20 March 2023

Living Lab Program for Climate Change and Conservation - Final Report

Project title: Assessing the distribution of critical blue carbon habitats within the coastal waters of BC Parks

Lead researcher(s): Dr. Julia Baum, Matthew Csordas

Research findings

The following were the 4 major deliverables promised from this project:

1. Maps of where kelp and seagrass species are currently within BC Parks and over the entirety of the West Coast Region
2. Maps for the extent of each species (for eelgrass and the 6-8 most common kelps) within BC parks and over the entirety of Vancouver Island
3. Blue Carbon estimates within relevant BC parks
4. Species lists for all existing BC Parks on Vancouver Island

These deliverables were all achieved to some extent with some completely ready and included in this report, some in a preliminary state that will continue to be improved for use in Parks management, and others in prep through affiliation with other projects.

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1. **Maps of where kelp and seagrass species are currently in BC Parks and species list for surveyed Parks.**
   Underwater ROV Transect Surveys were carried out in ten focal regions and a total of 24 BC Parks around Vancouver Island. Surveys were carried out within and around BC Parks and a total of 360 transects were collect over the course of June-September. Focal regions and the number of Parks where sampling occurred are displayed in Figure A1 in the appendix and are listed below:
   - Victoria Area
     - Oak Bay Islands Ecological Reserve
   - Race Rocks
     - Race Rocks Ecological Reserve
   - Juan de Fuca Entrance
     - Juan de Fuca Park
   - Barkley Sound
     - Baeria Rocks Ecological Reserve (no surveys within the park)
   - Clayoquot Sound
     - Dawley Passage Park
     - Flores Island Park
     - Maquinna Marine Park

    - Sulphur Passage Park
    - Sydney Inlet Park
    - Vargas Island Park
- Checleset Bay and Brooks Peninsula
    - Muqqiwn/Brooks Peninsula Park
    - Checleset Bay Ecological Reserve
    - Dixie Cove Marine Park
    - Rugged Point Marine Park
- Broughton Archipelago
    - Cormorant Channel Marine Park
    - Broughton Archipelago Park
- Central Salish Sea
    - Boyle Point Park
    - Helliwell Park
    - Tribune Bay Park
    - South Texada Island Park
    - Sabine Channel Marine Park
- Gulf Islands
    - Burgoyne Bay Park
    - Mount Maxwell Ecological Reserve
    - Ruckle Park
- Saanich Inlet
    - Gowlland Tod Park

In addition to the above locations, we have pre-planned and funded surveys with the Lyackson First Nation which will occur this spring/early summer in Drumbeg Park, Pirates Cove Marine Park and Wakes Cove Park around Leey'qsun Island.

Raw video footage from all of these transects was captured and can be made available to BC Parks in whatever way works best for you (just let us know how to transfer these files). Figures A2 through A12 in the appendix zoom in on our focal areas and display each transect as a line from start GPS location to end GPS location. In these figures each transect is labelled with its name which corresponds to the transect name used in the attached csv files containing species occurrence records for all kelps species, eelgrass, and surfgrass, and species occurrence summarized by transect and park.

<u>Excel files summary:</u>

- "Depth_Substrate_Associated_Species_Records.csv" – raw species occurrences with associated depth, substrate, transect name, and location data.
- "Species_by_Transect_Depth.csv" – species occurrences summarized by transect and depth bin.
- "Species Lists by Park.xlsx" – species occurrences summarized by Park.
- "Species ID codes.xlsx" – List of species ID codes used as shorthand in the above tables.

2. **Maps for the extent of each species (for eelgrass and the 6-8 most common kelps) within BC parks and over the entirety of Vancouver Island**

Figures A13 through A22 in the appendix show the predicted extent of 8 kelp species, *Phyllospadix spp.,* and *Zostera spp.* Around Vancouver Island. **These estimates are based on extremely preliminary species distribution models and should not be reproduced or used to make management decisions within Parks.** However, these models will continue to be refined and BC Parks will be kept up to date with the newest versions and informed when they are of a quality to be considered useful as a management tool. Importantly these maps will eventually provide predictions for where habitat forming species occur even where surveys weren't completed.

Preliminary species distribution model predictions are included for the following species:

- *Alaria marginata* (winged kelp)
- *Costaria costata* (5 rib kelp)
- *Laminaria setchelii* (NA)
- *Macrocystis pyrifera* (Giant kelp)
- *Neoagarum Fimbriatum* (Sieve kelp)
- *Nereocystis luetkeana* (Bull kelp)
- *Pterygophora californica* (Walking kelp)
- *Saccharina latissima* (Sugar kelp)
- *Zostera spp.* (Eelgrass)
- *Phyllospadix spp.* (Surfgrass)

3. Blue Carbon estimates within relevant BC parks

The Baum Lab led DFO contract "Blue Carbon as a Canadian Climate Change Solution: Modeling the Mitigation Potential of Kelp Under Future Climate Change Scenarios" will produce the first nationwide assessment of the potential for Canada's kelp forests to contribute to ocean climate solutions. Using the available estimates of kelp biomass and net primary productivity from the literature, Baum lab Post -doc Dr. Jennifer McHenry is currently in the final stages of putting together an assessment of the current and future blue carbon drawdown potential of kelp forests in BC and the rest of Canada. Data from this project has contributed to our understanding of the depth distributions for kelp species in BC, which has helped us mask the area of potential kelp habitat while creating these estimates. This publication will soon be ready for submission to peer review. Further refined estimates will be created after this first pass using the improved species distribution models parameterized with this and other collaborators datasets. In our broader NSERC Alliance partnership grant "Evaluating the Current and Future Capacity for Natural Climate Solutions in Canada's Oceans" (called "Blue Carbon Canada"), estimates of the future drawdown potential of eelgrasses, salt marshes, and kelp forests across Canada's three coasts (Pacific, Atlantic, and Arctic) will be generated.

Methods summary

Survey methodology summary:

1. Before the field work occurred, a list of transects were generated in each of the parks surveyed. During the field work, a member of the field team had a list of transect locations and this determined the position of the boat for the start of each transect.
2. Once the transect video was started, a shot of the transect number and a compass bearing towards shore were taken. The ROV was then dropped in approximately 50ft of water. The

ROV pilot maneuvered the ROV to the bottom, determined the edge of the kelp zone and then positioned the ROV towards a heading on shore (determined from a compass bearing).

3. The ROV pilot began flying the ROV slowly towards shore. In general, the ROV stayed within 2 meters of the substrate and any kelp along the transect was observed in enough detail so confident species IDs could be determined during video analysis.
4. During the transect, a third member of the field team was responsible for managing the ROV tether and made sure there were no hazards (i.e., Tether getting too close to boat engines) as well as keeping track of the ROV and making sure it was heading in the right direction.
5. Once the ROV reached the shore, the transect video and ROV propellers were turned off and tether was reeled in, pulling the ROV to shore.
6. For each transect a shore and start latitude and longitude were taken.

After data collection was completed video analysis was carried out over the fall semester (September – December). During this process transects were analyzed using the online video analysis tool BIIGLE. Annotations were made for species occurrence, depth, substrate class, and many other categories. For a visualization of how a transect occurred and how analysis was done see Figure 1. For an in-depth procedure on video analysis and BIIGLE use see the following two included pdf files:

- "ROV_video_analysis_protocol.pdf"
- "BIIGLE_protocol.pdf"

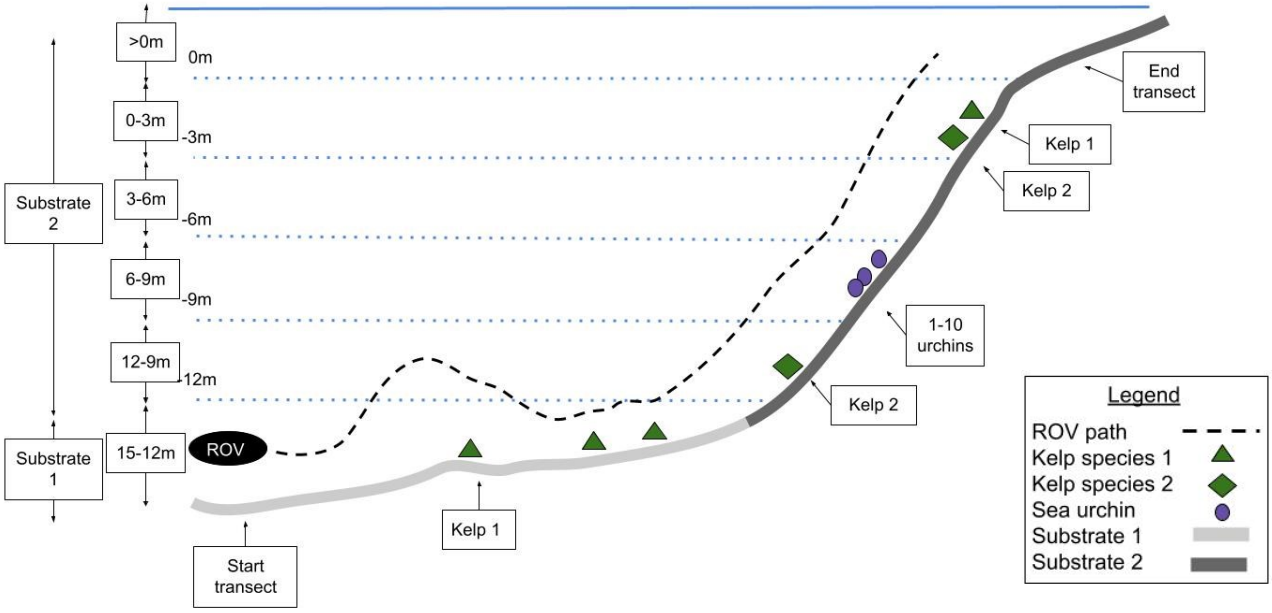

Figure 1. *Diagram showing annotations on a sample transect. All annotations are shown in black squares, with extended annotations (for substrate and depth bins) on the left of the transect and single-frame annotations along the length of the transect.*

Key outcomes for BC Parks

Our project outcomes are directly relevant to BC Parks' Living Lab Program's Research Themes. This work directly helps to identify priority lands (in this case priority coastal waters) for enhancing protected areas, in that it provides a look at where important habitat forming species of kelp and seagrass occur within and outside of BC Parks. By providing the first comprehensive analysis of the extent of kelp forests and seagrass meadows along Vancouver Island's coastline, this project evaluates how well BC Parks currently protect these key ecosystems and species (e.g., what percent of these productive ecosystems are currently protected?). It also provides information on key areas (from an ecological and carbon sequestration perspective) that BC Parks does not currently manage or protect, or areas which are currently protected that should be prioritized for conservation and management action. This new knowledge will directly help BC Parks to meet their goal of identifying priority coastal areas for enhancing protected area connectivity. Through identifying diverse habitats and large areas of connected productive coastal habitats, our project will help identify locations where the expansion of existing or creation of new parks would help BC protect and conserve critical coastal habitats as part of Canada's 30 by 30 protection targets. The potential for future collaboration involving climate change projections through the above mentioned 'Blue Carbon Canada' project would allow managers to identify important refugia for kelp forests and seagrass meadows as climate change progresses where conservation efforts may be extremely important for enhancing nearshore productivity and habitat connectivity into the future.

In addition to assessing the distribution of critical habitats within BC Parks, this project also assesses key vulnerabilities to climate change in the park system. Generated estimates of the blue carbon potential for kelp and eelgrass in BC, combined with knowledge on the extent of kelp/eelgrass within BC Parks will allow researchers and Parks staff to estimate the potential value of the Parks system as a natural carbon sink and climate solution. This information could inform where new BC parks would protect valuable blue carbon resources, where restoration and more effective management could increase blue carbon capacity, and whether BC Parks can be an important part of Canadian climate solutions and carbon offsetting. Future climate projection work will enhance the value of these estimates by highlighting where BC blue carbon is vulnerable to being lost and where these blue carbon stocks are likely to be resilient or even increase.

Finally, this project covered a large area of coast and involves many local First Nations. This includes the the Namgis, Kwicksutaineuk-ah-kwaw-ah-mish, Mamalilikulla, Ka:'yu:'k't'h'/Che:k:tles7et'h', Hesquiaht, Ahousaht, Tla-o-qui-aht, Huu-ay-aht, Pacheedaht, and Lyackson First Nations who we were able to work with directly, as well as other Nations who were consulted with through BC Parks staff. Each of these Nations had their own reasons for wanting to take part in these surveys, from their own concerns about local waters to simply wanting to learn about our survey techniques. Lines of communication have been kept open as we generate deliverables from this project that are of interest to these Nations at their local and regional scales. The collaborative nature of this project, data sharing with the Nations, and what we have learned and continue to learn about their concerns could help to build relationships between Parks and First Nations and identify goals that can be worked towards together in a co-management structure.

