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Canadian Science Advisory Secretariat
Science Response 2018/047

Pacific Region

SUMMARY OF LOCATIONS IN BRITISH COLUMBIA, CANADA SUPPORTING INVASIVE TUNICATE SPECIES AND EUROPEAN GREEN CRAB AS OF 2017

Context

Aquatic Invasive Species (AIS) can be redistributed both intentionally and unintentionally by a number of human-mediated vectors, including shellfish transfers as part of routine aquaculture operations. For example, in British Columbia, shellfish transfers are known to pose a risk of inadvertently moving invasive tunicates and European Green Crab. Although it is not possible to know the exact distribution of any AIS with complete confidence, Fisheries and Oceans Canada's (DFO) Science Branch in Pacific Region maintains geospatial information on all survey locations and the specific locations where AIS occur as part of its Regional AIS Monitoring Program. This information, even with some uncertainties (i.e., the coastline of British Columbia has not fully been surveyed), can be useful for management and policy decisions about AIS in British Columbia. For example, maps indicating the locations of various AIS can be used by shellfish managers to help identify locations where additional management measures may be needed when aquaculture transfer applications are reviewed, thereby reducing the likelihood that AIS will be moved unintentionally.

DFO's Aquaculture Management Division in Pacific Region has requested science advice on known high risk invasive tunicate and European Green Crab presence as well as a summary of locations that have been surveyed for these AIS. European Green Crab and four tunicate species known to occur in British Columbia are listed as Control species in the Aquatic Invasive Species (AIS) Regulations under the federal *Fisheries Act*.

The purpose of this Canadian Science Advisory Secretariat (CSAS) Science Response (SR) is to generate geospatial maps of locations with positive confirmation of invasive tunicates and European Green Crab, along with survey locations for these AIS. The assessment and advice arising from this SR will be used to inform the management/policy development of the British Columbia Aquaculture Regulation. It will also be used in making Pacific Aquaculture Regulatory and Introductions and Transfers license decisions. Further, data may inform ecosystem management, aquaculture siting guidelines, and/or industry best management practices, while future AIS analyses may help delineate the spatial scale at which shellfish aquaculture is managed in British Columbia (i.e., BC shellfish transfer zones versus discrete BC ecosystems (ecoregion or bay scale)).

This Science Response results from the Science Response Process of May 2018, Presence and distribution of European Green Crab and invasive tunicate species in British Columbia

Analysis and Response

This Science Response (SR) is focused on five high risk species listed in the AIS Regulations: Violet Tunicate (*Botrylloides violaceus*); Golden Star Tunicate (*Botryllus schlosseri*), Club Tunicate (*Styela clava*); *Didemnum vexillum*; and European Green Crab (*Carcinus maenas*). As higher risk AIS each has been targeted via DFO Science Pacific Region's AIS Monitoring Program. Further, each of these species has the potential to be moved with shellfish movements (Therriault and Herborg, 2007; Therriault et al., 2008; Curtis et al, 2015). Due to differences in life history characteristics, invasive tunicates and European Green Crab have been targeted by different survey methods. Biofouling surveys that encounter invasive tunicates are generally subtidal settling plate surveys (see Gartner et al. 2016) while European Green Crab has been targeted via trapping surveys (primarily intertidal habitats) (see Gillespie et al. 2007). The known occurrence of each AIS, either from DFO surveys or confirmed additional reports (i.e., public, non-AIS surveys, etc.), and corresponding DFO AIS Monitoring survey locations (i.e., plates for tunicates and trapping for crab) are shown in Figures 1-5 based on data available up to October, 2017. More detailed maps are provided in the Appendices to aid management decisions at smaller spatial scales.

The current known distribution of each AIS is quite distinct. The two botryllid tunicates are fairly widespread in British Columbia and both have established in Haida Gwaii (Shellfish Zone 1) (Figures 1, 2). This suggests extensive suitable habitat exists for these tunicates in British Columbia so management of invasion vectors will be important to reduce the likelihood of spread. In contrast, both club tunicate *Styela clava* and *Didemnum vexillum* show much more restricted distributions at this time (Figures 3, 4). This could reflect lower habitat suitability, fewer invasion vectors, or both. European Green Crab continues to spread northward, likely by natural larval dispersal, and has now reached the Central Coast of British Columbia but has not been detected in Canadian waters in the Salish Sea thus far (Figure 5). Previous studies have highlighted that potential suitable habitat could be extensive for invasive tunicates (Therriault and Herborg, 2007) and European Green Crab (Therriault et al., 2008) in British Columbia, but spread depends on both available vectors for movement and suitable conditions in the receiving environment.

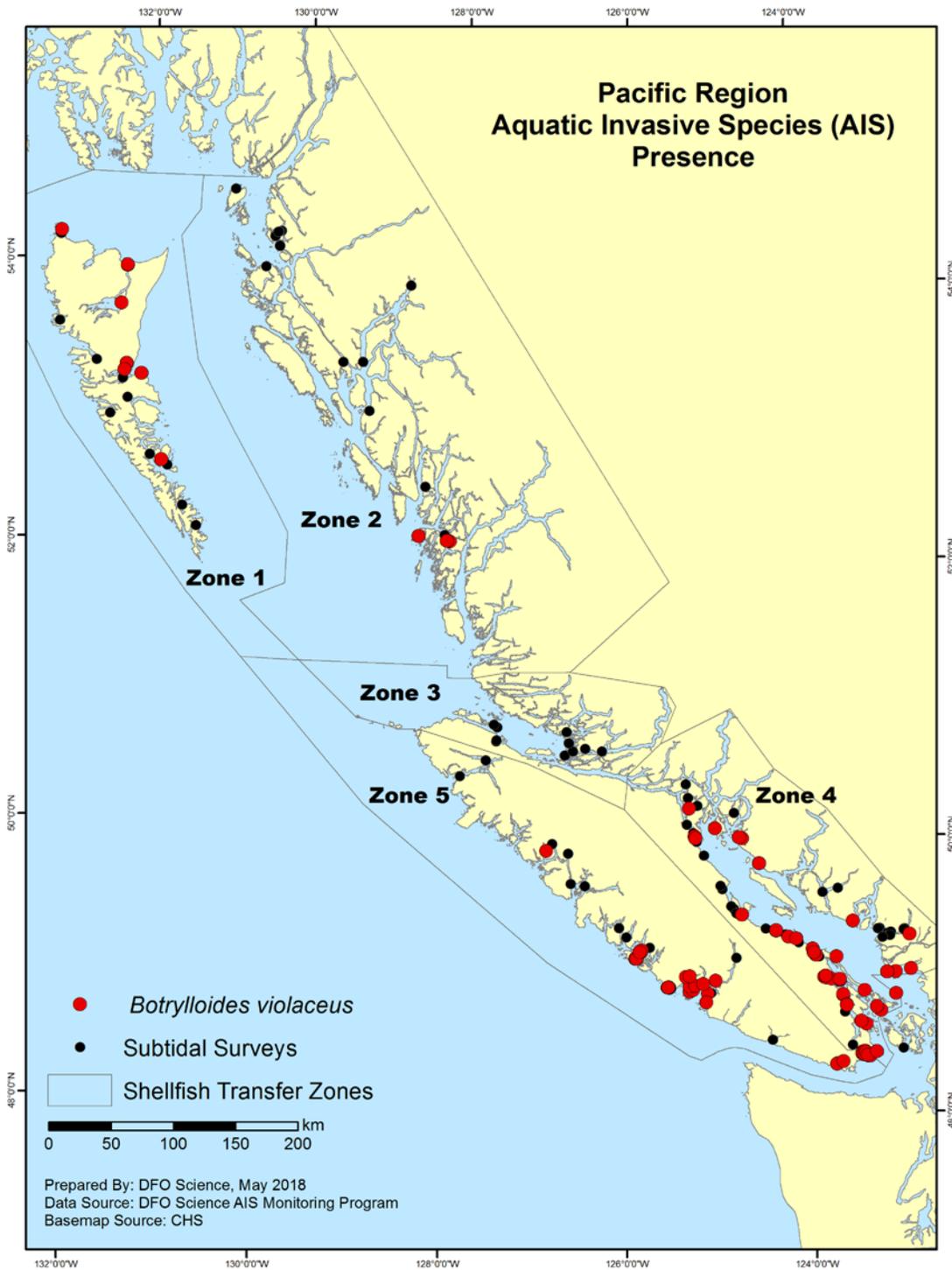


Figure 1: Current confirmed presence of violet tunicate (*Botrylloides violaceus*) in British Columbia (red circles) compared with overall subtidal survey locations (black circles represent surveyed areas where presence of *B. violaceus* was not confirmed, rather than indicating confirmed absence).

