Outer coast estuary *Zostera japonica* 2013 mapping and monitoring

Rationale

The seagrass *Zostera japonica* occurs throughout Willapa Bay and Grays Harbor outer coast estuaries of Washington. Some residents report that *Z. japonica* has expanded its range in recent years, and that this expansion has caused sandy areas to accumulate fine particles, becoming muddy and unsuitable for shellfish aquaculture. At present, there is little scientific data to confirm or contradict these reports. This project aims to capitalize on a 2006/07 bay-wide survey of *Z. japonica* conducted by USDA-ARS researchers in order to address three questions:

- Has *Z. japonica* expanded and/or increased in abundance since 2006/07?
- Does *Z. japonica* now occupy areas where *Spartina alterniflora* was eradicated?
- What is the relationship between *Z. japonica* presence and sediment characteristics?
- What is the *Z. marina* density in Willapa Bay and Grays Harbor?

Scope

The 2006/07 USDA-ARS survey sampled 4,237 waypoints across Willapa Bay. The protocol consisted of rapid qualitative assessments of *Z. japonica* cover and sediment characteristics at each waypoint. This project expanded sampling into Grays Harbor, which was not included in the 2006/07 survey. Furthermore, this project augmented the methods of the 2006/07 survey by collecting *Z. japonica* and sediment samples at each waypoint, to provide quantitative data that will support more rigorous statistical analyses. A subset of the waypoints sampled in 2006/07 were sampled in 2013 according to three criteria:

- Waypoints where *Z. japonica* was absent in 2006/07
- Waypoints where *S. alterniflora* was present in 2003
- Waypoints that maximize the geographic breadth of sampling in Willapa Bay and Grays Harbor

We returned to ~1,000 of the same points, collected data following the 2006/2007 USDA methods, collected some new data. We also generated a new grid covering all of Greys Harbor, and mapped ~400 points there.

Figure details:

1) Figure one shows the change in Z. japonica level from 2006/2007 to 2013 in Willapa Bay. At each point, we performed a qualitative assessment of Z. japonica cover: the surveyor classified Z. japonica as ‘absent’, ‘present
- minor,’ ‘present - medium,’ or ‘present - major.’ In order to evaluate change, I coded these four classifications as 0, 1, 2, and 3, respectively. Thus, any point where Z. japonica was ‘absent’ (0) in 2006/2007 and ‘present -major’ (3) in 2013 exhibited a change of +3 (or ‘+++’ in this figure.) Any point where Z. japonica was ‘present -medium’ (2) in 2006/2007 and ‘absent’ (0) in 2013 exhibited a change of -2 (or ‘--‘ in this figure.)

2) Figure two shows the distribution and qualitative level of Z. japonica in Willapa Bay in 2013.

3) Figure three shows the biomass-per-area of Z. japonica in Willapa Bay in 2013. The 2006/2007 survey did not collect Z. japonica samples, so unfortunately we cannot test whether the biomass of Z. japonica has changed over time.

4) Figure four shows sediment organic content in Willapa Bay in 2013. Because some shellfish growers suggest that Z. japonica causes sediment to become muddy and smother manila clams, we wanted to examine the correlation between Z. japonica abundance and sediment organic content - a good measure of 'muddiness.'

5) Figure five shows the distribution and qualitative level of Z. japonica in Greys Harbor in 2013.

6) Figure six shows the biomass-per-area of Z. japonica in Greys Harbor in 2013.

7) Figure seven shows sediment organic content in Greys Harbor in 2013.

) Figure eight shows the distribution and qualitative level of Z. marina in Willapa Bay in 2013.

9) Figure nine shows the density of Z. marina in Willapa Bay in 2013.

10) Figure ten shows the distribution and qualitative level of Z. marina in Greys Harbor in 2013.

