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Is it appropriate to composite fish samples for mercury trend monitoring and consumption advisories?

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ABSTRACT

Monitoring mercury levels in fish can be costly because variation by space, time, and fish type/size needs to be captured. Here, we explored if compositing fish samples to decrease analytical costs would reduce the effectiveness of the monitoring objectives. Six compositing methods were evaluated by applying them to an existing extensive dataset, and examining their performance in reproducing the fish consumption advisories and temporal trends. The methods resulted in varying amount (average 34–72%) of reductions in samples, but all (except one) reproduced advisories very well (96–97% of the advisories did not change or were one category more restrictive compared to analysis of individual samples). Similarly, the methods performed reasonably well in recreating temporal trends, especially when longer-term and frequent measurements were considered. The results indicate that compositing samples within 5 cm fish size bins or retaining the largest/smallest individuals and compositing in-between samples in batches of 5 with decreasing fish size would be the best approaches. Based on the literature, the findings from this study are applicable to fillet, muscle plug and whole fish mercury monitoring studies. The compositing methods may also be suitable for monitoring Persistent Organic Pollutants (POPs) in fish. Overall, compositing fish samples for mercury monitoring could result in a substantial savings (approximately 60% of the analytical cost) and should be considered in fish mercury monitoring, especially in long-term programs or when study cost is a concern.

1. Introduction

Mercury is a contaminant of global concern (UNEP, 2013a). Virtually every fish in North America, and possibly worldwide, contains mercury (Stahl et al., 2009; Depew et al., 2013; Evers et al., 2013). Consumption of fish is generally a dominant route of human exposure to mercury (UNEP/WHO, 2008). Mercury is responsible for the most number of restrictive fish consumption advisories, at least in North America (e.g., USEPA, 2013a,b; OMOECC, 2015). Due to spatial variation in fish mercury levels, location-specific advisories are typically provided (e.g., USEPA, 2013a; OMOECC, 2015). Since mercury levels vary by fish species and size (Gewurtz et al., 2011b), monitoring efforts to issue fish consumption advisories and track long-term changes require collection and analysis of a variety of fish spanning their natural size range (USEPA, 2013b). As a result, the total number of annual samples required to adequately monitor fish mercury levels for numerous locations can range from hundreds to tens of thousands.

Due to analytical costs, most contaminant studies limit sample size by reducing the fish species monitored, replication of samples, sampling frequency and/or study period; however, these options are generally not suitable for agencies that rely on the data for long-term trend monitoring and issuing of fish consumption advisories aimed at protecting human health (Gewurtz et al., 2011a). Further, Article 19 of the recently formulated Minamata Convention on Mercury requires parties to develop and improve geographically representative mercury monitoring in environmental media, including fish (UNEP, 2013b). In less than a decade, monitoring data will be called upon to assist in the implementation and evaluation of the convention, which emphasizes the importance of improving monitoring efforts to optimize both the quality of the programs as well as costs.

To decrease program costs, combining multiple temporally or spatially discrete samples, widely known as composites, has been suggested as an effective alternative to chemical analysis on individual samples (USEPA, 2002; Gewurtz et al., 2011a). In addition to substantially reducing analytical cost, the data collected through compositing samples can provide wider temporal and spatial coverage without increasing the sample count. The analysis of data may give more representative estimates of mean concentrations than can the same number of

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discrete samples, albeit at the cost of variability in the observations (USEPA, 2002).

There are several potential approaches to compositing fish contaminant monitoring samples that incorporate different dimensions of the study, such as time (within/across years), location, fish species, and fish size. The optimal compositing approach would be one that reduces the total number of samples for analysis without compromising the objectives of the monitoring program. In addition, the composite method chosen should follow assumptions that correspond to the statistical analysis that is ultimately applied to the data. Several studies have used compositing as a part of their designs for both organic and inorganic contaminants in all media including biota (Rajagopal and Williams, 1989; Turle and Collins, 1992; Blomqvist, 2001; Braune and Noble, 2009; Gewurtz et al., 2011a). However, to our knowledge, a comprehensive study investigating the effectiveness of various compositing approaches for monitoring mercury in fish is lacking in the literature, especially for programs designed to generate fish consumption advice, where variability and the presence of outliers can affect overall risk (Gewurtz et al., 2011a).

In this study, we evaluate six methods of compositing fish samples by examining their performance if they would have been utilized instead of collecting >220,000 individual mercury measurements for >3000 locations by the Province of Ontario, Canada over nearly 50 years. The effectiveness of the composite methods was evaluated by comparing the fish consumption advisories and temporal trends from individual measurements (current sampling design) with those from estimated composite values, calculated by averaging the individual measurements included in each composite. The findings of the study determine whether a compositing method can effectively minimize costs for regular, long term, large scale monitoring programs and set advisories for fish consumption.

2. Methods

2.1. Compositing methods

Fish mercury levels vary by species and size, and can change seasonally as well as over time under the influence of a variety of internal and external factors, such as bioenergetics and ambient water chemistry (Bhavsar et al., 2010; Azim et al., 2011; Gewurtz et al., 2011a; Stern et al., 2012; Greenfield et al., 2013). As such, we opted to group species-specific samples collected during the same sampling event within the composites.

There is a well-known relationship between mercury concentrations and fish size that is typically described by the power-series regression (Gewurtz et al., 2011b). As such, similar sized samples could be considered for creating a composite sample. However, the resultant fish size range (i.e., maximum–minimum fish lengths) would likely be less than the regular, individual measurements. This could result in trimming of a regression at the extreme ends, and thereby loss of advisories for certain fish sizes. Alternatively, if one or two of the largest and/or smallest individuals are retained with all other samples being composited, then the fish size range could be captured, and a power series regression between fish length and composited mercury concentrations might be improved.

Compositing of 3, 5, 7, 10 or more samples have been used in many studies (Hites et al., 2004; Carlson and Swackhamer, 2006; French et al., 2011; Pantazopoulos et al., 2013). Since a collection of about 20 fish samples per species and sampling event over a possible maximum size range is generally considered a preferred method for mercury monitoring (e.g., Gewurtz et al., 2011a), compositing more than 5 samples (i.e., having less than four composites), may not be sufficient for characterizing the fish size/mercury relationships. Alternatively, compositing samples within a narrow size range (e.g., 35–40 cm, 40–45 cm and so on) regardless of the number of samples within that size range may be appropriate as the impact on the fish size/mercury relationship would likely be minimal.

Based on the above notes, we considered six compositing methods: (1) composite samples in batches of five in the order of decreasing fish size (Fig. 1a, b), (2) retain individual samples for the largest and smallest fish and composite samples in between in batches of five in order of decreasing fish size (Fig. 1a, c), (3) retain the two largest and smallest individual samples and composite the samples in between in batches of five in order of decreasing fish size (Fig. 1a, d), (4) retain the largest and smallest individual samples and composite the samples in between in batches of three in order of decreasing fish size (Fig. 1a, e), (5) retain the two largest and smallest individual samples and composite the samples in between in batches of three in the order of decreasing fish size (Fig. 1a, f), and (6) composite samples within a 5 cm size range (Fig. 1a, g).

2.2. Data source

The above described compositing methods were evaluated by simulating composite data from the individual fish measurements, assuming that the same mass of each fish is added to the composite. For this purpose, we used an extensive and consistent fish mercury dataset comprising 223,318 individual, widely varying measurements for skinless, boneless dorsal fillets of >10 cm fish of 66 fish species (Table S1) collected by the Ontario Ministry of the Environment and Climate Change (OMOECC), Canada in partnership with the Ontario Ministry of Natural Resources and Forestry and other agencies over nearly 50 years (1967–2014) from >3000 locations in the Province of Ontario, Canada, that spans 41° to 56° N and 74° to 95° W (Fig. S1). The samples were analyzed for total mercury using acid digestion and cold vapor flameless atomic absorption spectroscopy as described in detail by Bhavsar et al. (2010). The dataset contained 16,900 species/location/year combinations for 6440 sampling events (location/year) and varied widely (1 to 274) in the number of individual samples for a species in a sampling event (species/location/year) (Fig. S2).

2.3. Statistical analysis

The performance of each composite method in comparison to the regular, individual measurements was evaluated based on its accuracy in reproducing the fish consumption advisories as well as the direction and magnitude of the long-term temporal trends. As illustrated in Fig. S3, a power series regression was conducted for each of 16,900 species/location/year-specific sampling events using the regular, individual measurements as well as the composite values calculated using the six methods considered in this study. Using these total 118,300 power series regressions (i.e., 16,900 × 7), fish mercury levels were calculated at 5 cm intervals for the available size range in each species-specific sampling event (Fig. S3). These mercury concentrations were used in calculating fish consumption advisories using the benchmarks for the general population and sensitive population (children and women of child-bearing age), which is the standard method used by the Province of Ontario, Canada (Table S2, Fig. S3). Advisories for each 5 cm interval calculated using the six composite methods were compared with those from the regular, individual measurements (Table S4), and classified into three categories: 1) same, 2) more restrictive, and 3) less restrictive..

For a comparison of temporal trend analyses from the regular and composite methods, rates of changes in fish mercury levels (μg/g decade) were calculated using the slope of the linear relationship between year and mercury concentration standardized to a fish length. Since the purpose is to compare rates from the regular and composite methods, appropriateness of a linear regression is essentially a moot point (Azim et al., 2011). Since a temporal trend analysis is typically conducted on a suitable indicator species with good monitoring data, four species, namely Lake Trout (*Salvelinus namaycush*), Walleye (*Sander*

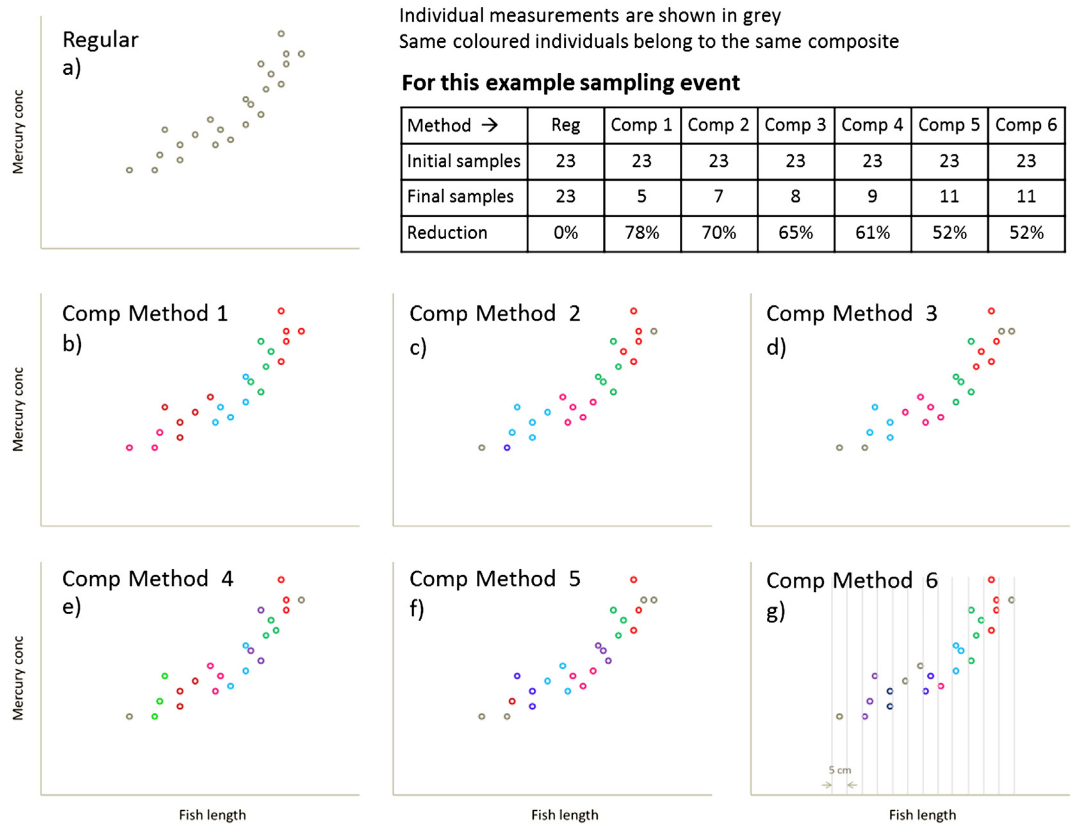

Fig. 1. Illustration of six compositing methods considered in the study.

vitreus), Northern Pike (*Esox lucius*) and Smallmouth Bass (*Micropterus dolomieu*), were considered. Mercury concentrations standardized to 50 cm fish size were used. The standardization was conducted using a power series regression $y = a\,x^b$, where y is concentration in μg/g, x is fish length in cm, and a and b are regression coefficients. The number of temporal trend rate estimates was maximized by considering every combination of the start and end years as illustrated in Fig. S4. In total, 83,664 rates of fish mercury changes were calculated. All statistical analyses were conducted in either Excel 2010 or R-3.2.0 for Windows™ (R Core Development Team, 2015).

3. Results

3.1. Reductions in samples

The composite method 1 resulted in the highest (average/median 72/78%) reduction in number of samples to be analyzed for mercury (Fig. 2). The composite methods 2 and 3 required retention of one and two extreme sized individual samples, respectively. As such, the reductions in number of samples were less (method 2: 54/64%; method 3: 40/50%; Fig. 2). The methods 4 and 5 required compositing samples in the batches of 3, compared to 5 for the methods 2 and 3. As a result, reductions in the number of samples by implementing the methods 4 and 5 were less (method 4: 45/53%; method 5: 34/42%; Fig. 2). Although the composite method 6 resulted in more variable (0–98%) reductions in the samples because of its dependence on number of samples in 5 cm fish size bins, overall reductions were similar to the method 2 (55/60%; Figs. 2, S5).

3.2. Performance in reproducing advisories

Seven sets of fish consumption advisories (regular plus six composite methods) were calculated for each sampling event (species/location/year) as illustrated in Fig. S3, and compared as shown in Table S3. The resultant fish size ranges (minimum to maximum length) for the composite method 1 were lower than from the regular, individual measurements for many sampling events. In addition, method 1 produced one composite for each of 3681 sampling events with ≤5 samples (Fig. S2), resulting in no power series regression for an advisory calculation. Therefore, about 35% of the advisories from method 1 were missing (Fig. 3, Table S3).

The advisories were calculated using power series regressions on fish size vs mercury concentrations for each sampling event (location/

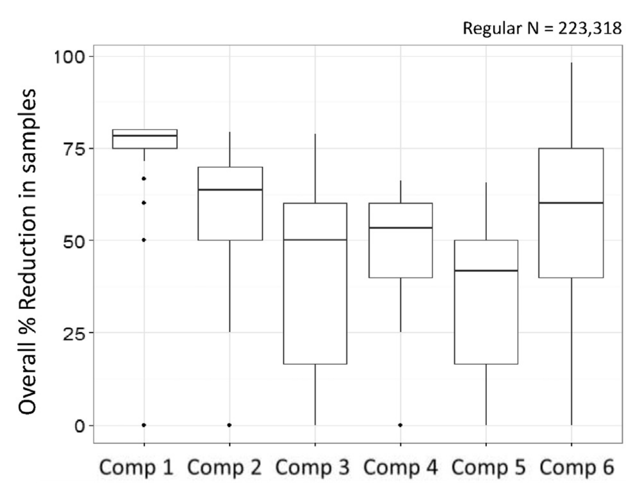

Fig. 2. Overall reduction (%) in number of samples per sampling event (location/year/species) analyzed in each of the six composite methods compared to the regular method of analyzing all individual fish samples for mercury.

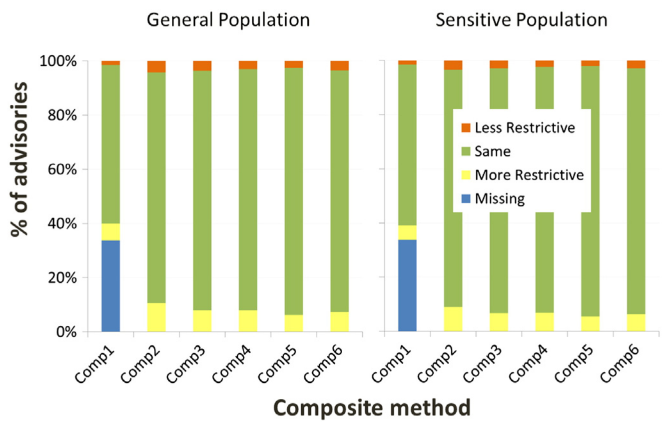

Fig. 3. Comparison on fish consumption advisories for mercury for the general and sensitive populations using composite methods compared to the current OMOECC method of analyzing individual fish samples.

year/species). The statistical significance of the regressions was evaluated on the basis of their p-values. Since the composites were aimed at reducing the sample size, which is generally positively related to a p-value of a regression, it was not surprising to observe lower statistical significance for regressions from a composite method that produced a greater reduction in sample sizes (Figs. 2, S6).

Overall, advisories for the general population from the methods 2 to 6 were largely (85–91%) similar to those from the regular, individual measurements (Fig. 3, Table S4a). About 6–11% of the advisories were more restrictive, mostly by only one advisory category (Fig. 3, Table S4a). Only 3–4% of the advisories were less restrictive, again mostly by only one advisory category (Fig. 3, Table S4a). The results for the sensitive population advisories were even better (similar: 88-93%; more restrictive: 5-9%; less restrictive: 2-3%; Fig. 3, Table S4b).

The increasingly fewer reductions in the number of samples from the composite methods 2 to 5 only marginally improved reproduction of the advisories (Fig. 3). The performance of the method 6 was similar to the method 4 and overall second best among the methods (Fig. 3, Table S4). Based on the reductions in the number of samples and performances in reproducing the advisories, we focus further analysis and the following discussions on results for the general population using the methods 2 and 6.

Next we examined if there was a pattern in the underestimation of mercury concentrations and thereby less restrictive advisories from the composite methods that could be linked to sample size, species, fish size class, and/or level of mercury. As shown in Tables S5-S8, individually these four factors had minimal impact on the performance of the composite methods 2 and 6. The only exception was that increasing fish size worsened the performance of method 2, with relatively more cases of less restrictive advisories for large size categories within individual species (Table S9). Nevertheless, there were only 3–4 combinations of species/size for which the total number of advisories were >100 and >10% of the advisories were less restrictive (Table S9). Similarly, there was no fish species-specific mercury concentration that substantially affected the performance of the composite methods 2 and 6 (Table S10).

