I am most grateful for the opportunity to correct the statements made in the commentary of Covernton and Cox.

Covernton and Cox state that the microplastic abundances reported by Kazmiruk et al. [1] are unfounded due to inappropriate methodologies. Data from Pearce et al. [2] and Covernton et al. [3] is used to suggest that only microfibers dominate within Baynes Sound and microfibers recovered from shellfish, water and sediments within Baynes Sound are of textile origin and not attributed to the degradation of shellfish aquaculture infrastructure.

Kazmiruk et al. [1] report only on sediment concentrations of microplastics (MPs) pollution within Baynes Sound, their key finding, and the point at issue, the extremely high concentrations of spheres, higher than any reported literature value [1,3] in two locations in the northern portion of the Sound. Two sources were implicated, the estuary and the shellfish industry. Recommendations of Kazmiruk et al. [1] were to determine the source and the ecological implications of such concentrations of MPs within this region. Sediment sampling by Kazmiruk et al. [1] took advantage of the lowest tides of the year which allowed for subtidal collection where accumulations of MPs would be the greatest and disturbance from tides, wave action and storms the least. Covernton et al. [3] sampled the upper 5 cm of near shore surficial sediments, regions of high energy due to wave and tidal influence where such accumulations would not occur. The two sampling methods are not comparable with Kazmiruk et al. [1] providing information on the accumulation of MPs, notably spheres, over time, within this region.

Kazmiruk et al. [1] applied standard methodologies [4] for the separation of microplastics from sediment; a density gradient under limited air flow, followed by visual inspection at 40 X magnification coupled with other supportive measures such as image analysis, compression and a hot needle test where appropriate. Procedures used distilled deionized water (DDW) and a NaCl solution of which neither contained microspheres as indicated by procedural blanks. Covernton and Cox use [5] to suggest that sediment samples should have been treated with hydrogen peroxide to remove organic matter (OM) and aid in MPs recovery. This procedure is most effective for samples such as sewage sludge which contain OM concentrations over 20% [5] and not required for sediments low in OM% i.e., ca. 3% for sediments sampled by Kazmiruk et al. [1].

Covernton and Cox use the study of Covernton et al. [3] to justify that microfibers of textile origin dominate in bivalves, water and sediment within Baynes Sound. Covernton et al. [3] transplanted oysters and Manila clams from a shellfish farm located within Baynes Sound to non-aquaculture and aquaculture sites. Bivalves were left for 3 months, oysters on the sediment surface, clams at 2.5 cm depth, then collected and analysed for MPs. The study objective was to determine if shellfish aquaculture infrastructure contributed to MPs pollution within the bivalves. Oysters because of their bias in particle selection, cannot be used to indicate MPs pollution within aquatic environments [6] and the findings of Covernton et al. [3] with respect to MPs recovered from oysters are not valid. Limited recovery (10 of 60 deployed) and poor survival (no recovery from 3 sites including a reference site within Baynes Sound) of clams, with no condition index to support that clams were healthy and feeding during their time of exposure undermines the findings for clams reported by Covernton et al. [3].

Bendell et al. [7] recently sampled Manila clams from two regions within Baynes Sound, Henry Bay where high concentrations of spheres were reported by Kazmiruk et al. [1] and Metcalf Bay a region intensively used for shellfish aquaculture. Clams and both positive and negative controls were subject to a 10% KOH digestion followed by a 30% hydrogen peroxide rinse and MPs collected on filters submitted for FTIR analysis (Department of Chemistry, Simon Fraser University). In contrast to Covernton et al. [3], clams were healthy and would have been actively feeding up until the time of sampling. Recovered MPs included those that could be directly linked to aquaculture gear, a polypropylene composite (PPC) (Figures 1a-d) and spheres and particles composed of high density polyethylene, (HDPE), PPC and poly (methyl methacrylate) (PMMA) (Figures 2a-g).

Covernton and Cox state that the region of Baynes Sound is “managed comparatively well” and cite [8] to support this claim. Reference [8] reports on the management of plastic waste globally (e.g., comparing Canada to other countries such as China) with no information on the management of plastics, specifically plastic derelict aquaculture fishing gear associated with the shellfish industry within Baynes Sound. There is no management of the plastic debris within Baynes Sound [9,10] (Figures 3a-f) and the unabated flow of plastics from the BC shellfish industry, ca. 6 tonnes annually, continues to degrade one of Canada’s most sensitive coastal ecosystems [9,10].