11) Figure eleven shows the density of Z. marina in Greys Harbor in 2013

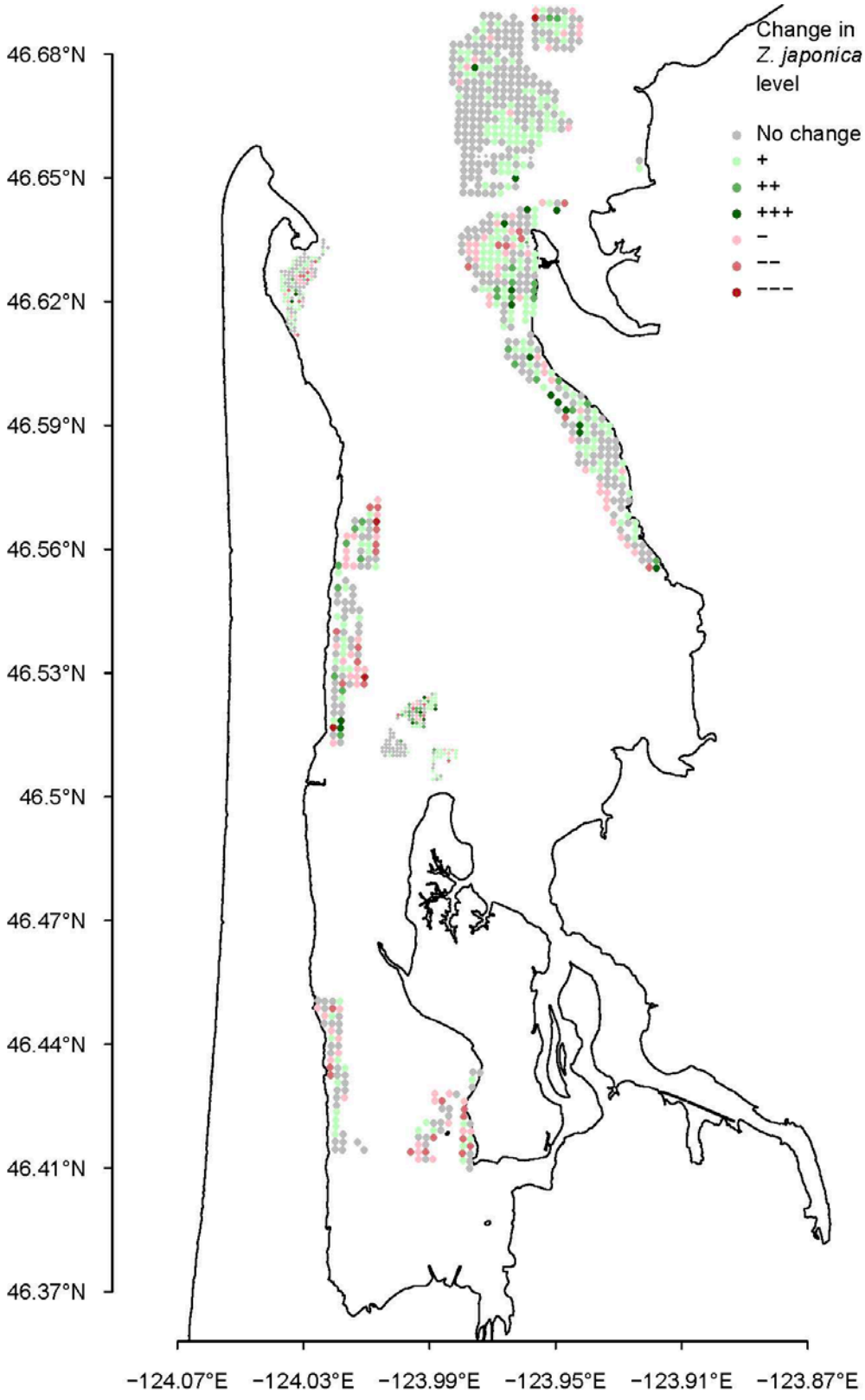

Figure 1 WB map of change