Relevance to BC Parks management

In its current form this data provides a tool for Parks managers to understand the composition of their nearshore habitats. This understanding could directly influence the way different parks are managed and how park funds are allocated. For example, Parks with highly diverse and carbon-rich

ecosystems may benefit from increased conservation and protection measures. Some Parks included in this assessment don't include a marine component. This assessment may also provide information on where expanding existing Parks to the nearshore could have the most benefits. As distribution maps are refined and improved, they will also provide tools that can help Parks manage where certain activities such as anchoring/mooring are allowed within protected areas (this may be important to protecting carbon stored in delicate eelgrass and understory kelp beds.

Project's challenges/opportunities

While the project went well overall, and a large amount of data was collected, there were definitely some lessons learned and challenges presented along the way. Firstly, was the importance of and time it takes to build local connections with First Nations groups. While we were lucky to be able to work with some incredible and understanding groups over this past summer, miscommunications during the application process, and concerning what we should be doing before receiving funding led to less-than-ideal timelines for connecting with and co-developing project plans with local First Nations. This led to lessons learned both within BC Parks and our lab, with BC Parks updating their protocol for reaching out to Nations regarding funding applications to be more explicit, and with our lab seeking to build relationship with Nations directly from the beginning of the grant writing process. This has been reflected in the work we will continue for this project of the summer of 2023, where Nations have been consulted with throughout the entire process and surveys are being developed in a much more mutualistic way. For example, we will be completing surveys with the Tla'amin First Nation and have been in talks with them since October determining where surveys should generally occur (based on their concerns in the Desolation Sound region) and timing the project so we can be out with their Guardians team and provide them training on our survey techniques.

Another lesson learned over the course of this project was the significant amount of post processing that data such as this requires. For a summer of field work we required a full-time technician working for 4 months afterwards to analyze all the video footage, even to the simple species occurrence level we wanted. This delayed species distribution modeling and other plans with the data. However, now that protocols for this are in place and this realization has been made, future work can occur in a smooth manner built from previous workflows. Plans to increase the amount of data collected this summer already have us hiring on a summer and fall technician, and hopefully bringing on another MSc student to work on data from this project.

Conclusions/next steps

In conclusion, this project was a large and valuable undertaking which capitalized on the relatively inexpensive and rapid use of underwater remote operated vehicles for benthic surveys. While the time needed for post processing of data was underestimated, first passes at all deliverables promised are now available, or soon to be, and provide an unprecedented look at what is currently being protected within the nearshore of many BC Parks. Continued work will help to refine estimates of kelp and eelgrass extent throughout BC, and next steps include surveying new focal regions in Southern BC to fill data gaps from our previous field season. In this sense we are planning to get out to Desolation Sound, Howe Sound, Cape Scott and Quatsino Sound, and Nootka Island this summer to complete more surveys. As species distribution model estimates improve these maps will provide

important tools when evaluating the level of protection offered by current Parks and locations for new protected areas. Climate change is drastically changing the temperate nearshore and work like this will help allow BC's protected areas to buffer these impacts in as effective a manner as possible.

References and links

Attached files which break down how Living Labs and License Plate Program Funding was spent including explanations as to why expenses were necessary especially when these differed from initial estimates in the funding application.

- "License_Plate_final report_income_expenses.pdf"
- "Living Lab_final report_income_expenses.pdf"

Affiliated Project Links:

- Blue Carbon Canada (https://www.bluecarboncanada.ca/)
- Kelp Rescue (https://kelprescue.org/)

Appendix

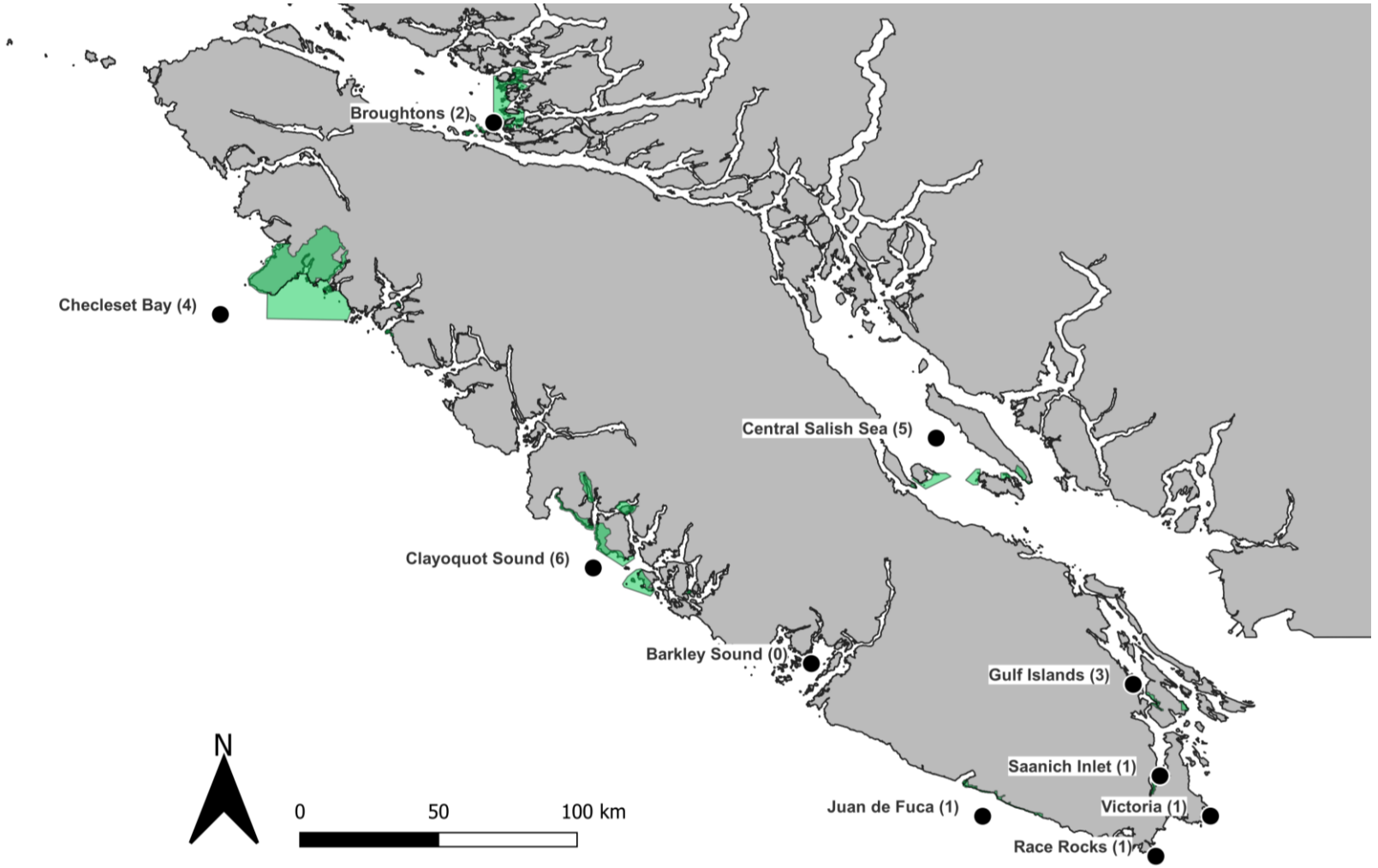

Figure A1. *Map of the focal regions where ROV transects were carried out over the summer of 2022. BC Parks where surveys occurred are overlaid in green and numbers beside the names of the focal areas represent the number of BC Parks surveys were completed in for this area.*

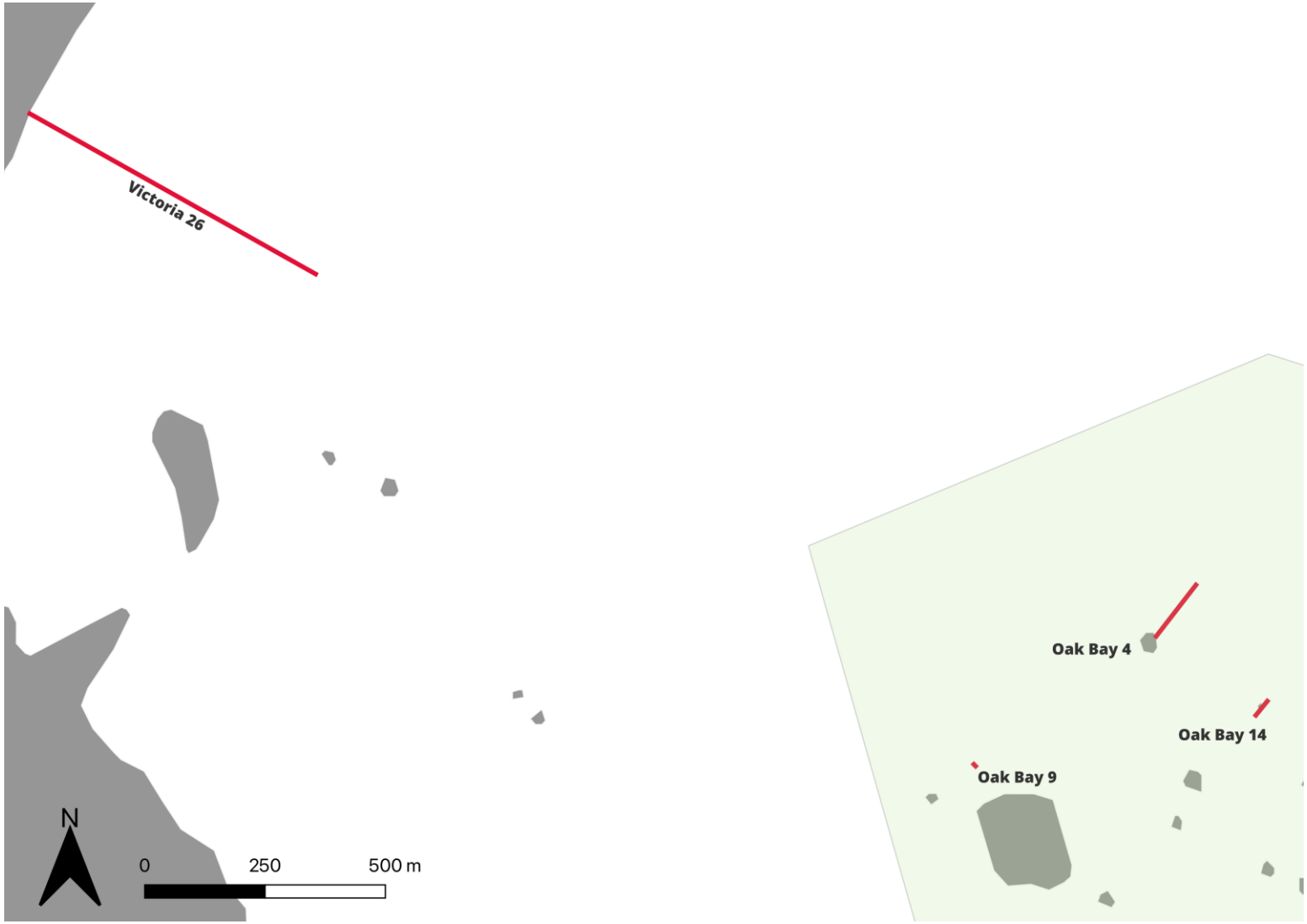

Figure A2. *Map of ROV transects (shown in red) completed in the Victoria Area over Summer 2022. Areas highlighted in green indicate the extent of BC Parks in the area.*