Acknowledgements. The author is extremely grateful to Wen Zhou of the Department of Chemistry, Simon Fraser University for the FTIR analysis of all MPs.

References

[1] Kazmiruk TN, Kazmiruk VD, Bendell LI. Abundance and distribution of microplastics within surface sediments of a key shellfish growing region of Canada. PLOS ONE. 2018; 13: e0196005. https://doi.org/10. 1371/journal.pone.0196005 PMID: 29791448

[2] Pearce C, Dudas S, Gurney-Smith H, Ross, P, Stevenson R. Microplastics and shellfish aquaculture: investigating presence, extent, potential impacts and mitigation measures. Grant # 15-1-P-01, http://www.dfo-mpo.gc.ca/aquaculture/acrdp-pcrda/info-eng.html British Columbia Shellfish Growers Association and Fisheries and Oceans Canada.

[3] Covernton G, Collicutt B, Gurney-Smith H, Pearce C, Dower J, Ross P, et al. Microplastics in bivalves and their habitat in relation to shellfish aquaculture proximity in coastal British Columbia, Canada. Aqua cult Environ Interact. 2019; https://doi.org/10.3354/aei00316

[4] NOAA Marine Debris Program 2015. Laboratory methods for the analysis of microplastics in the Marine Environment: Recommendations for quantifying synthetic particles in water and sediments. NOAA, U.S. Department of Commerce. Technical Memorandum NOS-OR&R-48.

[5] Hurley RR, Lusher AL, Olsen M, Nizzetto L. Validation of a method for extracting microplastics from complex, organic-rich, environmental matrices. Environ Sci Technol. 2018; https://doi.org/10.1021/acs. est.8b01517 PMID: 29886731

[6] Ward, J.E., S. Zhao, B. A. Holohan, K. M. Mladinich, T. W. Griffin, J. Wozniak, and S. E. Shumway 2019 Selective Ingestion and Egestion of Plastic Particles by the Blue Mussel (Mytilus edulis) and Eastern Oyster (Crassostrea virginica): Implications for Using Bivalves as Bioindicators of Microplastic Pollution Environmental Science & Technology 53 (15), 8776-8784 DOI: 10.1021/acs.est.9b02073

[7] Bendell, L.I., LaCadre, E. and Zhou, W. 2019. Use of bivalves as a biomonitor of microparticle pollution; a review and study. Submitted to PLOS ONE, special issue on Plastics in the Environment, December 6th 2019.

[8] Jambeck JR, Geyer R, Wilcox C, Siegler TR, Perryman M, Andrady A, et al. Plastic waste inputs from land into the ocean. Science. 2015; 347: 768–771. https://doi.org/10.1126/science.1260352 PMID: 25678662

[9] Bendell, L.I. and S. McKeachie. 2019 The demand for a luxury shellfish is polluting the ocean with plastics. The conversation. https://theconversation.com/the-demand-for-luxury-shellfish-is-polluting-the-ocean-with-plastic-118668

[10] Bendell, L.I., Gallaugher, P., McKeachie, S and Wood, L. (2019) Baynes Sound; The challenge of managing sensitive ecosystems. L.I. Bendell, P. Gallaugher, S. McKeachie and L. Wood editors. CRC Press, Taylor and Francis Group, New York.

Figure 1 a), b), c) and d). Example of shellfish aquaculture derelict fishing gear collected from the intertidal region of Baynes Sound a) and its associated FTIR spectra b). MPs particles recovered from a Manila clam from Baynes Sound c) and its associated FTIR spectra d). Both spectra indicate a polypropylene composite (PPC). The x and y axis are 1 mm.

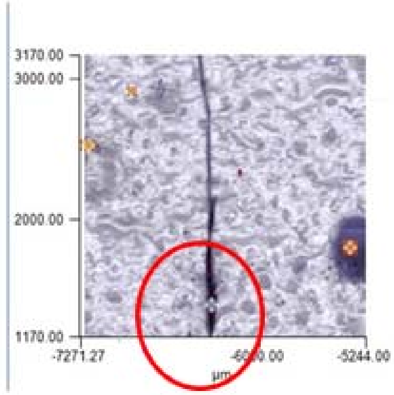
Figure 2 a), b), c), d), e), f) and g). Examples of MPs recovered from Manila clams sampled from Henry (a-d) and Metcalf (e-h) Bays. Spheres in a) and b) are high density polyethylene (HDPE) and c) and d) are poly(methyl methacrylate) (PMMA). The MP in e) is PPC and f), g) and h) are HDPE as determined by FTIR. The x and y axis are 1 mm.