in Zj level from 2006-2013

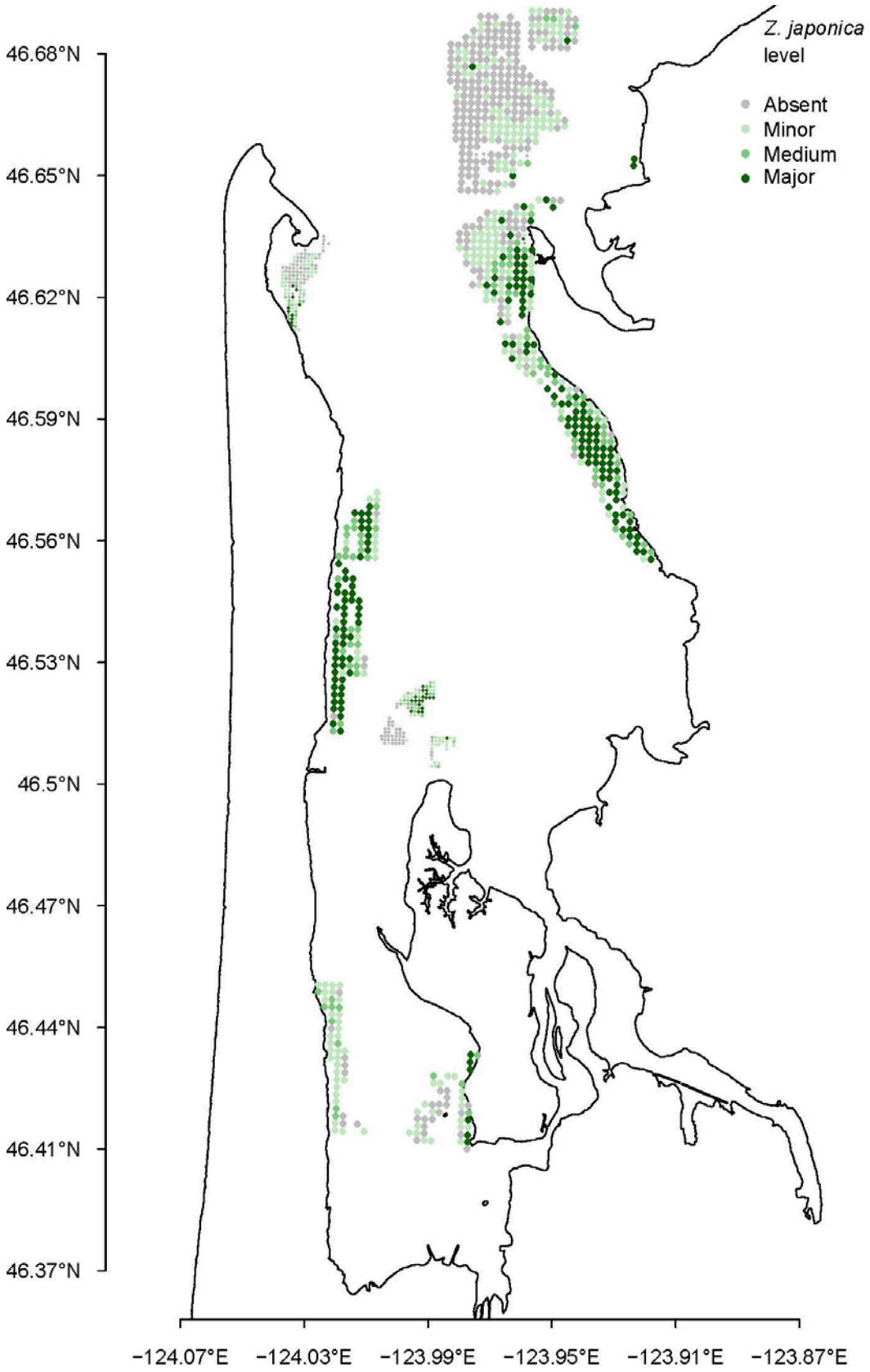

Figure 2 WB map of 2013 Zj level

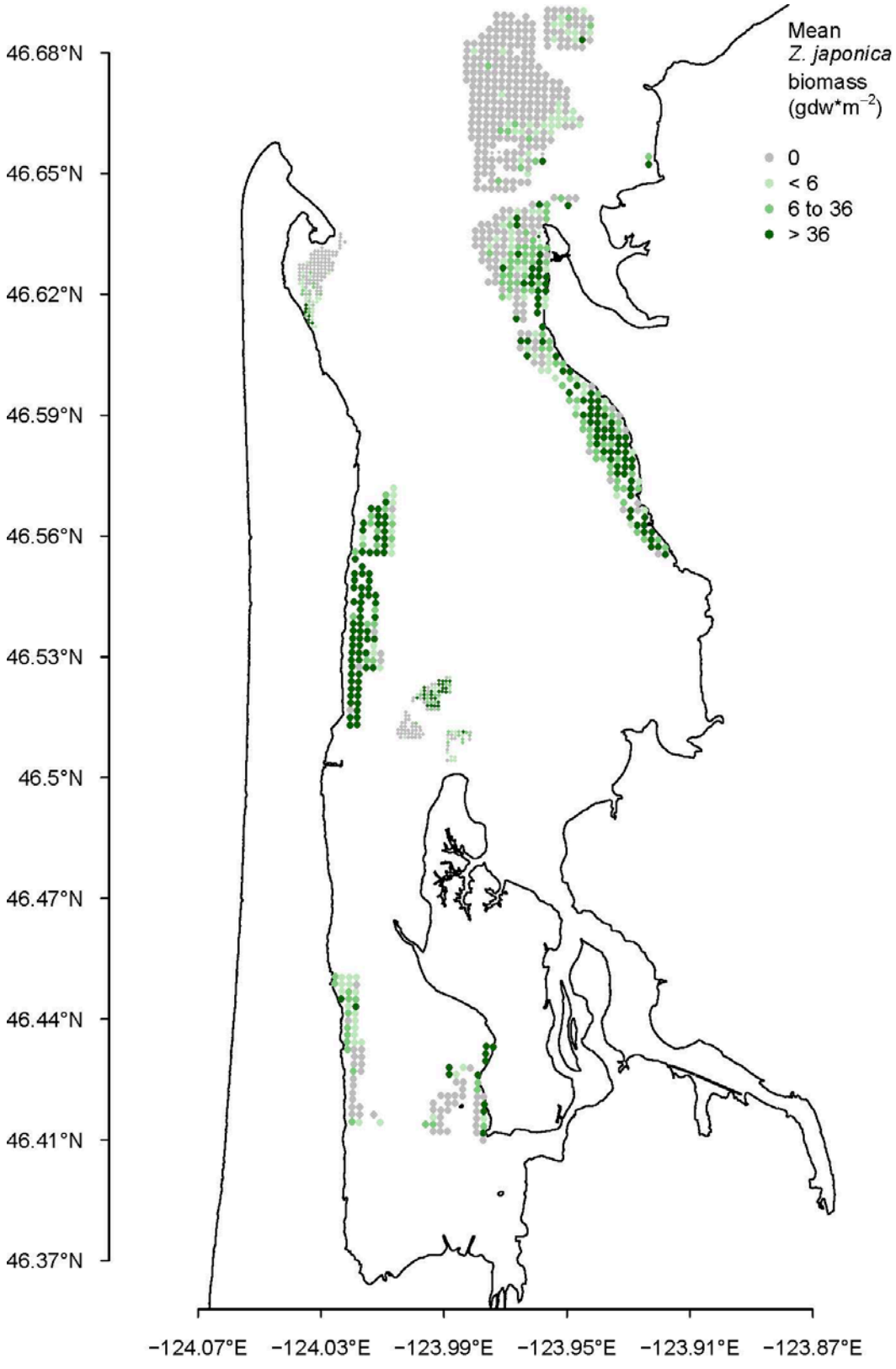

