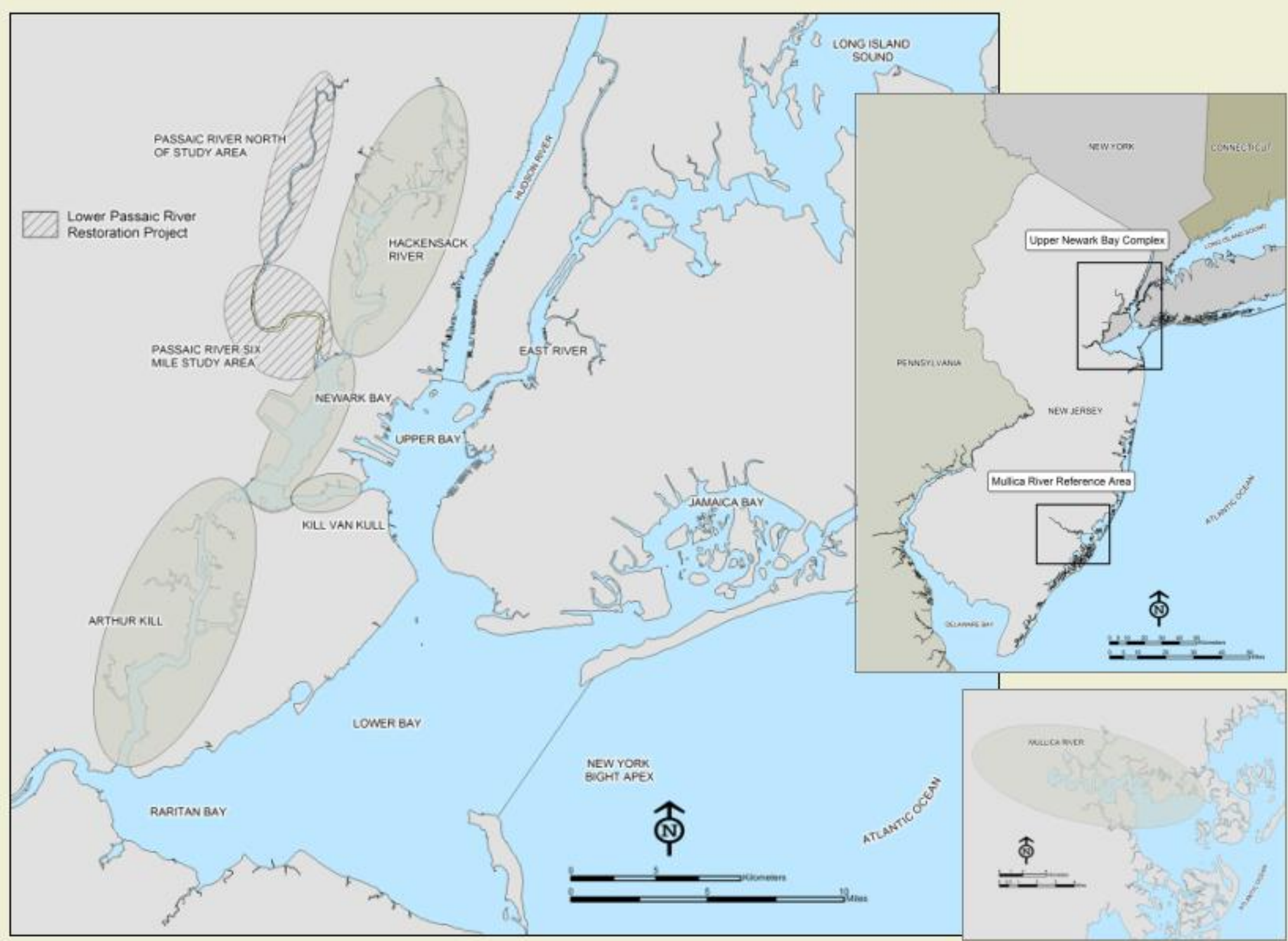


STUDY AREA



New York/New Jersey Harbor Area. Newark Bay Complex includes the tidal Passaic (17 miles between Dundee Dam and its confluence with Newark Bay, Hackensack River between Oradell Dam and its confluence with Newark Bay, Arthur Kill, Kill van Kull and their tributaries.