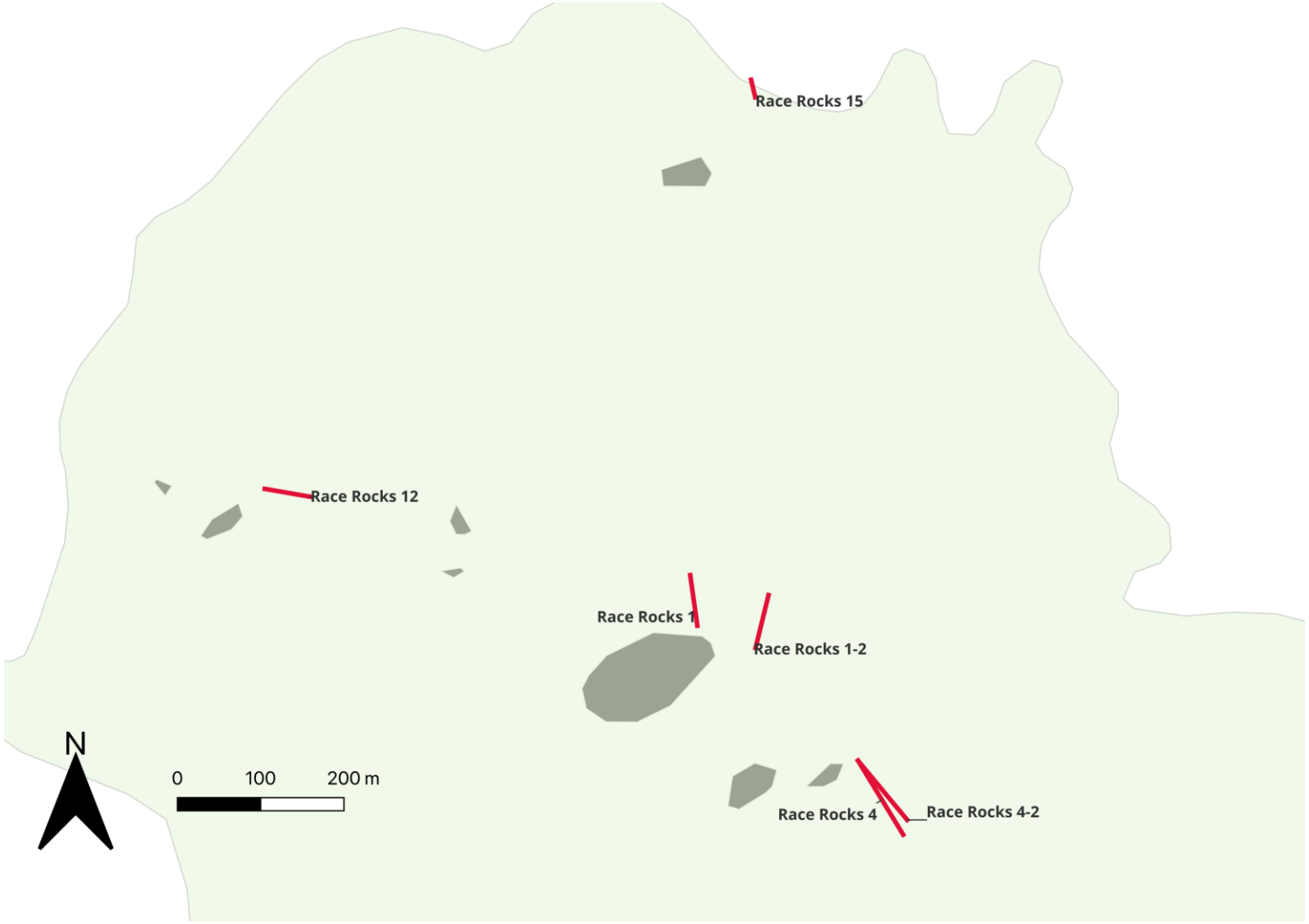

Figure A3. *Map of ROV transects (shown in red) competed at Race Rocks over Summer 2022. Areas highlighted in green indicate the extent of BC Parks in the area.*

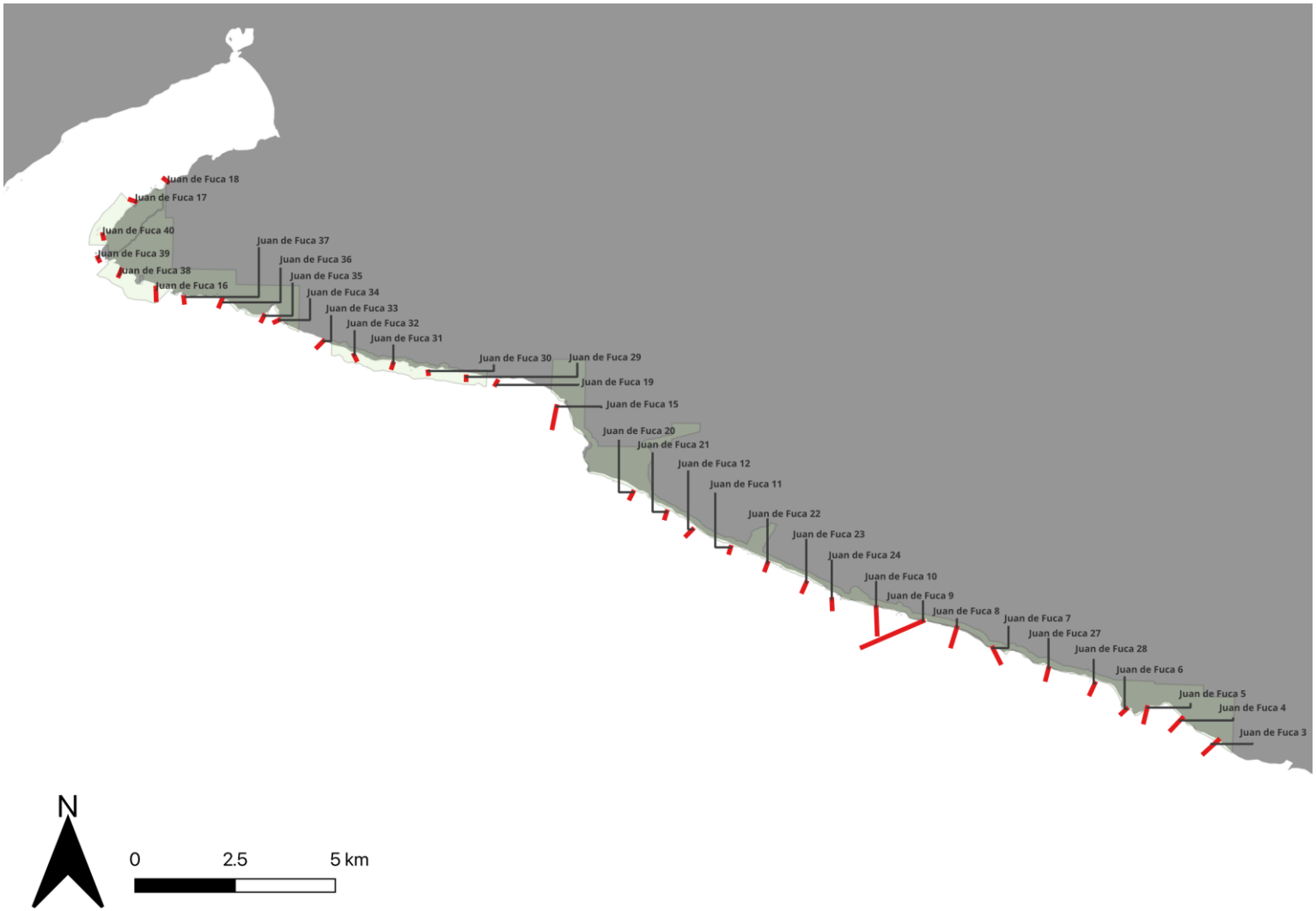

Figure A4. *Map of ROV transects (shown in red) competed in the Juan de Fuca area over Summer 2022. Areas highlighted in green indicate the extent of BC Parks.*

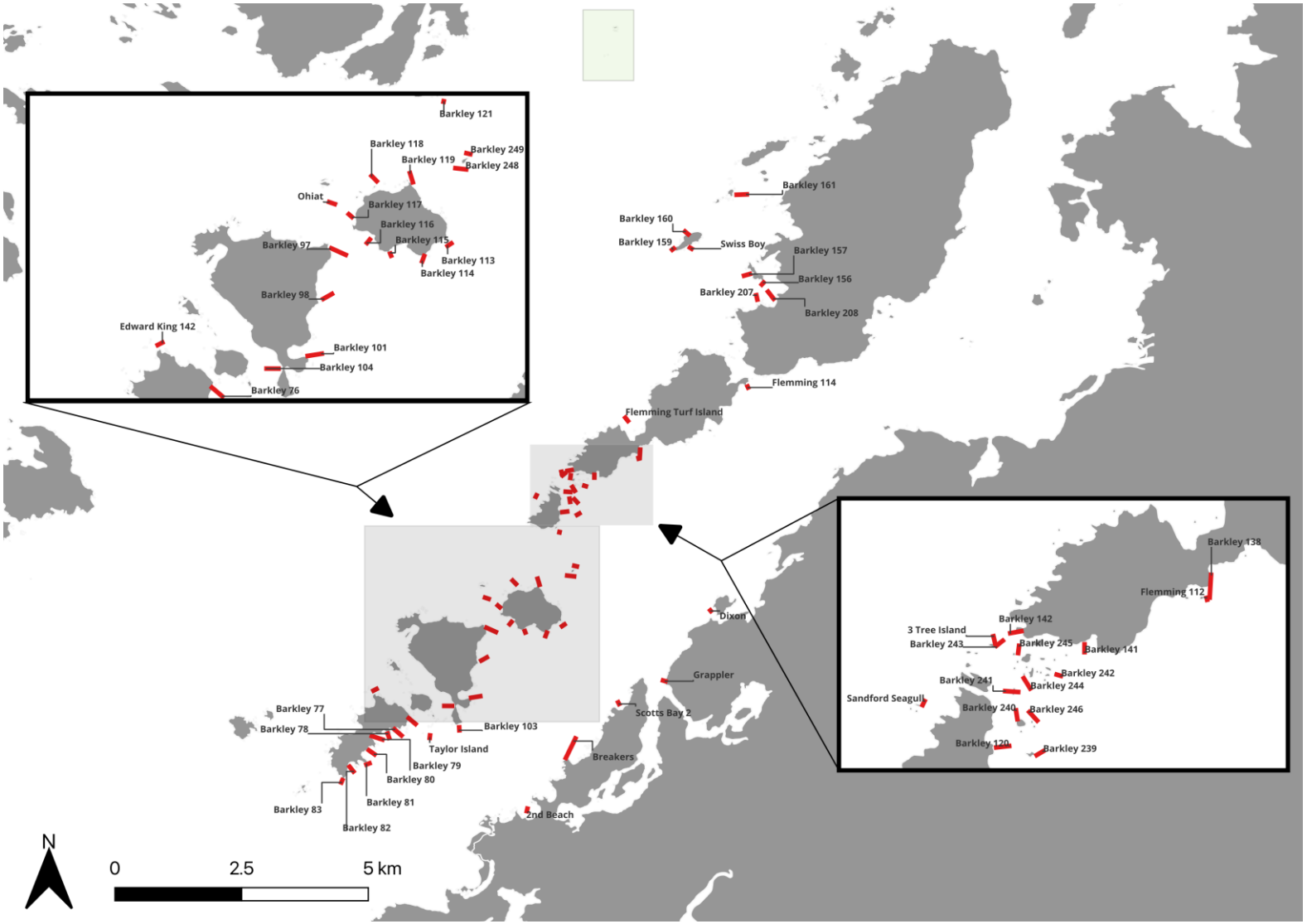

Figure A5. *Map of ROV transects (shown in red) competed in Barkley Sound over Summer 2022. Areas highlighted in green indicate the extent of BC Parks in the area.*

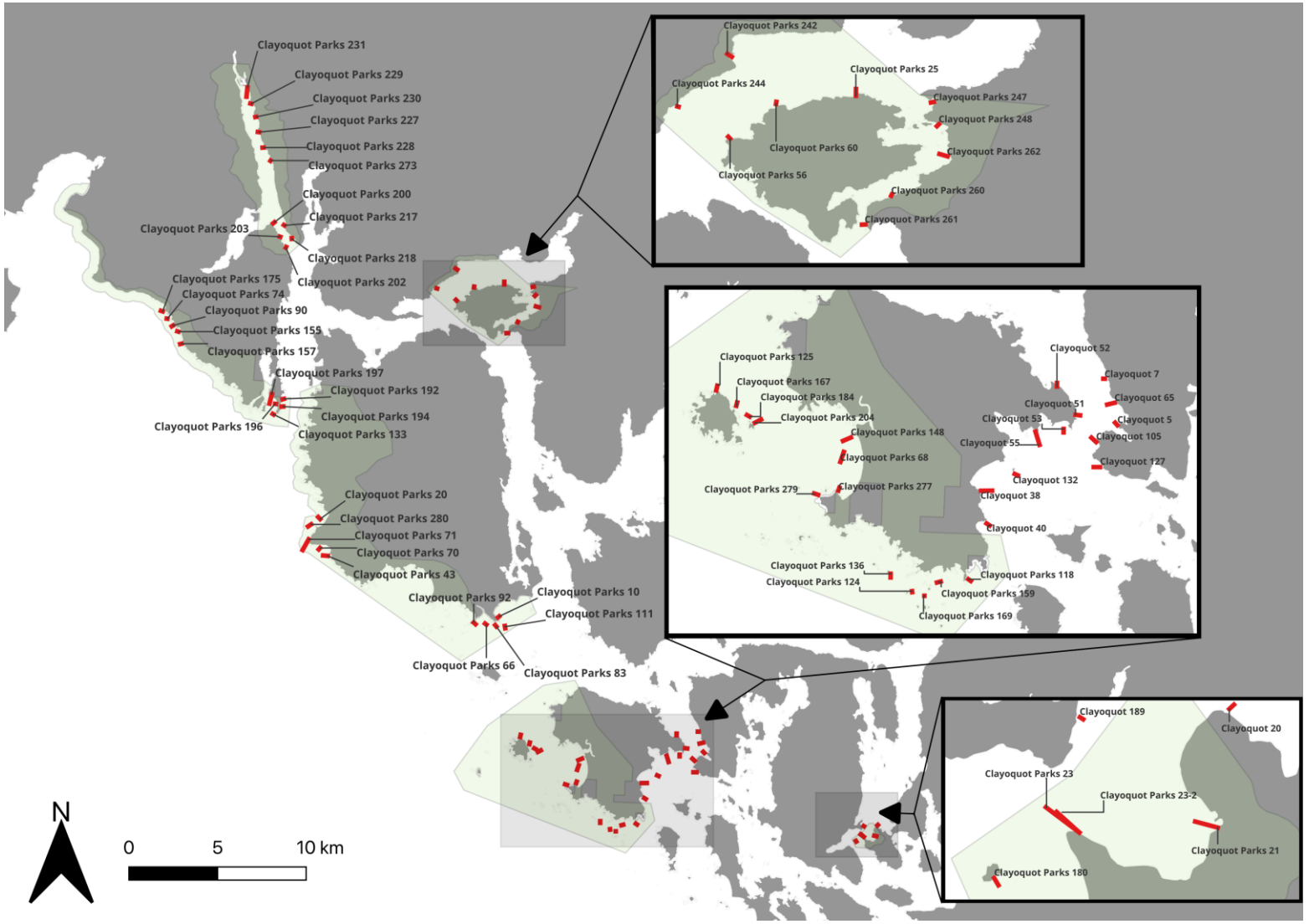

Figure A6. *Map of ROV transects (shown in red) competed in Clayoquot Sound over Summer 2022. Areas highlighted in green indicate the extent of BC Parks in the area.*