3.3. Performance in reproducing temporal trends

In this assessment, we examined if the nature of the mercury versus time slopes from the composite methods corresponded with the regular method. The composite methods resulted in the same temporal trends as observed for the individual samples in most (90–94%) cases (Fig. S7). The performances of the composite methods improved from 90–94% to 94–96% when cases with a minimum time span of 15 years and 5 sampling years were considered, and to 95–97% when cases with a minimum time span of 15 years and 10 sampling years were considered (Fig. S7).

For a majority (72–82%) of the cases, the rates of changes in fish mercury levels from the composite methods were within a factor of two of the corresponding rates from the regular method (Fig. S8). Approximately 81–88% of the rates were within a factor of three (Fig. S8). When cases with a minimum time span of 15 years and 5 sampling years were considered, the percentages of cases improved to 81–88% for within a factor of two and 88–92% for within a factor of three (Fig. S8). The corresponding results for cases with a minimum time span of 15 years and 10 sampling years were better at 83–90% and 89–93%, respectively (Fig. S8).

The performance of the composite methods in reproducing the rates of changes was also evaluated for each of the four selected fish species. All composite methods provided the same temporal trends for a majority (83–95%) of the cases for all species (Fig. S9). When cases with a minimum time span of 15 years and 10 sampling years were considered, the percentages of cases improved to 97–100% for Lake Trout, Northern Pike and Walleye, and 86–90% for Smallmouth Bass (Fig. S9). Likewise, performances of all methods in reproducing the rates within a factor of two were comparatively similar for all species (Fig. 4). When a more robust dataset (cases with a minimum time span of 15 years and 10 sampling years) was considered, all methods resulted in rates that were within a factor of three in 97–100% of the cases for Lake Trout, Northern Pike and Walleye (Fig. 4). The performance of the composite samples in reproducing the rates of change for Smallmouth Bass was less (86–90%) compared to the other three species (Fig. 4), indicating that Smallmouth Bass is the least preferred species for trend monitoring when a composite method is utilized.

As expected, the composite methods that resulted in fewer reductions in the number of fish mercury measurements provided better estimates of the rates of changes in the fish mercury levels (Figs. 2 and 4). Although reductions (55/60%) in number of measurements from method 6 were comparable to method 2 (54/64%), method 6 provided better estimates of the rates of change (Figs. 2 and 4). Furthermore, the performance of method 6 was comparable to the method 3, which consisted of relatively more mercury measurements (Figs. 2 and 4). The differences in the performance of the methods in reproducing the rates were minimal when cases with a minimum time span of 15 years and 10 sampling years were considered (Fig. 4).

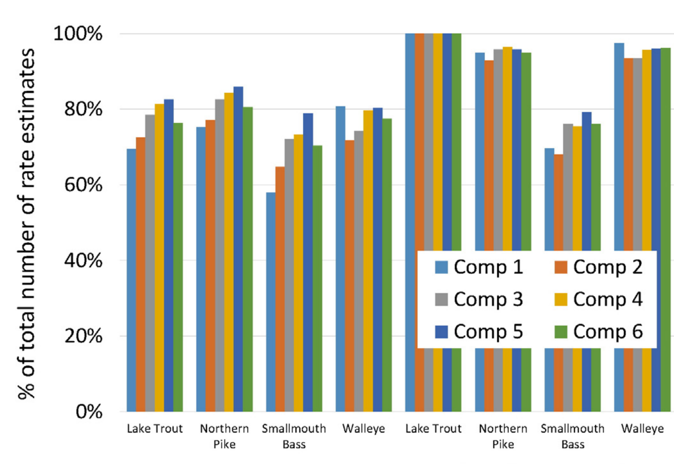

Fig. 4. Comparison of rates of change in fish mercury levels of the six composite methods with those from the current OMOECC method of analyzing individual fish samples for mercury. The results have been presented as percentage of the total number of rate estimates within 2 and 3 times the corresponding rates from the current OMOECC method.

4. Discussion

Composite sampling combines environmental samples or subsamples to form a new sample on which chemical or biological analyses are performed. Compared to evaluating individuals, composite sampling is beneficial as it decreases analytical cost by analyzing fewer samples and reduces/simplifies the sample handling process (USEPA, 2002). Composite sampling is recommended when laboratory costs are substantially greater than field sampling costs (USEPA, 2002). The collection of a few more fish samples at a particular location may not substantially increase the field cost. However, the analytical savings associated with composite sampling in long-term fish mercury monitoring and for issuance of fish consumption advisories can be substantial, especially over time. For example, the approximately 60% reductions in sample analyses in the OMOECC dataset used in this study would have resulted in approximately 134,000 fewer fish mercury analyses over the 47 year period, which sums to about $5,400,000 (or $114,000 per year) at an average rate of $40 per sample. Similarly, about $1,000,000 could be saved for the dataset compiled by USGS from data collected by US states (Hearn et al., 2006). Further, the composite sampling would have resulted in substantial saving in other operational costs due to reduced number of samples to handle. Although the extent of cost saving would depend on nature of the program (e.g., how many individual samples of which fish species and sizes are presently analyzed for mercury) and analytical cost, which has been declining with advances in the analytical technology, the results presented in this study show that savings can be achieved without any major impact on the quality of the advisories or temporal trend assessments.

There are, however, some potential disadvantages of the composite sampling approach. For example, composite sampling can result in a loss of information on extreme contamination levels and variability. Although this is true in many cases, a composite method retaining one or two largest and smallest individual samples as suggested in this study can potentially capture extreme fish mercury levels due to the strong relationship of fish size and mercury concentration. Although method 6 considered in this study may not preserve individual samples, a power series relationship between fish length and mercury indicates that compositing within a 5 cm fish size bin would likely be able to provide values closer to the extreme levels. This could be a result of the pattern in fish mercury levels, where even though there is a strong relationship between fish length and mercury levels, it is not necessary that the biggest fish has the highest concentration and the smallest fish has the lowest concentration likely due to differences in mercury levels in spatially integrated fish samples. Compositing reduces sample size, and as such decreases statistical power; however, statistical formulas can be used to derive composite size that results in a sufficient power (Rohlf et al., 1996). The composite methods examined in this study also resulted in some loss of statistical significance (Fig. S6). Nevertheless, the methods performed reasonably well in reproducing the advisories and temporal trends (Figs. 3, 4, S7).

If contaminants other than mercury are also of interest, further evaluation of the compositing methods may be necessary. For North America, other major contaminants of concerns include persistent organic pollutants (POPs) for which compositing is often performed (Hites et al., 2004; Gewurtz et al., 2011a) for studies focused on the health of fish themselves and not on the generation of fish consumption advice. Gewurtz et al. (2011a) found compositing fish samples appropriate for temporal trend monitoring of polychlorinated biphenyls (PCBs) based on a limited evaluation of Lake Ontario Lake Trout measurements from different Canadian and U.S. monitoring programs. However, their evaluation did not consider the impact of compositing on the ability to detect outliers. It should be noted that the relationship between fish length and POPs, such as PCBs, is much weaker than is typically observed for mercury (e.g., Gewurtz et al., 2011b). As such, compositing fish samples based on size categories (e.g., method 6 in this study) may be less effective in capturing outliers for POPs. However, many agencies use the "75% rule" (i.e., the length of the smallest fish in a composite should be at least 75% of the length of the largest fish) for compositing fish samples for POP monitoring (e.g., Stahl et al., 2009). The method 6 considered in this study will composite samples within a 5 cm size range (Fig. 1a, g) and follow the 75% rule (except for fish smaller than 15 cm, which are generally not consumed anyway). Similarly, the method 2 (and probably the other methods considered) will also create composites (Fig. 1a, c) that have a high potential to follow the 75% rule (Tables S11–S12), depending on the extent of sample collection by a program. As such, the compositing methods and findings of this study may also be suitable for monitoring POPs in fish.

A reliable temporal trend analysis depends on within-year samples and duration of monitoring (Sokal and Rohlf, 1995). Based on an exploratory analysis performed on data collected by some Great Lakes biomonitoring programs and a comparison with the literature, it was concluded that >10 years of monitoring with 10–15 samples per year is optimal to achieve 80% statistical power, which is typically considered adequate (Gewurtz et al., 2011a). This is largely due to diminished sensitivity of a temporal trend analysis to start and end points when a reasonable length of monitoring data is available (Gewurtz et al., 2011a). In this study, the correspondence between the results from the regular and composite methods improved when a longer time span and increased number of sampling years were considered (Figs. 4, S7–S9). As such, compositing samples may not be advisable for a short term assessment; however, the accuracy of the regular method based on individual samples may also be poor.

In this study, we utilized skinless, boneless fillet mercury measurements to evaluate the compositing methods. However, some monitoring programs use muscle plug or whole fish measurements to track environmental conditions. Since fish fillet, muscle plug and whole fish mercury measurements can be linked to one another (Baker et al., 2004; Peterson et al., 2005), findings from this study should be applicable to muscle plug and whole fish mercury monitoring studies as well. Ontario's fish contaminant monitoring is conducted exclusively in temperate environments and thus the results from this study have broad applicability to other monitoring programs in temperate latitudes. Although the in-depth analyses conducted on an extensive dataset indicate that the findings should be applicable to tropical environment as well, further work to verify these results in tropical environment may be warranted.

In summary, we explored the suitability of six composite methods for fish mercury monitoring using an extensive dataset. The methods resulted in varying amount of reductions in number of samples to be analyzed. In general, all compositing methods performed well for both advisories on consumption of fish and temporal trend monitoring. The methods resulting in lower reductions in sample count performed marginally better. Overall, compositing samples would have resulted in a substantial cost savings for OMOECC (approximately $5.4 M over 47 years assuming 60% sample reduction), and should be considered in fish mercury monitoring especially in long-term extensive monitoring programs or when study cost is a concern.

Conflict of interest

The authors declare no competing financial interest.

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Appendix A. Supplementary data

Additional 12 tables and 9 figures. This material is available free of charge via the Internet at http://dx.doi.org/10.1016/j.envint.2015.11.013.

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<u>Supplementary Material</u>

Is it appropriate to composite fish samples for mercury trend monitoring and consumption advisories?

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Table S1: Fish species, individual mercury measurements (n) and summary statistics (minimum, mean, median and maximum) of the concentrations (μg/g ww) available in the monitoring dataset from the Ontario Ministry of the Environment and Climate Change, Canada.

Species	n	min	mean	median	max
Alewife	39	0.02	0.07	0.05	0.40
American Eel	405	0.01	0.31	0.28	1.43
Atlantic Salmon	24	0.07	0.13	0.11	0.43
Bigmouth Buffalo	13	0.01	0.09	0.03	0.29
Black Crappie	2564	0.01	0.18	0.12	2.00
Blackfin Cisco	20	0.13	0.20	0.21	0.29
Bloater	583	0.01	0.12	0.08	0.72
Bluegill	1765	0.01	0.10	0.08	0.88
Bowfin	149	0.06	0.31	0.23	1.60
Brook Trout	2690	0.01	0.25	0.19	2.00
Brown Bullhead	5506	0.01	0.13	0.09	1.47
Brown Trout	1666	0.01	0.17	0.15	1.45
Catfish species	13	0.02	0.10	0.09	0.30
Channel Catfish	2730	0.01	0.32	0.23	2.50
Chinook Salmon	2581	0.01	0.21	0.21	0.97
Chub (not C. artedii)	296	0.02	0.11	0.09	0.43
Cisco(Lake Herring)	3650	0.01	0.20	0.16	2.76
Coho Salmon	1581	0.01	0.15	0.13	0.95
Common Carp	5684	0.01	0.23	0.18	1.70
Creek Chub	7	0.13	0.25	0.18	0.53
Freshwater Drum	2043	0.01	0.29	0.20	2.00
Gizzard Shad	222	0.01	0.06	0.05	0.27
Golden Redhorse Sucker	8	0.09	0.16	0.15	0.29
Golden Shiner	2	0.01	0.01	0.01	0.01
Goldeye	124	0.05	0.32	0.30	0.74
Goldfish	34	0.01	0.06	0.05	0.33
Greater Redhorse	51	0.11	0.33	0.34	0.73
Humper (Banker) Lake Trout	93	0.08	0.25	0.18	1.40
Lake Chub	12	0.08	0.21	0.18	0.41
Lake Trout	20144	0.01	0.40	0.26	10.00
Lake Whitefish	11445	0.01	0.16	0.10	5.51
Largemouth Bass	5423	0.01	0.34	0.27	3.40
Ling (Burbot)	2078	0.03	0.48	0.39	3.55
Longnose Gar	10	0.06	0.69	0.64	1.80
Longnose Sucker	1310	0.01	0.29	0.17	2.60

Table S1: continued

Species	**n**	**min**	**mean**	**median**	**max**
Mooneye	274	0.01	0.60	0.50	4.27
Muskellunge	126	0.04	0.88	0.48	7.11
Northern Hog Sucker	2	0.04	0.16	0.16	0.28
Northern Pike	33005	0.01	0.66	0.46	13.00
Pink Salmon	500	0.01	0.07	0.06	0.92
Pumpkinseed	2827	0.01	0.15	0.11	1.20
Quillback Carpsucker	130	0.04	0.45	0.39	1.26
Rainbow Smelt	154	0.02	0.17	0.10	1.30
Rainbow Trout	3245	0.01	0.15	0.13	0.94
Redhorse Sucker	694	0.02	0.41	0.27	6.00
River Redhorse	2	0.17	0.38	0.38	0.59
Rock Bass	4737	0.01	0.29	0.21	2.20
Round Whitefish	522	0.01	0.08	0.05	0.89
Salmon Hybrid	9	0.07	0.14	0.14	0.20
Sauger	1719	0.04	0.84	0.59	6.39
Shorthead Redhorse	130	0.04	0.19	0.14	0.79
Silver Redhorse	47	0.04	0.27	0.21	0.98
Siscowet	155	0.09	0.53	0.51	1.70
Smallmouth Bass	17466	0.01	0.41	0.32	5.00
Splake	429	0.01	0.17	0.16	1.30
Spotted Sucker	6	0.02	0.09	0.09	0.17
Sturgeon	551	0.03	0.40	0.26	4.70
Sucker Family	21	0.03	0.08	0.07	0.15
Walleye	50622	0.01	0.71	0.46	24.00
White Bass	3732	0.01	0.25	0.17	2.80
White Crappie	240	0.01	0.14	0.09	1.34
White Perch	1595	0.01	0.15	0.10	2.10
White Sucker	12036	0.01	0.21	0.13	5.30
Whitefish hybrid	15	0.10	0.58	0.55	1.20
Yellow Bullhead	5	0.11	0.21	0.25	0.28
Yellow Perch	13357	0.01	0.19	0.14	2.86

Table S2: Fish consumption advisory benchmarks for Hg (µg/g ww) used by Ontario Ministry of the Environment and Climate Change, Canada (OMOECC 2015). Separate benchmarks are used for the general population and sensitive population of children under 15 and women of child-bearing age.

Meals per month	Sensitive	General
0 (do not eat)	>0.5	>1.8
2		1.2-1.8
4	0.25-0.5	0.6-1.2
8	0.16-0.25	0.4-0.6
12	0.12-0.16	0.3-0.4
16	0.06-0.12	0.15-0.3
32	<0.06	<0.15

Table S3: An example of an advisory comparison between the current method of analyzing individual samples and six methods considered for compositing samples. The comparisons were specific to a fish species and sampling event (location/year). The advisory values are in meals per month; fish sizes are in cm. Blue cells highlight missing advisories due to loss of smallest/largest fish size after compositing, yellow cells highlight more restrictive advisories and red cells highlight less restrictive advisories compared to the regular method.

Size (cm) →	15	20	25	30	35	40	45	50	55	60	65	70	75	75+
Regular		**4**	**4**	**4**	**2**	**2**	**2**	**2**	**2**	**2**	**0**	**0**	**0**	
Comp 1			4	2	2	2	2	2	2	2	0	0		
Comp 2		4	4	2	2	2	2	2	2	2	0	0	0	
Comp 3		4	4	2	2	2	2	2	2	2	0	0	0	
Comp 4		4	4	4	4	2	2	2	2	2	0	0	0	
Comp 5		4	4	2	2	2	2	2	2	2	0	0	0	
Comp 6		4	4	4	2	2	2	2	2	2	2	0	0	

Table S4a(a): Breakdown (numbers) of the general population advisories from the six composite methods compared to those used in the regular method of analyzing individual samples. The percentages of the advisories that were equal have been highlighted in bold fonts with yellow background, and the less restrictive and missing have been highlighted with a grey background.

