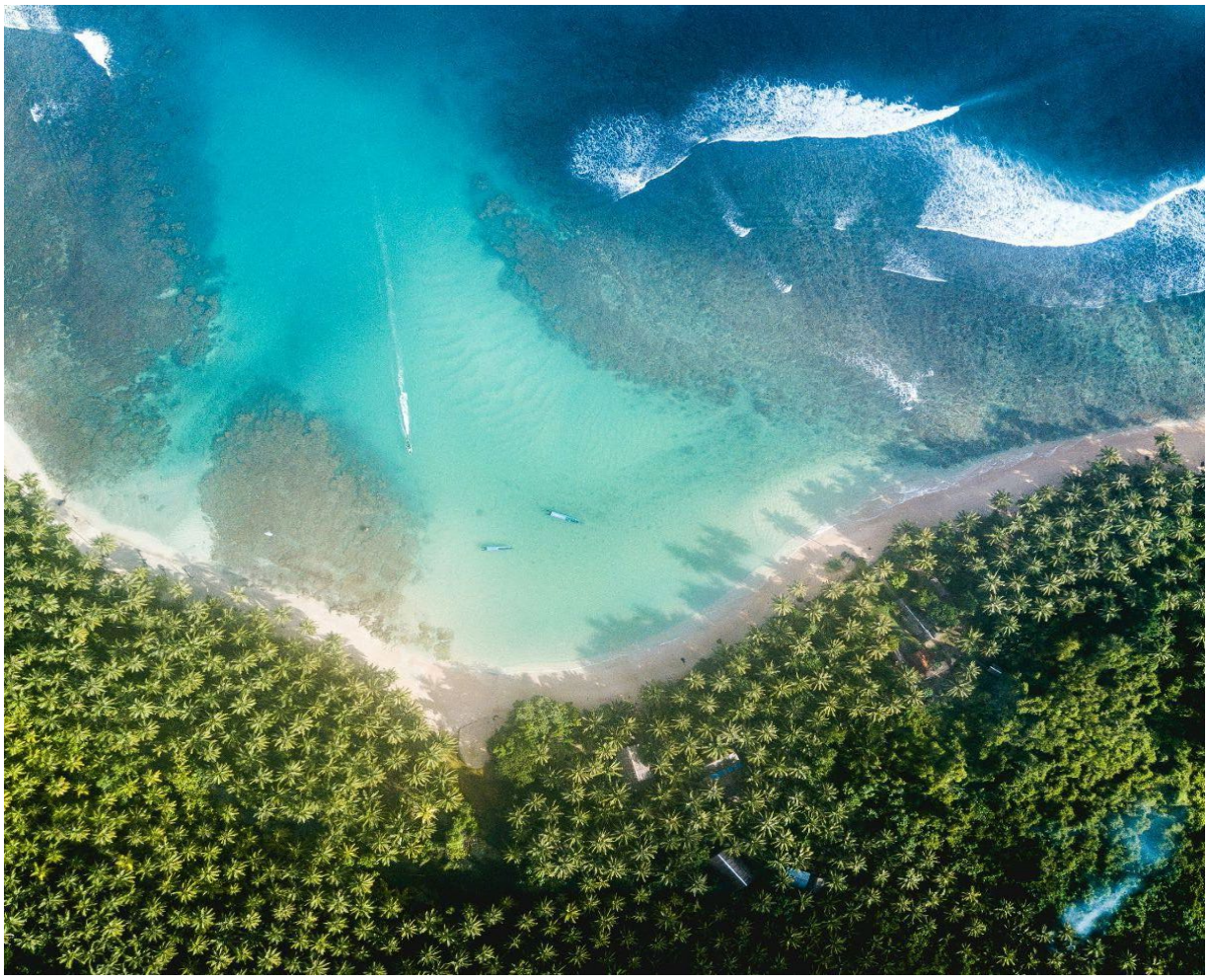
Introduction to Spatial Data in R Workshop Report

Ocean Country Partnership Programme

January 2026



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Evidence Quality Assurance:
This report is compliant with JNCC's Evidence Quality Assurance Policy.