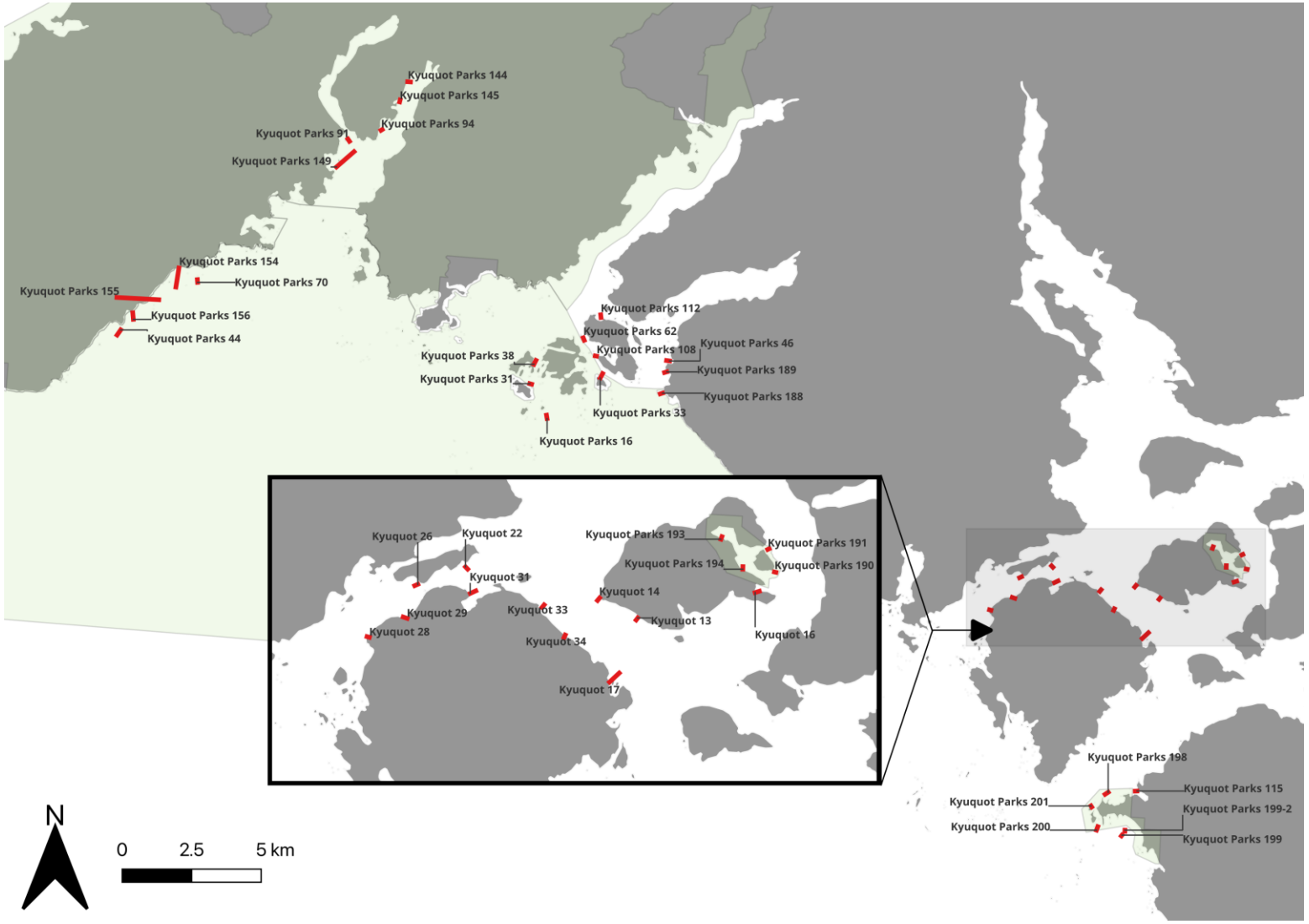

***Figure A7**. Map of ROV transects (shown in red) competed in Kyuquot over Summer 2022. Areas highlighted in green indicate the extent of BC Parks in the area.*

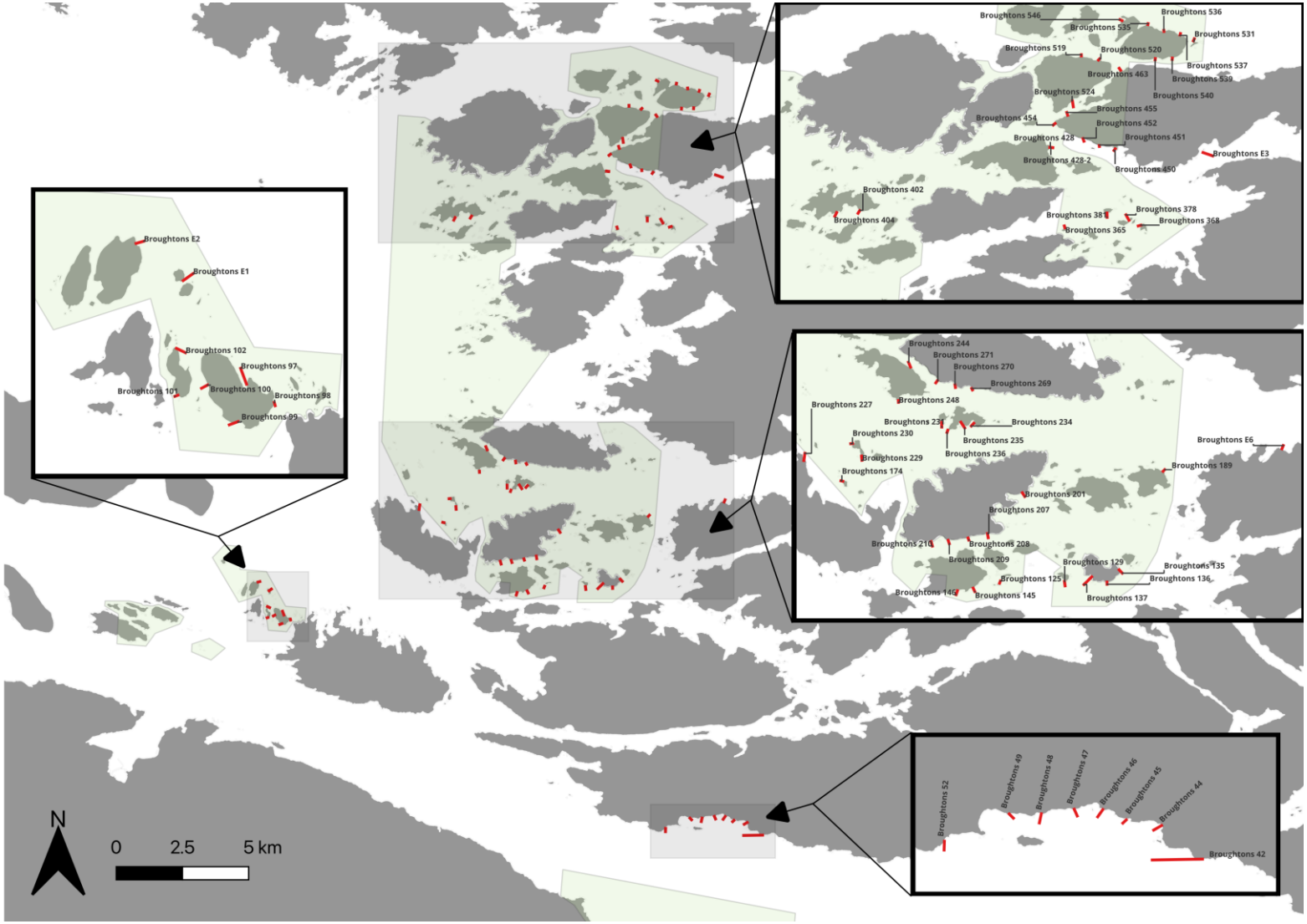

Figure A8. *Map of ROV transects (shown in red) competed in the Broughton's over Summer 2022. Areas highlighted in green indicate the extent of BC Parks in the area.*

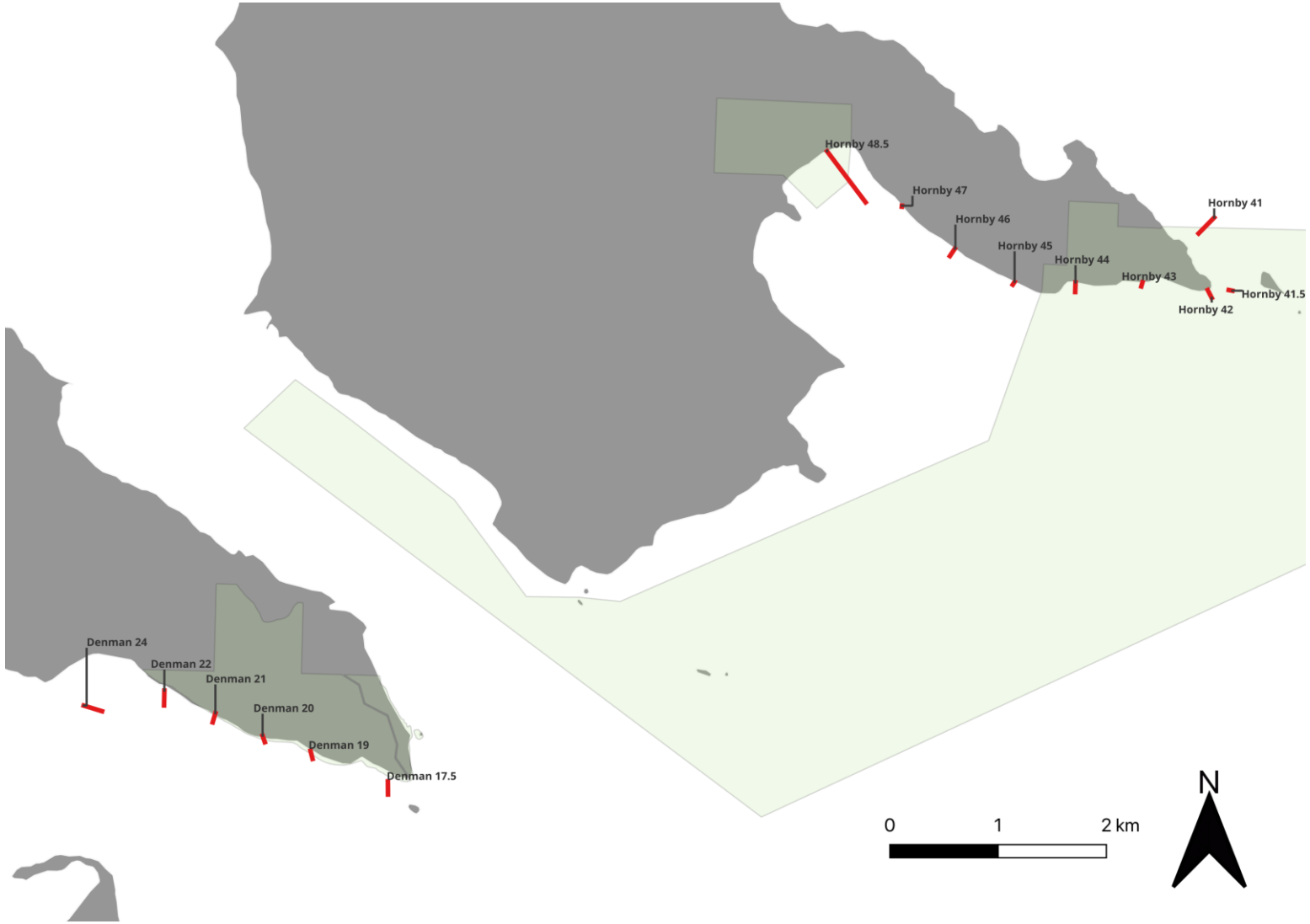

Figure A9. *Map of ROV transects (shown in red) competed at Hornby and Denman Islands over Summer 2022. Areas highlighted in green indicate the extent of BC Parks in the area.*