SITE INFORMATION

The Newark Bay Complex, an important economic, ecological and cultural resource, consists of 89 linear kilometers (55 miles) of waterways, 389 km (242 mi) of shorelines, and encompasses 44 km² (17 mi²) of water.¹ Over 75 aquatic species utilize the area for feeding, breeding, and nursery habitat. Numerous bird species, including colonial wading birds, also use this area for feeding, breeding, and migratory stopovers. Portions of the complex have been designated significant habitat by the U.S. Fish and Wildlife Service.² While the public uses this area for recreational purposes, fish consumption advisories have been in effect since the mid-1980's due to the presence of dioxin and PCBs.³ In addition to providing significant habitat for fisheries, this area supports major shipping and maritime activities.

Situated on the southern shore of the tidal Passaic River in the highly industrialized city of Newark, New Jersey, are the upland properties of the Diamond Alkali Plant where chemical manufacturing occurred. The former Kolker Chemical Works primarily produced DDT and phenoxy herbicides at the Plant. DDT production began sometime before World War II and herbicide production by 1948. Production of DDT shifted out of state in the late 1950's.⁴ While DDT use in the US was essentially terminated in 1972, production for export continued into the mid 1980's.⁵ An estimated 100 million pounds of DDT was produced at the Newark Plant⁶ and DDT was directly discharged to the Passaic River during Plant operations.⁷ The Diamond Alkali Plant has been a dominant source of DDT and its metabolites to Newark Bay for over forty years⁸. This release is also reflected in Raritan Bay sediments.⁹ Another source of DDT is the Arthur Kill/Kill van Kull area, which show increases in total DDT in sediment cores since the early 1980's.¹⁰

The Diamond Alkali Site is characterized by high concentrations of DDT and DDD in various media:

- Of the pesticides detected in site near-surface soils, DDT was the most prevalent and at the highest concentrations followed by DDD (DDT 0.62-5,090 mg/kg; DDD 1.2-164 mg/kg).⁴
- DDT was reported at 22 mg/L in groundwater.⁴
- Peak subsurface sediment concentrations coincide with historical production at the Site. Increases in near surface concentrations are consistent with elevated river stage and site flooding in the 1980's.⁸
- A maximum concentration of 9,520 mg/kg p,p'-DDT was recorded in a mudflat adjacent to the Diamond Alkali Plant at the 137-168 cm depth interval (4.5-5.5 ft depth).¹¹
- A maximum surface (0 to 15 cm/6 inches) sediment concentration of 3.2 mg/kg was recorded in near shore surface sediment.¹¹

[1] Calculated using ArcView 3.3 GIS, [2] USFWS 1997, [3] Belton et al. 1995, NIDEP 2003, [4] USEPA 1987 [5] Gillis et al. 1995, [6] IT 1985, [7] Diamond Shamrock v. Aetna Casualty and Surety Co. et al. 1984, [8] Bopp et al. 1991, [9] Chaky 2003, [10] Robinson 2002 in Chaky 2003, [11] NOAA Query Manager Database 2003

PURPOSE

The purpose of this evaluation is to (1) assess the extent and degree of total DDT or its metabolites in sediments of the Newark Bay Complex due to a known source condition in the Passaic River sediment, (2) compare Passaic River DDT distributions to a broader regional geographic area, (3) evaluate tissue residues of DDD, DDE and DDT in several species of fish and shellfish within the Passaic River and the greater NY/NJ harbor area, and (4) assess risks to aquatic biota and piscivorous wildlife in these waterways.

METHODS

NOAA developed a Newark Bay Watershed Database and Mapping Project by compiling sediment chemistry, tissue residue and bioassay results for a variety of contaminants and species (<http://response.restoration.noaa.gov/cpr/watershed/watershedtools.html>). This database consists of numerous studies conducted between 1985 and 2001 by academics, state and federal agencies and private companies. We also had access to 1999-2000 tissue residue data collected by the New York State Dept. of Environmental Conservation through the Contaminant Assessment and Reduction Program (CARP)¹² that have yet to be entered into the database. Various sampling and analytical methods were employed with different approaches to sediment segmentation schemes, tissues and organisms sampled, and metabolites analyzed.

Surface Concentrations were reported as total DDT and o,p'- and p,p'-DDD, DDE and DDT in the surface (generally from 2 to 30.48 cm). Subsurface concentrations were reported as total DDT and p,p'-DDD, DDE and DDT. Tissue data within the NOAA database was primarily reported as p,p'-DDD, DDE and DDT and were essentially restricted to the Passaic River. The CARP DDT data covered a broader geographic area and consisted of o,p'- and p,p'- metabolites. Summary statistics (including mean and range of concentrations) were calculated by subset regions within the New York/New Jersey complex.