Ocean Country Partnership Programme:
The Ocean Country Partnership Programme (OCPP) is a bilateral technical assistance and capacity building programme that provides tailored support to countries to manage the marine environment more sustainably, including by strengthening marine science expertise, developing science-based policy and management tools and creating educational resources for coastal communities. The OCPP delivers work under three thematic areas: biodiversity, marine pollution, and sustainable seafood.

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1. Workshop Overview

MarFishEco (MFE) delivered a three-day, in-person training workshop titled **Introduction to Spatial Data in R** for technical staff from the Coastal Zone Management Authority and Institute (CZMAI) and the Fisheries Department designed by MFE and led by Dr. Jordan DiNardo. This workshop builds on MFE's previous engagement in Belize, which included developing the Geospatial Data Curation Guidelines and delivering a workshop to present them to stakeholders across the country. It further strengthened national capacity for coastal and marine spatial data management, improving data accessibility and integration to support effective decision-making.

The training provided in this workshop focused on technical skills for working with spatial and non-spatial data in R, including data import and wrangling and analytical techniques using packages within tidyverse as well as the sf and terra packages, and spatial and non-spatial visualization using of data using ggplot2 and tmap packages. Emphasis was placed on developing reproducible workflows and applying best practices for data management, analysis, and visualization. The workshop blended lectures, live demonstrations, hands-on exercises, homework assignments, and a final applied project that encouraged participants to practice their new skills using their own datasets.

2. Participants

A total of 5 participants attended the workshop (Photo 1), representing CZMAI and the Fisheries Department. Participants' experience levels ranged from first-time R users to those with basic coding familiarity.

Photo 1. Participants of the workshop from left to right: Israel Correa (Data Manager), Jarain Lockwood (Fisheries Officer), Delwin Guevara (MSP Spatial Analyst), Janiel Chan (MSP GIS Technician), and Caisha Fermin (GIS Technician/GOAP Fellow). Workshop lead, Dr. Jordan DiNardo, pictured at bottom left.

3. Workshop Schedule and Structure

The workshop was organized into four structured sessions designed to build skills progressively, from foundational concepts in R to more advanced spatial analysis and visualization techniques (Table 1).

Table 1. General structure of the Introduction to Spatial Data in R Workshop.

Topic	Session	Date	Engagement hours
Installation and Introduction to R and RStudio	Session 0 (recording/work through independently)	1 Dec 2025	–
Foundations of General Data Manipulation, Analysis, and Visualisation	Session 1	3 Dec 2025	9 AM – 4 PM
Foundations of Spatial Data Manipulation, Analysis, and Visualization	Session 2	4 Dec 2025	9 AM – 3 PM
Advanced Spatial Data Manipulation, Analysis, and Visualization	Session 3	5 Dec 2025	9 AM – 3:30 PM

Session 0, which was a pre-recorded lecture, was completed independently by participants ahead of the workshop, ensuring that software installation and basic orientation were in place before the in-person sessions began. Sessions 1–3 were delivered in person over three consecutive days, each combining lectures, demonstrations, hands-on exercises, and assigned homework (Tables 2, Table 3, and Table 4). A final project was assigned to workshop participants to apply skills learned from the workshop to their own dataset and produce an output of value to their ongoing work.

Table 2. Structure of Session 1 of the Introduction to Spatial Data in R Workshop outlining the sequence of instructional topics, descriptions of each topic, time breakdown, and corresponding session schedule. Yellow rows highlight administrative components of the session. Blue rows represent the core instructional blocks, including lectures, demonstrations, and hands-on exercises. Green rows indicate scheduled breaks and lunch periods within the session.