Figure 3 WB map of 2013 Zj biomass

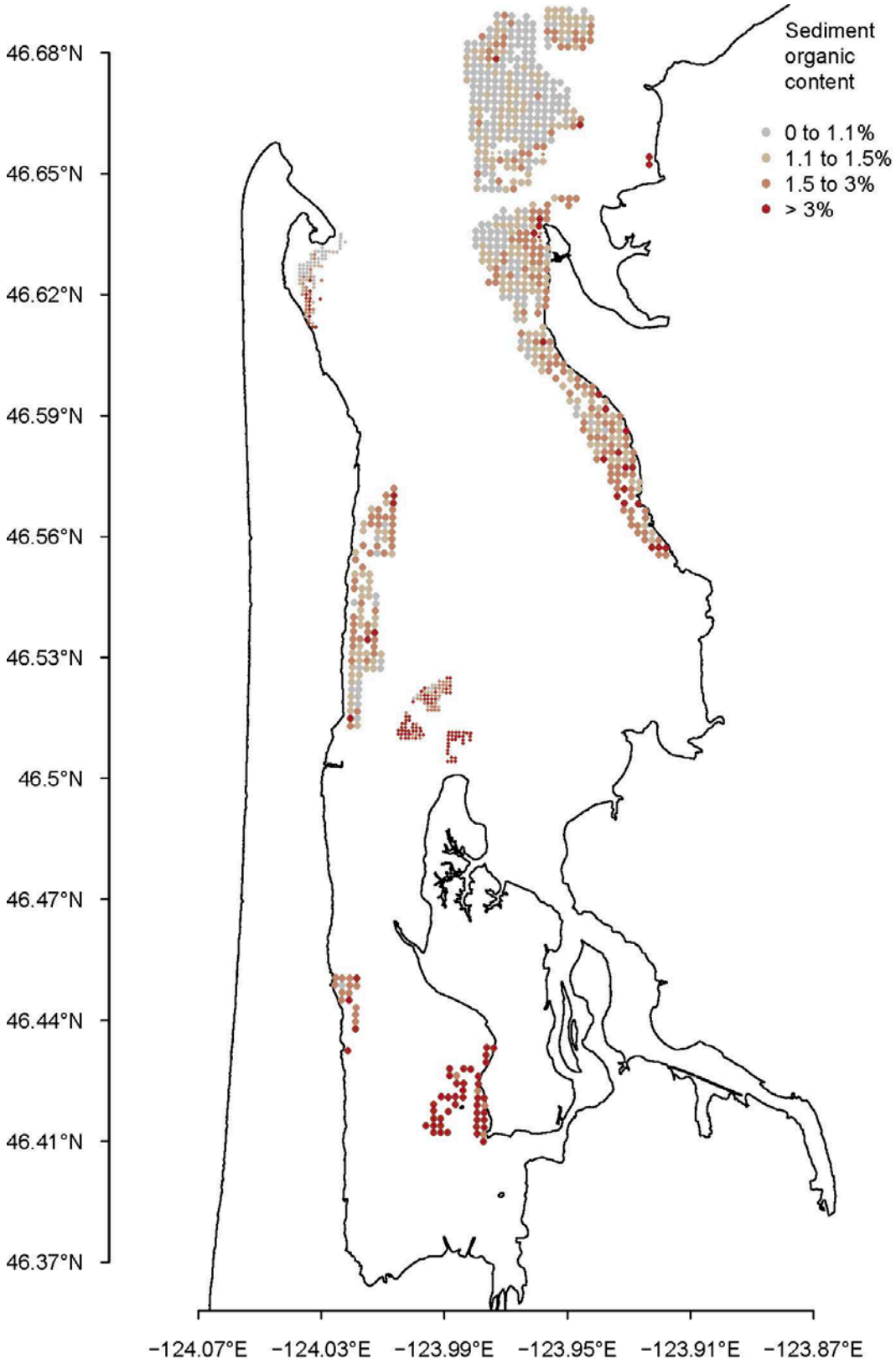

Figure 4 WB map of 2013 sediment organic content