Figure 3 a), b), c), d), e), f) and g). Examples of derelict shellfish aquaculture gear recovered from the intertidal regions of Baynes Sound. Examples are of a) polystyrene, b) oyster pouches, c) oyster baskets and mesh, d) rope, e) oyster trays and mesh, f) oyster fencing and g) anti-predator netting. http://adims.ca/photo-gallery/

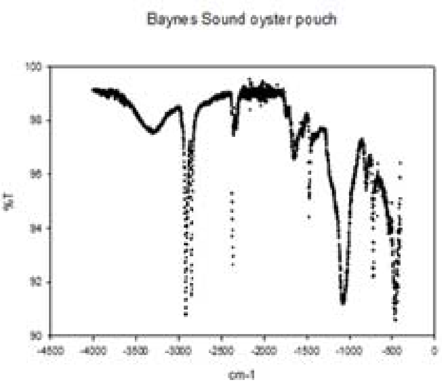
a)


Baynes
Sound
oyster pouch

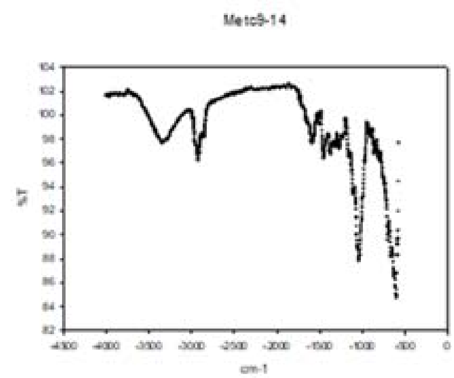
c)