The 1999 dataset consisted of 15 Passaic River stations and three reference stations in the Mullica River. Station 14, adjacent to the Diamond Alkali Plant, is located about 3.2 km (2 mi) upstream from the downstream edge of the 10 km (6 mi) study area. Sample sizes vary by species and location. Whole body tissue analysis was conducted for the three fish species while soft tissue was analyzed for the invertebrate species. Crab and mussel data were reported as one value per station, representing composites of 3 cages. Mummichog data was reported as one value per cage with 3 cages per station. White perch and juvenile striped bass are fish composites¹³. The CARP data represents 5 species of fish collected from 9 locations in the NY/NJ metropolitan area. Tissue type analyzed included whole body homogenate, whole body head and viscera removed (h/v), standard filets, and liver. Sample size ranged from 1 to 50 depending on species, tissue type, and sampling location.

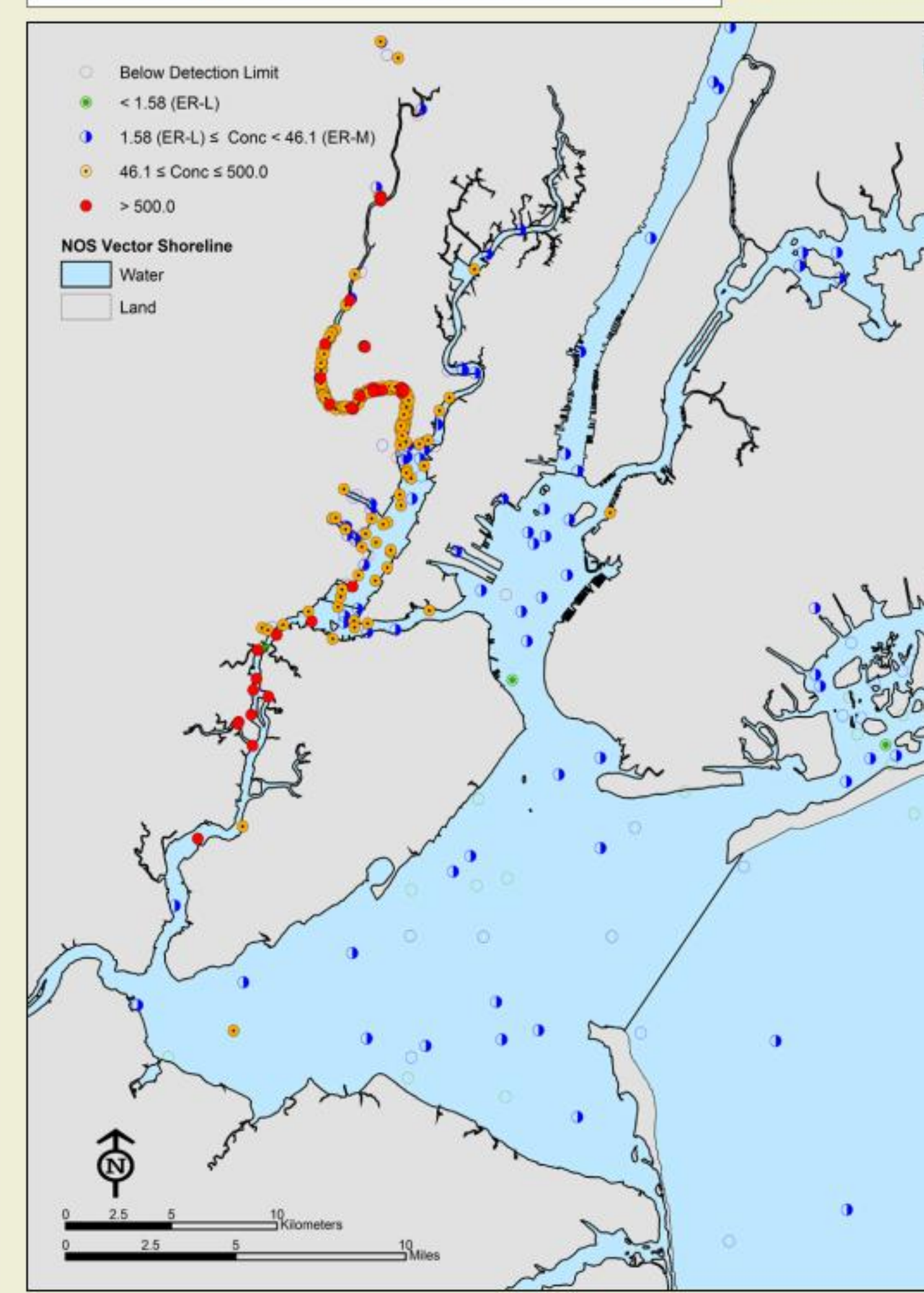
Tissue residues are presented as total DDT and proportionally as DDD, DDE, and DDT. Total DDT equals the sum of the metabolites. Only the p,p'- metabolites were available for the Passaic River dataset, while all 6 metabolites were used from the CARP dataset.