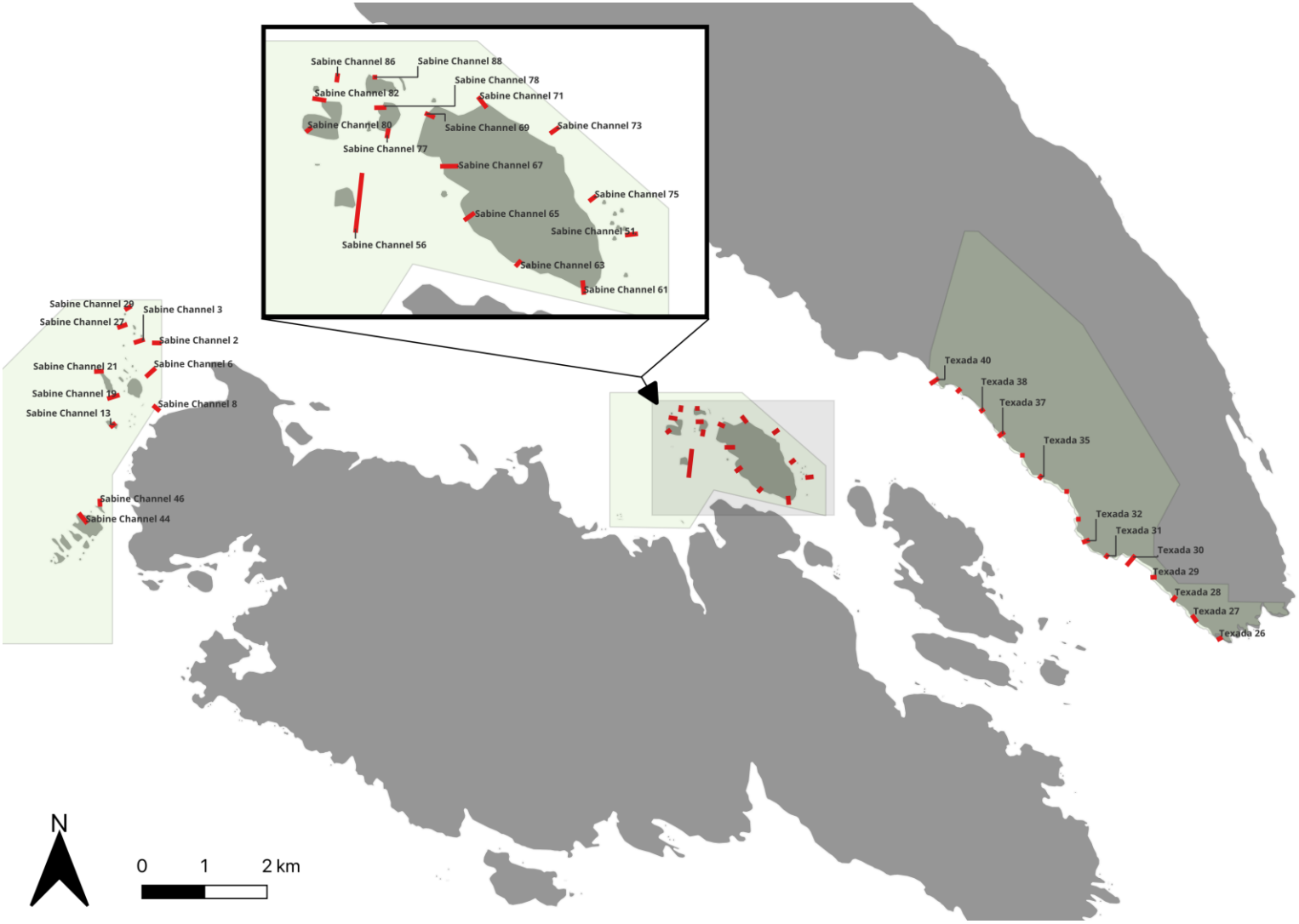

Figure A10. *Map of ROV transects (shown in red) competed at Texada Island and in Sabine Channel marine Park over Summer 2022. Areas highlighted in green indicate the extent of BC Parks in the area.*

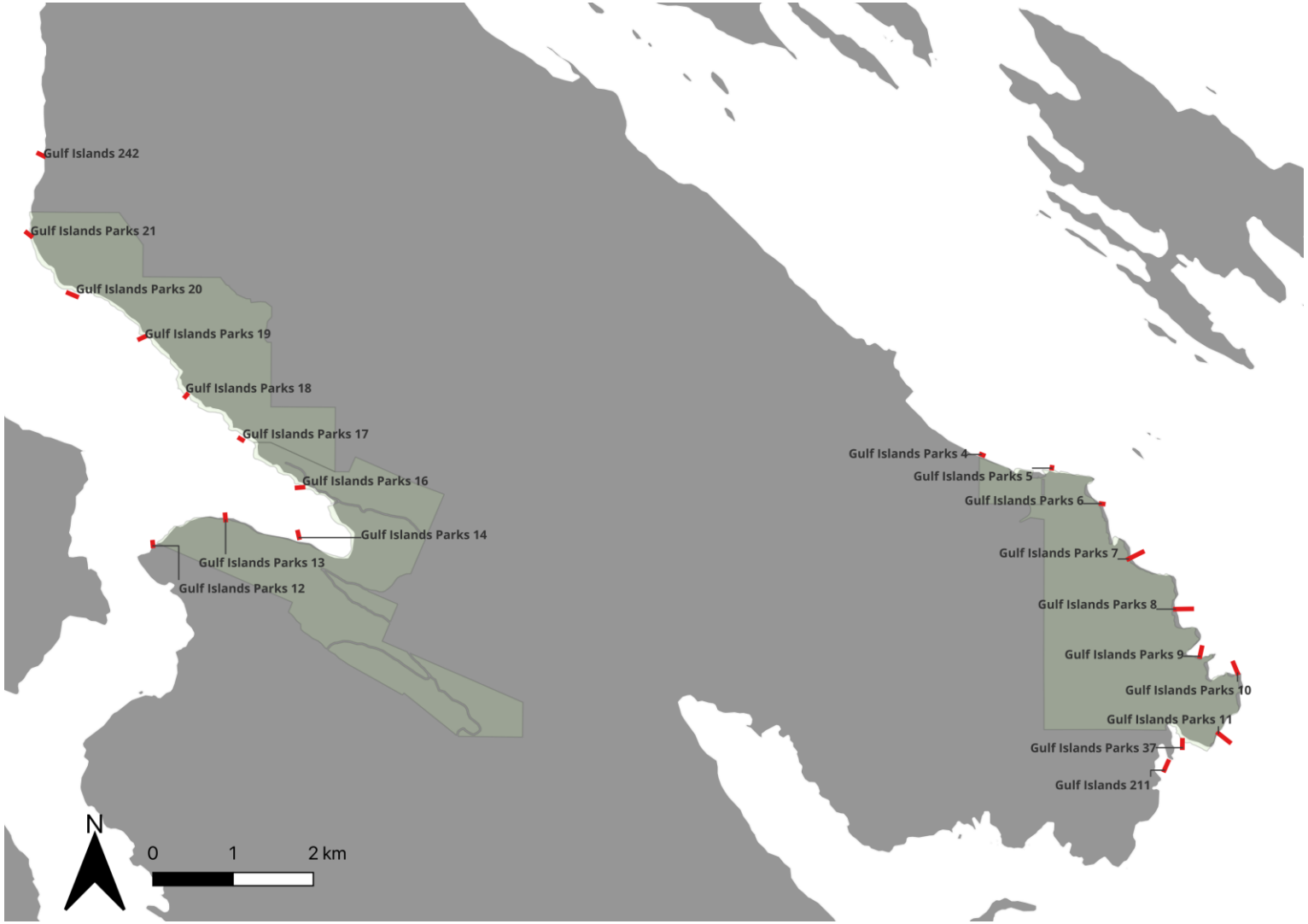

Figure A11. *Map of ROV transects (shown in red) competed in the Gulf Islands over Summer 2022. Areas highlighted in green indicate the extent of BC Parks in the area.*

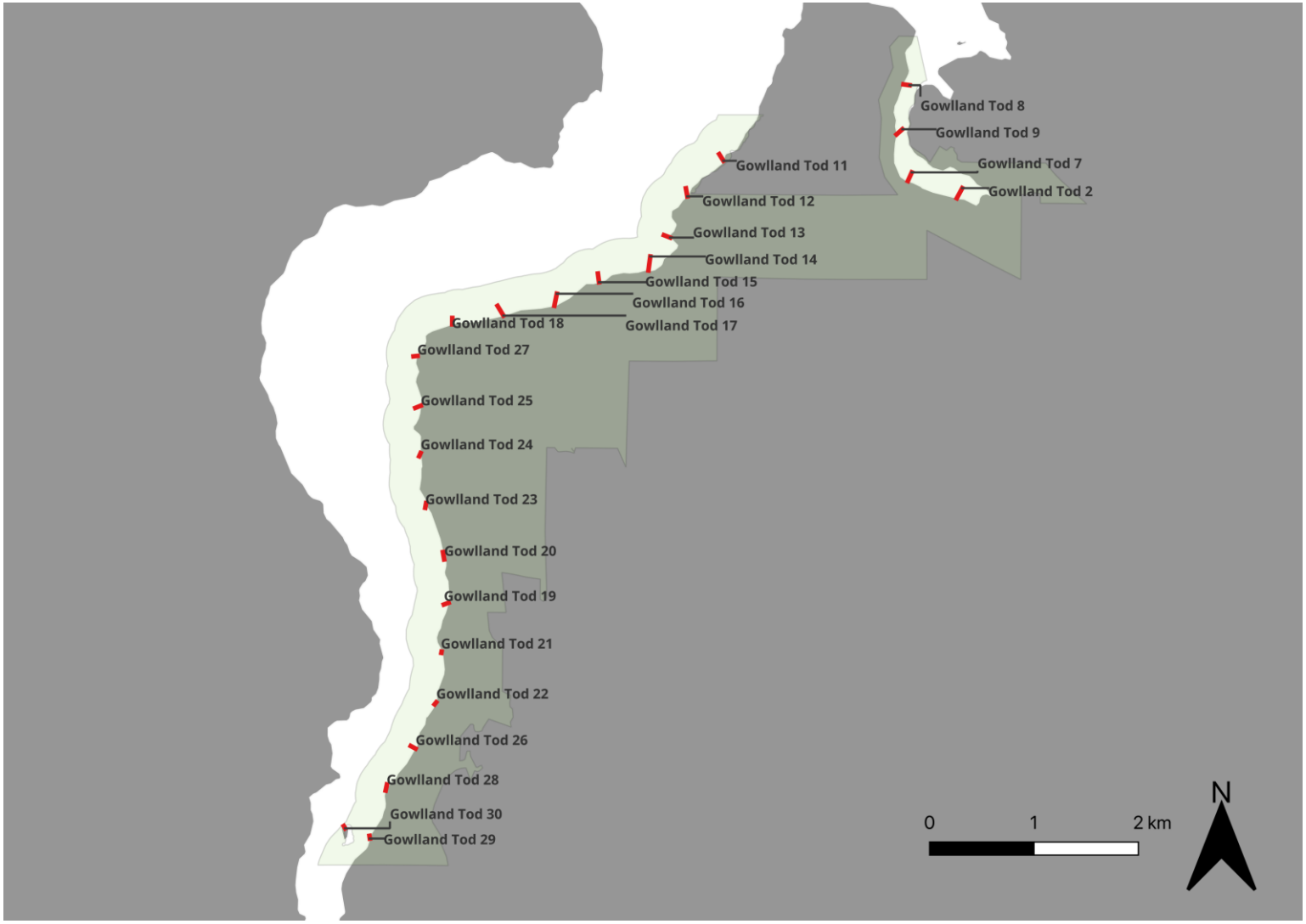

Figure A12. *Map of ROV transects (shown in red) competed in Gowlland Tod Park over Summer 2022. Areas highlighted in green indicate the extent of BC Parks in the area.*

The following 10 figures are based on extremely preliminary analyses and should not be reproduced or used to inform any decisions regarding BC Parks management!