		Advisories from the regular method							
	Meals/month	0	2	4	8	12	16	32	Total
Comp 1	0	**1039**	172	2	1		1		1215
	2	29	**1664**	387	11				2091
	4	9	96	**9017**	1075	8	2		10207
	8	2	2	216	**7488**	1214	34	1	8957
	12	1		15	270	**5094**	1188	4	6572
	16	10	1	9	30	264	**12203**	885	13402
	32	5	1	5	10	7	271	**10413**	10712
	Missing	1147	1782	5454	3848	2853	6106	5985	27175
	Total	2242	3718	15105	12733	9440	19805	17288	80331
Comp 2	0	**2063**	377	6	1				2447
	2	178	**2966**	823	11				3978
	4	1	374	**13519**	1727	31	2		15654
	8		1	747	**10194**	1999	86		13027
	12			10	770	**6610**	1961	4	9355
	16				28	799	**17201**	1483	19511
	32				2	1	554	**15801**	16358
	Total	2242	3718	15105	12733	9440	19804	17288	80330
Comp 3	0	**2083**	286						2369
	2	158	**3114**	623	11				3906
	4	1	318	**13828**	1341	4			15492
	8			653	**10738**	1537	23		12951
	12				628	**7229**	1501		9358
	16			1	15	669	**17828**	1133	19646
	32					1	453	**16155**	16609
	Total	2242	3718	15105	12733	9440	19805	17288	80331
Comp 4	0	**2099**	284						2383
	2	142	**3166**	567	1				3876
	4	1	268	**14020**	1315	7			15611
	8			516	**10865**	1517	38		12936
	12			2	533	**7380**	1523		9438
	16				19	535	**17841**	1162	19557
	32					1	402	**16126**	16529
	Missing								
	Total	2242	3718	15105	12733	9440	19804	17288	80330
Comp 5	0	**2122**	214						2336
	2	120	**3272**	460	11				3863
	4		232	**14183**	1003	2			15420
	8			462	**11286**	1210	7		12965
	12				423	**7748**	1176		9347
	16				10	480	**18294**	887	19671
	32						328	**16401**	16729
	Total	2242	3718	15105	12733	9440	19805	17288	80331
Comp 6	0	**2074**	254	5	2		1		2336
	2	132	**3149**	508	2	1		1	3793
	4	4	301	**13966**	1175	25	6	2	15479
	8	2	2	582	**10872**	1407	52	2	12919
	12			10	603	**7367**	1364	2	9346
	16	8	1	5	38	596	**17803**	1084	19535
	32	5	1	1	8	7	485	**16061**	16568
	Total	2225	3708	15077	12700	9403	19711	17152	79976

Table S4a(b): Breakdown (percentage) of the general population advisories from the six composite methods compared to those used in the regular method of analyzing individual samples. The percentages of the advisories that were equal have been highlighted in bold fonts with yellow background, and the less restrictive and missing have been highlighted with a grey background.

		Advisories from the regular method							
	Meals/month	0	2	4	8	12	16	32	Total
Comp 1	0	**46.3%**	4.6%	0.0%	0.0%		0.0%		1.5%
	2	1.3%	**44.8%**	2.6%	0.1%				2.6%
	4	0.4%	2.6%	**59.7%**	8.4%	0.1%	0.0%		12.7%
	8	0.1%	0.1%	1.4%	**58.8%**	12.9%	0.2%	0.0%	11.2%
	12	0.0%	0.0%	0.1%	2.1%	**54.0%**	6.0%	0.0%	8.2%
	16	0.4%	0.0%	0.1%	0.2%	2.8%	**61.6%**	5.1%	16.7%
	32	0.2%	0.0%	0.0%	0.1%	0.1%	1.4%	**60.2%**	13.3%
	Missing	51.2%	47.9%	36.1%	30.2%	30.2%	30.8%	34.6%	33.8%
	Total	100%	100%	100%	100%	100%	100%	100%	100%
Comp 2	0	**92.0%**	10.1%	0.0%	0.0%				3.0%
	2	7.9%	**79.8%**	5.4%	0.1%				5.0%
	4	0.0%	10.1%	**89.5%**	13.6%	0.3%	0.0%		19.5%
	8		0.0%	4.9%	**80.1%**	21.2%	0.4%		16.2%
	12			0.1%	6.0%	**70.0%**	9.9%	0.0%	11.6%
	16				0.2%	8.5%	**86.9%**	8.6%	24.3%
	32				0.0%	0.0%	2.8%	**91.4%**	20.4%
	Total	100%	100%	100%	100%	100%	100%	100%	100%
Comp 3	0	**92.9%**	7.7%						2.9%
	2	7.0%	**83.8%**	4.1%	0.1%				4.9%
	4	0.0%	8.6%	**91.5%**	10.5%	0.0%			19.3%
	8			4.3%	**84.3%**	16.3%	0.1%		16.1%
	12				4.9%	**76.6%**	7.6%		11.6%
	16			0.0%	0.1%	7.1%	**90.0%**	6.6%	24.5%
	32					0.0%	2.3%	**93.4%**	20.7%
	Total	100%	100%	100%	100%	100%	100%	100%	100%
Comp 4	0	**93.6%**	7.6%						3.0%
	2	6.3%	**85.2%**	3.8%	0.0%				4.8%
	4	0.0%	7.2%	**92.8%**	10.3%	0.1%			19.4%
	8			3.4%	**85.3%**	16.1%	0.2%		16.1%
	12			0.0%	4.2%	**78.2%**	7.7%		11.7%
	16				0.1%	5.7%	**90.1%**	6.7%	24.3%
	32					0.0%	2.0%	**93.3%**	20.6%
	Missing								
	Total	100%	100%	100%	100%	100%	100%	100%	100%
Comp 5	0	**94.6%**	5.8%						2.9%
	2	5.4%	**88.0%**	3.0%	0.1%				4.8%
	4		6.2%	**93.9%**	7.9%	0.0%			19.2%
	8			3.1%	**88.6%**	12.8%	0.0%		16.1%
	12				3.3%	**82.1%**	5.9%		11.6%
	16				0.1%	5.1%	**92.4%**	5.1%	24.5%
	32						1.7%	**94.9%**	20.8%
	Total	100%	100%	100%	100%	100%	100%	100%	100%
Comp 6	0	**93.2%**	6.9%	0.0%	0.0%	0.0%	0.0%		2.9%
	2	5.9%	**84.9%**	3.4%	0.0%	0.0%		0.0%	4.7%
	4	0.2%	8.1%	**92.6%**	9.3%	0.3%	0.0%	0.0%	19.4%
	8	0.1%	0.1%	3.9%	**85.6%**	15.0%	0.3%	0.0%	16.2%
	12			0.1%	4.7%	**78.3%**	6.9%	0.0%	11.7%
	16	0.4%	0.0%	0.0%	0.3%	6.3%	**90.3%**	6.3%	24.4%
	32	0.2%	0.0%	0.0%	0.1%	0.1%	2.5%	**93.6%**	20.7%
	Total	100%	100%	100%	100%	100%	100%	100%	100%

Table S4b(a): Breakdown (numbers) of the <u>sensitive</u> population advisories from the six composite methods compared to those used in the regular method of analyzing individual samples. The percentages of the advisories that were equal have been highlighted in bold fonts with yellow background, and the less restrictive and missing have been highlighted with a grey background.

		Advisories from the regular method						
	Meals/month	0	4	8	12	16	32	Total
Comp 1	0	**16205**	1180	4				17389
	4	239	**14180**	1190	8	2	1	15620
	8	15	297	**7174**	870	39	2	8397
	12	7	17	262	**3052**	701	2	4041
	16	6	10	25	199	**5007**	309	5556
	32	2	2		6	122	**2021**	2153
	Missing	10111	6702	3863	2012	2970	1517	27175
	Total	26585	22388	12518	6147	8841	3852	80331
Comp 2	0	**25834**	1957	5				27796
	4	751	**19698**	1885	15	3		22352
	8		729	**10031**	1496	73	2	12331
	12		4	572	**4187**	1197	2	5962
	16			24	448	**7387**	575	8434
	32				1	181	**3273**	3455
	Total	26585	22388	12517	6147	8841	3852	80330
Comp 3	0	**25944**	1506	1				27451
	4	641	**20243**	1425	7	1		22317
	8		637	**10606**	1144	31		12418
	12		2	477	**4605**	867		5951
	16			4	391	**7754**	423	8572
	32			5		188	**3429**	3622
	Total	26585	22388	12518	6147	8841	3852	80331

		Advisories from the regular method						
	Meals/month	0	4	8	12	16	32	Total
Comp 4	0	**26064**	1443					27507
	4	521	**20446**	1439	4			22410
	8		495	**10669**	1181	45	1	12391
	12		4	393	**4643**	955	2	5997
	16			16	319	**7674**	455	8464
	32					167	**3394**	3561
	Total	26585	22388	12517	6147	8841	3852	80330
Comp 5	0	**26130**	1197					27327
	4	455	**20755**	1156	3			22369
	8		436	**11014**	912	14		12376
	12			340	**4967**	717		6024
	16			8	265	**7971**	353	8597
	32					139	**3499**	3638
	Total	26585	22388	12518	6147	8841	3852	80331
Comp 6	0	**25907**	1362	5		3		27277
	4	592	**20316**	1351	17	7	1	22284
	8	9	607	**10603**	1072	52		12343
	12	4	16	464	**4631**	829	7	5951
	16	4	8	29	391	**7662**	418	8512
	32	1	3		4	221	**3380**	3609
	Total	26517	22312	12452	6115	8774	3806	79976

Table S4b(b): Breakdown (percentage) of the sensitive population advisories from the six composite methods compared to those used in the regular method of analyzing individual samples. The percentages of the advisories that were equal have been highlighted in bold fonts with yellow background, and the less restrictive and missing have been highlighted with a grey background.

		Advisories from the regular method						
	Meals/month	0	4	8	12	16	32	Total
Comp 1	0	**61.0%**	5.3%	0.0%				21.6%
	4	0.9%	**63.3%**	9.5%	0.1%	0.0%	0.0%	19.4%
	8	0.1%	1.3%	**57.3%**	14.2%	0.4%	0.1%	10.5%
	12	0.0%	0.1%	2.1%	**49.7%**	7.9%	0.1%	5.0%
	16	0.0%	0.0%	0.2%	3.2%	**56.6%**	8.0%	6.9%
	32	0.0%	0.0%		0.1%	1.4%	**52.5%**	2.7%
	Missing	38.0%	29.9%	30.9%	32.7%	33.6%	39.4%	33.8%
	Total	100%	100%	100%	100%	100%	100%	100%
Comp 2	0	**97.2%**	8.7%	0.0%				34.6%
	4	2.8%	**88.0%**	15.1%	0.2%	0.0%		27.8%
	8		3.3%	**80.1%**	24.3%	0.8%	0.1%	15.4%
	12		0.0%	4.6%	**68.1%**	13.5%	0.1%	7.4%
	16			0.2%	7.3%	**83.6%**	14.9%	10.5%
	32				0.0%	2.0%	**85.0%**	4.3%
	Total	100%	100%	100%	100%	100%	100%	100%
Comp 3	0	**97.6%**	6.7%	0.0%				34.2%
	4	2.4%	**90.4%**	11.4%	0.1%	0.0%		27.8%
	8		2.8%	**84.7%**	18.6%	0.4%		15.5%
	12		0.0%	3.8%	**74.9%**	9.8%		7.4%
	16			0.0%	6.4%	**87.7%**	11.0%	10.7%
	32			0.0%		2.1%	**89.0%**	4.5%
	Total	100%	100%	100%	100%	100%	100%	100%

		Advisories from the regular method						
	Meals/month	0	4	8	12	16	32	Total
Comp 4	0	**98.0%**	6.4%					34.2%
	4	2.0%	**91.3%**	11.5%	0.1%			27.9%
	8		2.2%	**85.2%**	19.2%	0.5%	0.0%	15.4%
	12		0.0%	3.1%	**75.5%**	10.8%	0.1%	7.5%
	16			0.1%	5.2%	**86.8%**	11.8%	10.5%
	32					1.9%	**88.1%**	4.4%
	Total	100%	100%	100%	100%	100%	100%	100%
Comp 5	0	**98.3%**	5.3%					34.0%
	4	1.7%	**92.7%**	9.2%	0.0%			27.8%
	8		1.9%	**88.0%**	14.8%	0.2%		15.4%
	12			2.7%	**80.8%**	8.1%		7.5%
	16			0.1%	4.3%	**90.2%**	9.2%	10.7%
	32					1.6%	**90.8%**	4.5%
	Total	100%	100%	100%	100%	100%	100%	100%
Comp 6	0	**97.7%**	6.1%	0.0%	0.0%	0.0%		34.1%
	4	2.2%	**91.1%**	10.8%	0.3%	0.1%	0.0%	27.9%
	8	0.0%	2.7%	**85.2%**	17.5%	0.6%		15.4%
	12	0.0%	0.1%	3.7%	**75.7%**	9.4%	0.2%	7.4%
	16	0.0%	0.0%	0.2%	6.4%	**87.3%**	11.0%	10.6%
	32	0.0%	0.0%		0.1%	2.5%	**88.8%**	4.5%
	Total	100%	100%	100%	100%	100%	100%	100%

Table S5: Classification (equal, more restrictive and less restrictive) of the general population advisories from composite methods 2 and 6 compared to those from the regular method of analyzing individual samples broken down by sample sizes for the individual measurements.

	Comp method 2 advisories compared to Regular							Comp method 6 advisories compared to Regular						
N	EQUAL	Less Res	More Res	Total	EQUAL	Less Res	More Res	EQUAL	Less Res	More Res	Total	EQUAL	Less Res	More Res
1	590			590	100.0%	0.0%	0.0%	590			590	100.0%	0.0%	0.0%
2	1710	1		1711	99.9%	0.1%	0.0%	1627	80	2	1709	95.2%	4.7%	0.1%
3	1994			1994	100.0%	0.0%	0.0%	1889	53	43	1985	95.2%	2.7%	2.2%
4	2195	84	167	2446	89.7%	3.4%	6.8%	2300	64	79	2443	94.1%	2.6%	3.2%
5	2625	165	281	3071	85.5%	5.4%	9.2%	2789	110	150	3049	91.5%	3.6%	4.9%
6	2397	151	346	2894	82.8%	5.2%	12.0%	2624	100	157	2881	91.1%	3.5%	5.4%
7	2363	176	362	2901	81.5%	6.1%	12.5%	2633	97	154	2884	91.3%	3.4%	5.3%
8	2711	186	328	3225	84.1%	5.8%	10.2%	2947	105	164	3216	91.6%	3.3%	5.1%
9	2600	183	300	3083	84.3%	5.9%	9.7%	2762	120	195	3077	89.8%	3.9%	6.3%
10	5750	350	803	6903	83.3%	5.1%	11.6%	6172	278	421	6871	89.8%	4.0%	6.1%
11	1842	133	274	2249	81.9%	5.9%	12.2%	1991	85	165	2241	88.8%	3.8%	7.4%
12	1834	107	259	2200	83.4%	4.9%	11.8%	1994	57	140	2191	91.0%	2.6%	6.4%
13	1622	124	261	2007	80.8%	6.2%	13.0%	1771	68	164	2003	88.4%	3.4%	8.2%
14	2025	119	251	2395	84.6%	5.0%	10.5%	2123	94	168	2385	89.0%	3.9%	7.0%
15	4653	253	638	5544	83.9%	4.6%	11.5%	4934	166	427	5527	89.3%	3.0%	7.7%
16	1940	115	292	2347	82.7%	4.9%	12.4%	2023	80	230	2333	86.7%	3.4%	9.9%
17	1605	68	228	1901	84.4%	3.6%	12.0%	1655	72	166	1893	87.4%	3.8%	8.8%
18	1791	81	235	2107	85.0%	3.8%	11.2%	1847	67	185	2099	88.0%	3.2%	8.8%
19	2215	109	312	2636	84.0%	4.1%	11.8%	2300	99	228	2627	87.6%	3.8%	8.7%
20	15056	736	1965	17757	84.8%	4.1%	11.1%	15450	639	1560	17649	87.5%	3.6%	8.8%
21	1129	43	177	1349	83.7%	3.2%	13.1%	1178	41	125	1344	87.6%	3.1%	9.3%
22	916	43	122	1081	84.7%	4.0%	11.3%	938	42	96	1076	87.2%	3.9%	8.9%
23	579	31	83	693	83.5%	4.5%	12.0%	602	20	69	691	87.1%	2.9%	10.0%

	Comp method 2 advisories compared to Regular							Comp method 6 advisories compared to Regular						
N	EQUAL	Less Res	More Res	Total	EQUAL	Less Res	More Res	EQUAL	Less Res	More Res	Total	EQUAL	Less Res	More Res
24	489	15	76	580	84.3%	2.6%	13.1%	501	19	59	579	86.5%	3.3%	10.2%
25	880	39	99	1018	86.4%	3.8%	9.7%	862	54	100	1016	84.8%	5.3%	9.8%
26	359	10	52	421	85.3%	2.4%	12.4%	366	12	38	416	88.0%	2.9%	9.1%
27	323	23	36	382	84.6%	6.0%	9.4%	325	16	37	378	86.0%	4.2%	9.8%
28	354	14	40	408	86.8%	3.4%	9.8%	362	14	30	406	89.2%	3.4%	7.4%
29	246	5	32	283	86.9%	1.8%	11.3%	248	10	23	281	88.3%	3.6%	8.2%
30	1491	47	215	1753	85.1%	2.7%	12.3%	1466	53	225	1744	84.1%	3.0%	12.9%
31	152	7	18	177	85.9%	4.0%	10.2%	155	6	16	177	87.6%	3.4%	9.0%
32	89	8	22	119	74.8%	6.7%	18.5%	91	7	21	119	76.5%	5.9%	17.6%
33	74		13	87	85.1%	0.0%	14.9%	74	1	12	87	85.1%	1.1%	13.8%
34	91	6	30	127	71.7%	4.7%	23.6%	102	3	21	126	81.0%	2.4%	16.7%
35	58	1	5	64	90.6%	1.6%	7.8%	54		10	64	84.4%	0.0%	15.6%
36	87	8	16	111	78.4%	7.2%	14.4%	92	7	11	110	83.6%	6.4%	10.0%
37	38	3	3	44	86.4%	6.8%	6.8%	40		4	44	90.9%	0.0%	9.1%
38	88	1	10	99	88.9%	1.0%	10.1%	88		10	98	89.8%	0.0%	10.2%
39	74	4	9	87	85.1%	4.6%	10.3%	77	3	7	87	88.5%	3.4%	8.0%
40	113		13	126	89.7%	0.0%	10.3%	108	2	16	126	85.7%	1.6%	12.7%
41	59		6	65	90.8%	0.0%	9.2%	56	2	6	64	87.5%	3.1%	9.4%
42	42		4	46	91.3%	0.0%	8.7%	41	2	3	46	89.1%	4.3%	6.5%
43	40		3	43	93.0%	0.0%	7.0%	32	6	3	41	78.0%	14.6%	7.3%
44	46		7	53	86.8%	0.0%	13.2%	41	3	8	52	78.8%	5.8%	15.4%
45	32		4	36	88.9%	0.0%	11.1%	29		7	36	80.6%	0.0%	19.4%
46	18			18	100.0%	0.0%	0.0%	18			18	100.0%	0.0%	0.0%
47	22		10	32	68.8%	0.0%	31.3%	24		8	32	75.0%	0.0%	25.0%
48	102	2	17	121	84.3%	1.7%	14.0%	99	4	18	121	81.8%	3.3%	14.9%
49	63		7	70	90.0%	0.0%	10.0%	60	2	8	70	85.7%	2.9%	11.4%
50	163	4	17	184	88.6%	2.2%	9.2%	159	10	14	183	86.9%	5.5%	7.7%