Nine species of aquatic biota collected from the Passaic River (1995, 1999-2001) and Mullica River (1999-2000) were used to generate total DDT (as described above) for the risk analyses. Tissue residues were compared to toxic reference values (TRVs) protective of fish, crustacea, and piscivorous birds and mammals. The TRVs plotted on the Passaic River Biota figure were used to assess risk over the geographic areas depicted in the CARP biota plot.

[12] McReynolds 2004 (Data considered preliminary as QA/QC not fully complete), [13] CLH 1999

SURFACE SEDIMENT

Surface Sediment Total DDT (ug/kg)



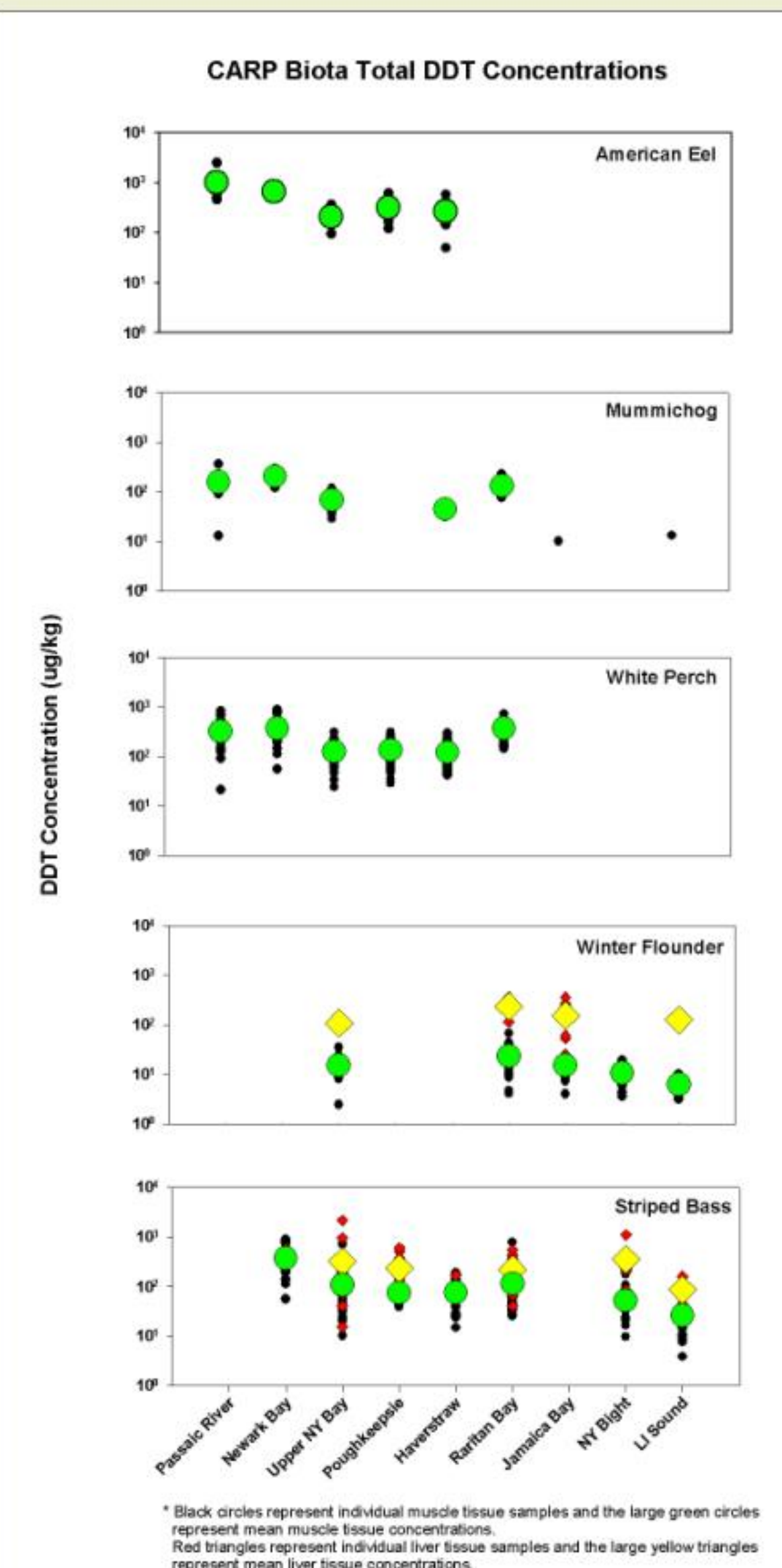
Total DDT exceeded the Effect Range-Median (ER-M) sediment guideline in the Newark Bay Complex and the Effect Range-Low (ER-L) elsewhere in the NY Harbor. ¹⁴ Concentrations (data in Query Manager from 1990-2000) tend to decrease with increasing distance from the Diamond Alkali Plant, with the exception of the Arthur Kill. Total DDT in the Passaic River was about 2-3 times higher than that recorded for Newark Bay and the Kill van Kull. Concentrations in the Hackensack River, Upper & Lower Bay and Raritan Bay were up to an order of magnitude lower.