Focus	Description	Time Breakdown (minutes)	Timing
Welcome and Introductions	Introductions, objectives of the session, quick recap of previous session or outline flow of session	10	9:00-9:10
Review of Session 0 material	Present correct answers, review common errors from assignments, live code troubleshooting and Q&A	20	9:10-9:30
General Coding and Syntax (Lecture and Exercises)	Walk through coding basics	30	9:30-10:00
Break 1	Short break	15	10:00-10:15
Data Wrangling with Tidyverse (Lecture, Demonstrations, and Exercises)	Presentation of tidyverse packages with concepts demonstrated through live examples and exercises	105	10:15-12:00
Lunch	Lunch break	60	12:00-1:00
Continued Data Wrangling with Tidyverse (Lecture, Demonstrations, and Exercises)	Presentation of tidyverse packages with concepts demonstrated through live examples and exercises	60	1:00-2:00
Data Visualisation with ggplot2 (Lecture, Demonstrations, and Exercises)	Presentation on ggplot with concepts demonstrated through live examples and exercises	90	2:00-3:30
Concluding Remarks	Recap key takeaways, address final questions, assign homework, and present the final project.	30	3:30-4:00

Table 3. Structure of Session 2 of the Introduction to Spatial Data in R Workshop outlining the sequence of instructional topics, descriptions of each topic, time breakdown, and corresponding session schedule.

Focus	Description	Time Breakdown (minutes)	Timing
Review of Session 1 Homework	Present correct answers, review common errors from assignments, live code troubleshooting and Q&A	30	9:00-9:30
Simple Features in R with sf (Lecture and Demonstration)	Presentation of sf package with concepts demonstrated through live examples and exercises	45	9:30-10:15
Break	Short break	15	10:15-10:30
Spatial Data Visualization (simple features) with ggplot (Lecture and Demonstrations)	Presentation of mapping simple features in ggplot with concepts demonstrated through live examples and exercises	30	10:30-11:00
Rasters in R with terra (Lecture and Demonstration)	Presentation of terra package with concepts demonstrated through live examples and exercises	60	11:00-12:00
Lunch	Lunch break	60	12:00-1:00
Spatial Data Visualisation (rasters) with ggplot2 (Lecture, Demonstrations, and Exercises)	Presentation on ggplot with concepts demonstrated through live examples and exercises	90	1:00-2:30
Concluding Remarks	Recap key takeaways, address final questions, and discuss the final project.	30	2:30-3:00

Table 4. Structure of Session 3 of the Introduction to Spatial Data in R Workshop outlining the sequence of instructional topics, descriptions of each topic, time breakdown, and corresponding session schedule.

Focus	Description	Time Breakdown (minutes)	Timing
Spatial Manipulation of sf objects using sf package	Presentation of sf package with concepts demonstrated through live examples and exercises	45	9:00-9:30
Break	Short break	15	9:30-9:45
Spatial Visualization using tmap	Presentation of tmap package with concepts demonstrated through live examples.	60	9:45-10:45
Review of ggplot with penguins dataset	Presentation of terra package with concepts demonstrated through live examples and exercises	60	10:45-11:45
Lunch	Lunch break	60	11:45-12:45
Final Project	Work on final project	135	12:45-3:00
Concluding Remarks	Recap key takeaways, address final questions, and discuss next steps about the final project.	30	3:00-3:30

4. Workshop Demonstrations and Activities

Each day of the workshop combined short lectures with live demonstrations in R and hands-on activities designed to reinforce key concepts (Photo 2). Demonstrations were run in R script files that were provided to workshop participants to follow step-by-step in their own RStudio projects and ask questions in real time. Hands-on activities and homework assignments accompanied some of the lectures/sessions, allowing participants to directly apply the concepts covered. Participants first attempted the activities/homework assignments on their own, and we then worked through them together as a group, after which an answer key was provided for reference.

Participants showed strong foundational GIS knowledge, which helped them pick up spatial concepts in R quickly once examples were demonstrated. The main challenge was adjusting to a code-based workflow. Several participants struggled with the general syntax and use of functions, which is expected when introducing a new coding language and with continued practice will become more intuitive. Despite these challenges, participants saw how powerful R can be for automating tasks and producing maps. This highlighted the value of adopting R, even if the transition will take additional practice.

Photo 2. Workshop participants engaged in a hands-on activity exploring spatial mapping in R.

5. Final Project

A final project was assigned to workshop participants to consolidate learning and encourage direct application of new skills to their own work. Participants were asked to select a dataset relevant to their current role, either tabular, spatial, or a combination of both, and to build a small, end-to-end workflow in R.