N	Comp method 2 advisories compared to Regular							Comp method 6 advisories compared to Regular						
	EQUAL	Less Res	More Res	Total	EQUAL	Less Res	More Res	EQUAL	Less Res	More Res	Total	EQUAL	Less Res	More Res
51	88	2	3	93	94.6%	2.2%	3.2%	90		3	93	96.8%	0.0%	3.2%
52	42		2	44	95.5%	0.0%	4.5%	42	1	1	44	95.5%	2.3%	2.3%
53	7			7	100.0%	0.0%	0.0%	6	1		7	85.7%	14.3%	0.0%
54	33	1	1	35	94.3%	2.9%	2.9%	29	1	5	35	82.9%	2.9%	14.3%
55	34	1	1	36	94.4%	2.8%	2.8%	32	2	2	36	88.9%	5.6%	5.6%
56	37	1	6	44	84.1%	2.3%	13.6%	35	1	8	44	79.5%	2.3%	18.2%
57	3			3	100.0%	0.0%	0.0%	3			3	100.0%	0.0%	0.0%
58	14		5	19	73.7%	0.0%	26.3%	15		4	19	78.9%	0.0%	21.1%
59	18		1	19	94.7%	0.0%	5.3%	17		2	19	89.5%	0.0%	10.5%
60	26	2	7	35	74.3%	5.7%	20.0%	24	1	10	35	68.6%	2.9%	28.6%
61	5			5	100.0%	0.0%	0.0%	5			5	100.0%	0.0%	0.0%
62	32		2	34	94.1%	0.0%	5.9%	30	1	3	34	88.2%	2.9%	8.8%
64	15		1	16	93.8%	0.0%	6.3%	15		1	16	93.8%	0.0%	6.3%
66	6	1		7	85.7%	14.3%	0.0%	5	2		7	71.4%	28.6%	0.0%
67	7			7	100.0%	0.0%	0.0%	4	3		7	57.1%	42.9%	0.0%
68	5		1	6	83.3%	0.0%	16.7%	6			6	100.0%	0.0%	0.0%
69	3			3	100.0%	0.0%	0.0%	3			3	100.0%	0.0%	0.0%
70	2		2	4	50.0%	0.0%	50.0%	2		2	4	50.0%	0.0%	50.0%
71	15		3	18	83.3%	0.0%	16.7%	14		4	18	77.8%	0.0%	22.2%
73	7		1	8	87.5%	0.0%	12.5%	6		2	8	75.0%	0.0%	25.0%
74	3		3	6	50.0%	0.0%	50.0%	3		3	6	50.0%	0.0%	50.0%
75	3			3	100.0%	0.0%	0.0%	2		1	3	66.7%	0.0%	33.3%
76	9		2	11	81.8%	0.0%	18.2%	9		2	11	81.8%	0.0%	18.2%
78	8		1	9	88.9%	0.0%	11.1%	9			9	100.0%	0.0%	0.0%
79	3			3	100.0%	0.0%	0.0%	2	1		3	66.7%	33.3%	0.0%
80	29		1	30	96.7%	0.0%	3.3%	26	1	2	29	89.7%	3.4%	6.9%
89	17	1		18	94.4%	5.6%	0.0%	15	1	2	18	83.3%	5.6%	11.1%

N	Comp method 2 advisories compared to Regular							Comp method 6 advisories compared to Regular						
	EQUAL	Less Res	More Res	Total	EQUAL	Less Res	More Res	EQUAL	Less Res	More Res	Total	EQUAL	Less Res	More Res
90	8		1	9	88.9%	0.0%	11.1%	7		2	9	77.8%	0.0%	22.2%
91	6		4	10	60.0%	0.0%	40.0%	5		5	10	50.0%	0.0%	50.0%
97	6			6	100.0%	0.0%	0.0%	6			6	100.0%	0.0%	0.0%
99	2			2	100.0%	0.0%	0.0%	2			2	100.0%	0.0%	0.0%
101	6		1	7	85.7%	0.0%	14.3%	6		1	7	85.7%	0.0%	14.3%
104	10			10	100.0%	0.0%	0.0%	7	1	2	10	70.0%	10.0%	20.0%
106	8			8	100.0%	0.0%	0.0%	5		3	8	62.5%	0.0%	37.5%
107	9		2	11	81.8%	0.0%	18.2%	9		2	11	81.8%	0.0%	18.2%
108	11		1	12	91.7%	0.0%	8.3%	11		1	12	91.7%	0.0%	8.3%
111	12		1	13	92.3%	0.0%	7.7%	13			13	100.0%	0.0%	0.0%
113	6		2	8	75.0%	0.0%	25.0%	5		3	8	62.5%	0.0%	37.5%
115	7			7	100.0%	0.0%	0.0%	4		3	7	57.1%	0.0%	42.9%
147	9			9	100.0%	0.0%	0.0%	8		1	9	88.9%	0.0%	11.1%
157	3			3	100.0%	0.0%	0.0%	3			3	100.0%	0.0%	0.0%
165	4	1	3	8	50.0%	12.5%	37.5%	4	1	3	8	50.0%	12.5%	37.5%
167	4			4	100.0%	0.0%	0.0%	4			4	100.0%	0.0%	0.0%
171	6			6	100.0%	0.0%	0.0%	6			6	100.0%	0.0%	0.0%
181	8		2	10	80.0%	0.0%	20.0%	8		2	10	80.0%	0.0%	20.0%
195	8		1	9	88.9%	0.0%	11.1%	6		3	9	66.7%	0.0%	33.3%
274	15		2	17	88.2%	0.0%	11.8%	15		2	17	88.2%	0.0%	11.8%
Total	68354	3465	8511	80330	85.1%	4.3%	10.6%	71292	2791	5893	79976	89.1%	3.5%	7.4%

Table S6a: Classification (equal, more restrictive and less restrictive) of the general population advisories **from composite method 2** compared to those from the regular method of analyzing individual samples broken down by species.

	Comp method 2 advisories compared to Regular						
Species	**EQUAL**	**Less Res**	**More Res**	**Total**	**EQUAL**	**Less Res**	**More Res**
Alewife	10			10	100.0%	0.0%	0.0%
American Eel	104	15	15	134	77.6%	11.2%	11.2%
Atlantic Salmon	12	2		14	85.7%	14.3%	0.0%
Bigmouth Buffalo	6			6	100.0%	0.0%	0.0%
Black Crappie	526	18	55	599	87.8%	3.0%	9.2%
Blackfin Cisco	4			4	100.0%	0.0%	0.0%
Bloater	74	3	5	82	90.2%	3.7%	6.1%
Bluegill	206	10	28	244	84.4%	4.1%	11.5%
Bowfin	50	9	11	70	71.4%	12.9%	15.7%
Brook Trout	776	39	93	908	85.5%	4.3%	10.2%
Brown Bullhead	1177	37	83	1297	90.7%	2.9%	6.4%
Brown Trout	749	27	58	834	89.8%	3.2%	7.0%
Catfish species	2			2	100.0%	0.0%	0.0%
Channel Catfish	886	44	189	1119	79.2%	3.9%	16.9%
Chinook Salmon	969	26	38	1033	93.8%	2.5%	3.7%
Chub	39			39	100.0%	0.0%	0.0%
Cisco (Lake Herring)	709	42	44	795	89.2%	5.3%	5.5%
Coho Salmon	613	17	21	651	94.2%	2.6%	3.2%
Common Carp	2445	182	217	2844	86.0%	6.4%	7.6%
Creek Chub	4			4	100.0%	0.0%	0.0%
Freshwater Drum	545	66	112	723	75.4%	9.1%	15.5%
Gizzard Shad	70	1		71	98.6%	1.4%	0.0%
Golden Redhorse Sucker	7			7	100.0%	0.0%	0.0%
Goldeye	21	4	3	28	75.0%	14.3%	10.7%
Goldfish	12			12	100.0%	0.0%	0.0%
Greater Redhorse	8	1		9	88.9%	11.1%	0.0%
Humper Lake Trout	14		3	17	82.4%	0.0%	17.6%
Lake Chub	4			4	100.0%	0.0%	0.0%
Lake Trout	7336	346	1063	8745	83.9%	4.0%	12.2%
Lake Whitefish	2949	106	235	3290	89.6%	3.2%	7.1%
Largemouth Bass	1906	59	290	2255	84.5%	2.6%	12.9%
Ling (Burbot)	828	89	68	985	84.1%	9.0%	6.9%
Longnose Gar	4			4	100.0%	0.0%	0.0%
Longnose Sucker	318	19	34	371	85.7%	5.1%	9.2%
Mooneye	54	3	7	64	84.4%	4.7%	10.9%

	Comp method 2 advisories compared to Regular						
Species	**EQUAL**	**Less Res**	**More Res**	**Total**	**EQUAL**	**Less Res**	**More Res**
Muskellunge	92	3	17	112	82.1%	2.7%	15.2%
Northern Hog Sucker	2			2	100.0%	0.0%	0.0%
Northern Pike	13920	935	1601	16456	84.6%	5.7%	9.7%
Pink Salmon	106		1	107	99.1%	0.0%	0.9%
Pumpkinseed	281	13	49	343	81.9%	3.8%	14.3%
Quillback Carpsucker	30	1	5	36	83.3%	2.8%	13.9%
Rainbow Smelt	23	2	2	27	85.2%	7.4%	7.4%
Rainbow Trout	1508	57	104	1669	90.4%	3.4%	6.2%
Redhorse Sucker	271	22	30	323	83.9%	6.8%	9.3%
River Redhorse	2			2	100.0%	0.0%	0.0%
Rock Bass	655	49	105	809	81.0%	6.1%	13.0%
Round Whitefish	128	1	6	135	94.8%	0.7%	4.4%
Salmon Hybrid	2	1		3	66.7%	33.3%	0.0%
Sauger	363	26	33	422	86.0%	6.2%	7.8%
Shorthead Redhorse	62	4	7	73	84.9%	5.5%	9.6%
Silver Redhorse	30		1	31	96.8%	0.0%	3.2%
Siscowet	31	3	3	37	83.8%	8.1%	8.1%
Smallmouth Bass	5478	177	847	6502	84.3%	2.7%	13.0%
Splake	158	4	6	168	94.0%	2.4%	3.6%
Spotted Sucker	5			5	100.0%	0.0%	0.0%
Sturgeon	120	16	7	143	83.9%	11.2%	4.9%
Sucker Family	1		1	2	50.0%	0.0%	50.0%
Walleye	15671	682	2407	18760	83.5%	3.6%	12.8%
White Bass	523	31	61	615	85.0%	5.0%	9.9%
White Crappie	61	7	3	71	85.9%	9.9%	4.2%
White Perch	252	15	25	292	86.3%	5.1%	8.6%
White Sucker	3197	128	271	3596	88.9%	3.6%	7.5%
Whitefish hybrid	8			8	100.0%	0.0%	0.0%
Yellow Bullhead	4			4	100.0%	0.0%	0.0%
Yellow Perch	1933	123	247	2303	83.9%	5.3%	10.7%
Grand Total	**68354**	**3465**	**8511**	**80330**	**85.1%**	**4.3%**	**10.6%**

Table S6b: Classification (equal, more restrictive and less restrictive) of the general population advisories **from composite method 6** compared to those from the regular method of analyzing individual samples broken down by species.

Comp method 6 advisories compared to Regular							
Species	**EQUAL**	**Less Res**	**More Res**	**Total**	**EQUAL**	**Less Res**	**More Res**
Alewife	10			10	100.0%	0.0%	0.0%
American Eel	114	7	13	134	85.1%	5.2%	9.7%
Atlantic Salmon	13	1		14	92.9%	7.1%	0.0%
Bigmouth Buffalo	6			6	100.0%	0.0%	0.0%
Black Crappie	524	21	42	587	89.3%	3.6%	7.2%
Blackfin Cisco	4			4	100.0%	0.0%	0.0%
Bloater	71	6	3	80	88.8%	7.5%	3.8%
Bluegill	195	21	24	240	81.3%	8.8%	10.0%
Bowfin	55	7	8	70	78.6%	10.0%	11.4%
Brook Trout	793	32	80	905	87.6%	3.5%	8.8%
Brown Bullhead	1154	48	82	1284	89.9%	3.7%	6.4%
Brown Trout	777	21	34	832	93.4%	2.5%	4.1%
Catfish species	2			2	100.0%	0.0%	0.0%
Channel Catfish	928	49	140	1117	83.1%	4.4%	12.5%
Chinook Salmon	983	19	30	1032	95.3%	1.8%	2.9%
Chub	38			38	100.0%	0.0%	0.0%
Cisco(Lake Herring)	693	48	45	786	88.2%	6.1%	5.7%
Coho Salmon	624	9	14	647	96.4%	1.4%	2.2%
Common Carp	2578	127	132	2837	90.9%	4.5%	4.7%
Creek Chub	2	2		4	50.0%	50.0%	0.0%
Freshwater Drum	602	44	71	717	84.0%	6.1%	9.9%
Gizzard Shad	70	1		71	98.6%	1.4%	0.0%
Golden Redhorse Sucker	7			7	100.0%	0.0%	0.0%
Goldeye	22	3	3	28	78.6%	10.7%	10.7%
Goldfish	11			11	100.0%	0.0%	0.0%
Greater Redhorse	7	2		9	77.8%	22.2%	0.0%
Humper Lake Trout	14		3	17	82.4%	0.0%	17.6%
Lake Chub	4			4	100.0%	0.0%	0.0%
Lake Trout	7796	263	663	8722	89.4%	3.0%	7.6%
Lake Whitefish	2977	109	190	3276	90.9%	3.3%	5.8%
Largemouth Bass	2015	57	176	2248	89.6%	2.5%	7.8%
Ling (Burbot)	880	54	50	984	89.4%	5.5%	5.1%
Longnose Gar	3	1		4	75.0%	25.0%	0.0%
Longnose Sucker	328	13	27	368	89.1%	3.5%	7.3%
Mooneye	55	3	5	63	87.3%	4.8%	7.9%

	Comp method 6 advisories compared to Regular						
Species	**EQUAL**	**Less Res**	**More Res**	**Total**	**EQUAL**	**Less Res**	**More Res**
Muskellunge	101	5	6	112	90.2%	4.5%	5.4%
Northern Hog Sucker	2			2	100.0%	0.0%	0.0%
Northern Pike	14848	552	1018	16418	90.4%	3.4%	6.2%
Pink Salmon	106		1	107	99.1%	0.0%	0.9%
Pumpkinseed	253	31	44	328	77.1%	9.5%	13.4%
Quillback Carpsucker	29	4	3	36	80.6%	11.1%	8.3%
Rainbow Smelt	22	3	2	27	81.5%	11.1%	7.4%
Rainbow Trout	1547	45	73	1665	92.9%	2.7%	4.4%
Redhorse Sucker	250	40	33	323	77.4%	12.4%	10.2%
River Redhorse	2			2	100.0%	0.0%	0.0%
Rock Bass	639	60	106	805	79.4%	7.5%	13.2%
Round Whitefish	127	1	5	133	95.5%	0.8%	3.8%
Salmon Hybrid	3			3	100.0%	0.0%	0.0%
Sauger	367	27	26	420	87.4%	6.4%	6.2%
Shorthead Redhorse	65	2	5	72	90.3%	2.8%	6.9%
Silver Redhorse	29	1		30	96.7%	3.3%	0.0%
Siscowet	34		3	37	91.9%	0.0%	8.1%
Smallmouth Bass	5769	170	534	6473	89.1%	2.6%	8.2%
Splake	160	3	4	167	95.8%	1.8%	2.4%
Spotted Sucker	4	1		5	80.0%	20.0%	0.0%
Sturgeon	112	18	13	143	78.3%	12.6%	9.1%
Sucker Family	1		1	2	50.0%	0.0%	50.0%
Walleye	16550	542	1599	18691	88.5%	2.9%	8.6%
White Bass	494	30	75	599	82.5%	5.0%	12.5%
White Crappie	60	8	2	70	85.7%	11.4%	2.9%
White Perch	235	16	34	285	82.5%	5.6%	11.9%
White Sucker	3225	133	221	3579	90.1%	3.7%	6.2%
Whitefish hybrid	8			8	100.0%	0.0%	0.0%
Yellow Bullhead	4			4	100.0%	0.0%	0.0%
Yellow Perch	1891	131	250	2272	83.2%	5.8%	11.0%
Grand Total	**71292**	**2791**	**5893**	**79976**	**89.1%**	**3.5%**	**7.4%**

Table S7: Classification (equal, more restrictive and less restrictive) of the general population advisories from composite methods 2 and 6 compared to those from the regular method of analyzing individual samples broken down by fish size class.