[14] Long et al. 1995

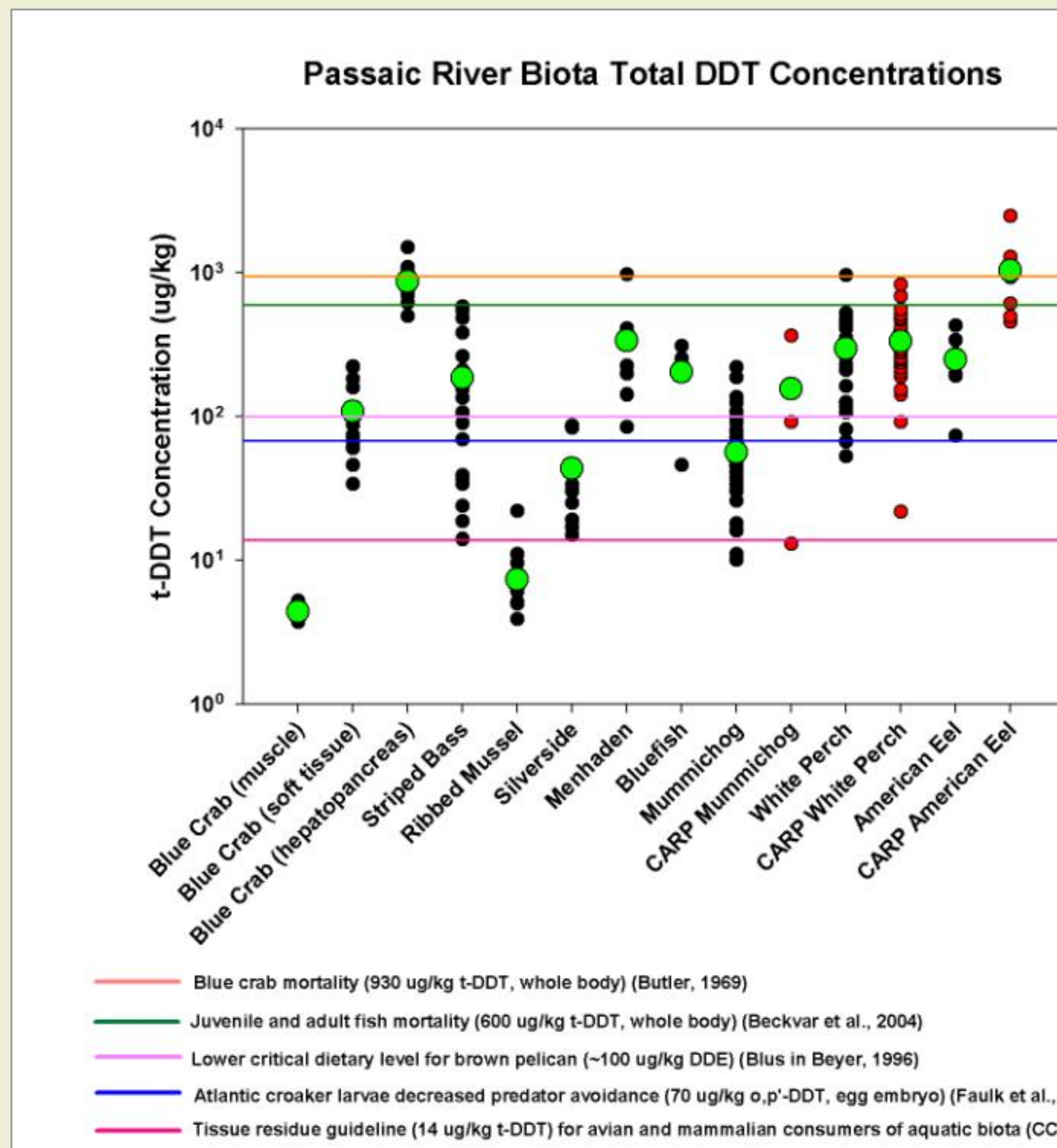
Area	Mean (ug/kg) Concentration	Range (ug/kg)
ULRRP: Passaic River 10 km Study Area	245.8	3.9-5980
LPRR: Passaic River North of 10 km Study Area	191.8	5.7-290.0
Hackensack River	39.4	6.0-156.0
Upper Bay	21.1	1.2-56.9
Newark Bay	88.6	3.8-729.7
Kill Van Kull	84.4	16.4-223.0
Jamaica Bay	6.5	0.4-40.0
Arthur Kill	1046.8	0.9-4631.1
Raritan Bay/Lower Bay	10.1	1.0-53.2