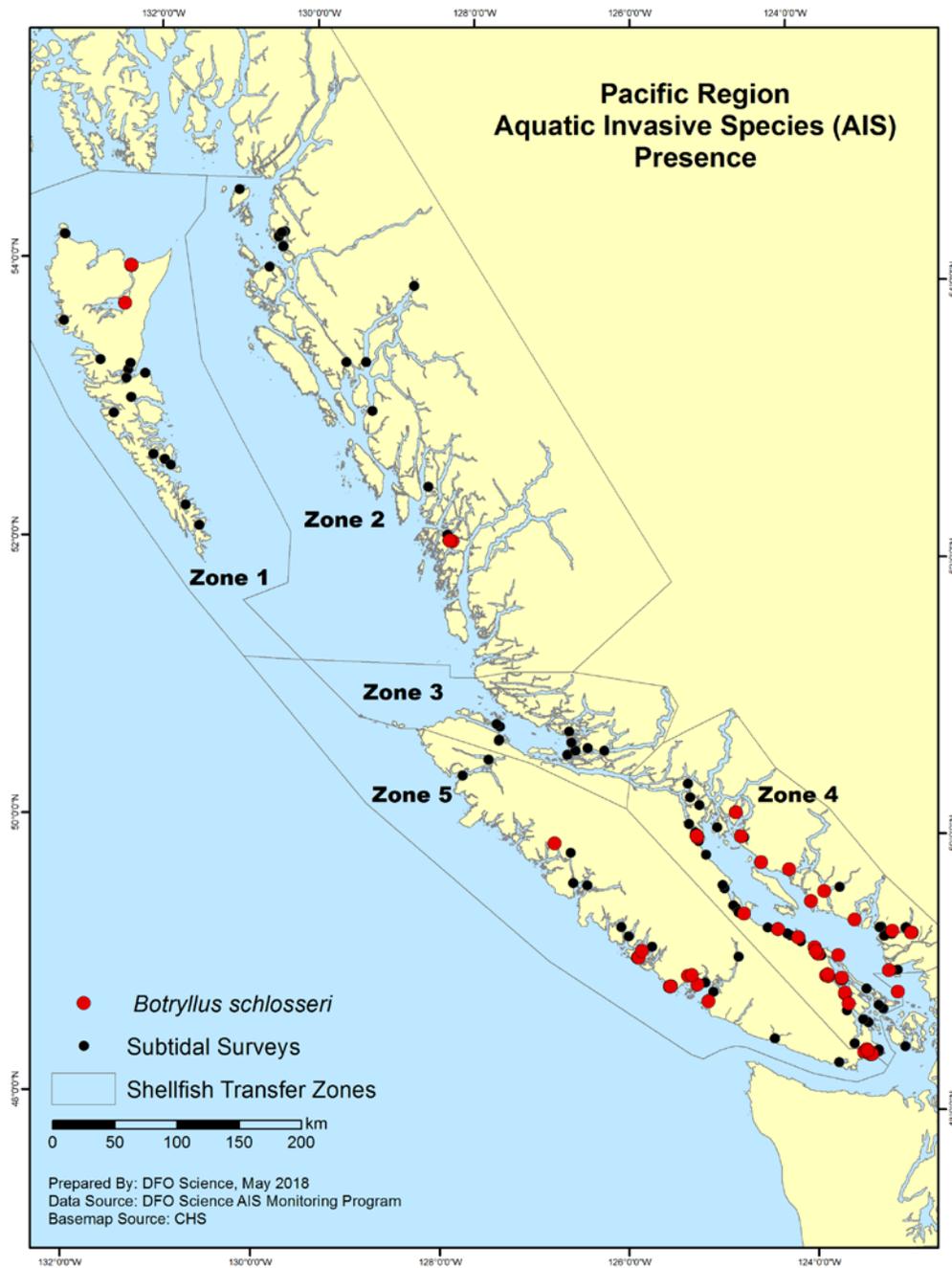


Figure 2: Current confirmed presence of golden star tunicate (*Botryllus schlosseri*) in British Columbia (red circles) compared with overall subtidal survey locations (black circles represent surveyed areas where presence of *B. schlosseri* was not confirmed, rather than indicating confirmed absence).

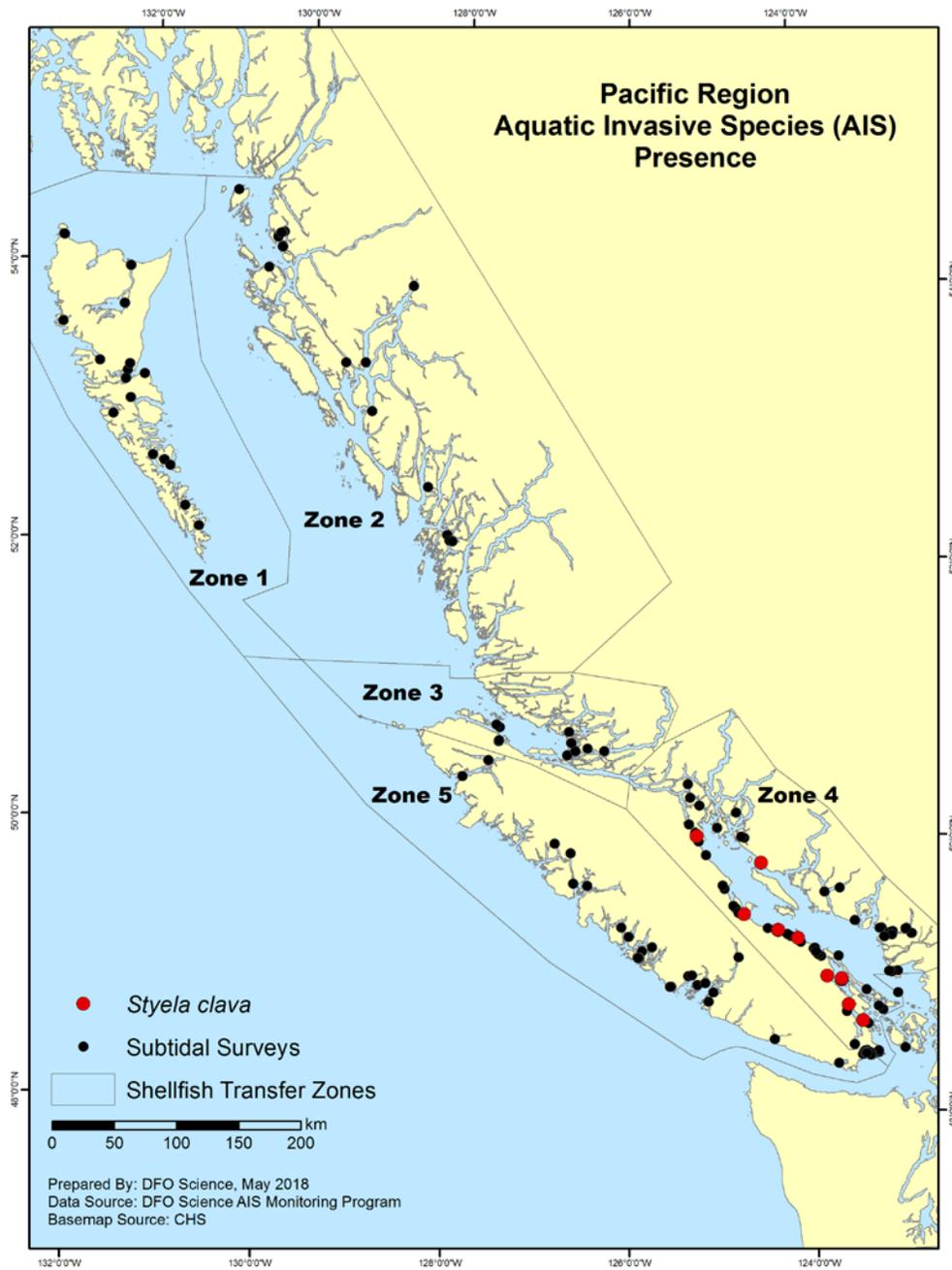


Figure 3: Current confirmed presence of club tunicate (*Styela clava*) in British Columbia (red circles) compared with overall subtidal survey locations (black circles represent surveyed areas where presence of *S. clava* was not confirmed, rather than indicating confirmed absence).