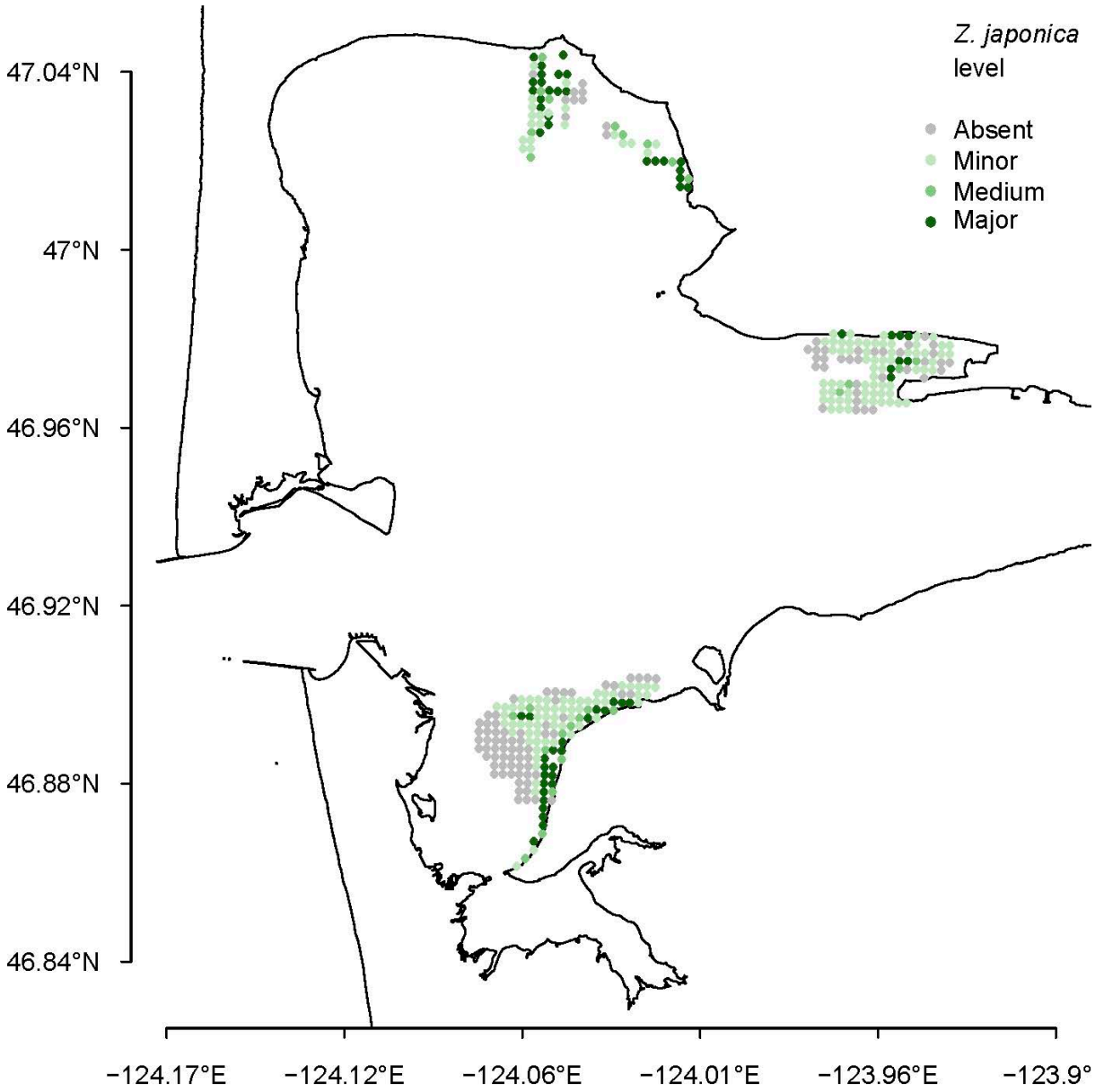

Figure 5 GH map of 2013 Zj level

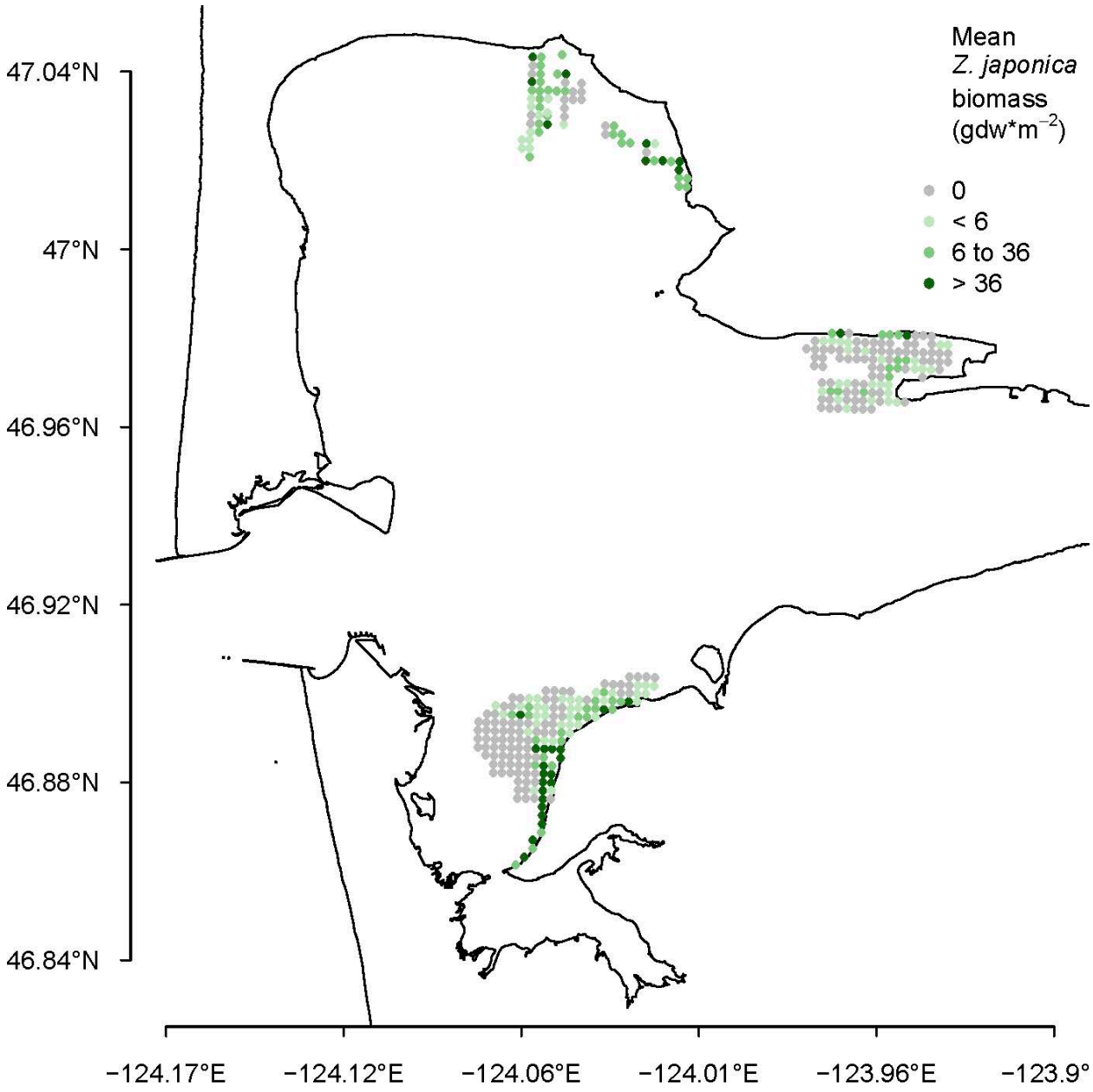

Figure 6 GH map of 2013 Zj biomass