Comp method 2 advisories compared to Regular									Comp method 6 advisories compared to Regular							
Size class	EQUAL	Less Res	More Res	Total	EQUAL	Less Res	More Res		Size class	EQUAL	Less Res	More Res	Total	EQUAL	Less Res	More Res
15-20cm	2789	73	232	3094	90.1%	2.4%	7.5%		15-20cm	2715	120	192	3027	89.7%	4.0%	6.3%
20-25cm	4477	140	496	5113	87.6%	2.7%	9.7%		20-25cm	4494	162	394	5050	89.0%	3.2%	7.8%
25-30cm	5691	185	626	6502	87.5%	2.8%	9.6%		25-30cm	5762	203	497	6462	89.2%	3.1%	7.7%
30-35cm	6677	225	826	7728	86.4%	2.9%	10.7%		30-35cm	6889	230	572	7691	89.6%	3.0%	7.4%
35-40cm	7371	303	958	8632	85.4%	3.5%	11.1%		35-40cm	7709	249	634	8592	89.7%	2.9%	7.4%
40-45cm	7756	336	1000	9092	85.3%	3.7%	11.0%		40-45cm	8109	271	694	9074	89.4%	3.0%	7.6%
45-50cm	7483	407	983	8873	84.3%	4.6%	11.1%		45-50cm	7864	313	676	8853	88.8%	3.5%	7.6%
50-55cm	6681	385	855	7921	84.3%	4.9%	10.8%		50-55cm	7026	278	596	7900	88.9%	3.5%	7.5%
55-60cm	5843	363	752	6958	84.0%	5.2%	10.8%		55-60cm	6245	250	457	6952	89.8%	3.6%	6.6%
60-65cm	4907	303	624	5834	84.1%	5.2%	10.7%		60-65cm	5206	205	415	5826	89.4%	3.5%	7.1%
65-70cm	3841	285	503	4629	83.0%	6.2%	10.9%		65-70cm	4108	182	333	4623	88.9%	3.9%	7.2%
70-75cm	2831	221	372	3424	82.7%	6.5%	10.9%		70-75cm	3011	164	244	3419	88.1%	4.8%	7.1%
>75cm	2007	239	284	2530	79.3%	9.4%	11.2%		>75cm	2154	164	189	2507	85.9%	6.5%	7.5%
Total	68354	3465	8511	80330	85.1%	4.3%	10.6%		Total	71292	2791	5893	79976	89.1%	3.5%	7.4%

Table S8: Classification (equal, more restrictive and less restrictive) of the general population advisories from composite methods 2 and 6 compared to those from the regular method of analyzing individual samples broken down by mercury concentration class (mean concentration - in µg/g ww - for a species-, location-, year-specific sampling event was classified into one of the mentioned classes).

Comp method 2 advisories compared to Regular									Comp method 6 advisories compared to Regular							
Conc class	EQUAL	Less Res	More Res	Total	EQUAL	Less Res	More Res		Conc class	EQUAL	Less Res	More Res	Total	EQUAL	Less Res	More Res
0-0.1	7789	106	168	8064	96.6%	1.3%	2.1%		0-0.1	7509	93	124	8081	92.9%	1.2%	1.5%
0.1-0.2	13208	616	1185	15009	88.0%	4.1%	7.9%		0.1-0.2	13442	493	908	14843	90.6%	3.3%	6.1%
0.2-0.3	10354	770	1540	12664	81.8%	6.1%	12.2%		0.2-0.3	10758	602	1021	12381	86.9%	4.9%	8.2%
0.3-0.5	15085	997	2628	18710	80.6%	5.3%	14.0%		0.3-0.5	15917	771	1900	18588	85.6%	4.1%	10.2%
0.5-0.75	11347	550	1668	13565	83.6%	4.1%	12.3%		0.5-0.75	11844	449	1031	13324	88.9%	3.4%	7.7%
0.75-1	5710	256	737	6703	85.2%	3.8%	11.0%		0.75-1	6300	229	508	7037	89.5%	3.3%	7.2%
1-1.5	3321	141	433	3895	85.3%	3.6%	11.1%		1-1.5	3764	125	296	4185	89.9%	3.0%	7.1%
1.5-2	757	14	94	865	87.5%	1.6%	10.9%		1.5-2	912	20	64	996	91.6%	2.0%	6.4%
2-3	599	12	53	664	90.2%	1.8%	8.0%		2-3	570	7	35	612	93.1%	1.1%	5.7%
3-5	136	3	5	144	94.4%	2.1%	3.5%		3-5	228	2	6	236	96.6%	0.8%	2.5%
5-10	41			41	100.0%	0.0%	0.0%		5-10	41			41	100.0%	0.0%	0.0%
10-20	7			7	100.0%	0.0%	0.0%		10-20	7			7	100.0%	0.0%	0.0%
Total	68354	3465	8511	80331	85.1%	4.3%	10.6%		Total	71292	2791	5893	80331	88.7%	3.5%	7.3%

Table S9a: Fish species- and size category-specific number of advisories and percentage of advisories from the composite method 2 that are less restrictive compared to those from the regular method. The cases where the number of advisories were >100 have been highlighted in bold; cases where >10% of the advisories were less restrictive have been highlighted in red; and cases where the number of total advisories were >100 and >10% of the advisories were less restrictive have been highlighted with a black border.

	# of advisories for each size category														% of advisories that are less restrictive compared to the regular method													
Species	15-20cm	20-25cm	25-30cm	30-35cm	35-40cm	40-45cm	45-50cm	50-55cm	55-60cm	60-65cm	65-70cm	70-75cm	>75cm	Total	15-20cm	20-25cm	25-30cm	30-35cm	35-40cm	40-45cm	45-50cm	50-55cm	55-60cm	60-65cm	65-70cm	70-75cm	>75cm	Total
Sturgeon				1	1	2	8	11	17	18	18	21	46	143				0%	0%	0%	13%	18%	12%	6%	6%	14%	13%	11%
Longnose Gar								1					3	4								0%					0%	0%
Bowfin			1	2	6	9	10	12	14	8	6	2		70			0%	0%	17%	11%	20%	8%	7%	25%	17%	0%		13%
Alewife	7	3												10	0%	0%												0%
Gizzard Shad	4	8	11	17	17	10	4							71	0%	0%	0%	0%	0%	10%	0%							1%
Pink Salmon				8	22	25	24	19	9					107				0%	0%	0%	0%	0%	0%					0%
Coho Salmon		2	8	20	45	58	70	82	88	86	79	65	48	651		0%	0%	0%	0%	3%	1%	5%	3%	3%	0%	2%	6%	3%
Chinook Salmon	2	3	11	20	50	69	79	89	129	132	141	146	162	1033	0%	0%	0%	0%	0%	0%	0%	1%	2%	2%	3%	3%	8%	3%
Rainbow Trout	5	16	21	66	115	170	195	206	220	211	188	152	104	1669	0%	0%	0%	0%	1%	1%	2%	2%	2%	3%	5%	4%	17%	3%
Atlantic Salmon							2	3	3	3	1	1	1	14							0%	33%	33%	0%	0%	0%	0%	14%
Brown Trout	12	33	42	55	67	81	104	115	112	97	70	35	11	834	0%	3%	0%	4%	4%	6%	3%	1%	1%	2%	7%	3%	27%	3%
Brook Trout	80	128	164	172	161	117	59	24	3					908	4%	3%	4%	2%	7%	5%	2%	8%	0%					4%
Lake Trout	90	207	401	602	755	896	1005	1046	1050	972	786	563	372	8745	0%	2%	2%	3%	3%	3%	4%	3%	5%	4%	6%	7%	8%	4%
Splake	2	8	11	17	21	23	24	20	17	11	7	4	3	168	0%	0%	0%	0%	0%	9%	4%	5%	0%	0%	0%	0%	0%	2%
Siscowet		1	2	2	2	4	4	4	4	4	4	3	3	37		0%	0%	0%	0%	0%	0%	0%	0%	25%	25%	0%	33%	8%
Humper (Banker) Lake Trout		1	2	2	2	2	2	2	2	2				17		0%	0%	0%	0%	0%	0%	0%	0%	0%				0%
Lake Whitefish	24	82	194	326	461	566	608	506	321	138	51	11	3	3291	0%	2%	3%	2%	2%	2%	4%	4%	3%	6%	6%	0%	0%	3%
Cisco(Lake Herring)	66	122	152	171	149	93	30	10	2					795	3%	2%	5%	5%	5%	12%	7%	0%	50%					5%
Bloater	3	22	27	20	9	1								82	0%	0%	4%	0%	22%	0%								4%
Blackfin Cisco			1	1	1	1								4			0%	0%	0%	0%								0%
Round Whitefish	1	3	8	25	34	34	23	6	1					135	0%	0%	0%	0%	3%	0%	0%	0%	0%					1%
Chub (not C. artedii)	6	12	13	5	2	1								39	0%	0%	0%	0%	0%	0%								0%
Rainbow Smelt	18	8	1											27	6%	13%	0%											7%
Northern Pike	37	68	182	469	888	1431	1914	2190	2268	2152	1921	1611	1325	16456	0%	0%	1%	2%	3%	4%	5%	5%	6%	5%	7%	7%	10%	6%
Muskellunge			2	3	3	6	7	9	9	12	16	14	31	112			0%	0%	0%	0%	14%	0%	0%	0%	6%	0%	3%	3%
Goldeye		3	5	10	8	2								28		0%	20%	10%	25%	0%								14%
Mooneye		6	12	20	20	3	1	1	1					64		0%	8%	10%	0%	0%	0%	0%	0%					5%
Sucker Family						1	1							2						0%	0%							0%
Quillback Carpsucker	2	2	3	3	4	6	6	6	4					36	0%	0%	0%	0%	0%	0%	0%	0%	25%					3%
Longnose Sucker		14	28	56	81	92	70	26	3	1				371		0%	0%	0%	1%	4%	9%	19%	67%	100%				5%
White Sucker	70	229	379	538	664	712	595	323	77	9				3596	0%	0%	1%	1%	2%	4%	5%	9%	17%	22%				4%
Northern Hog Sucker			1	1										2			0%	0%										0%
Bigmouth Buffalo					1	1	1		1	1	1			6					0%	0%	0%		0%	0%	0%			0%
Spotted Sucker					2	2	1							5					0%	0%	0%							0%
Silver Redhorse	1	2	4	4	5	5	5	3	2					31	0%	0%	0%	0%	0%	0%	0%	0%	0%					0%
Golden Redhorse Sucker			1	2	3	1								7			0%	0%	0%	0%								0%
Shorthead Redhorse	3	4	8	12	15	15	11	3	2					73	0%	0%	0%	0%	0%	13%	18%	0%	0%					5%
Greater Redhorse					1	2	3	2	1					9					0%	50%	0%	0%	0%					11%
River Redhorse								1	1					2								0%	0%					0%
Redhorse Sucker		6	20	37	53	63	59	44	23	10	6	2		323		17%	10%	8%	6%	8%	7%	7%	0%	10%	0%	0%		7%
Goldfish	1	3	2	2	2				2					12	0%	0%	0%	0%	0%				0%					0%
Lake Chub	1	1	1	1										4	0%	0%	0%	0%										0%
Common Carp	6	19	47	94	149	211	302	366	392	390	361	288	219	2844	0%	0%	2%	2%	5%	4%	7%	6%	5%	8%	9%	7%	9%	6%
Creek Chub	2	1	1											4	0%	0%	0%											0%
Yellow Bullhead		1	3											4		0%	0%											0%
Brown Bullhead	107	356	425	304	101	4								1297	2%	1%	2%	5%	10%	0%								3%
Channel Catfish	6	19	53	86	118	147	155	149	133	106	77	46	24	1119	0%	5%	6%	3%	2%	5%	2%	4%	5%	4%	6%	7%	0%	4%
Catfish species (not I. punctatus)			1	1										2			0%	0%										0%
American Eel		1	1	1	2	2	4	11	13	16	26	28	29	134		0%	0%	0%	0%	0%	25%	18%	15%	6%	8%	11%	14%	11%
Ling (Burbot)	4	13	31	60	96	127	139	146	134	106	69	36	24	985	25%	0%	3%	8%	5%	6%	9%	6%	8%	14%	16%	19%	17%	9%
White Perch	77	113	80	21	1									292	1%	4%	8%	14%	0%									5%
White Bass	20	97	165	188	129	16								615	0%	3%	2%	4%	12%	0%								5%
Rock Bass	412	313	83	1										809	2%	9%	12%	0%										6%
Pumpkinseed	261	81	1											343	3%	5%	100%											4%
Bluegill	170	73	1											244	4%	4%	0%											4%
Smallmouth Bass	350	842	1159	1295	1236	1011	515	88	6					6502	3%	1%	3%	2%	3%	3%	5%	7%	17%					3%
Largemouth Bass	126	334	459	482	420	295	125	13	1					2255	1%	1%	1%	2%	4%	4%	4%	0%	0%					3%
White Crappie	16	23	18	10	4									71	6%	9%	6%	20%	25%									10%
Black Crappie	147	211	165	68	8									599	2%	2%	2%	9%	0%									3%
Yellow Perch	708	821	569	187	18									2303	3%	5%	7%	10%	22%									5%
Sauger	13	70	103	118	85	24	6	1	1	1				422	0%	3%	4%	6%	8%	8%	33%	100%	0%	100%				6%
Walleye	221	692	1344	1997	2462	2630	2601	2311	1854	1336	797	394	121	18760	1%	1%	2%	2%	3%	3%	4%	5%	5%	5%	4%	5%	5%	4%
Freshwater Drum	13	36	75	124	132	119	99	71	36	11	4	2	1	723	0%	6%	3%	5%	11%	9%	13%	10%	19%	27%	0%	0%	100%	9%
Salmon Hybrid									1	1	1			3									0%	0%	100%			33%
Whitefish hybrid				1	1	2	2	1	1					8				0%	0%	0%	0%	0%	0%					0%
Total	3094	5113	6502	7728	8632	9092	8873	7921	6958	5834	4630	3424	2530	80331	2%	3%	3%	3%	4%	4%	5%	5%	5%	5%	6%	6%	9%	4%

Table S9b: Fish species- and size category-specific number of advisories, and percentage of advisories from the composite method 6 that are less restrictive compared to those from the regular method. The cases where the number of advisories were >100 have been highlighted in bold; cases where >10% of the advisories were less restrictive have been highlighted in red; and cases where the number of total advisories were >100 and >10% of the advisories were less restrictive have been highlighted with a black border.