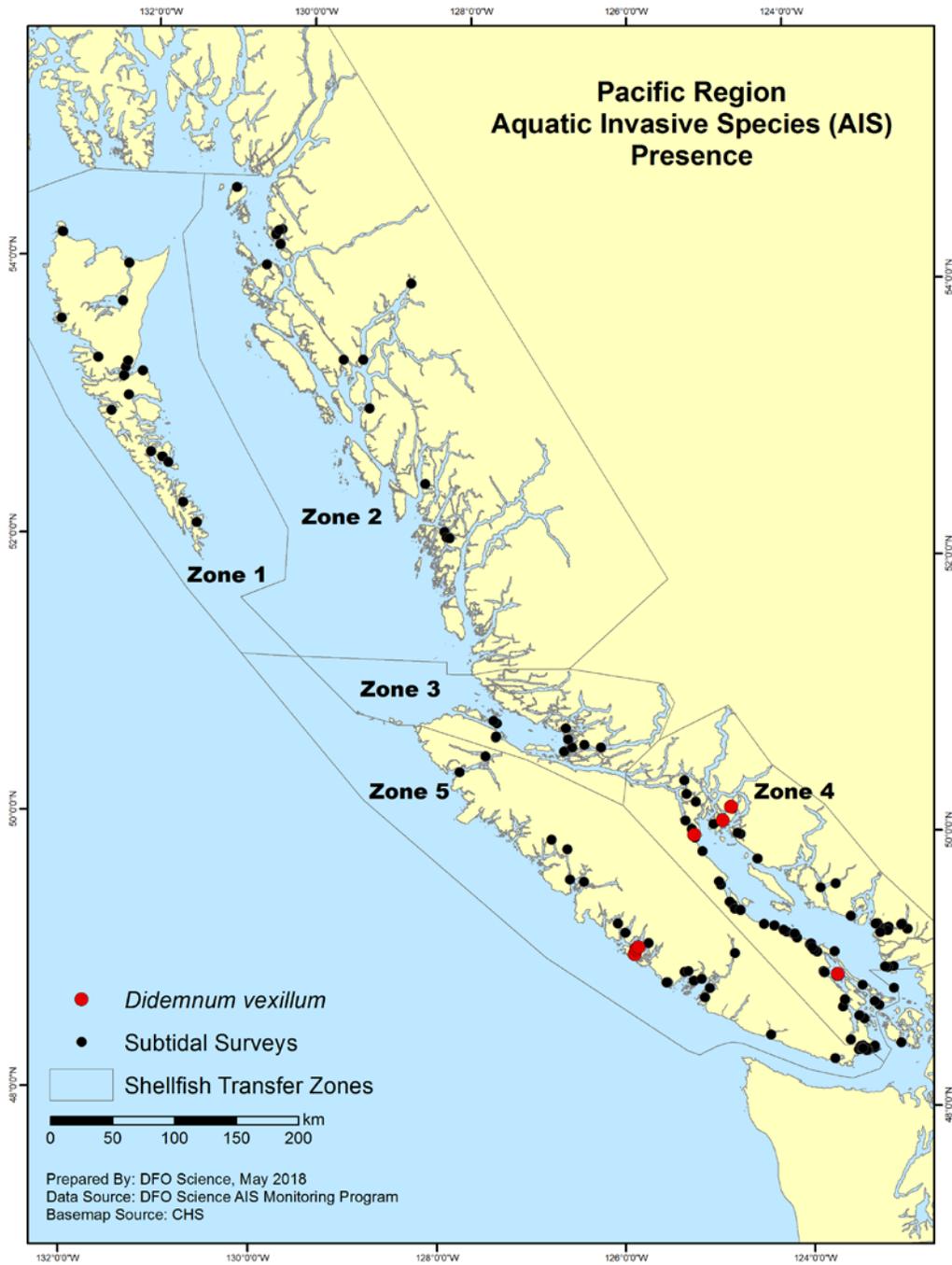


Figure 4: Current confirmed presence of *Didemnum vexillum* in British Columbia (red circles) compared with overall subtidal survey locations (black circles represent surveyed areas where presence of *D. vexillum* was not confirmed, rather than indicating confirmed absence).

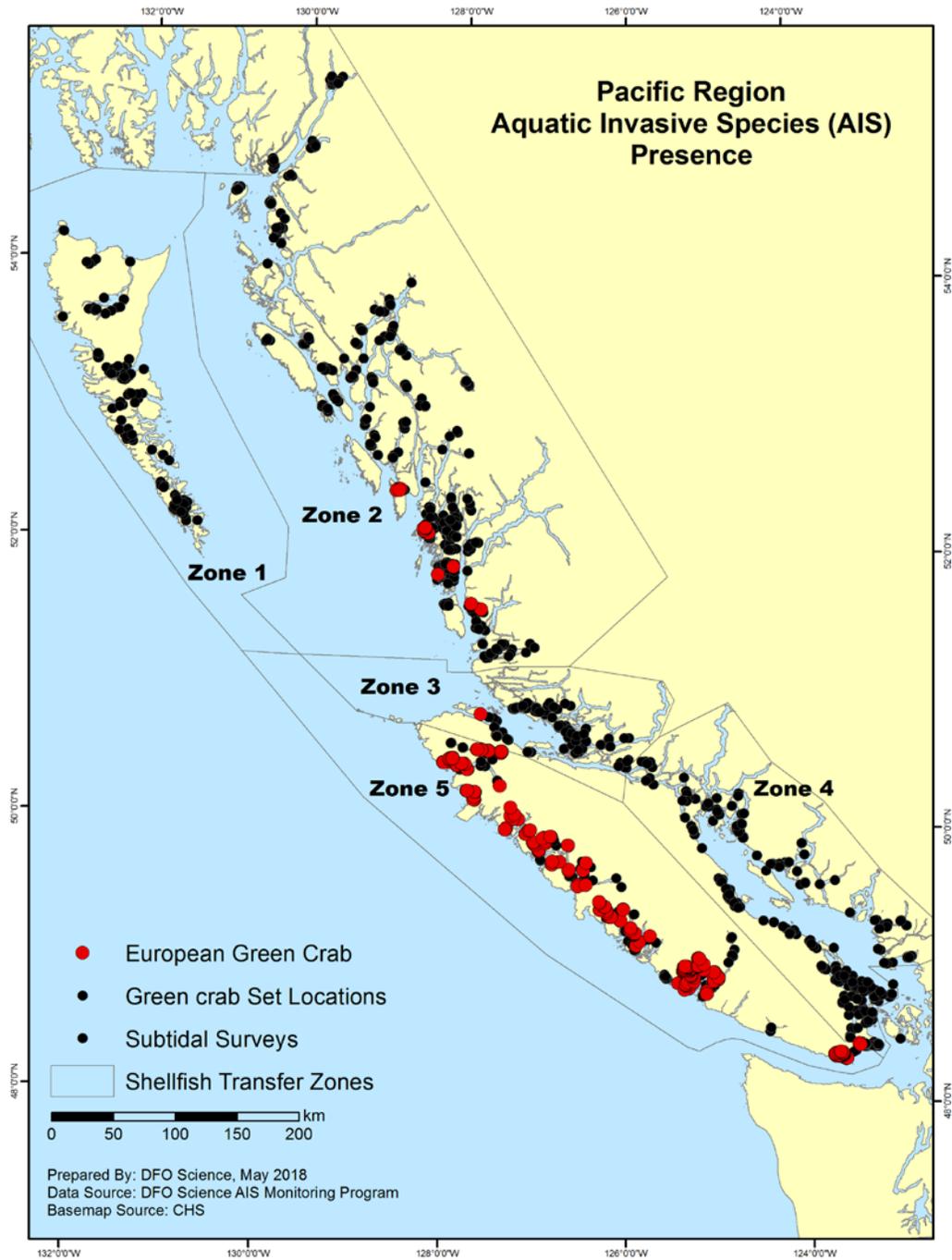


Figure 5: Current confirmed presence of European Green Crab (*Carcinus maenas*) in British Columbia (red circles) compared with overall subtidal survey locations (black circles represent surveyed areas where presence of *C. maenas* was not confirmed, rather than indicating confirmed absence).

Conclusions

The current confirmed presence and accompanying survey information for five high risk AIS in British Columbia is mapped as shown (Figures 1-5, Appendices). However, as invasions are not static it should be anticipated that these distributions will change over time and that long-distance, human-mediated dispersal can occur for many AIS. Further, additional surveys and/or reports from the public could identify invaded locations that were not confirmed at the time these maps were generated. Thus, maps will need to be updated on an ongoing basis to ensure AIS management decisions are based on the best available information.

An online, searchable database and mapping tool would facilitate regular updates and provide an accessible source of information for managers and the public on the distribution of AIS in British Columbia (or Canada). If developed and supported, this could provide almost real-time information on the distribution of AIS in British Columbia. In order to reduce the potential impacts of AIS in new environments, efforts should be made to constrain their distributions in British Columbia. For example, if shellfish movements are essential, then moving gear or product from a location that has a specific AIS to another location with that same AIS may limit potential impacts, compared with transfer of shellfish from AIS-infested waters to non-infested waters where the risk is higher.