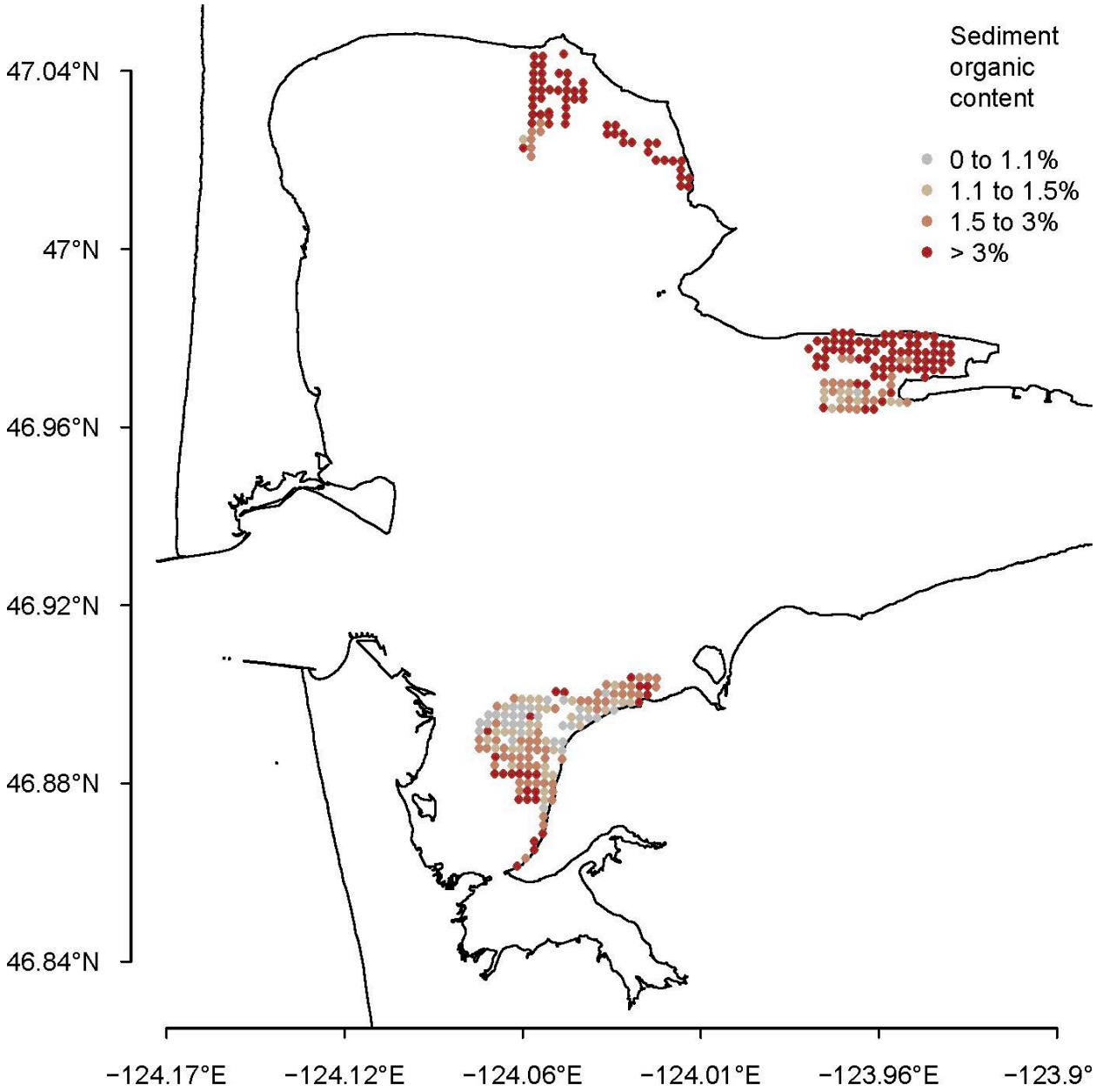

Figure 7 GH map of 2013 sediment organic content

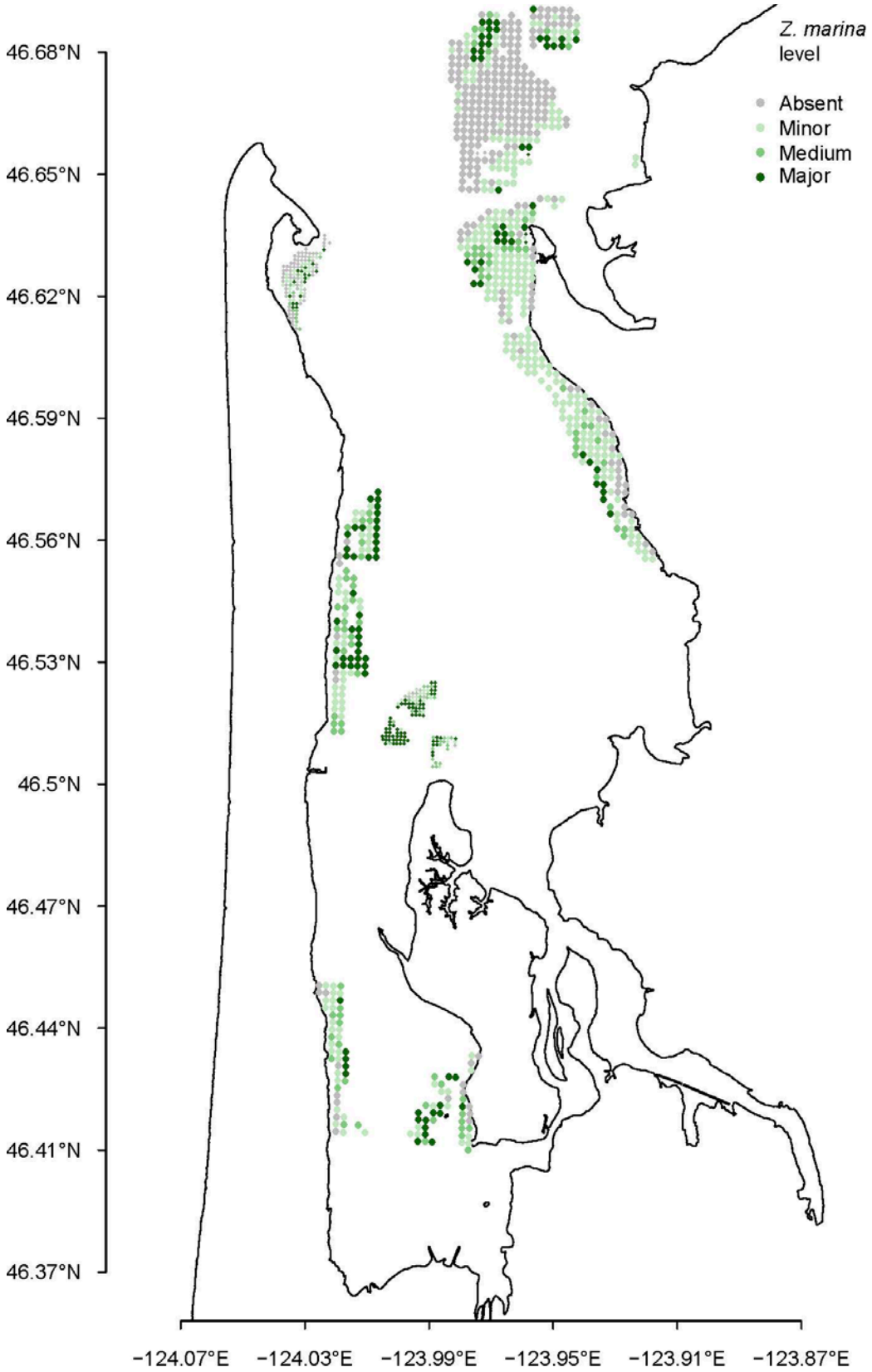