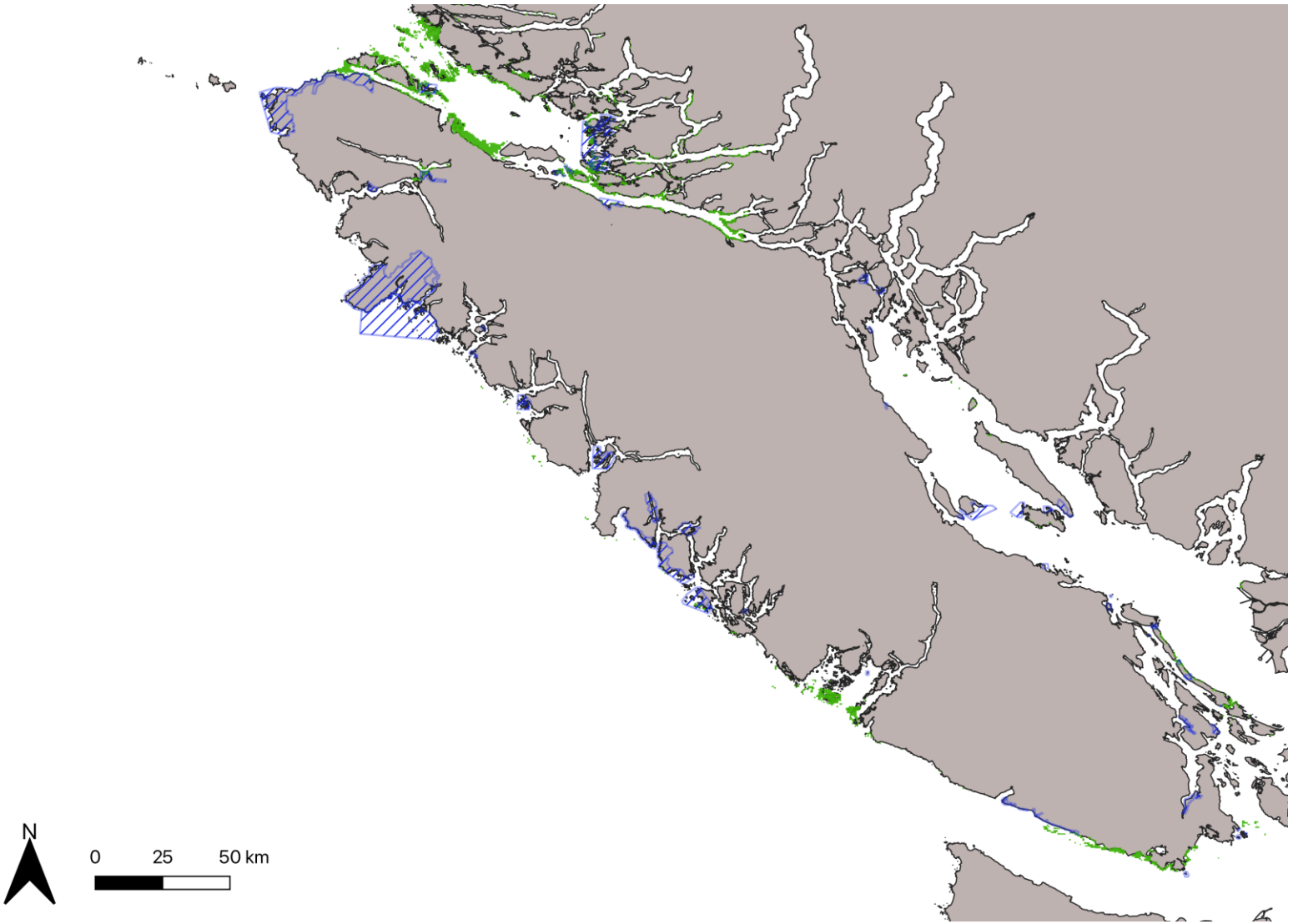

Figure A13. *Map showing the species distribution of Alaria marginata in BC's South Coast and Vancouver Island, with green indicating presence of the species. BC parks are shown in blue.* ***Preliminary analysis.***

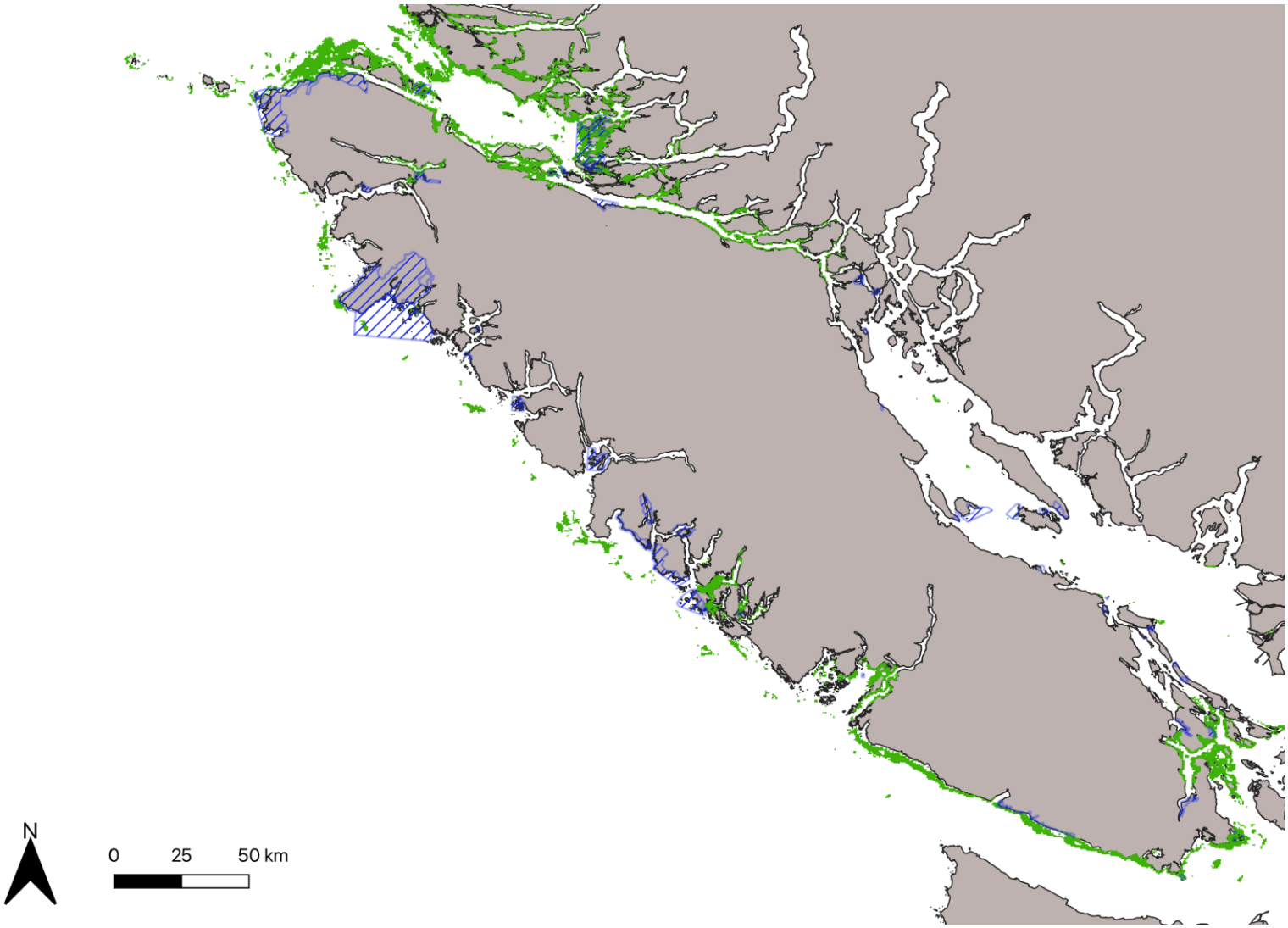

Figure A14. *Map showing the species distribution of Costaria costata in BC's South Coast and Vancouver Island, with green indicating presence of the species. BC parks are shown in blue.* ***Preliminary analysis.***

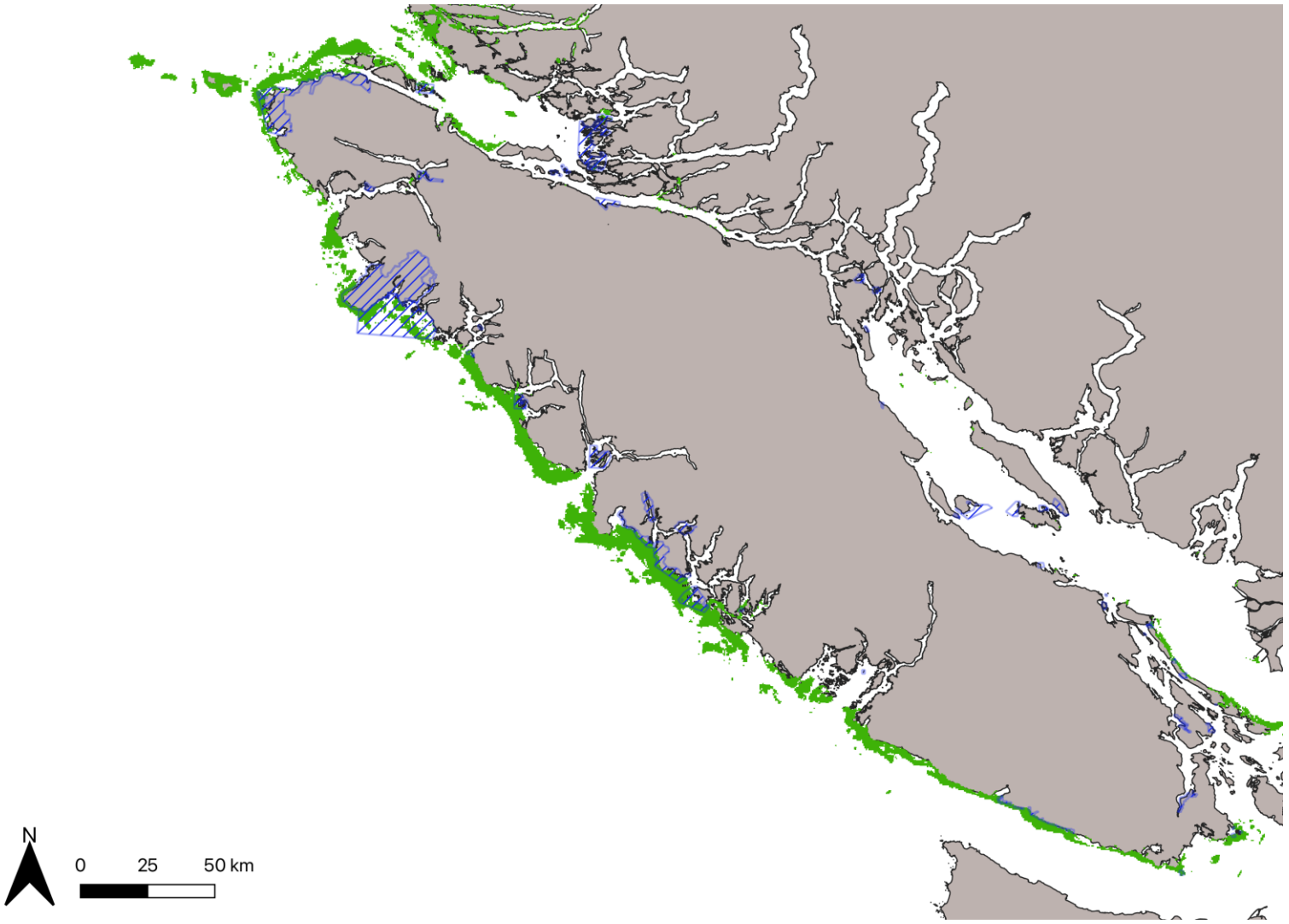

Figure A15. *Map showing the species distribution of Laminaria setchellii in BC's South Coast and Vancouver Island, with green indicating presence of the species. BC parks are shown in blue.* ***Preliminary analysis.***

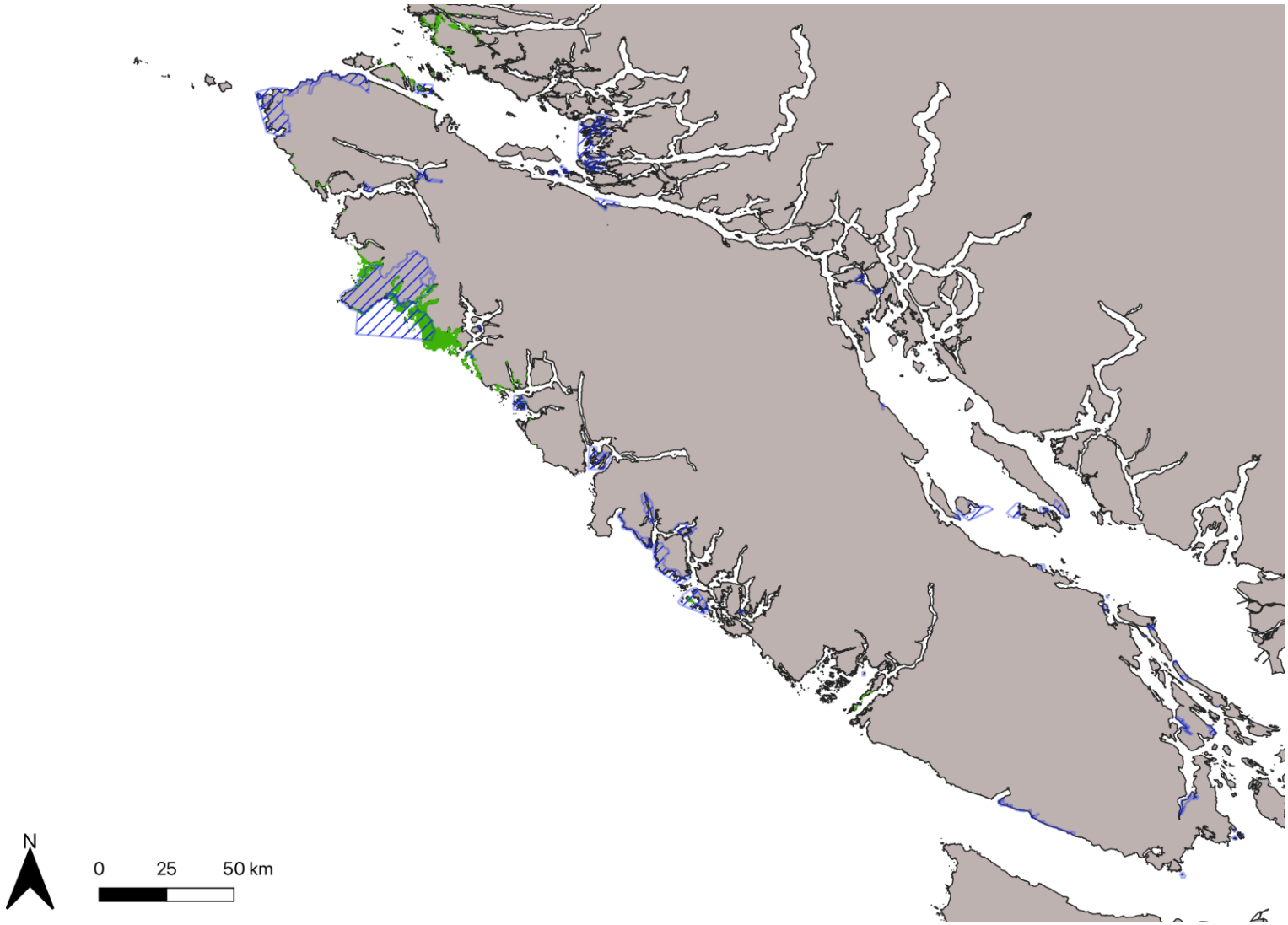

Figure A16. *Map showing the species distribution of Macrocystis pyrifera BC's South Coast and Vancouver Island, with green indicating presence of the species. BC parks are shown in blue.* ***Preliminary analysis.***