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August 28, 2018

Sources of Information

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- Gillespie, G.E., Phillips, A.C., Paltzat, D.L., and Therriault, T.W. 2007. Status of the European Green Crab, *Carcinus maenas*, in British Columbia - 2006. Can. Tech. Rep. Fish. Aquat. Sci. 2700: vii + 39 p.

**Screening of the Pacific Fishery Regulations (PFR) Schedule
VIII Species for Risk of Invasiveness**

Pacific Region

Therriault, T.W., and L.-M. Herborg. 2007. Risk assessment for two solitary and three colonial tunicates in both Atlantic and Pacific Canadian Waters. DFO Can. Sci. Advis. Sec. Res. Doc 2007/063. iii + 64.

Therriault, T.W., L.-M. Herborg, A. Locke, and C.W. McKindsey. 2008. Risk Assessment for European Green Crab (*Carcinus maenas*) in Canadian Waters. DFO Can. Sci. Advis. Sec. Res. Doc . 2008/042. iii + 40.

Appendix

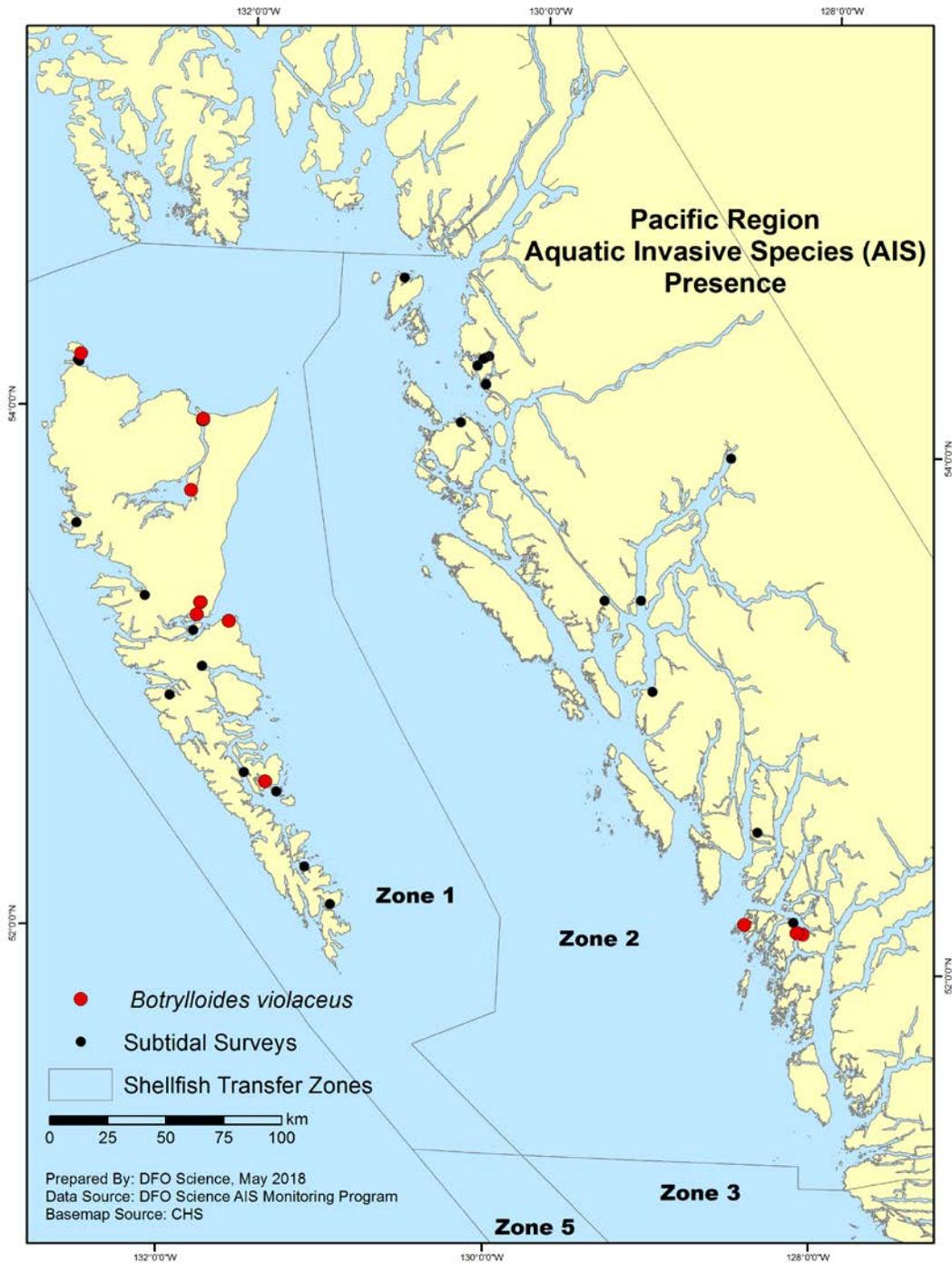


Figure A1: Current confirmed presence of violet tunicate (*Botrylloides violaceus*) in British Columbia's North Coast (red circles) compared with overall subtidal survey locations (black circles represent surveyed areas where presence of *B. violaceus* was not confirmed, rather than indicating confirmed absence).

Screening of the Pacific Fishery Regulations (PFR) Schedule VIII Species for Risk of Invasiveness

Pacific Region

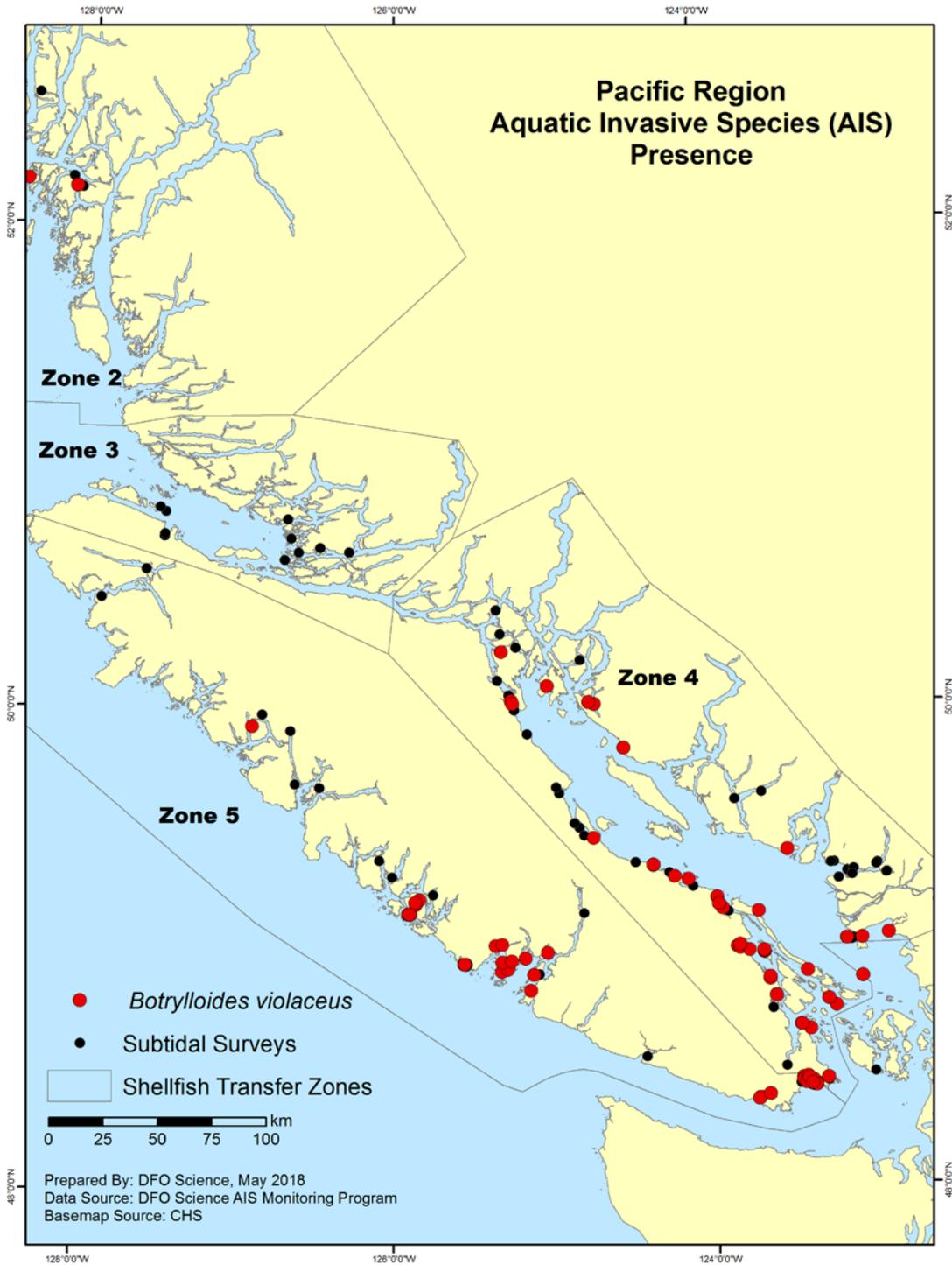


Figure A2: Current confirmed presence of violet tunicate (*Botrylloides violaceus*) in British Columbia's South Coast (red circles) compared with overall subtidal survey locations (black circles represent surveyed areas where presence of *B. violaceus* was not confirmed, rather than indicating confirmed absence).