Figure 8 WB map of 2013 Zm level

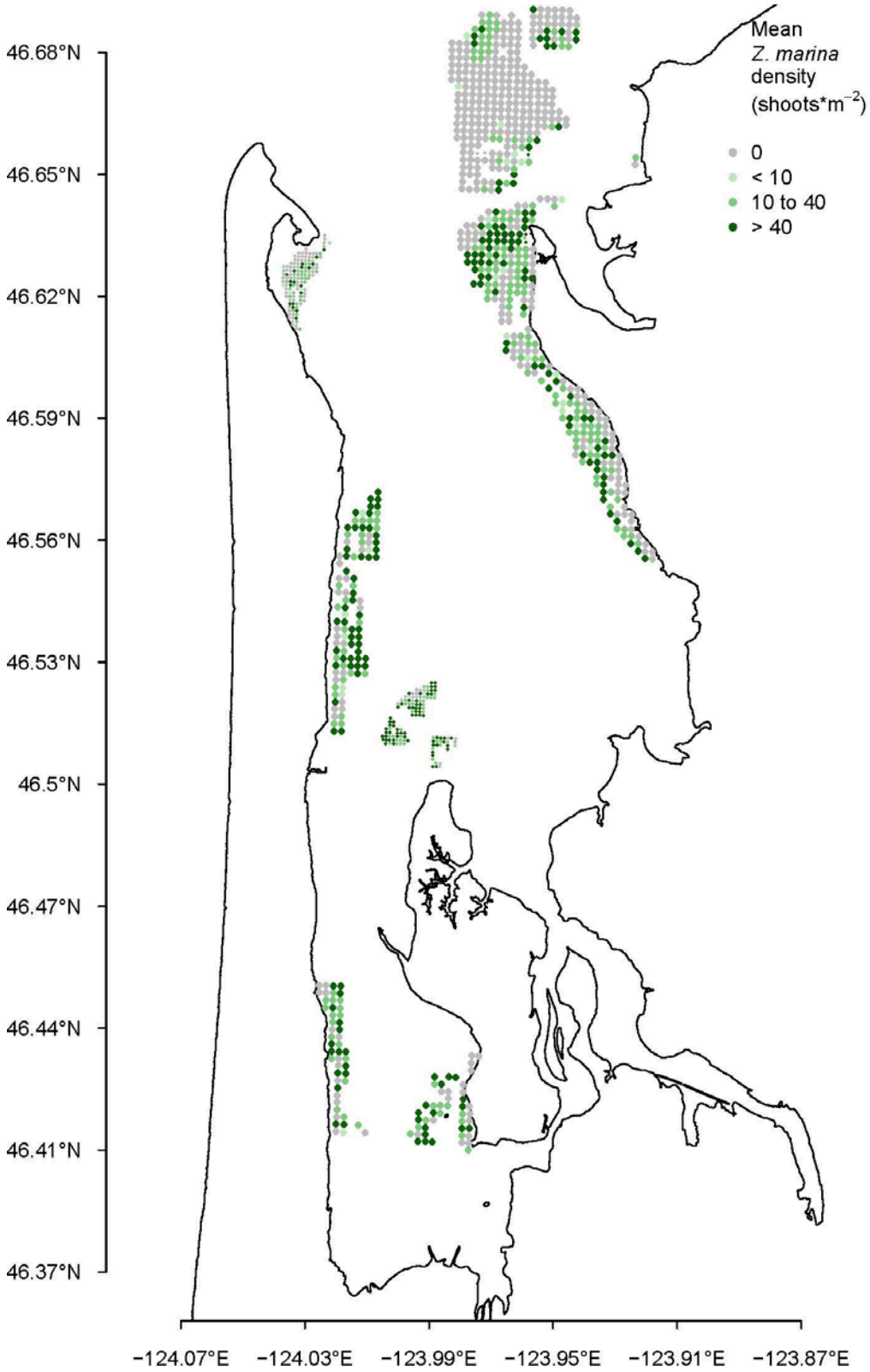

Figure 9 WB map of 2013 Zm density