The final project aimed to:

- Apply data import, cleaning, and transformation skills using the tidyverse package.
- Integrate spatial data (where applicable) using sf and/or terra packages.
- Produce at least one clear, interpretable visual output (e.g., a map or plot) using ggplot2 or tmap packages.

Participants began working on their projects during the final session of the workshop, with the instructor available for troubleshooting, debugging, and advice on workflow design. An optional follow-up online session was offered after the workshop to provide additional support for participants wishing to refine their projects further or address any remaining questions.

6. Follow-up Session

While most participants completed their final project during the last session of the workshop, participants were invited to join an optional follow-up session to continue working on their final projects or ask additional questions.

The plan for the follow-up session is as follows:

- Participants who are interested will notify the MFE via email.
- If multiple participants respond, they will coordinate a day and time that works for the group.
- A 1.5-hour Google Meet session will be scheduled to review workflows, troubleshoot errors, and refine project outputs.

7. Challenges

The most notable challenge that affected the preparation and delivery of the workshop was slow communication from CZMAI regarding final confirmation of participants, including their skill level with R and more importantly datasets to include in the workshop. While we were able to incorporate several CZMAI datasets into the workshop, earlier access would have supported more thorough customization of the exercises and examples.

8. Workshop Survey and Feedback

Participants completed a post-workshop survey at the end of Session 3. All respondents (100%) indicated that the workshop was easy to understand, useful to their current job responsibilities, and provided actionable insights they could apply to their workflows. Instructor effectiveness was rated positively, with several participants noting the clear explanations and supportive guidance. When asked how the workshop could be improved, most participants reported no suggestions and expressed satisfaction with the structure and delivery. One participant suggested that an additional day could be beneficial given the amount of material covered.

See also **Monitoring, Evaluation and Learning** in the **Annex**.

9. Recommendations

The Introduction to Spatial Data in R workshop represented an important step in strengthening analytical capacity across Belize’s coastal and marine institutions. Beyond the immediate skills gained, the workshop also provided valuable insight into how data are currently handled, where analytical bottlenecks sit, and where relatively small investments could unlock much greater efficiency and consistency.

The recommendations below build directly on what was observed during delivery of the training and subsequent discussions with participants. They are not intended as a wholesale redesign of existing systems, but rather as a set of practical, incremental next steps that reflect how staff are already working, the tools they are beginning to adopt, and the institutional role CZMAI plays in supporting wider marine data use across Belize.

Taken together, they point toward a longer-term pathway for embedding reproducible, transparent and efficient analytical practices, while remaining flexible enough to adapt to different agency needs and capacities.

9.1. Move from One-Off R Training to a Coordinated, Tiered National Programme

One of the clearest takeaways from the workshop was that the appetite for R-based analysis extends well beyond the immediate group trained. Rather than repeating the same introductory training in isolation, there is an opportunity to think about R capacity in Belize in a more structured way.

A useful next step could be to design a tiered training pathway, with:

- A shared foundational level (general syntax, data wrangling, basic plotting, reproducible scripts).
- A more applied level focused on spatial data and common marine data workflows.
- Advanced, task-driven sessions linked to real reporting or analytical needs.

This could be delivered through a mix of short in-person workshops and reusable materials (recorded modules, worked examples), making it easier to onboard new staff and maintain continuity as teams change. Over time, this would help create a common analytical “language” across CZMAI, Fisheries, and other marine-focused agencies.

9.2. Develop Custom R Packages and a Reproducible Analysis Toolkit for CZMAI Workflows

During the training, several recurring workflows came up that staff are currently handling manually or re-building from scratch each time. There are really two complementary opportunities here, and it’s worth keeping them distinct:

- **Custom R packages or internal functions:** These would encapsulate frequently used logic into reusable functions that staff can call without rewriting code. For example, creating packages or functions that help with standard data checks, spatial joins, indicator calculations, or develop recurring plots.
- **A broader reproducible analysis toolkit:** Alongside those functions, CZMAI could benefit from a set of standardised scripts and templates:
    - Data import and cleaning pipelines.
    - Automated QA/QC checks.
    - Mapping and plotting templates aligned with CZMAI outputs.
    - Reporting templates (e.g. R Markdown) for routine products.