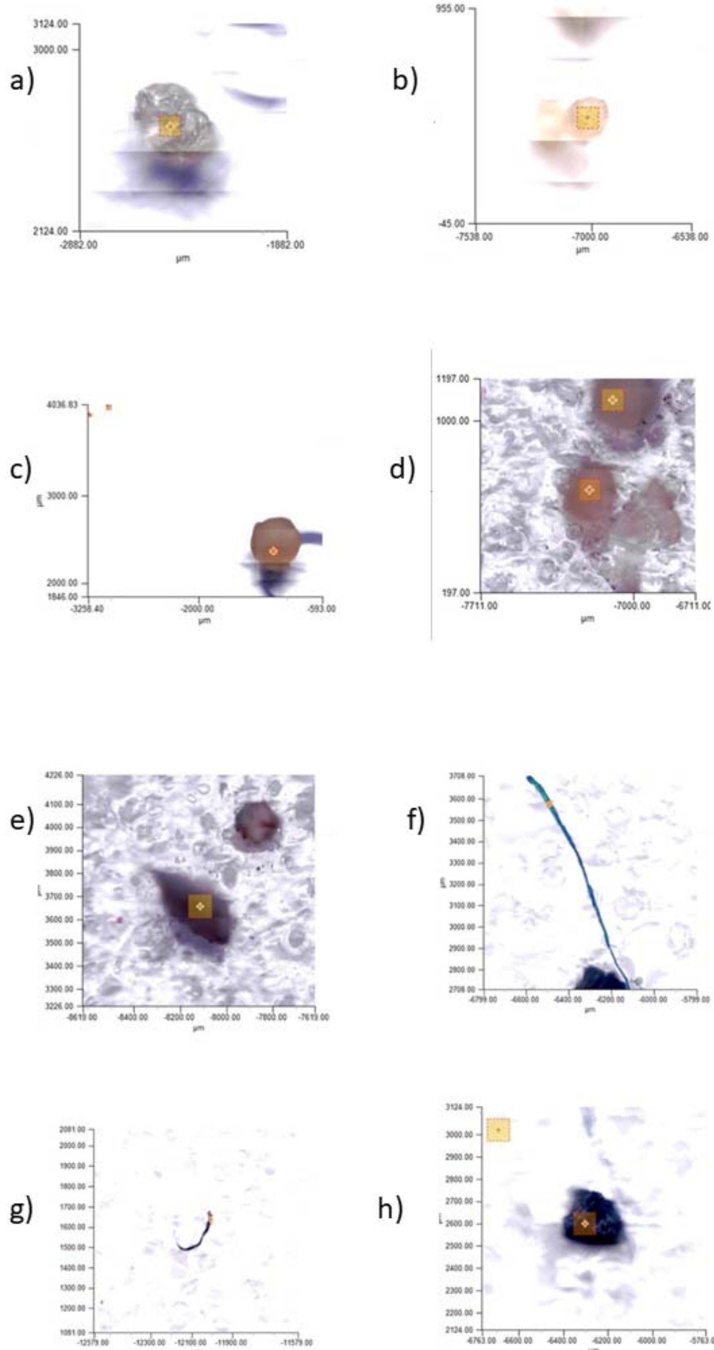

3170.00
3000.00
2000.00
1170.00
-7271.27
-6000.00
-5244.00
µm

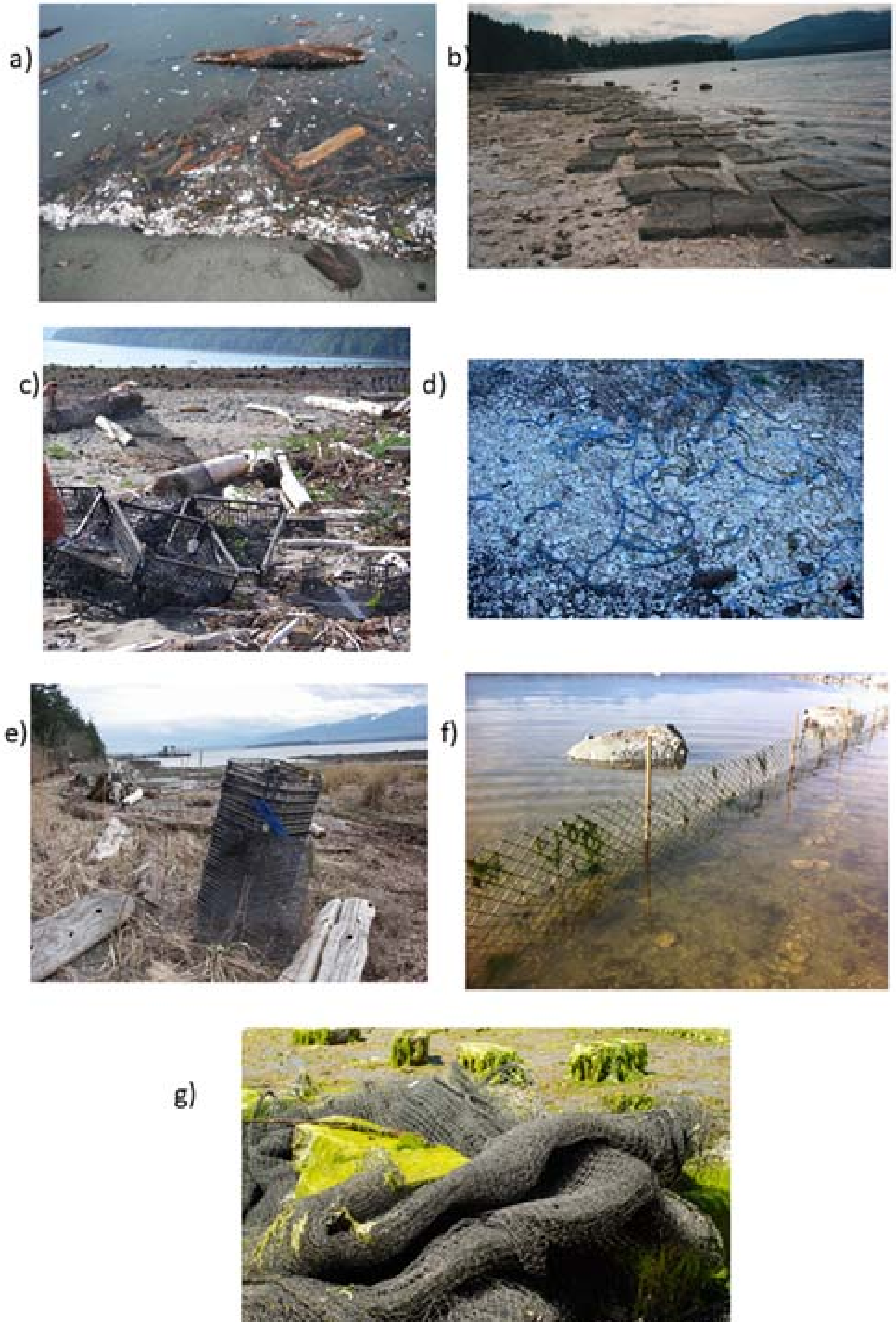
b)


Baynes Sound oyster pouch
%T
cm-1

d)


Meto9-14
%T
cm-1


a)
b)
c)
d)
e)
f)
g)
h)
µm


a)
b)
c)
d)
e)
f)
g)