity and sustained funding (Table 1 and Supplemental Table S5). The scientometric signals highlight sustainable fisheries, climate adaptation, groundwater resources, food systems, renewable energy and comprehensive biodiversity mapping as key priorities. Encouraging examples include growing collaborations between local NGOs, private partners and government for research, restoration and advocacy, such as the establishment of the coral gene bank and The Bahamas Mangrove Alliance. This capacity supports a national strategy to address data gaps, improve capacity and promote continuous monitoring rather than one–off studies. Collectively, these meta–themes provide a platform for a transition from serendipitous and externally driven research towards a more coordinated, nationally aligned research agenda.

Conclusion

This study provides the first longitudinal bibliometric mapping of Bahamas–based research over a 50–year period. The findings show that research on The Bahamas has been extensive, internationally connected and scientifically influential, but also unevenly distributed across disciplines. Early scholarship was dominated by carbonate geology, sea–level science and marine field–station research, while later decades show expansion into fisheries, conservation, microbial ecology, public health, climate impacts and computational methods (Figure 8). However, the analysis also shows persistent gaps in nationally important areas, including groundwater resources, food systems, renewable energy, social–ecological governance and locally led long–term monitoring. Thus, it seems that Bahamas–based research has produced a strong international knowledge base, but future research must be more deliberately aligned with national priorities, local capacity–building and sustained Bahamian leadership. A more coordinated research agenda is needed to move from externally driven and project–specific research towards work that directly supports climate resilience, biodiversity protection, public health, sustainable resource management, and national development.

Figure 8. *Graphical synthesis of 50 years of Bahamas–based research. The infographic summarizes the 12,113–record dataset, the 8 manually synthesized meta–themes, The Bahamas' role as a natural laboratory, and the central conclusion that future research should strengthen locally led, transdisciplinary and policy–linked scholarship. Icons and thematic placement are illustrative and do not encode quantitative rank.*

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