	# of advisories for each size category														% of advisories that are less restrictive compared to the regular method													
Species	**15-20cm**	**20-25cm**	**25-30cm**	**30-35cm**	**35-40cm**	**40-45cm**	**45-50cm**	**50-55cm**	**55-60cm**	**60-65cm**	**65-70cm**	**70-75cm**	**>75cm**	**Total**	**15-20cm**	**20-25cm**	**25-30cm**	**30-35cm**	**35-40cm**	**40-45cm**	**45-50cm**	**50-55cm**	**55-60cm**	**60-65cm**	**65-70cm**	**70-75cm**	**>75cm**	**Total**
Sturgeon				1	1	2	8	11	17	18	18	21	46	143				0%	0%	0%	0%	9%	12%	11%	11%	19%	15%	13%
Longnose Gar								1					3	4								100%					0%	25%
Bowfin			1	2	6	9	10	12	14	8	6	2		70			0%	0%	17%	11%	10%	8%	7%	13%	17%	0%		10%
Alewife	7	3												10	0%	0%												0%
Gizzard Shad	4	8	11	17	17	10	4							71	0%	0%	0%	0%	0%	10%	0%							1%
Pink Salmon				8	22	25	24	19	9					107				0%	0%	0%	0%	0%	0%					0%
Coho Salmon		2	8	20	45	58	70	82	88	86	79	65	48	651		0%	0%	0%	0%	2%	0%	2%	1%	2%	0%	2%	4%	1%
Chinook Salmon	2	3	11	20	50	69	79	89	**129**	**132**	**141**	**146**	**162**	1033	0%	0%	0%	0%	0%	0%	0%	0%	**2%**	**1%**	**2%**	**1%**	**6%**	2%
Rainbow Trout	5	16	21	66	**115**	**170**	**195**	**206**	**220**	**211**	**188**	**152**	**104**	1669	0%	0%	0%	0%	**2%**	**1%**	**3%**	**2%**	**1%**	**2%**	**4%**	**4%**	**11%**	3%
Atlantic Salmon							2	3	3	3	1	1	1	14							0%	33%	0%	0%	0%	0%	0%	7%
Brown Trout	12	33	42	55	67	81	**104**	**115**	**112**	97	70	35	11	834	0%	0%	0%	2%	1%	4%	**5%**	**0%**	**3%**	2%	4%	3%	18%	3%
Brook Trout	80	**128**	**164**	**172**	**161**	**117**	59	24	3					908	5%	**1%**	**3%**	**2%**	**7%**	**4%**	3%	0%	0%					4%
Lake Trout	90	**207**	**401**	**602**	**755**	**896**	**1005**	**1046**	**1050**	**972**	**786**	**563**	**372**	8745	0%	**2%**	**1%**	**3%**	**2%**	**2%**	**2%**	**4%**	**3%**	**3%**	**4%**	**5%**	**5%**	3%
Splake	2	8	11	17	21	23	24	20	17	11	7	4	3	168	0%	0%	0%	0%	0%	4%	0%	0%	0%	9%	0%	0%	33%	2%
Siscowet		1	2	2	2	4	4	4	4	4	4	3	3	37		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Humper (Banker) Lake Trout		1	2	2	2	2	2	2	2	2				17		0%	0%	0%	0%	0%	0%	0%	0%	0%				0%
Lake Whitefish	24	82	**194**	**326**	**461**	**566**	**608**	**506**	**321**	**138**	51	11	3	3291	0%	4%	**3%**	**3%**	**2%**	**2%**	**4%**	**5%**	**3%**	**7%**	4%	0%	0%	3%
Cisco(Lake Herring)	66	**122**	**152**	**171**	**149**	93	30	10	2					795	3%	**4%**	**4%**	**7%**	**5%**	12%	7%	10%	50%					6%
Bloater	3	22	27	20	9	1								82	0%	0%	7%	10%	22%	0%								7%
Blackfin Cisco			1	1	1	1								4			0%	0%	0%	0%								0%
Round Whitefish	1	3	8	25	34	34	23	6	1					135	0%	0%	0%	4%	0%	0%	0%	0%	0%					1%
Chub (not C. artedii)	6	12	13	5	2	1								39	0%	0%	0%	0%	0%	0%								0%
Rainbow Smelt	18	8	1											27	6%	25%	0%											11%
Northern Pike	37	68	**182**	**469**	**888**	**1431**	**1914**	**2190**	**2268**	**2152**	**1921**	**1611**	**1325**	16456	3%	0%	**2%**	**2%**	**2%**	**2%**	**3%**	**3%**	**3%**	**3%**	**3%**	**5%**	**6%**	3%
Muskellunge			2	3	3	6	7	9	9	12	16	14	31	112			0%	0%	0%	0%	14%	0%	0%	0%	0%	14%	6%	4%
Goldeye		3	5	10	8	2								28		0%	20%	10%	13%	0%								11%
Mooneye		6	12	20	20	3	1	1	1					64		0%	0%	0%	15%	0%	0%	0%	0%					5%
Sucker Family						1	1							2						0%	0%							0%
Quillback Carpsucker	2	2	3	3	4	6	6	6	4					36	0%	0%	0%	0%	0%	17%	50%	0%	0%					11%
Longnose Sucker		14	28	56	81	92	70	26	3	1				371		0%	0%	2%	0%	3%	9%	12%	0%	0%				4%
White Sucker	70	**229**	**379**	**538**	**664**	**712**	**595**	**323**	77	9				3596	1%	**0%**	**2%**	**2%**	**2%**	**4%**	**6%**	**9%**	10%	22%				4%
Northern Hog Sucker			1	1										2			0%	0%										0%
Bigmouth Buffalo					1	1	1		1	1	1			6					0%	0%	0%		0%	0%	0%			0%
Spotted Sucker					2	2	1							5					50%	0%	0%							20%
Silver Redhorse	1	2	4	4	5	5	5	3	2					31	0%	0%	0%	0%	0%	0%	20%	0%	0%					3%
Golden Redhorse Sucker			1	2	3	1								7			0%	0%	0%	0%								0%
Shorthead Redhorse	3	4	8	12	15	15	11	3	2					73	0%	0%	0%	8%	0%	7%	0%	0%	0%					3%
Greater Redhorse					1	2	3	2	1					9					0%	50%	0%	0%	100%					22%
River Redhorse								1	1					2								0%	0%					0%
Redhorse Sucker		6	20	37	53	63	59	44	23	10	6	2		323		17%	10%	8%	8%	14%	14%	18%	9%	10%	33%	0%		12%
Goldfish	1	3	2	2	2				2					12	0%	0%	0%	0%	0%				0%					0%
Lake Chub	1	1	1	1										4	0%	0%	0%	0%										0%
Common Carp	6	19	47	94	**149**	**211**	**302**	**366**	**392**	**390**	**361**	**288**	**219**	2844	0%	0%	2%	1%	**4%**	**4%**	**4%**	**3%**	**3%**	**5%**	**6%**	**6%**	**9%**	4%
Creek Chub	2	1	1											4	50%	100%	0%											50%
Yellow Bullhead		1	3											4		0%	0%											0%
Brown Bullhead	**107**	**356**	**425**	**304**	**101**	4								1297	**2%**	**2%**	**4%**	**5%**	**10%**	0%								4%
Channel Catfish	6	19	53	86	**118**	**147**	**155**	**149**	**133**	**106**	77	46	24	1119	0%	5%	2%	2%	**3%**	**4%**	**3%**	**3%**	**5%**	**7%**	8%	11%	8%	4%
Catfish species (not I. punctatus)			1	1										2			0%	0%										0%
American Eel		1	1	1	2	2	4	11	13	16	26	28	29	134		0%	0%	0%	0%	0%	0%	9%	0%	6%	4%	7%	7%	5%
Ling (Burbot)	4	13	31	60	96	**127**	**139**	**146**	**134**	**106**	69	36	24	985	0%	0%	3%	3%	4%	**5%**	**4%**	**4%**	**7%**	**6%**	9%	17%	13%	5%
White Perch	77	**113**	80	21	1									292	1%	**5%**	8%	14%	0%									5%
White Bass	20	97	**165**	**188**	**129**	16								615	0%	2%	**2%**	**4%**	**10%**	19%								5%
Rock Bass	**412**	**313**	83	1										809	**6%**	**9%**	11%	0%										7%
Pumpkinseed	**261**	81	1											343	**9%**	9%	100%											9%
Bluegill	**170**	73	1											244	**8%**	10%	0%											9%
Smallmouth Bass	**350**	**842**	**1159**	**1295**	**1236**	**1011**	**515**	88	6					6502	**4%**	**2%**	**2%**	**2%**	**3%**	**2%**	**4%**	6%	0%					3%
Largemouth Bass	**126**	**334**	**459**	**482**	**420**	**295**	**125**	13	1					2255	**1%**	**1%**	**2%**	**2%**	**4%**	**5%**	**2%**	0%	0%					3%
White Crappie	16	23	18	10	4									71	6%	9%	11%	20%	25%									11%
Black Crappie	**147**	**211**	**165**	68	8									599	**1%**	**3%**	**5%**	9%	0%									4%
Yellow Perch	**708**	**821**	**569**	**187**	18									2303	**4%**	**5%**	**7%**	**11%**	22%									6%
Sauger	13	70	**103**	**118**	85	24	6	1	1	1				422	0%	1%	**4%**	**6%**	13%	4%	33%	0%	0%	100%				6%
Walleye	**221**	**692**	**1344**	**1997**	**2462**	**2630**	**2601**	**2311**	**1854**	**1336**	**797**	**394**	**121**	18760	**2%**	**2%**	**3%**	**3%**	**2%**	**3%**	**3%**	**3%**	**5%**	**3%**	**3%**	**5%**	**4%**	3%
Freshwater Drum	13	36	75	**124**	**132**	**119**	99	71	36	11	4	2	1	723	0%	3%	4%	**3%**	**5%**	**6%**	6%	10%	14%	27%	25%	0%	100%	6%
Salmon Hybrid									1	1	1			3									0%	0%	0%			0%
Whitefish hybrid				1	1	2	2	1	1					8				0%	0%	0%	0%	0%	0%					0%
Total	**3094**	**5113**	**6502**	**7728**	**8632**	**9092**	**8873**	**7921**	**6958**	**5834**	**4630**	**3424**	**2530**	**80331**	**4%**	**3%**	**3%**	**3%**	**3%**	**3%**	**4%**	**4%**	**4%**	**4%**	**4%**	**5%**	**6%**	**3%**

Table S10a: Fish species- and conc (ug/g) category-specific number of advisories and percentage of advisories from the composite method 2 that are less restrictive compared to those from the regular method. The cases where the number of advisories were >100 have been highlighted in bold; cases where >10% of the advisories were less restrictive have been highlighted in red; and cases where the number of total advisories were >100 and >10% of the advisories were less restrictive have been highlighted with a black border.

	# of advisories for each conc category													% of advisories that are less restrictive compared to the regular method												
Species	**0-0.1**	**0.1-0.2**	**0.2-0.3**	**0.3-0.5**	**0.5-0.75**	**0.75-1**	**1-1.5**	**1.5-2**	**2-3**	**3-5**	**5-10**	**10-20**	**Total**	**0-0.1**	**0.1-0.2**	**0.2-0.3**	**0.3-0.5**	**0.5-0.75**	**0.75-1**	**1-1.5**	**1.5-2**	**2-3**	**3-5**	**5-10**	**10-20**	**Total**
Sturgeon	2	47	29	41	15	4	3	2					143	0%	13%	24%	2%	7%	0%	33%	0%					11%
Longnose Gar				1	1	1		1					4				0%	0%	0%		0%					0%
Bowfin		18	22	11	15	4							70		11%	27%	9%	0%	0%							13%
Alewife	9	1											10	0%	0%											0%
Gizzard Shad	65	4	2										71	2%	0%	0%										1%
Pink Salmon	104	3											107	0%	0%											0%
Coho Salmon	212	317	103	19									651	0%	4%	2%	0%									3%
Chinook Salmon	137	472	356	68									1033	1%	3%	2%	4%									3%
Rainbow Trout	400	985	236	47	1								1669	1%	3%	9%	0%	0%								3%
Atlantic Salmon	4	10											14	0%	20%											14%
Brown Trout	162	441	192	39									834	2%	3%	4%	5%									3%
Brook Trout	77	310	235	194	73	14	5						908	3%	3%	8%	5%	1%	7%	0%						4%
Lake Trout	504	1764	1484	2223	1421	766	419	81	61	22			8745	1%	3%	5%	5%	4%	5%	5%	0%	0%	9%			4%
Splake	39	95	23	8	2		1						168	3%	2%	0%	13%	0%		0%						2%
Siscowet				20	17								37				5%	12%								8%
Humper (Banker) Lake Trout			8		9								17			0%		0%								0%
Lake Whitefish	1432	1091	460	165	94	32	3	14					3291	1%	4%	8%	4%	1%	3%	67%	0%					3%
Cisco(Lake Herring)	169	297	189	95	35	7	2		1				795	1%	6%	7%	8%	3%	0%	0%		0%				5%
Bloater	63	7	12										82	3%	14%	0%										4%
Blackfin Cisco			4										4			0%										0%
Round Whitefish	105	16	12	2									135	0%	6%	0%	0%									1%
Chub (not C. artedii)	19	16	3	1									39	0%	0%	0%	0%									0%
Rainbow Smelt	9	11	1	6									27	0%	18%	0%	0%									7%
Northern Pike	211	1021	2116	4736	4269	2043	1341	322	310	81	6		16456	2%	5%	7%	8%	6%	4%	3%	1%	3%	1%	0%		6%
Muskellunge	1		12	62	8	13	8	1	4	2	1		112	0%		0%	5%	0%	0%	0%	0%	0%	0%	0%		3%
Goldeye		9	4	15									28		22%	25%	7%									14%
Mooneye	6	6	15	11	10	10	6						64	0%	0%	0%	0%	20%	10%	0%						5%
Sucker Family	2												2	0%												0%
Quillback Carpsucker			3	15	18								36			0%	7%	0%								3%
Longnose Sucker	77	111	88	49	21	17	8						371	1%	8%	5%	8%	5%	0%	0%						5%
White Sucker	1195	1406	495	343	97	43	17						3596	1%	4%	7%	6%	7%	5%	0%						4%
Northern Hog Sucker	1		1										2	0%		0%										0%
Bigmouth Buffalo	3	3											6	0%	0%											0%
Spotted Sucker	4	1											5	0%	0%											0%
Silver Redhorse		17	7	7									31		0%	0%	0%									0%
Golden Redhorse Sucker		7											7		0%											0%
Shorthead Redhorse		41	29	3									73		2%	7%	33%									5%
Greater Redhorse			5	4									9			0%	25%									11%
River Redhorse				2									2				0%									0%
Redhorse Sucker	21	77	108	59	37	6	4	9		2			323	5%	4%	13%	2%	5%	17%	0%	0%		0%			7%
Goldfish	11			1									12	0%			0%									0%
Lake Chub		2		2									4		0%		0%									0%
Common Carp	626	1163	662	312	64	17							2844	2%	6%	10%	10%	9%	0%							6%
Creek Chub		2		2									4		0%		0%									0%
Yellow Bullhead		2	2										4		0%	0%										0%
Brown Bullhead	688	462	96	36	7	8							1297	1%	5%	4%	3%	0%	0%							3%
Channel Catfish	104	281	230	333	125	26	20						1119	0%	4%	3%	5%	3%	8%	0%						4%
Catfish species (not I. punctatus)	2												2	0%												0%
American Eel	17	17	36	61		3							134	0%	0%	17%	15%		0%							11%
Ling (Burbot)	4	124	145	385	157	99	56	15					985	0%	5%	19%	9%	11%	3%	2%	7%					9%
White Perch	94	128	40	19	9		2						292	3%	5%	8%	16%	0%		0%						5%
White Bass	60	258	141	119	22	15							615	5%	5%	8%	3%	0%	0%							5%
Rock Bass	39	317	213	178	31	22	8	1					809	3%	5%	9%	6%	3%	0%	0%	0%					6%
Pumpkinseed	163	118	43	11	7		1						343	2%	6%	7%	0%	0%		0%						4%
Bluegill	151	73	14	3	3								244	5%	3%	0%	0%	33%								4%
Smallmouth Bass	96	686	1316	2316	1384	525	149	13	16	1			6502	2%	5%	3%	2%	2%	3%	5%	0%	0%	0%			3%
Largemouth Bass	70	442	531	819	327	47	19						2255	0%	2%	4%	3%	1%	2%	5%						3%
White Crappie	26	29	9	3	4								71	0%	0%	22%	100%	50%								10%
Black Crappie	230	200	95	50	23			1					599	1%	4%	3%	8%	4%			0%					3%
Yellow Perch	440	999	466	293	67	20	18						2303	2%	5%	8%	8%	6%	0%	6%						5%
Sauger		17	57	87	121	57	32	13	37	1			422		0%	14%	3%	8%	7%	0%	8%	0%	0%			6%
Walleye	166	879	2189	5180	4980	2891	1773	391	235	35	34	7	18760	0%	2%	5%	4%	3%	4%	4%	2%	1%	0%	0%	0%	4%
Freshwater Drum	44	199	125	254	87	13		1					723	9%	6%	11%	11%	8%	0%		0%					9%
Salmon Hybrid		3											3		33%											33%
Whitefish hybrid		4			4								8		0%			0%								0%
Total	**8064**	**15009**	**12664**	**18710**	**13565**	**6703**	**3895**	**865**	**664**	**144**	**41**	**7**	**80331**	**1%**	**4%**	**6%**	**5%**	**4%**	**4%**	**4%**	**2%**	**2%**	**2%**	**0%**	**0%**	**4%**

Table S10b: Fish species- and conc (ug/g) category-specific number of advisories, and percentage of advisories from the composite method 6 that are less restrictive compared to those from the regular method. The cases where the number of advisories were >100 have been highlighted in bold; cases where >10% of the advisories were less restrictive have been highlighted in red; and cases where the number of total advisories were >100 and >10% of the advisories were less restrictive have been highlighted with a black border.

	# of advisories for each conc category												
Species	0-0.1	0.1-0.2	0.2-0.3	0.3-0.5	0.5-0.75	0.75-1	1-1.5	1.5-2	2-3	3-5	5-10	10-20	Total
Sturgeon	2	46	30	43	11	7	2	1	1				143
Longnose Gar				1	1	1		1					4
Bowfin		12	28	16	10	4							70
Alewife	9	1											10
Gizzard Shad	65	4	2										71
Pink Salmon	100	7											107
Coho Salmon	192	331	109	19									651
Chinook Salmon	107	511	351	64									1033
Rainbow Trout	360	1022	229	57	1								1669
Atlantic Salmon	4	10											14
Brown Trout	154	451	183	46									834
Brook Trout	66	326	206	219	72	19							908
Lake Trout	472	1706	1594	2204	1445	691	470	80	61	22			8745
Splake	34	99	24	8	2		1						168
Siscowet				12	25								37
Humper (Banker) Lake Trout			8	9									17
Lake Whitefish	1415	1116	433	181	92	29	15	10					3291
Cisco(Lake Herring)	192	297	150	113	33	7	2	1					795
Bloater	58	12	12										82
Blackfin Cisco			4										4
Round Whitefish	105	13	15	1	1								135
Chub (not C. artedii)	22	13	3	1									39
Rainbow Smelt	9	11	1	6									27
Northern Pike	234	989	1880	4763	4199	2182	1427	380	244	152	6		16456
Muskellunge	1		31	43	12	9	8	1	1	5	1		112
Goldeye		9	2	14	3								28
Mooneye	7	5	14	12	10	10	6						64
Sucker Family	2												2
Quillback Carpsucker			7	29									36
Longnose Sucker	86	107	89	46	18	12	13						371
White Sucker	1247	1349	540	298	107	43	12						3596
Northern Hog Sucker	1		1										2
Bigmouth Buffalo	3	3											6
Spotted Sucker	4	1											5
Silver Redhorse	1	16	7	7									31
Golden Redhorse Sucker		7											7
Shorthead Redhorse	1	53	14	5									73
Greater Redhorse			1	8									9
River Redhorse				2									2
Redhorse Sucker	26	85	83	67	41	6		13		2			323
Goldfish	11			1									12
Lake Chub		2		2									4
Common Carp	621	1124	730	301	51	17							2844
Creek Chub		2		2									4
Yellow Bullhead		2	2										4
Brown Bullhead	681	453	113	33	7	10							1297
Channel Catfish	90	294	230	324	130	49	2						1119
Catfish species (not I. punctatus)	2												2
American Eel	17	17	36	61		3							134
Ling (Burbot)	1	105	179	324	186	115	53	22					985
White Perch	102	110	42	29	4	3	2						292
White Bass	66	236	173	98	24	15	3						615
Rock Bass	45	298	189	210	40	20	6	1					809
Pumpkinseed	164	126	27	18	6	1	1						343
Bluegill	147	80	9	5	3								244
Smallmouth Bass	121	660	1342	2324	1414	443	161	22	14	1			6502
Largemouth Bass	96	409	520	789	345	77	19						2255
White Crappie	26	29	9	3	4								71
Black Crappie	239	191	92	51	25			1					599
Yellow Perch	421	965	475	320	81	18	16	7					2303
Sauger	2	20	49	97	109	65	22	20	37	1			422
Walleye	216	904	1964	5087	4692	3170	1944	435	254	53	34	7	18760
Freshwater Drum	34	197	149	215	120	7		1					723
Salmon Hybrid		3											3
Whitefish hybrid		4				4							8
Total	8081	14843	12381	18588	13324	7037	4185	996	612	236	41	7	80331