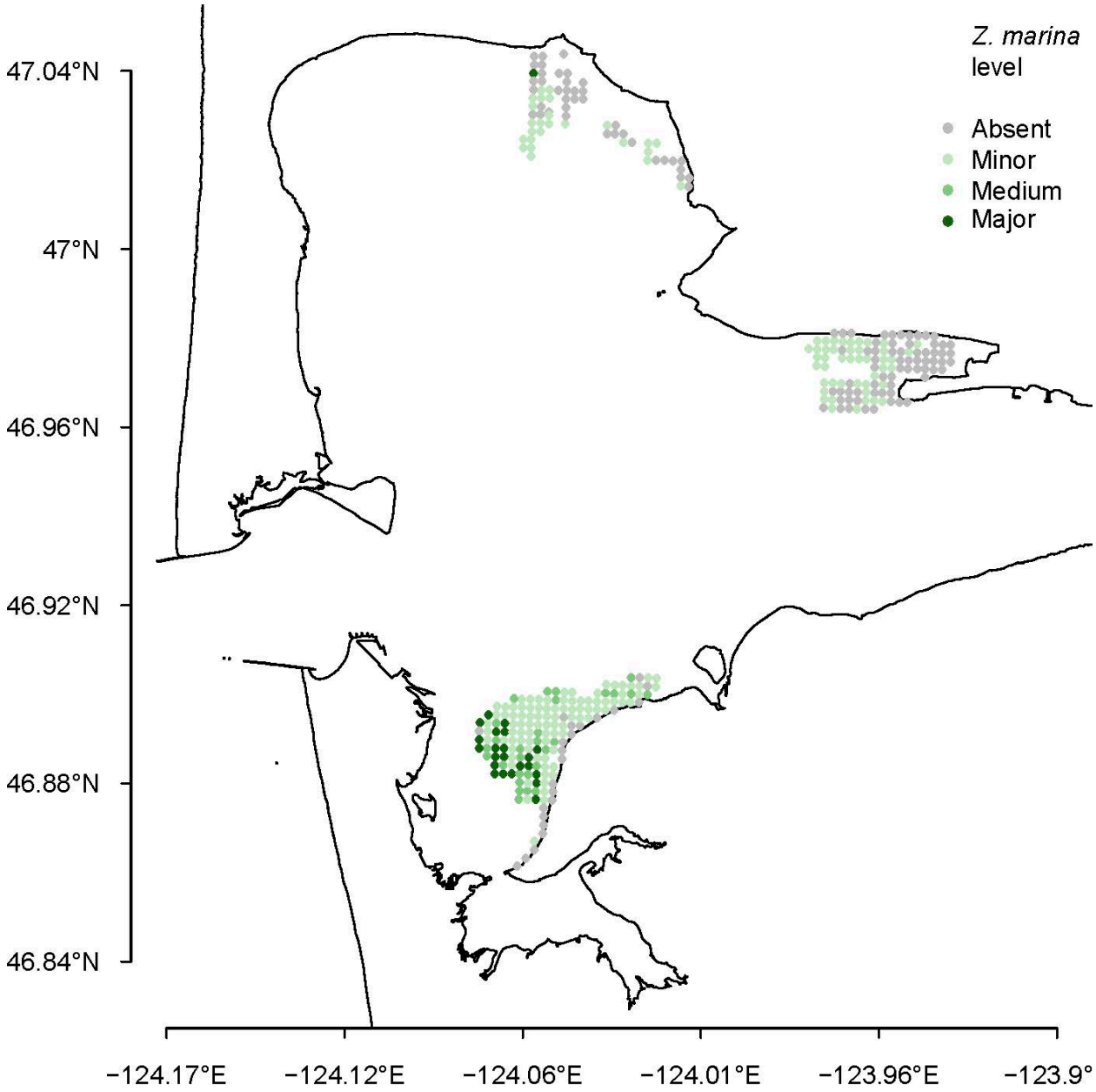

Figure 10 GH map of 2013 Zm level

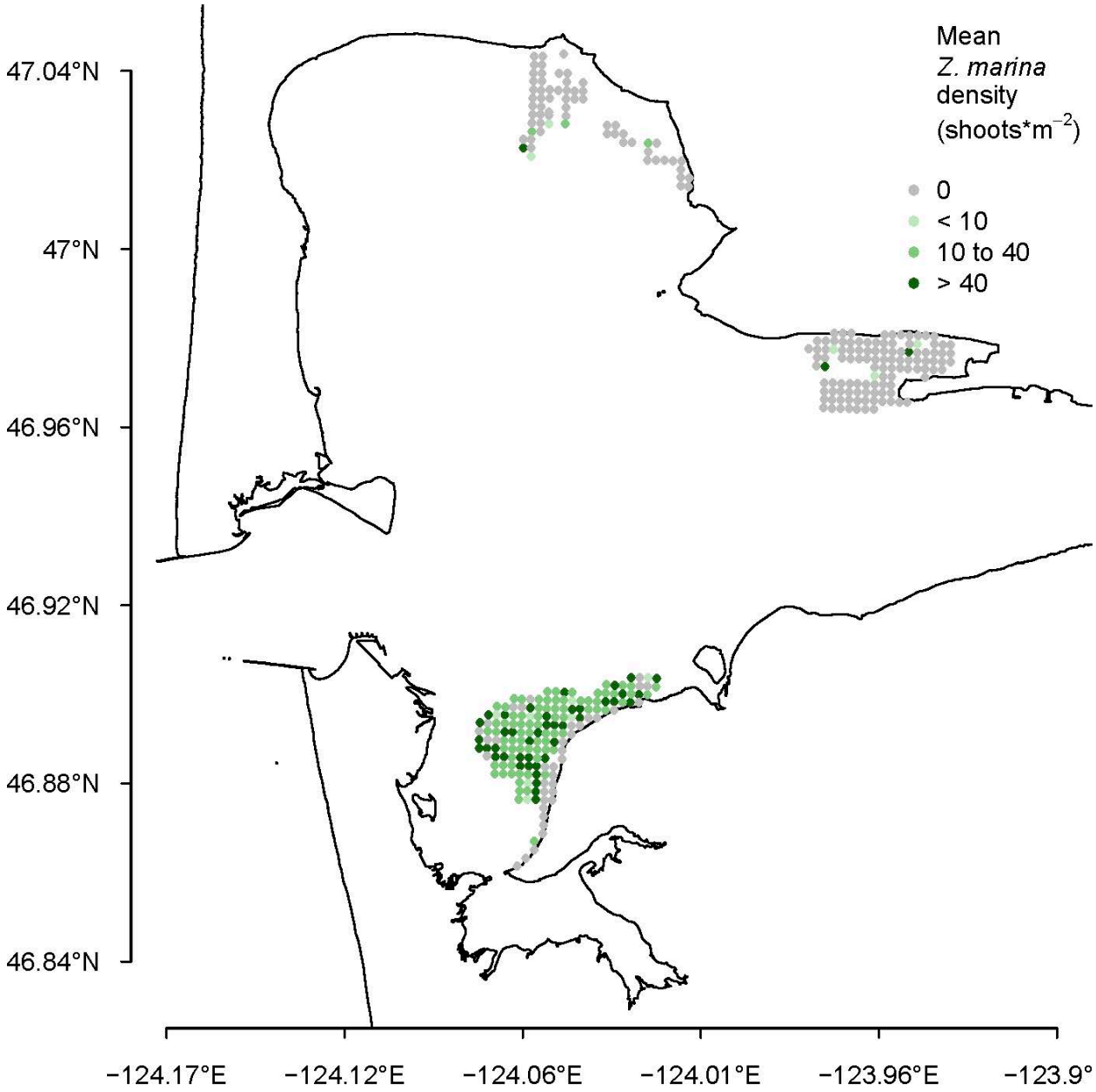

Figure 11 GH map of 2013 Zm density