Taken together, this would reduce duplication, improve consistency, and make it easier for different team members to pick up and run analyses with confidence, even if they didn’t originally write the code.

9.3. Agency-Specific Technical Visits to Co-Develop Practical R Workflows

The workshop worked well because it was grounded in real datasets and real problems. That same principle could be taken further through short, focused technical visits with individual agencies.

Rather than generic training, these would look more like working sessions, where we:

- Sit with teams to understand their routine analytical tasks.
- Identify steps that are currently time-consuming or error-prone.
- Co-develop simple R scripts or pipelines that directly replace those steps.

The output wouldn't be long reports, but practical tools: scripts, short notes, and examples that staff can immediately reuse. Over time, this also helps harmonise how similar data are handled across institutions, without forcing everyone into identical workflows.

9.4. Embed National Data Standards and Reproducibility within the Tools and Training

Rather than treating data standards as a separate exercise, there's an opportunity to build them directly into the training and tooling described above.

For example:

- Agreed data structures and naming conventions embedded in templates.
- Metadata expectations reinforced through example scripts.
- Reproducibility principles baked into reporting workflows.

This keeps standards practical rather than abstract and ensures that good practice is reinforced every time staff run an analysis, not just when guidance documents are written.

9.5. Develop R-Based and Native Monitoring Tools for Reporting and Decision Support

There was interest during the workshop in capability to make analytical outputs easier to update and reuse. One avenue here is the development of lightweight monitoring tools, which could include:

- R-based analytical outputs (e.g. R Markdown reports) that can be regenerated as data are updated.
- Simple dashboards where appropriate.
- Links or integration with native applications and platforms already in use, ensuring that R acts as the analytical engine rather than a parallel system.

The aim wouldn't be to replace GIS platforms or existing systems, but to strengthen the analytical backbone behind them and make updates faster and more transparent.

9.6. Formalise a Train-the-Trainer Pathway Within CZMAI

It's already clear from the training that there are different levels of expertise emerging within the group, with some participants well placed to support others going forward.

A natural next step would be to formalise this through a train-the-trainer approach, where a small number of staff receive:

- Deeper technical training.
- Support in adapting materials.
- Guidance on mentoring colleagues and troubleshooting workflows.

This builds on capacity that already exists, rather than creating something new, and helps ensure that skills don't sit with only one or two individuals.

9.7. Targeted Support for Data Readiness, QA, and External Reporting

Finally, there is scope for more focused support around data readiness for reporting, particularly where outputs feed into national plans, donor reporting, or international processes.

This could involve:

- Structured QA reviews of priority datasets.
- Documenting assumptions, gaps, and uncertainty.
- Preparing datasets and analyses so they are easier to defend, update, and reuse.

This kind of work tends to sit between "analysis" and "governance", but it directly supports evidence-based decision-making and reduces pressure on staff when reporting deadlines approach.

10. Conclusion

Looking ahead, there is a clear opportunity to move from isolated training and ad-hoc analysis toward a more joined-up, durable approach to marine data use in Belize. The emphasis throughout these recommendations is on *doing slightly more with what already exists*: extending skills that have been demonstrated, formalising good practice through tools rather than policy alone, and supporting staff to spend less time rebuilding analyses and more time interpreting results.

The relationships and working practices established through the workshop have laid a strong foundation for this next phase. There is now a shared understanding of both the potential of R-based workflows and the practical realities of applying them in day-to-day institutional contexts. This places the project team – and Martha Sheikha in particular – in a good position to continue supporting this work in a way that is technically sound, responsive to local needs, and aligned with CZMAI's coordinating role.

Any future activities can therefore be approached as a continuation of an existing collaboration rather than a new intervention, allowing momentum to be maintained while remaining sensitive to capacity, priorities and pace of change.

Contractor Details

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Recordings of selected lessons, particularly those that participants found most challenging, will be made available on the MarFishEco YouTube channel. Follow MarFishEco on LinkedIn to stay updated on these resources and others produced by MFE.