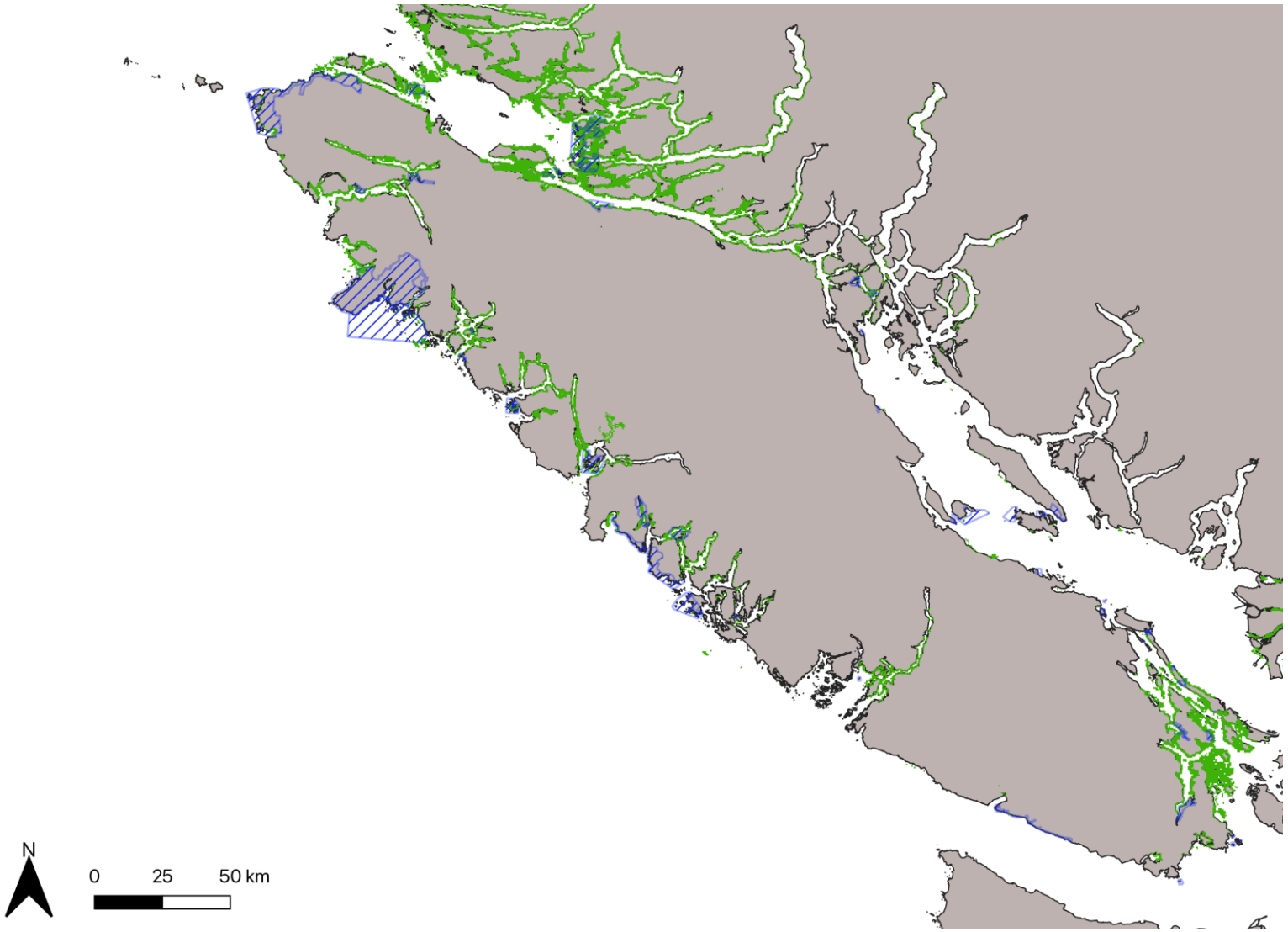

Figure A17. *Map showing the species distribution of Neoagarum fibriatum in BC's South Coast and Vancouver Island, with green indicating presence of the species. BC parks are shown in blue.* ***Preliminary analysis.***

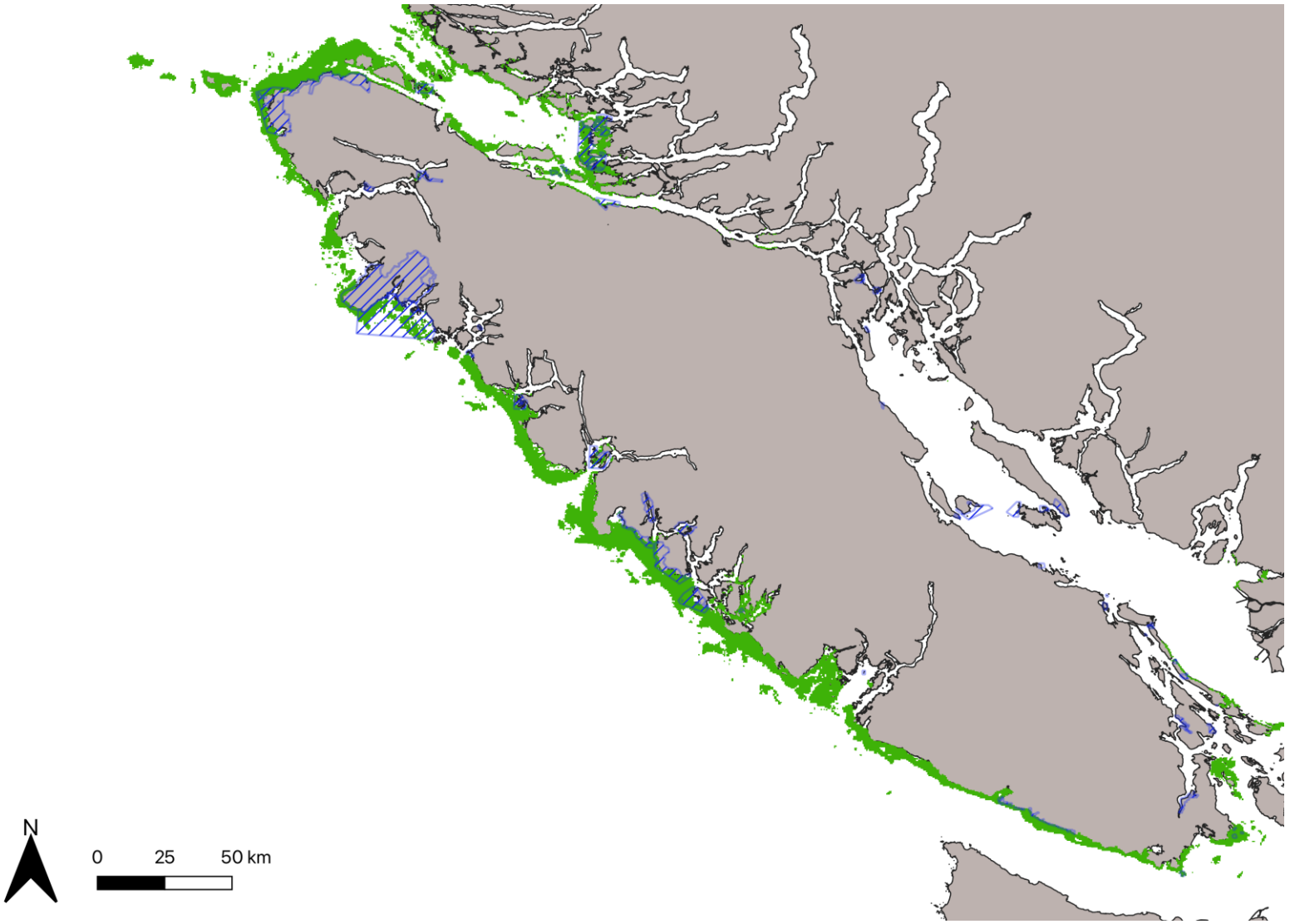

Figure A18. *Map showing the species distribution of Nereocystis luetkeana in BC's South Coast and Vancouver Island, with green indicating presence of the species. BC parks are shown in blue.* ***Preliminary analysis.***

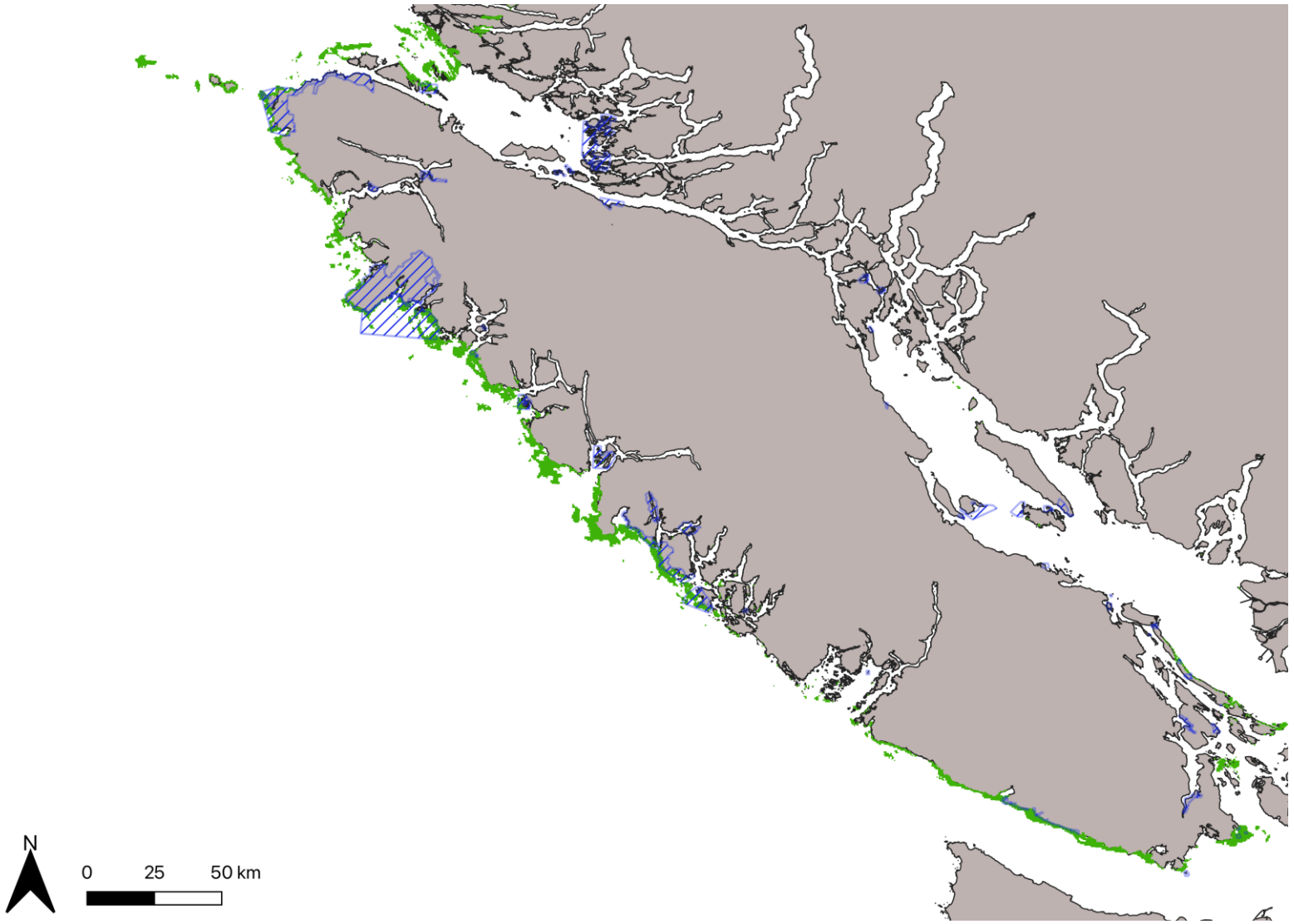

Figure A19. *Map showing the species distribution of Pterygophora californica in BC's South Coast and Vancouver Island, with green indicating presence of the species. BC parks are shown in blue.* ***Preliminary analysis.***