	% of advisories that are less restrictive compared to the regular method												
Species	0-0.1	0.1-0.2	0.2-0.3	0.3-0.5	0.5-0.75	0.75-1	1-1.5	1.5-2	2-3	3-5	5-10	10-20	Total
Sturgeon	0%	13%	33%	0%	9%	14%	0%	0%	0%				13%
Longnose Gar				100%	0%	0%		0%					25%
Bowfin		0%	25%	0%	0%	0%							10%
Alewife	0%	0%											0%
Gizzard Shad	2%	0%	0%										1%
Pink Salmon	0%	0%											0%
Coho Salmon	0%	2%	2%	0%									1%
Chinook Salmon	0%	2%	2%	3%									2%
Rainbow Trout	1%	2%	8%	2%	0%								3%
Atlantic Salmon	0%	10%											7%
Brown Trout	1%	3%	2%	4%									3%
Brook Trout	2%	1%	9%	4%	1%	0%							4%
Lake Trout	0%	2%	3%	4%	4%	3%	4%	4%	0%	0%			3%
Splake	0%	2%	0%	0%	0%		100%						2%
Siscowet				0%	0%								0%
Humper (Banker) Lake Trout			0%	0%									0%
Lake Whitefish	1%	4%	11%	2%	3%	0%	13%	0%					3%
Cisco(Lake Herring)	2%	6%	11%	8%	9%	0%	0%	0%					6%
Bloater	3%	8%	25%										7%
Blackfin Cisco			0%										0%
Round Whitefish	0%	0%	0%	100%	0%								1%
Chub (not C. artedii)	0%	0%	0%	0%									0%
Rainbow Smelt	0%	27%	0%	0%									11%
Northern Pike	0%	3%	4%	4%	4%	3%	2%	2%	2%	1%	0%		3%
Muskellunge	0%		3%	5%	8%	11%	0%	0%	0%	0%	0%		4%
Goldeye		11%	0%	14%	0%								11%
Mooneye	0%	0%	7%	8%	10%	0%	0%						5%
Sucker Family	0%												0%
Quillback Carpsucker			0%	14%									11%
Longnose Sucker	0%	7%	6%	2%	0%	0%	0%						4%
White Sucker	1%	3%	7%	8%	4%	12%	0%						4%
Northern Hog Sucker	0%		0%										0%
Bigmouth Buffalo	0%	0%											0%
Spotted Sucker	0%	100%											20%
Silver Redhorse	0%	6%	0%	0%									3%
Golden Redhorse Sucker		0%											0%
Shorthead Redhorse	0%	4%	0%	0%									3%
Greater Redhorse			0%	25%									22%
River Redhorse				0%									0%
Redhorse Sucker	4%	7%	16%	27%	5%	0%		0%		0%			12%
Goldfish	0%			0%									0%
Lake Chub		0%		0%									0%
Common Carp	1%	4%	6%	9%	18%	6%							4%
Creek Chub		0%		100%									50%
Yellow Bullhead		0%	0%										0%
Brown Bullhead	1%	5%	7%	21%	29%	0%							4%
Channel Catfish	0%	5%	3%	6%	5%	0%	0%						4%
Catfish species (not I. punctatus)	0%												0%
American Eel	0%	0%	14%	3%		0%							5%
Ling (Burbot)	0%	0%	9%	7%	4%	3%	6%	5%					5%
White Perch	0%	5%	14%	14%	0%	0%	0%						5%
White Bass	2%	3%	8%	5%	13%	7%	0%						5%
Rock Bass	9%	7%	10%	5%	13%	0%	17%	0%					7%
Pumpkinseed	6%	12%	19%	0%	17%	0%	0%						9%
Bluegill	7%	11%	22%	0%	0%								9%
Smallmouth Bass	1%	2%	2%	3%	2%	4%	5%	0%	0%	0%			3%
Largemouth Bass	0%	2%	3%	3%	2%	1%	0%						3%
White Crappie	0%	3%	22%	100%	50%								11%
Black Crappie	0%	5%	7%	12%	0%			0%					4%
Yellow Perch	3%	5%	9%	7%	6%	6%	0%	0%					6%
Sauger	0%	0%	10%	4%	8%	9%	14%	0%	0%	0%			6%
Walleye	0%	1%	3%	4%	3%	3%	3%	2%	0%	2%	0%	0%	3%
Freshwater Drum	0%	4%	7%	8%	8%	0%		0%					6%
Salmon Hybrid		0%											0%
Whitefish hybrid		0%				0%							0%
Total	1%	3%	5%	4%	3%	3%	3%	2%	1%	1%	0%	0%	3%

Table S11: Frequency distribution of the relative size (in percentage, %) of the smallest fish compared to the largest individual fish in the (total 30833) composites (of 5 individuals) derived using the composite method 2. *For example, if the smallest and largest sized fish in a composite of 5 individuals were of 79 and 100 cm, respectively, the relative size of the smallest fish would be 79% (i.e., 79/100) and would fall under the 75-80% bin in the following table*.

%	Frequency	Cumulative %
0-5	0	0%
5-10	0	0%
10-15	0	0%
15-20	0	0%
20-25	0	0%
25-30	0	0%
30-35	2	0%
35-40	8	0%
40-45	18	0%
45-50	41	0%
50-55	60	0%
55-60	152	1%
60-65	283	2%
65-70	519	4%
70-75	988	7%
75-80	1765	12%
80-85	3135	23%
85-90	5608	41%
90-95	9790	73%
95-100	8464	100%
Total	**30833**	

Table S12: Breakdown by species of total number of composites (of 5 individual fish) derived using the composite method 2, and number and percentage of those composite that met the 75% rule (i.e., the length of the smallest fish in a composite should be at least 75% of the length of the largest fish).

Species	# of composites	Composites met 75% rule	% met 75% rule
Alewife	3	3	100
American Eel	55	55	100
Atlantic Salmon	3	2	67
Bigmouth Buffalo	1	1	100
Black Crappie	323	314	97
Blackfin Cisco	3	3	100
Bloater	88	88	100
Bluegill	208	208	100
Bowfin	17	15	88
Brook Trout	352	314	89
Brown Bullhead	686	671	98
Brown Trout	213	189	89
Catfish species	2	2	100
Channel Catfish	383	369	96
Chinook Salmon	359	325	91
Chub	44	44	100
Cisco(Lake Herring)	522	498	95
Coho Salmon	219	204	93
Common Carp	726	687	95
Freshwater Drum	272	257	94
Gizzard Shad	28	27	96
Goldeye	16	16	100
Goldfish	3	3	100
Greater Redhorse	8	8	100
Humper (Banker) Lake Trout	17	17	100
Lake Chub	1	1	100
Lake Trout	2893	2636	91
Lake Whitefish	1632	1599	98
Largemouth Bass	649	539	83
Ling (Burbot)	267	251	94
Longnose Sucker	177	173	98
Mooneye	36	35	97

Table S12: Continued….

Species	**# of composites**	**Composites met 75% rule**	**% met 75% rule**
Muskellunge	6	5	83
Northern Pike	4457	4104	92
Pink Salmon	76	76	100
Pumpkinseed	328	324	99
Quillback Carpsucker	21	20	95
Rainbow Smelt	17	17	100
Rainbow Trout	432	396	92
Redhorse Sucker	74	71	96
Rock Bass	583	568	97
Round Whitefish	68	68	100
Salmon Hybrid	1	1	100
Sauger	240	230	96
Shorthead Redhorse	12	12	100
Silver Redhorse	5	5	100
Siscowet	28	25	89
Smallmouth Bass	2267	2008	89
Splake	57	51	89
Sturgeon	72	66	92
Sucker Family	3	3	100
Walleye	7571	6996	92
White Bass	558	552	99
White Crappie	28	24	86
White Perch	213	209	98
White Sucker	1666	1601	96
Whitefish hybrid	1	1	100
Yellow Perch	1843	1772	96
Total	**30833**	**28759**	**93**

Figure S1: Map of **s**ampling locations for the OMOECC fish mercury dataset used in this study.

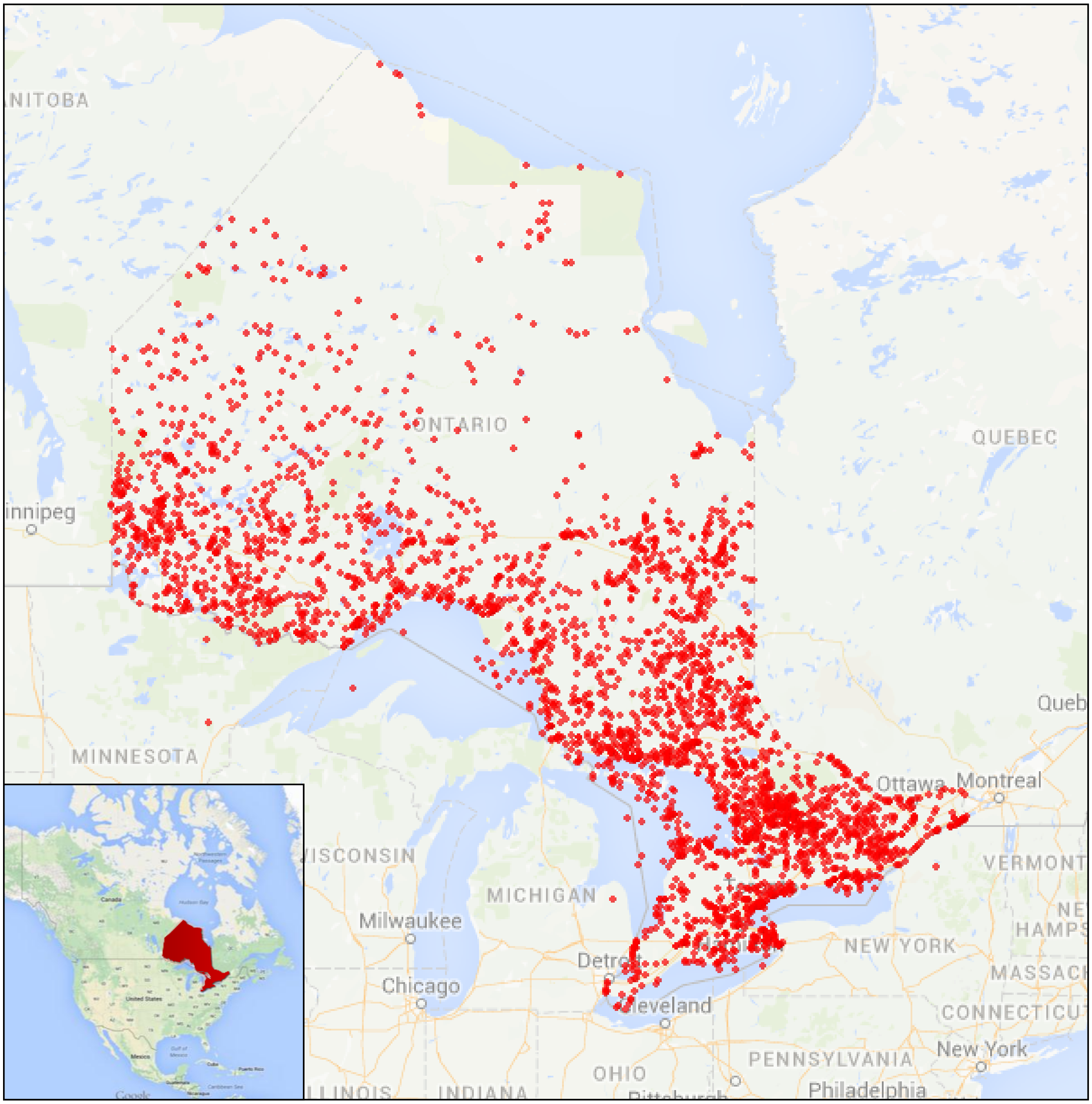


Figure S2: Histogram of number of individual samples collected in each sampling event (species/location/year) of the OMOECC fish Hg dataset used in this study (regular method) as well as in the datasets prepared by applying the six composite methods on the OMOECC dataset.

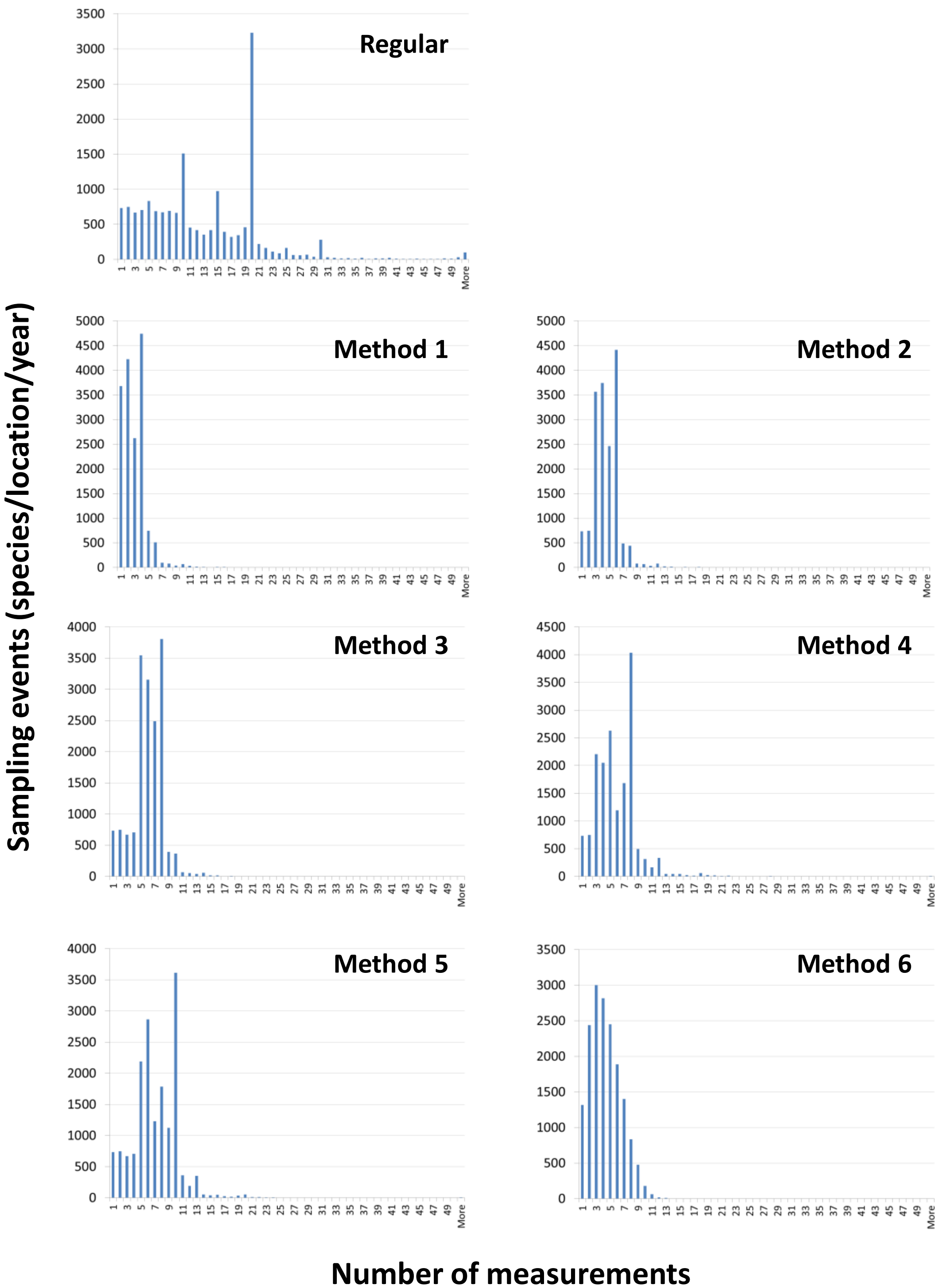


Figure S3: Illustration of calculating fish consumption advisories for regular individual Hg measurements (a) as well as composites using methods 1 (b), 2 (c) and 6 (d). The advisory benchmarks used for the calculations are shown in Table S2. Grey colour circles are for individual measurements; same coloured individuals belonged to the same composite; filled black circle is for a composite value calculated as an average of the individuals in the group. Regression analysis was performed on individual measurements for the "regular method" scenario, and on composites and retained individuals for the composite method scenarios.

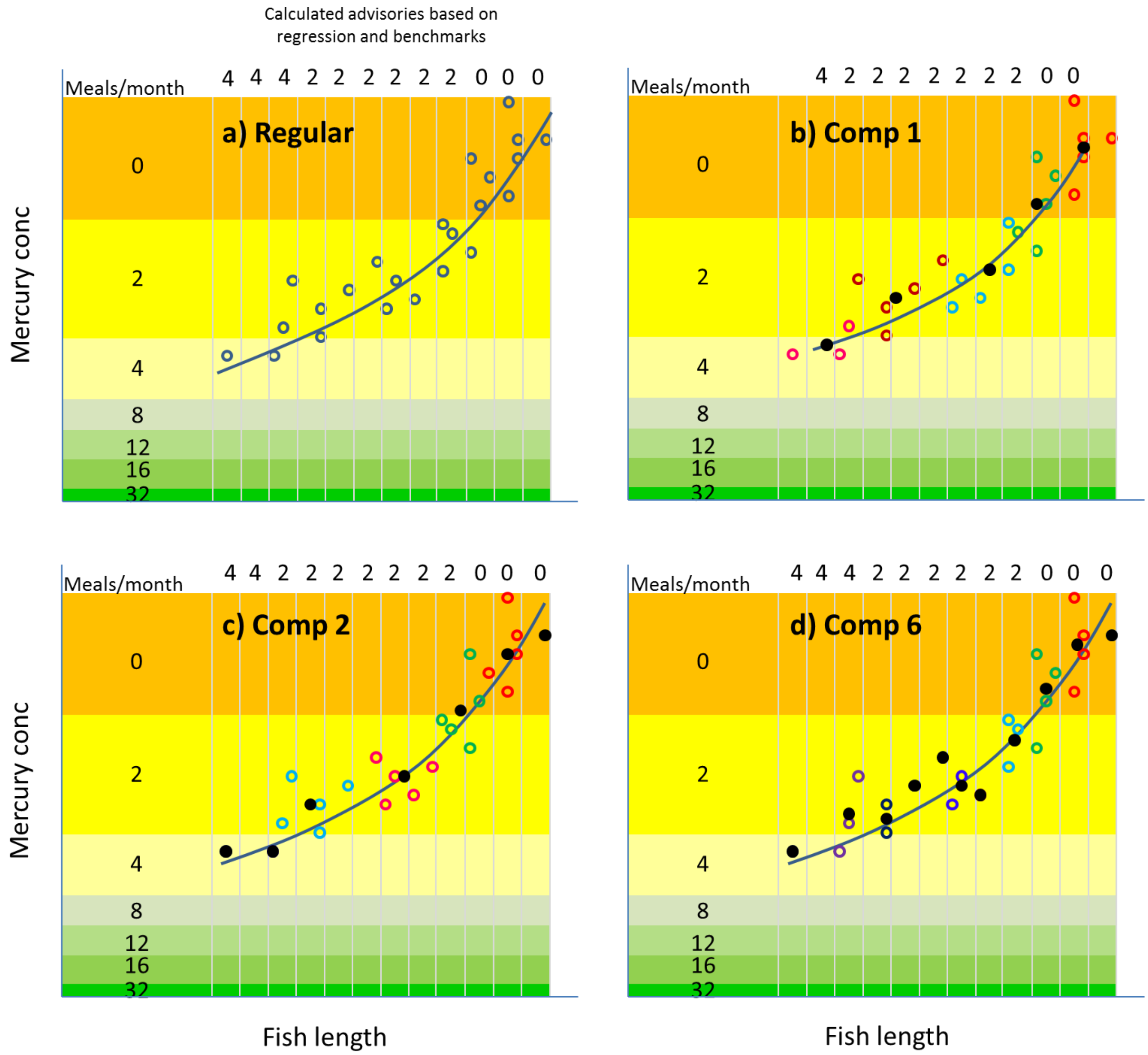


Figure S4: Illustration of the number of temporal trends conducted for a species at a location where sampling was conducted 8 times between 1981 and 2011. A rate of change in fish mercury levels was calculated for each grey coloured cell. The number combination (e.g., *13*, *4*) represents the time period (13 years) with (4) sampling years during the period. In this example, 28 rates of changes were calculated for each of the regular and six composite methods (total 196).