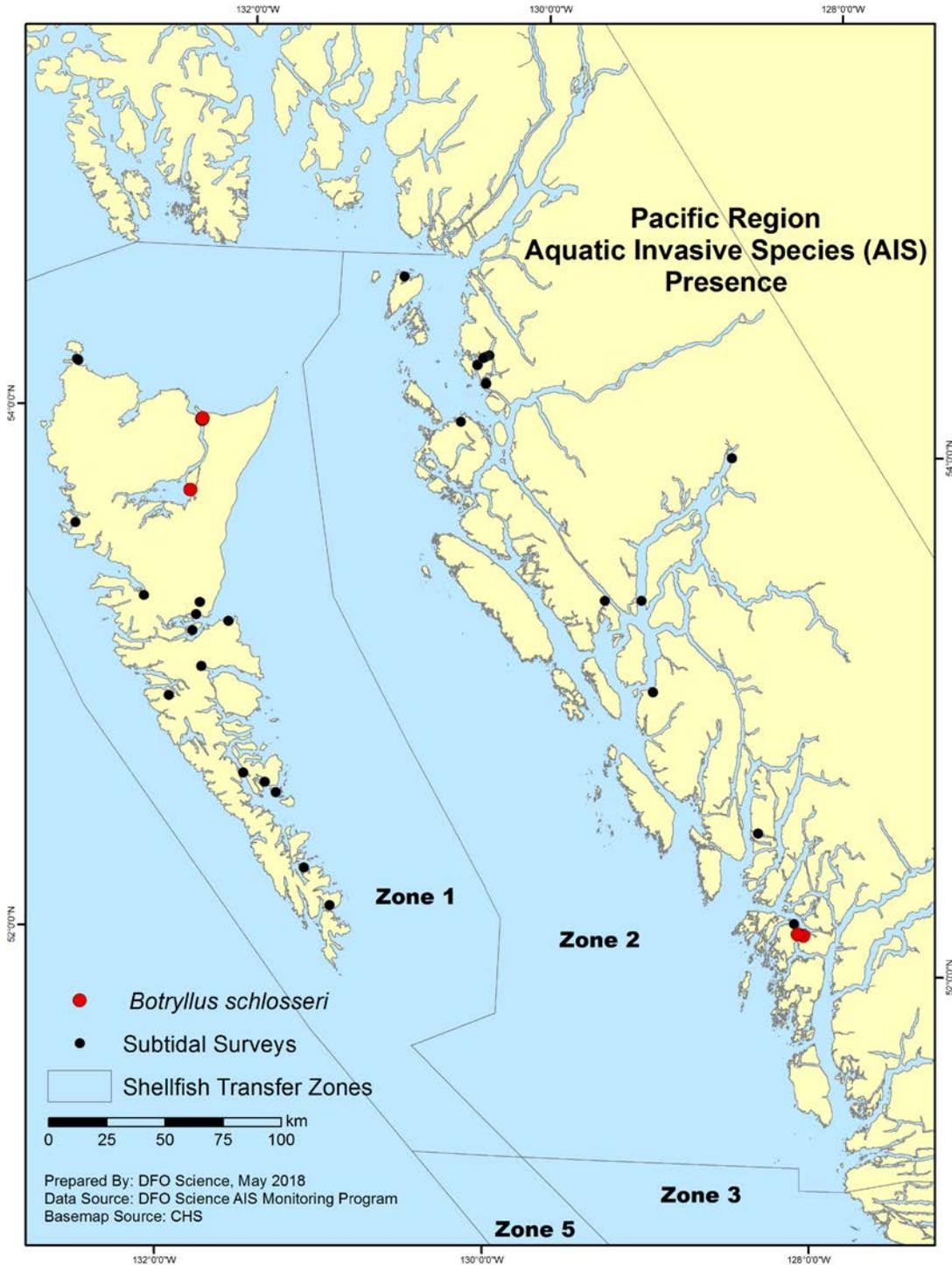


Figure A3: Current confirmed presence of golden star tunicate (*Botryllus schlosseri*) in British Columbia's North Coast (red circles) compared with overall subtidal survey locations (black circles represent surveyed areas where presence of *B. schlosseri* was not confirmed, rather than indicating confirmed absence).

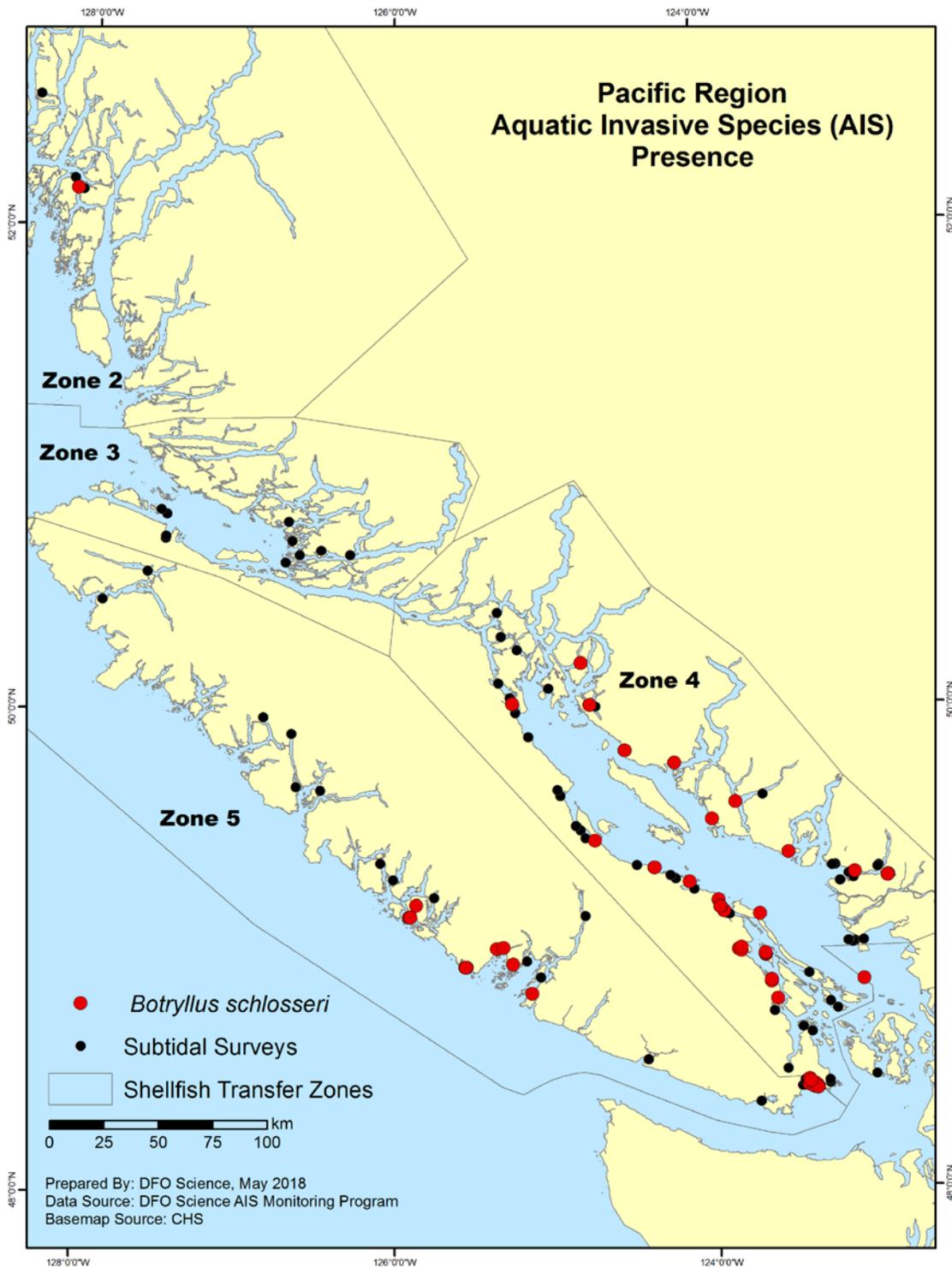


Figure A4: Current confirmed presence of golden star tunicate (*Botryllus schlosseri*) in British Columbia's South Coast (red circles) compared with overall subtidal survey locations (black circles represent surveyed areas where presence of *B. schlosseri* was not confirmed, rather than indicating confirmed absence).