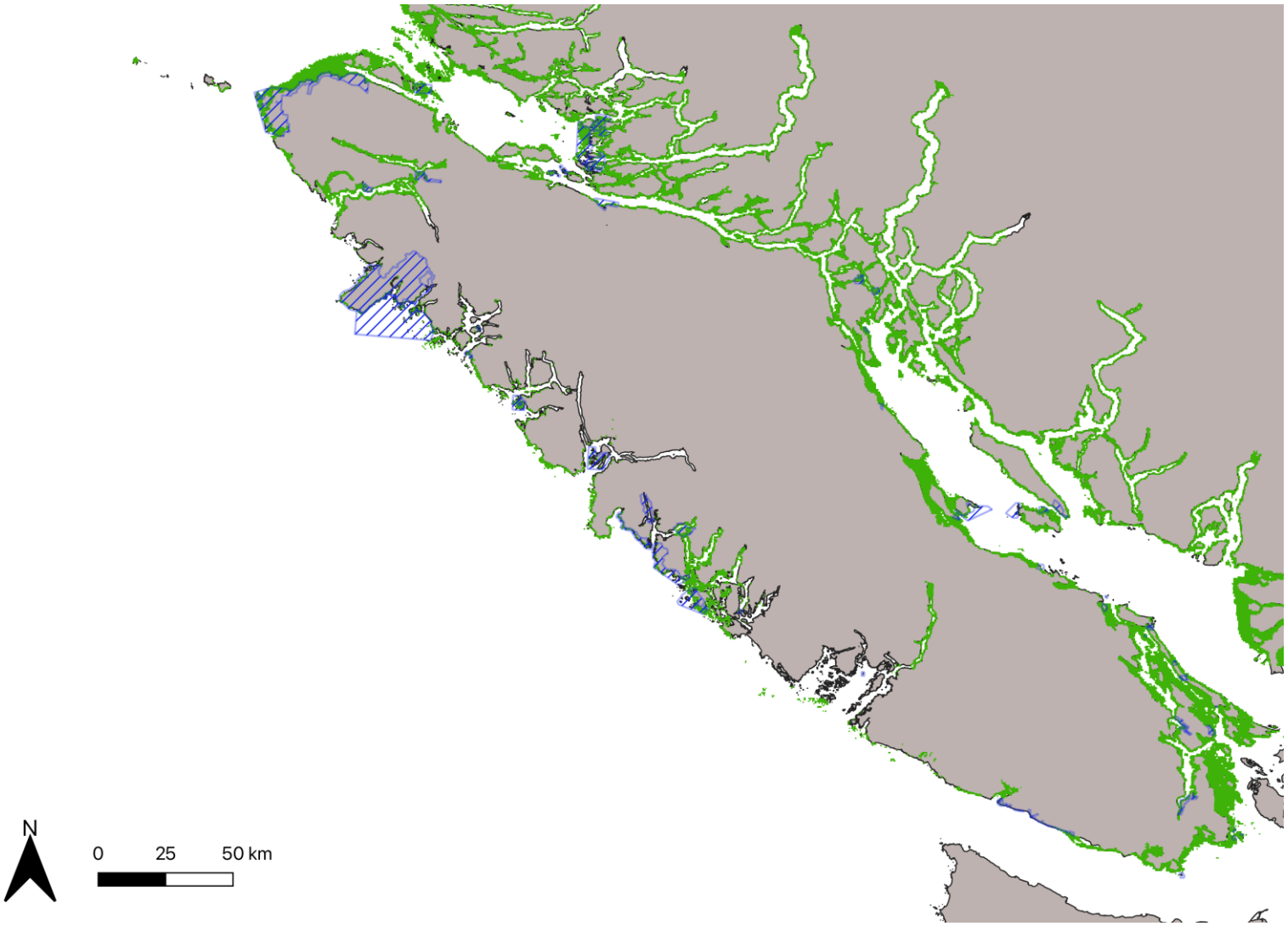

Figure A20. *Map showing the species distribution of Saccharina latissima in BC's South Coast and Vancouver Island, with green indicating presence of the species. BC parks are shown in blue.* ***Preliminary analysis.***

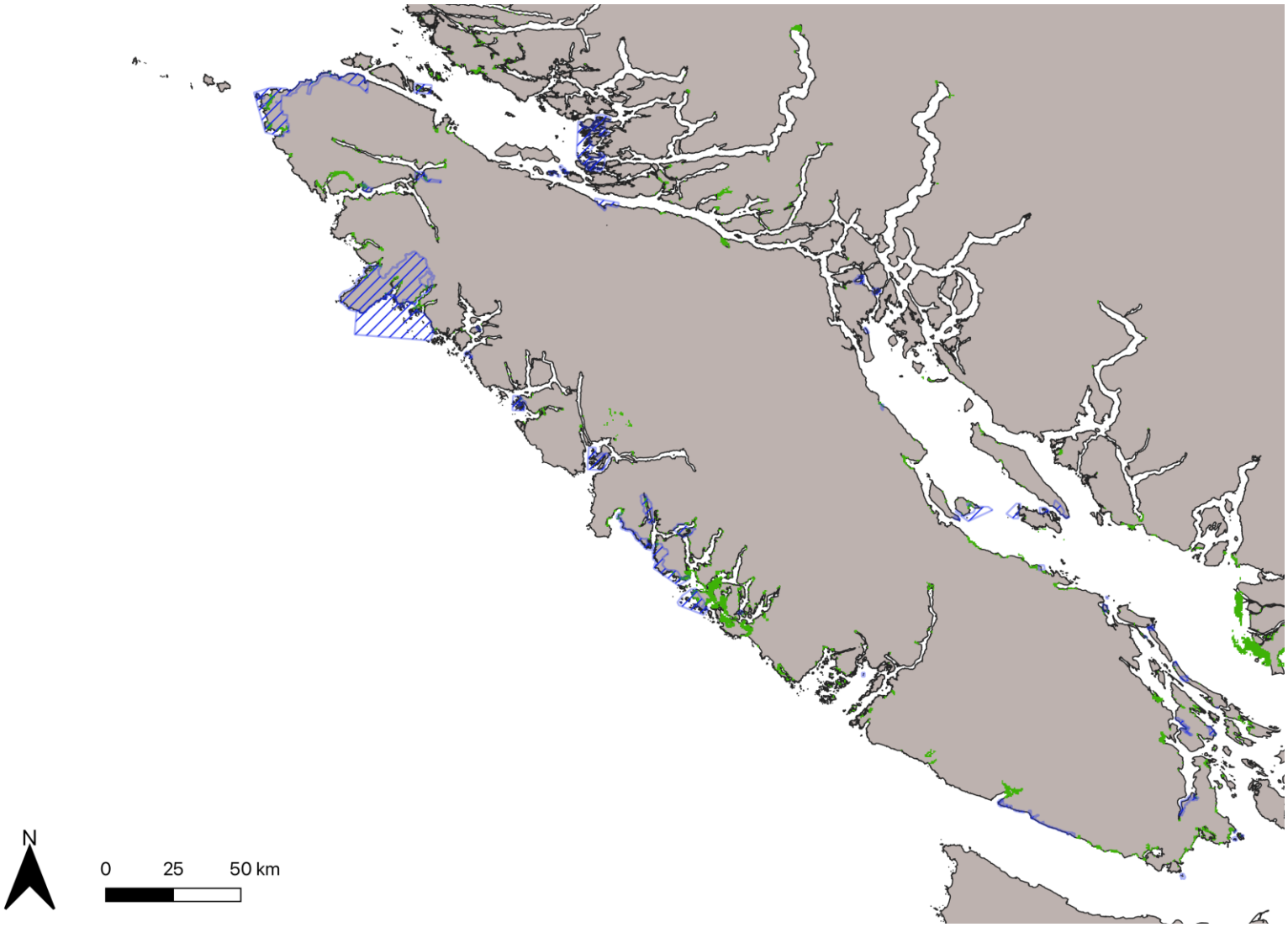

Figure A21. *Map showing the species distribution of Zostera sp. in BC's South Coast and Vancouver Island, with green indicating presence of the species. BC parks are shown in blue.* ***Preliminary analysis.***

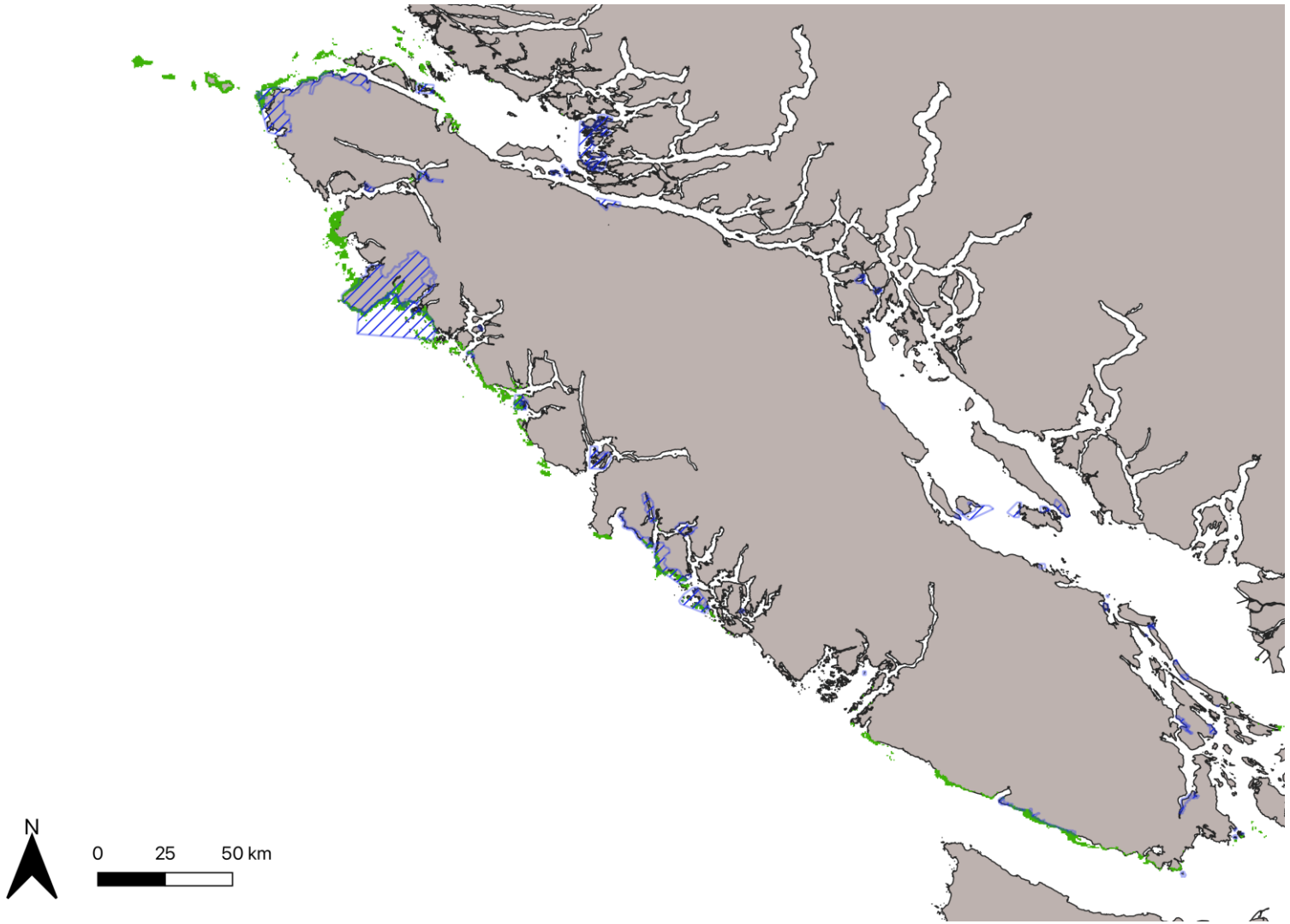

Figure A22. *Map showing the species distribution of Phyllospadix sp. in BC's South Coast and Vancouver Island, with green indicating presence of the species. BC parks are shown in blue.* ***Preliminary analysis.***