*LPRR: Lower Passaic River Restoration Project

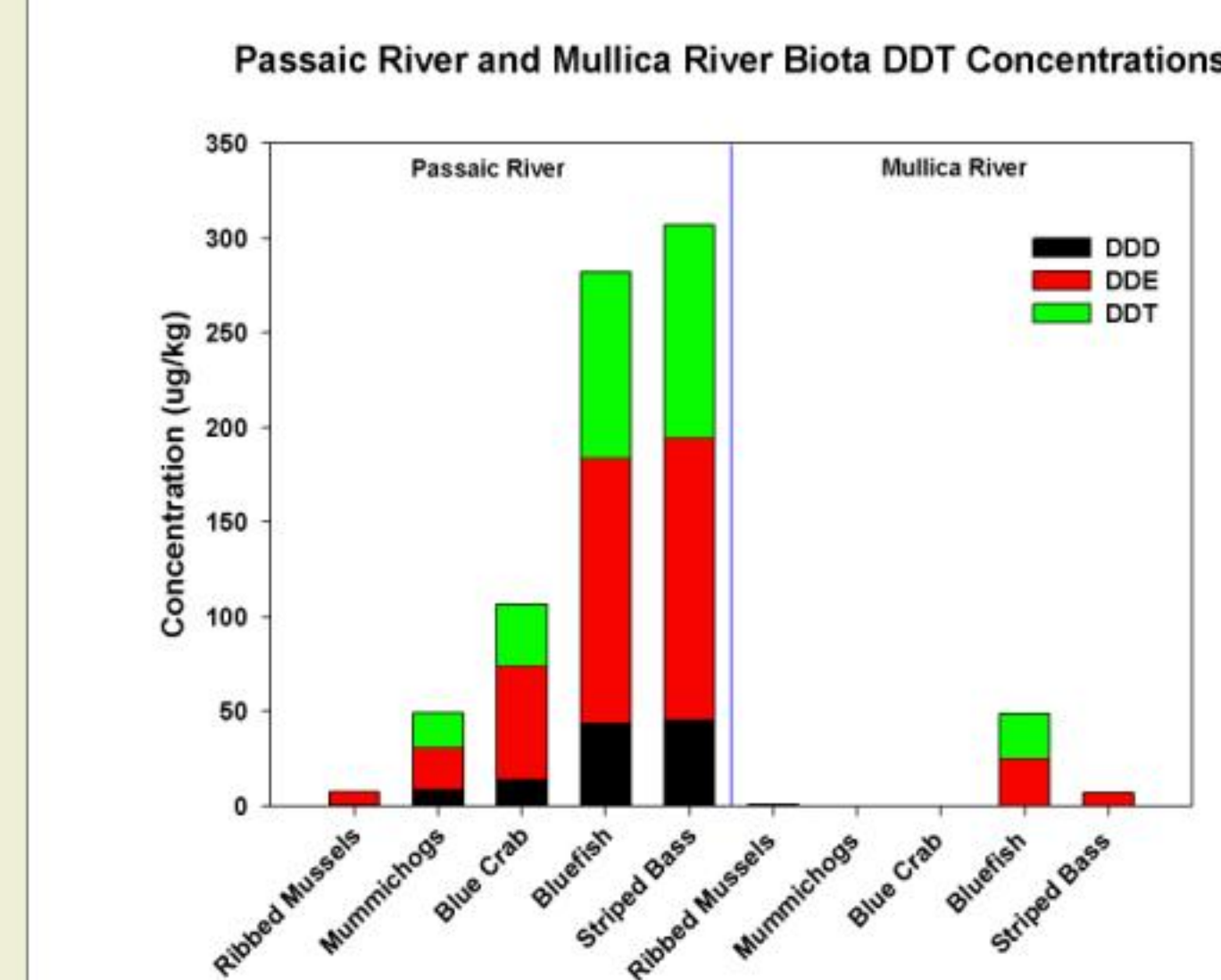
TISSUE RESIDUE AND ECOLOGICAL RISK ASSESSMENT