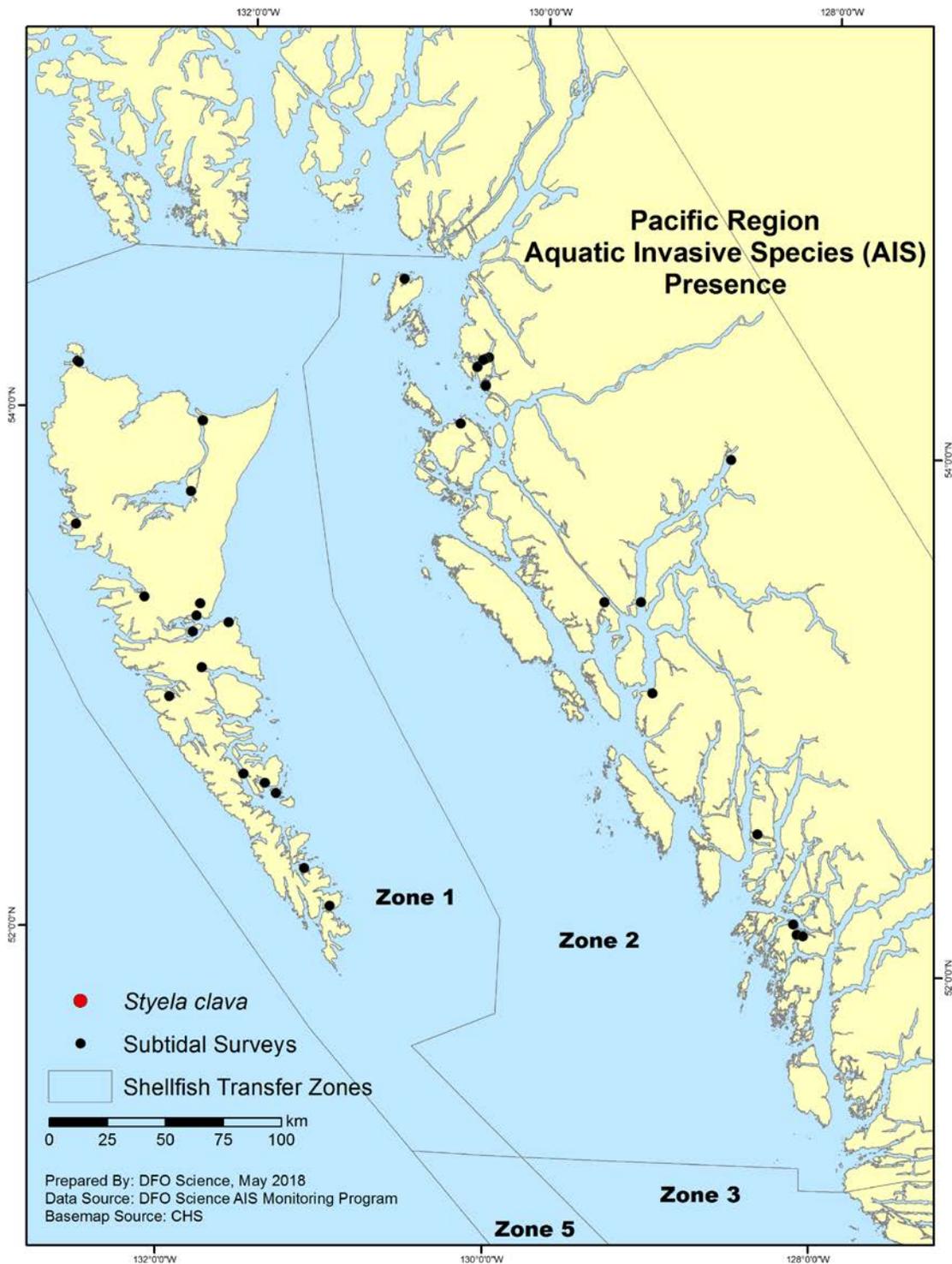


Figure A5: Current confirmed presence of club tunicate (*Styela clava*) in British Columbia's North Coast (red circles) compared with overall subtidal survey locations (black circles represent surveyed areas where presence of *S. clava* was not confirmed, rather than indicating confirmed absence).

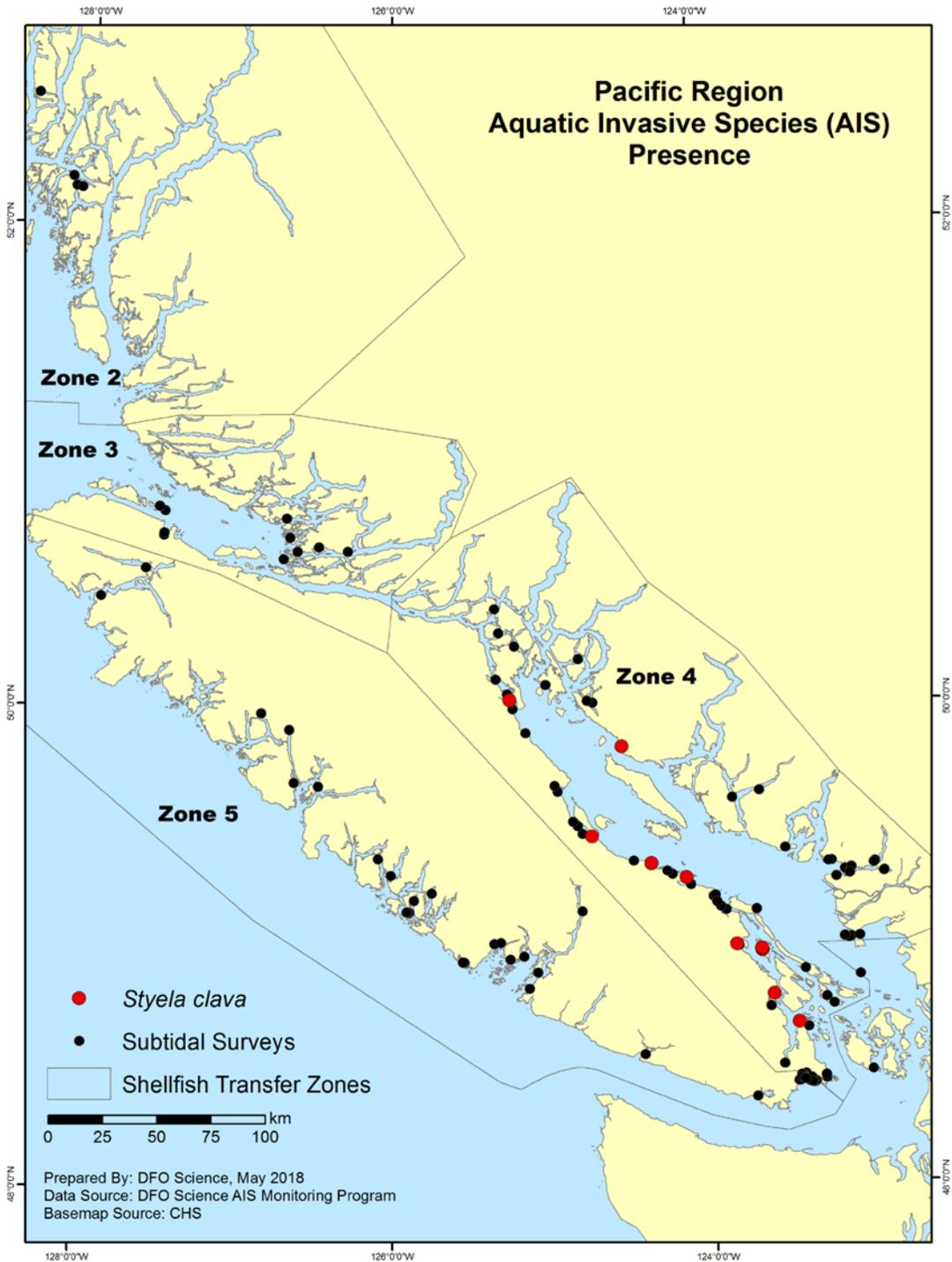


Figure A6: Current confirmed presence of club tunicate (*Styela clava*) in British Columbia's South Coast (red circles) compared with overall subtidal survey locations (black circles represent surveyed areas where presence of *S. clava* was not confirmed, rather than indicating confirmed absence).