	1981	**1983**	**1988**	**1994**	**1995**	**2001**	**2007**	**2011**
1981								
1983	*2, 2*							
1988	*7, 3*	*5, 2*						
1994	*13, 4*	*11, 3*	*6, 2*					
1995	*14, 5*	*12, 4*	*7, 3*	*1, 2*				
2001	*20, 6*	*18, 5*	*13, 4*	*7, 3*	*6, 2*			
2007	*26, 7*	*24, 6*	*19, 5*	*13, 4*	*12, 3*	*6, 2*		
2011	*30, 8*	*28, 7*	*23, 6*	*17, 5*	*16, 4*	*10, 3*	*4, 2*	

Figure S5: Reductions in number of samples to be analyzed for Hg after employing the six compositing methods as a function of number of samples in regular, individual measurements at each sampling event (species/location/year) of the OMOECC fish Hg dataset used in this study.

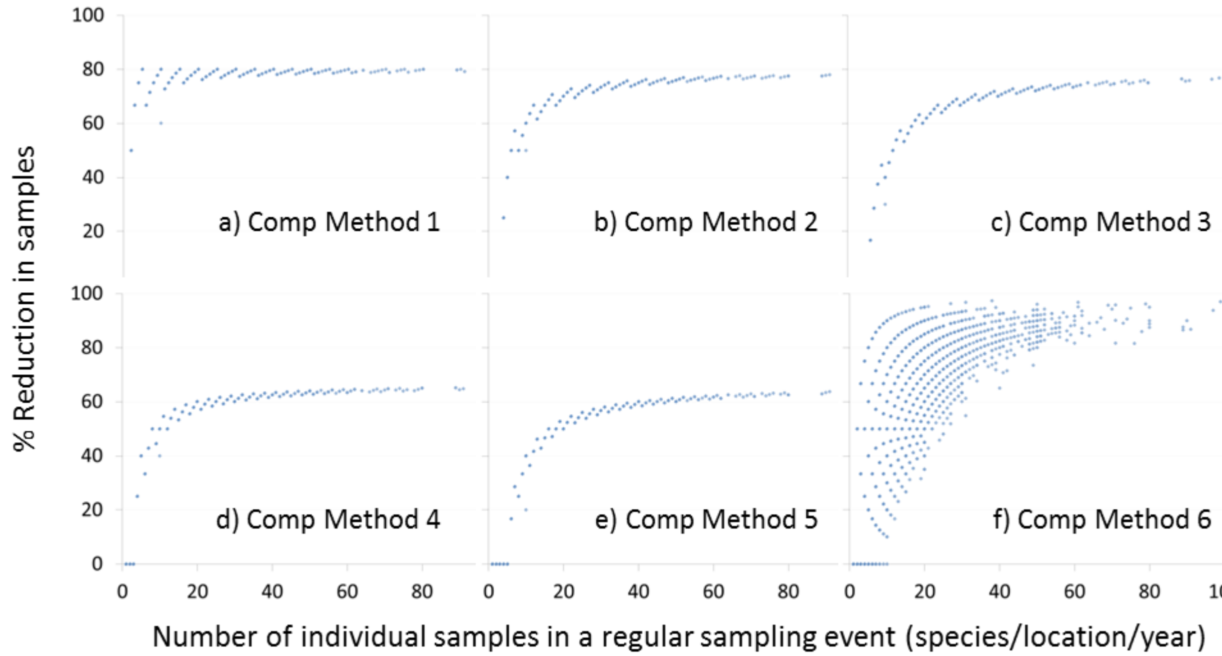


Figure S6: Distribution of ranking on p-value for power series regressions. Seven power series regressions on fish length versus Hg concentration were conducted for each sampling event (species/location/event; one for each of the regular and six composite methods). For each sampling event, ranking for seven p-values was assigned from 1 (lowest p-value) to 7 (highest p-value). The sampling events that resulted in 1 or 2 sample sizes after applying a compositing method were excluded from this analysis. If more than one method had the same rank, the average rank was assigned. The distribution of the rankings for the eligible sampling events are presented in this figure.

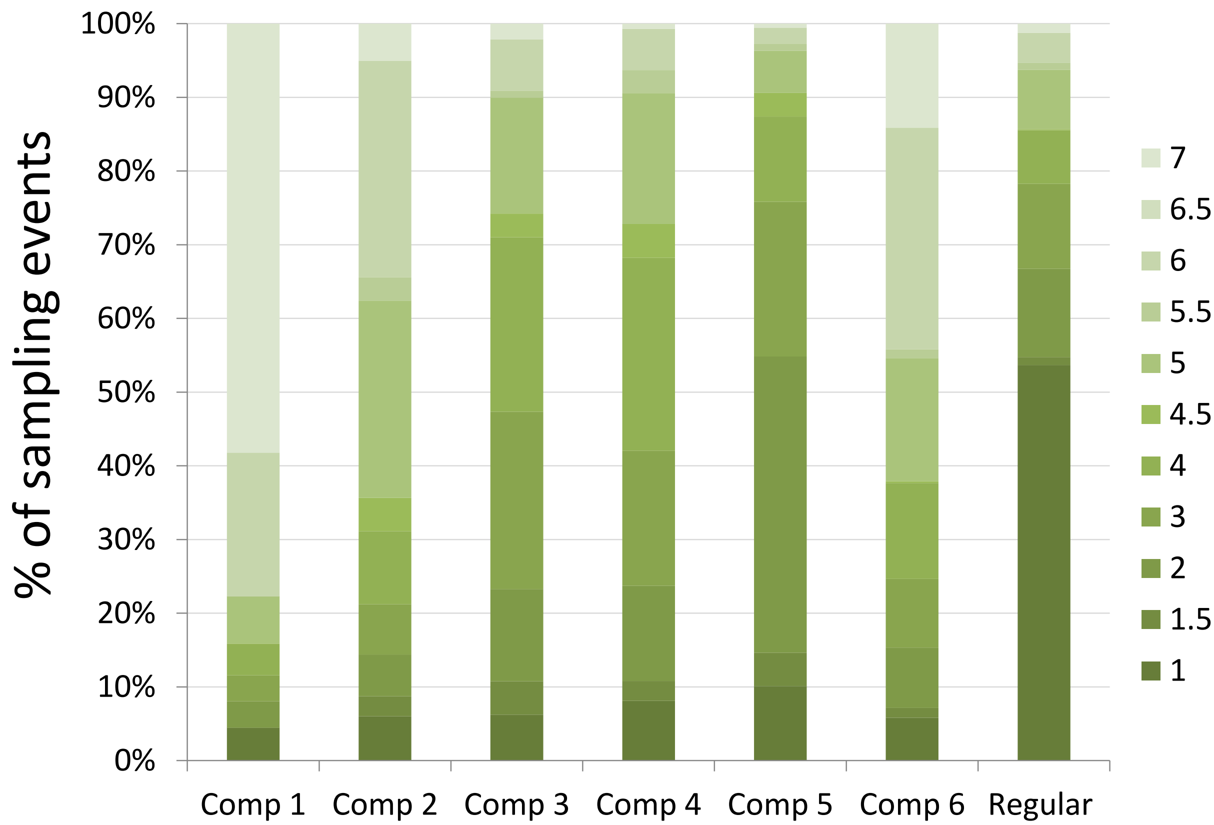


Figure S7: Comparison of temporal trends (increasing or decreasing) in fish mercury levels from six composite methods with those from the regular method of individual fish samples for mercury analysis.

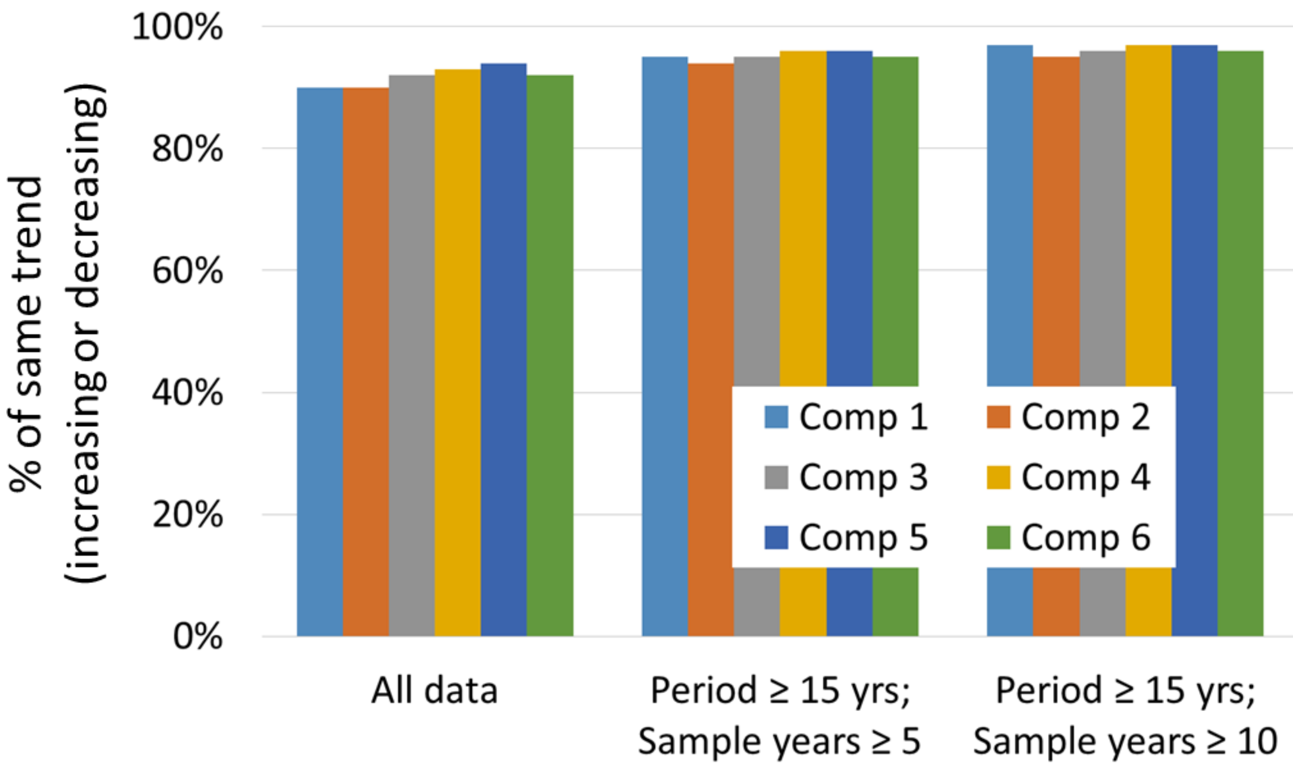


Figure S8: Comparison of rates of change in fish mercury levels from six composite methods with those from the regular method of individual fish samples for mercury analysis. The results have been presented as percentage of total number of rate estimates within 2 and 3 times of the corresponding rates from the regular method.

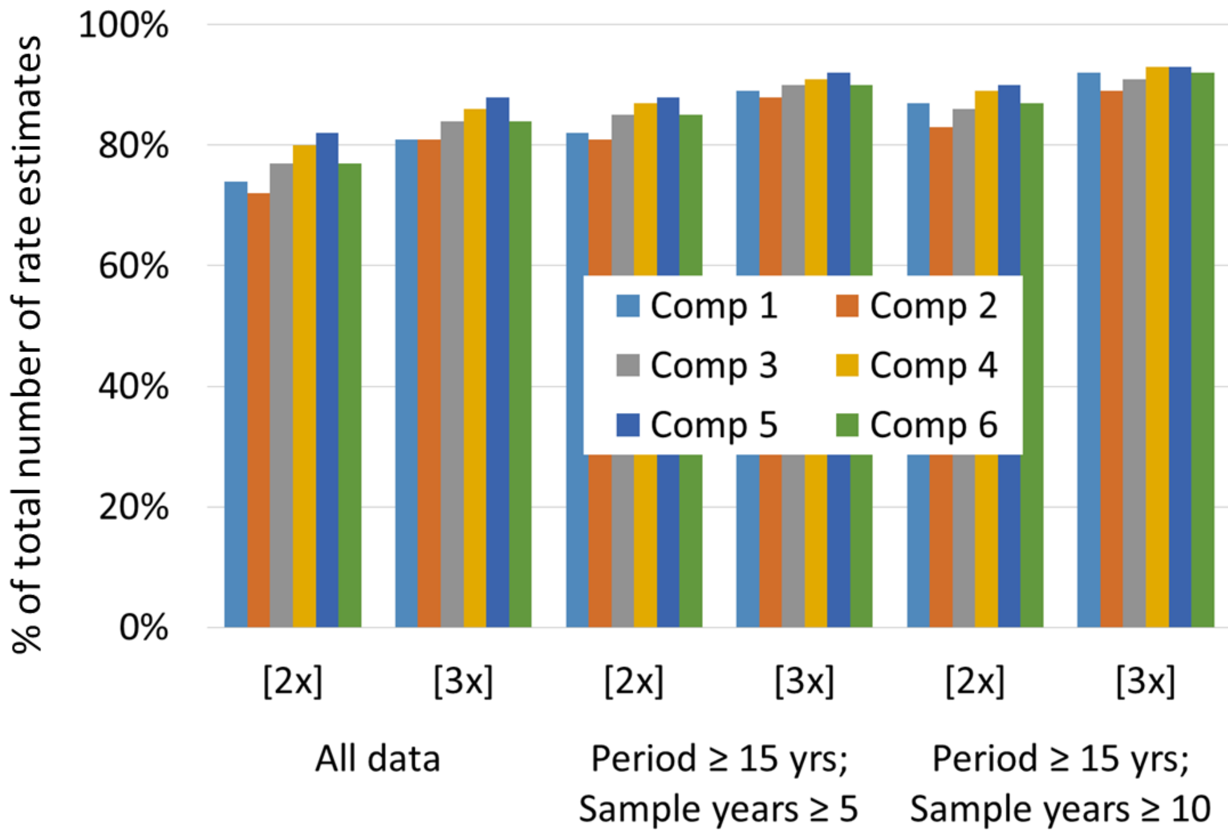
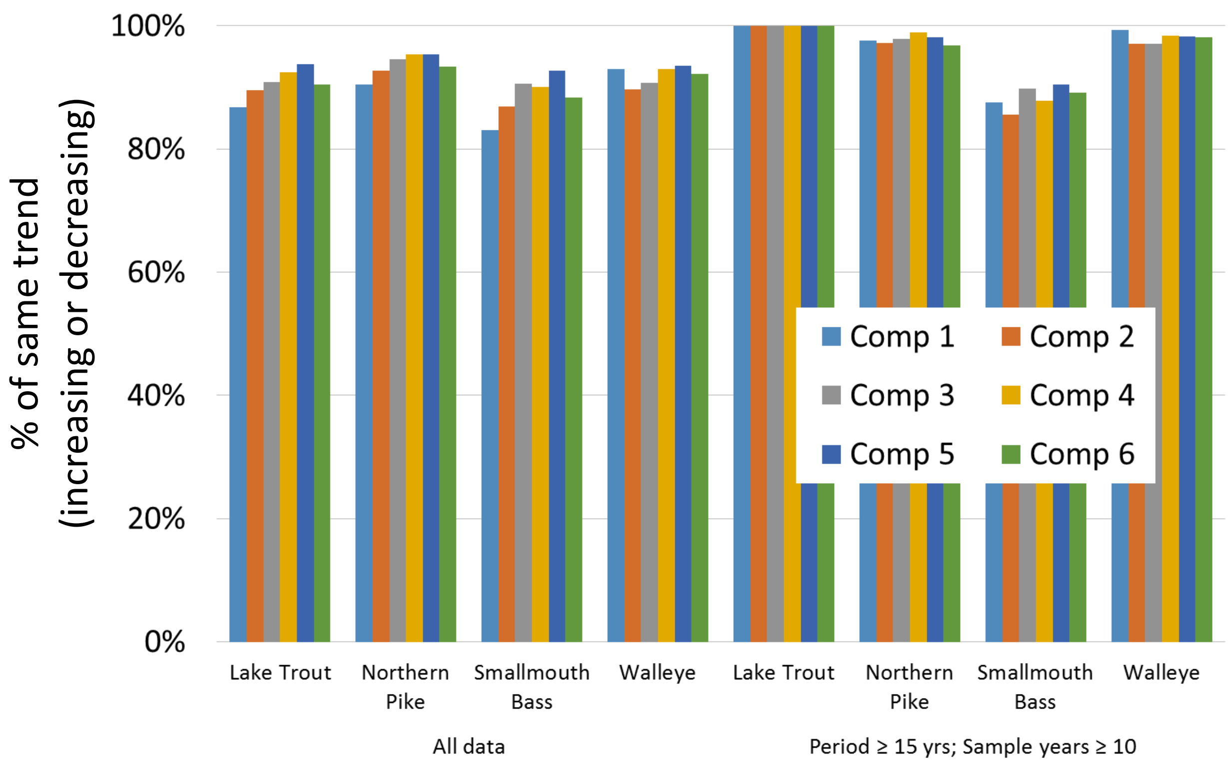


Figure S9: Comparison of temporal trends (increasing or decreasing) in fish mercury levels from six composite methods with those from the regular method of individual fish samples for mercury analysis.



References

OMOECC. 2015-2016 Guide to Eating Ontario Fish. Toronto, Ontario, Canada: Ontario Ministry of the Environment and Climate Change; 2015