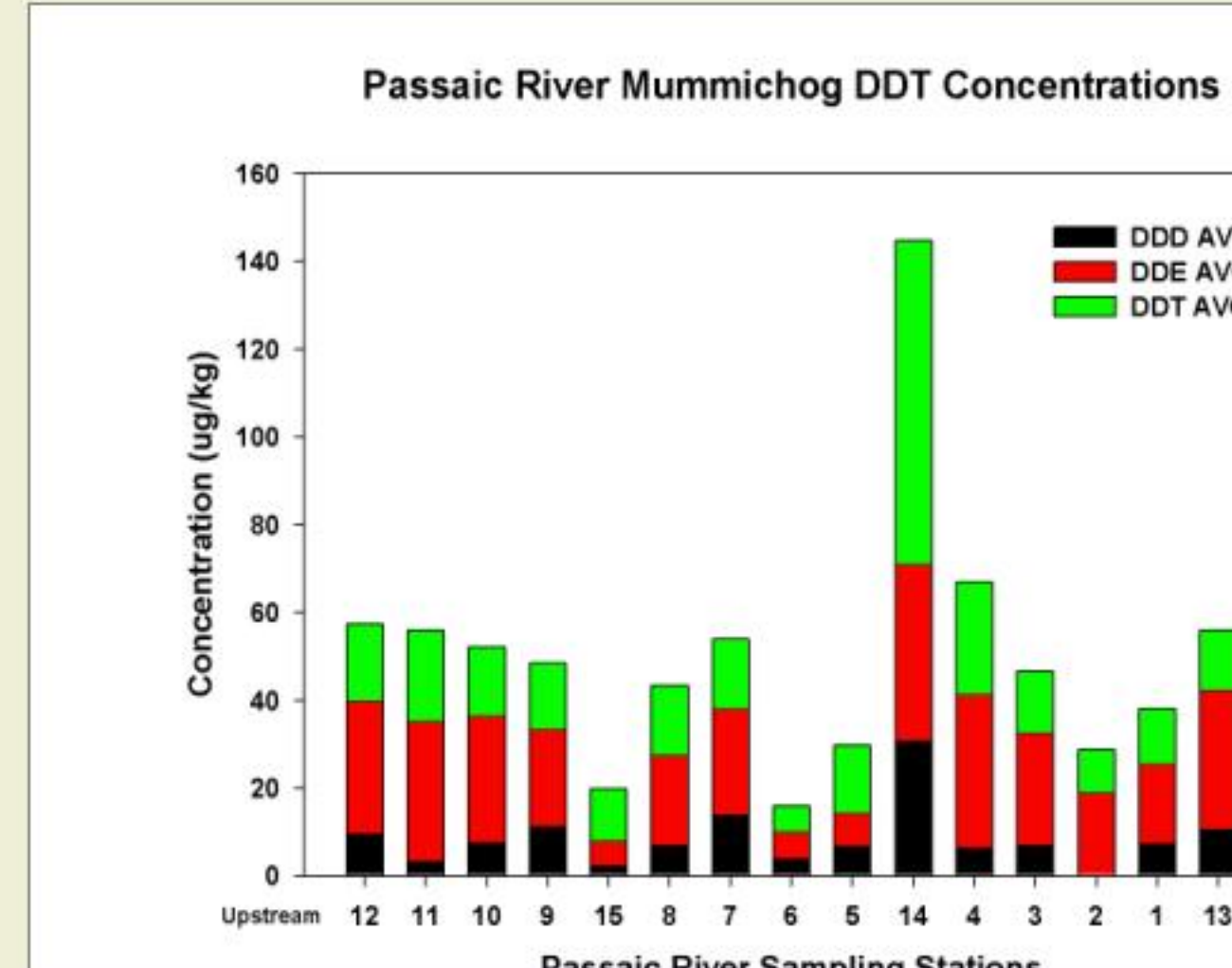
Total DDT in fish tissue did not show as strong a geospatial pattern as expected based on differences in surface sediment concentrations. Long Island Sound biota tended to have the lowest DDT concentrations.



The TRV protective of the most sensitive life stage for the most sensitive bird or mammalian species was exceeded for all species and tissue types except ribbed mussel soft tissue and blue crab muscle. Crab and eel (means) and menhaden and white perch (maximum) total DDT exceeded the fish and crab mortality TRVs. In addition, most species exceeded the fish behavioral effects TRV.