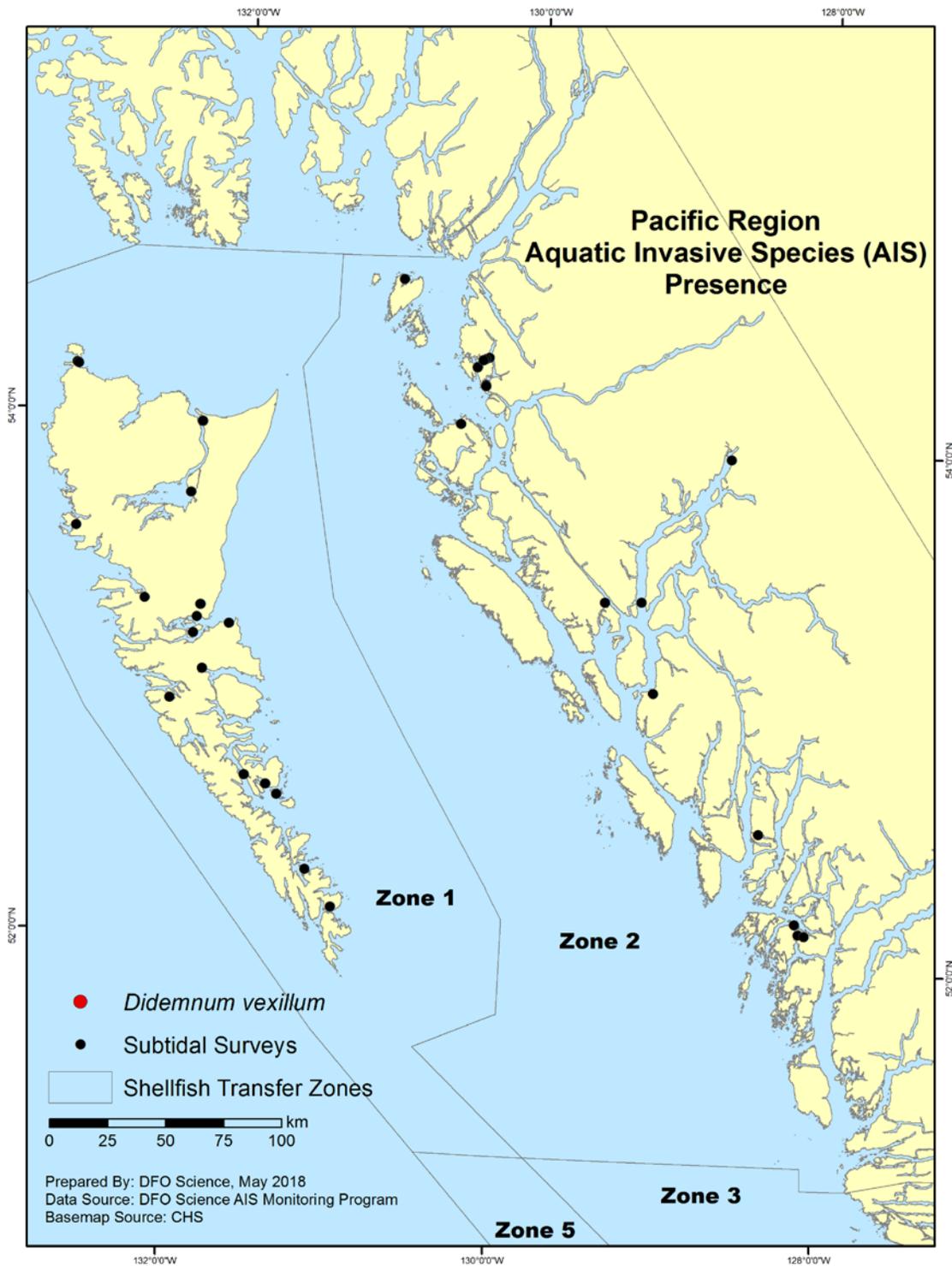


Figure A7: Current confirmed presence of *Didemnum vexillum* in British Columbia's North Coast (red circles) compared with overall subtidal survey locations (black circles represent surveyed areas where presence of *D. vexillum* was not confirmed, rather than indicating confirmed absence).

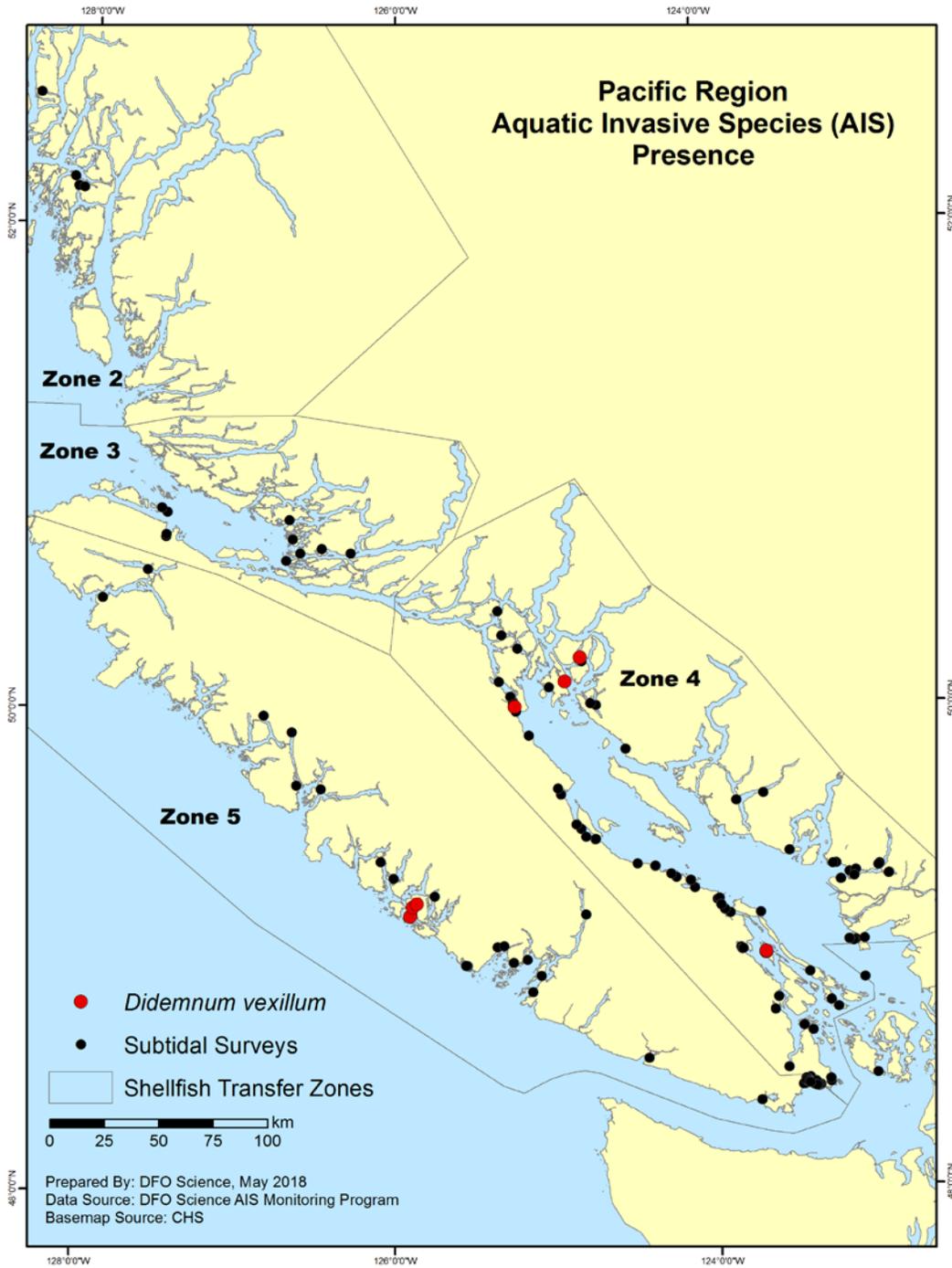


Figure A8: Current confirmed presence of *Didemnum vexillum* in British Columbia's South Coast (red circles) compared with overall subtidal survey locations (black circles represent surveyed areas where presence of *D. vexillum* was not confirmed, rather than indicating confirmed absence).

