Estimates of herring spawn are based on SCUBA-diver measurements of the spawn length, width and estimates of egg layers. These estimates are made every year in all parts of the BC coast. The SCUBA-diver estimates of spawn are summed for each stock assessment region in BC and the cumulative spawn is known as the herring spawn index. The spawn index is used as an essential part of the annual herring stock assessment methodology. The estimates of the numbers of spawn layers is an important component of the herring spawn index.

The motivation for this report was based on the observation that the estimated average number of layers has decreased gradually during the last 25 years. This decrease has occurred gradually and in all areas of the coast. In any year, there is considerale variation in the estimates of layers: some locations typically have more egg layers than others. Egg layer number seems to depend on a number of factors including the types of seaweed/vegetation available, the types of substrate and slope of the beach. Also, the times and locations of spawning vary from year-to year. The natural geographic and short-term year-to-year variation in spawn layers may be one reason why the gradual, long-term decline in estimated spawn layers has not been noticed or examined before.

The report begins by describing the apparent decline in average egg layers over the last 30 years. Other measurements of spawn, such as mean width, and mean spawn areas, were also examined to see if these measurements showed similar trends – but in general, they did not. Only the estimates of spawn layers showed a consistent temporal decline in all Regions. The next part of the report attempted to distinguish between two potential explanations for the decline: (i) a biological explanation or assumption that assumed that a change in herring behaviours or ecology is responsible for the decline in average layers. In this case, some might argue that lower egg density would be expected during years of lower spawning biomass. (ii) An explanation or assumption that the decline was not real but instead represented a gradual change in spawn survey methodology – or 'drift' in the spawn survey assessment criteria versus

The report examined the literature to determine if there were potential for systematic change in egg layers resulting from a change in herring spawn behaviour, such as a change in the density of aggregations of spawning herring, or a change in the ecosystem, such as an increase in the predation rates on eggs. In general there is no biological basis for assuming that the density of spawning herring would decrease as a function of spawning stock abundance (SSB). Herring spawn in schools, and it is unlikely that school density decreases in accordance with SSB. Further, several populations of BC herring have fluctuated up and down during the same time that herring egg density steadily decreased. It is difficult to rule out egg loss through predation as a cause of a systematic decrease in egg density. However, if predation were the explanation, then it seems unlikely that the effect would have been such a uniform change in mean egg density in all major BC herring populations.

In general there was no evidence of any change or reduction in spawn survey effort that could explain the decline in mean layers. Also, there was no evidence of changes in the timing or duration of the surveys relative to the times of spawn deposition. This might have been important because there is significant egg mortality during the incubation period. So, if there were a trend for the surveys to occur earlier or later relative to the spawning time, then there might have been potential for a change in the layers observed by divers, but this did not occur. Also, the database provided an opportunity to examine the duration that SCUBA divers spent on each transect, and then on each sampling station. Again, there were no significant changes in SCUBA diver procedures that could account for the estimated change in mean layers.

The statistical distribution of egg layer data was examined to see if there were any fundamental changes in the data. In general, there were no striking changes in frequency distributions of egg layer data: generally spawn data in recent years resembles data from early years, but with one exception: there was significantly more observations of ‘a low-density category called ‘trace’ spawns in recent years. The ‘trace’ category refer to situations where the density of eggs is very low or the percent cover by vegetation is low. The incidence of the trace category was relatively rare in the early years of diver surveys but it has increased and now accounts for more than 40 percent of all observations in most regions in recent years.

A trace category is entered into the spawn database as 0.01 layers. This is an arbitrary number and not meant to really reflect a real estimate of layer but it has been used in the computation of the herring spawn index as if it were a real number – or real observation. It is not clear if the increase in the ‘trace’ category reflects a real change in spawn distribution or abundance or if it reflects a gradual methodology shift. It is clear, however, that the conversion of a ‘trace’ observation to an estimate of 0.01 layers is arbitrary and could lead to unwarranted error in the estimation of total spawn, although the magnitude of such error is not clear. Also it is not clear if the practice of converting ‘trace’ observations to 0.01 layers would explain all of the decline in mean egg layers that occurs in the herring spawn database. The report recommended that the practice of converting trace layers to 0.01 layers be re-examined. The report also recommended that egg counts be made from locations with ‘trace’ layers be made in the 2011 spawning season.