Annex One: Presentation Recordings

Presentation recordings (select sections)

Annex Two: Monitoring, Evaluation and Learning (MEL)

Monitoring

Monitoring focused on confirming that the planned training activities were delivered as intended and reached the appropriate technical audience. MarFishEco delivered a three-day, in-person Introduction to Spatial Data in R workshop for staff from the Coastal Zone Management Authority and Institute (CZMAI) and the Fisheries Department between 3–5 December 2025, supported by a preparatory recorded session completed independently in advance.

The workshop was attended by five technical staff whose roles span data management, GIS, marine spatial planning, and fisheries analysis. Delivery combined lectures, live demonstrations, hands-on exercises, homework assignments, and a final applied project, ensuring that participants engaged actively with the material rather than passively receiving information. Training content covered general data manipulation and visualisation in R, spatial data handling using the sf and terra packages, and both spatial and non-spatial visualisation using ggplot2 and tmap.

All planned sessions were delivered in full, supported by reusable training materials including scripts, exercises, datasets, and slide decks. These materials were designed to be retained by participants for future reference and reuse, supporting longer-term institutional capacity beyond the workshop itself. Optional follow-up support was also offered through an additional online session to assist participants in refining their final projects or troubleshooting remaining challenges.

Overall, monitoring confirms that the activity met its delivery objectives in terms of scope, content, participation, and format.

Evaluation

Evaluation of the workshop drew on post-workshop participant feedback, instructor observation during delivery, and review of participant engagement with exercises and final project work.

Post-workshop survey responses indicated a consistently positive experience. All participants reported that the workshop was easy to understand, relevant to their current job responsibilities, and provided actionable skills that could be applied directly to their day-to-day workflows. Instructor effectiveness was rated highly, with participants highlighting the clarity of explanations and the supportive, problem-solving approach taken during hands-on sessions. Feedback suggested a high level of satisfaction with the structure and pacing of the workshop, with one participant noting that an additional day could have been beneficial given the volume of material covered.

From an instructional perspective, participants demonstrated strong foundational GIS knowledge, which supported rapid uptake of spatial concepts once these were demonstrated in R. As expected, the primary challenge observed was adjustment to a code-based workflow, particularly with respect to syntax, function usage, and debugging. These challenges were addressed through live troubleshooting, group review of exercises, and iterative practice. By the end of the workshop, participants were able to construct basic end-

to-end workflows, integrate spatial data, and produce interpretable visual outputs, indicating that core learning objectives had been met.

The final applied project component provided additional evidence of learning, allowing participants to work directly with datasets relevant to their institutional roles. This helped bridge the gap between training exercises and real-world application, reinforcing the practical value of the skills introduced.

Overall, evaluation findings indicate that the workshop was effective in building introductory spatial data analysis capacity in R, while also highlighting realistic constraints associated with adopting new analytical tools within existing institutional workflows.

Learning

Several key learning points emerged from the delivery of the workshop that are relevant for future capacity-building efforts under the Ocean Country Partnership Programme and related initiatives.

First, grounding training in real datasets and real institutional tasks proved critical for engagement and uptake. Participants responded particularly well when examples mirrored their day-to-day analytical challenges, reinforcing the importance of applied, context-specific training rather than generic instruction.

Second, while short, intensive workshops are effective for introducing new tools and concepts, sustained capacity development in coding-based workflows benefits from a more structured, tiered approach. Participants displayed varying levels of confidence and aptitude by the end of the workshop, suggesting value in future pathways that move from foundational skills through to more advanced, task-driven applications over time.

Third, the workshop highlighted opportunities to shift effort away from repeatedly rebuilding analyses toward more reproducible, reusable workflows. Participants quickly recognised the potential efficiency gains offered by scripted analysis, standardised templates, and automated quality checks, even where initial adoption requires additional practice.

Finally, the delivery process reinforced the importance of early access to participant information and datasets during workshop preparation. Considerably earlier confirmation of participant skill levels and priority datasets would enable even closer tailoring of examples and exercises, further strengthening relevance and impact.

These learning points directly inform the recommendations set out in the following section, which focus on incremental, practical steps for embedding reproducible and efficient analytical practices within CZMAI and partner institutions, while remaining sensitive to existing capacity, workloads, and institutional roles.