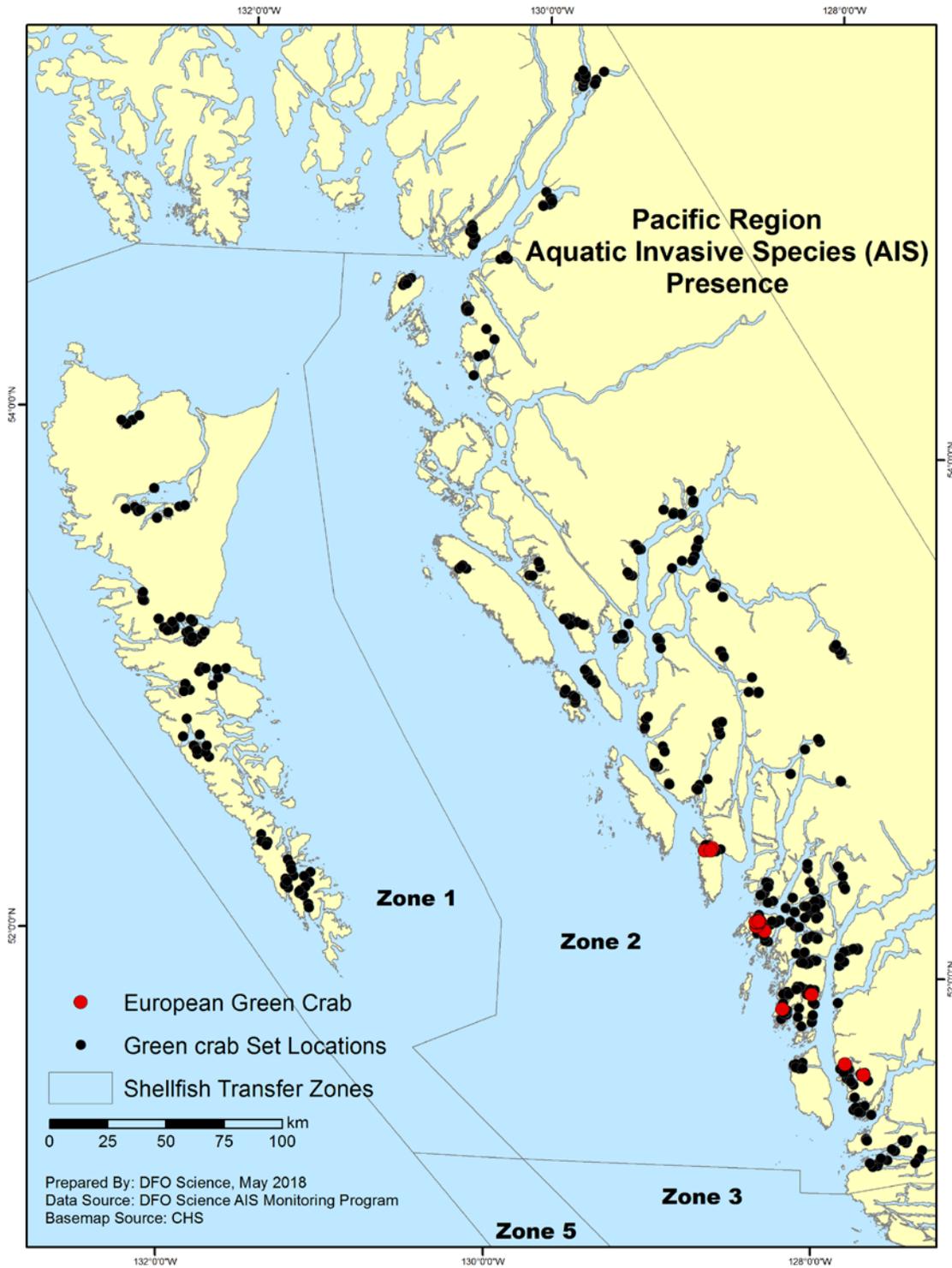


Figure A9: Current confirmed presence of European Green Crab (*Carcinus maenas*) in British Columbia's North Coast (red circles) compared with overall subtidal survey locations (black circles represent surveyed areas where presence of *C. maenas* was not confirmed, rather than indicating confirmed absence).

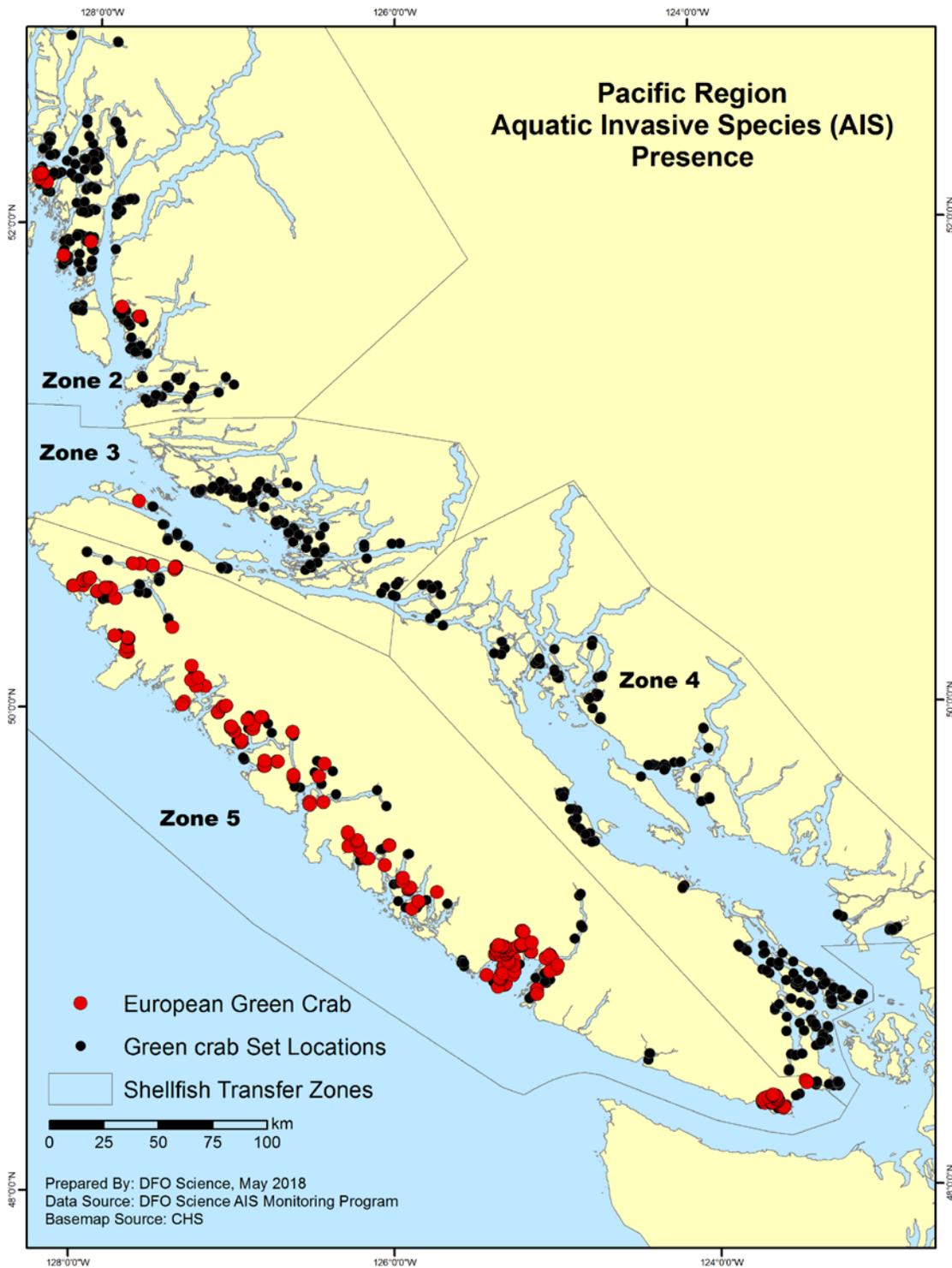


Figure A10: Current confirmed presence of European Green Crab (*Carcinus maenas*) in British Columbia's South Coast (red circles) compared with overall subtidal survey locations (black circles represent surveyed areas where presence of *C. maenas* was not confirmed, rather than indicating confirmed absence).

This Report is Available from the

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ISSN 1919-3769

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Correct Citation for this Publication:

DFO. 2018. Summary of Locations in British Columbia, Canada Supporting Invasive Tunicate Species and European Green Crab as of 2017. DFO Can. Sci. Advis. Sec. Sci. Resp. 2018/047.

Aussi disponible en français :

MPO. 2018. Sommaire des emplacements en Colombie-Britannique (Canada) confirmant la présence d'espèces de tuniciers envahissants et du crabe européen en 2017. Secr. can. de consult. sci. du MPO, Rép. des Sci. 2018/047.