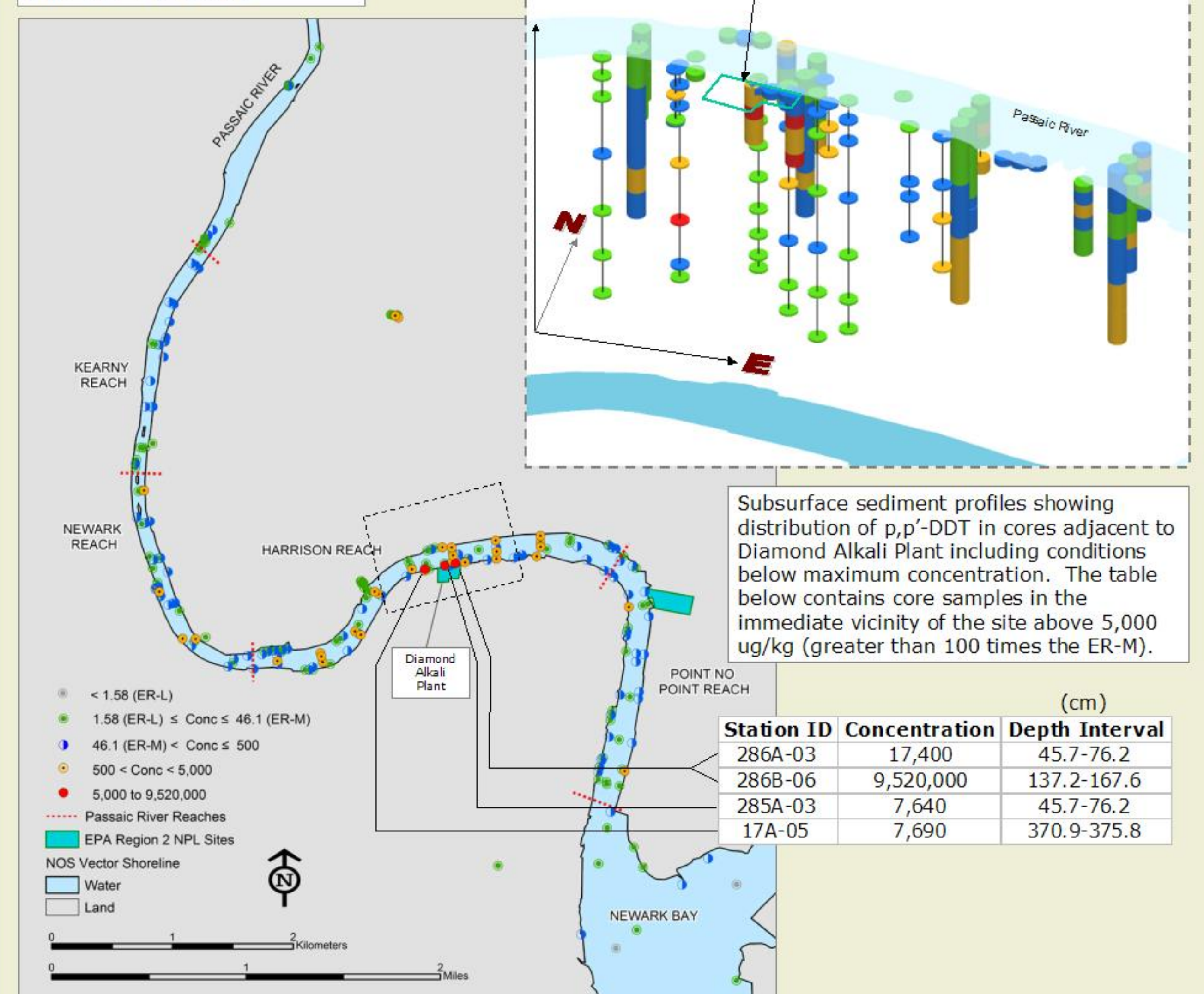
Total DDT was detected in all species sampled in the Passaic River while neither mummichog nor blue crab soft tissue (hepatopancreas not analyzed) showed evidence of this pesticide in Mullica River samples. Where DDT and its metabolites were detected, up to two orders of magnitude difference by species were found between the two rivers.



Maximum total DDT were observed in mummichogs collected adjacent to the DDT manufacturing Plant. p,p'-DDT was the primary metabolite measured (>50%) in Passaic River mummichog collected at stations 5, 14 and 15. This was in contrast to all other stations where p,p'-DDE dominated.

SUB-SURFACE SEDIMENT

Sub-surface Maximum p,p'-DDT (ug/kg)



Station ID	Concentration (ug/kg)	Depth Interval (cm)
286A-03	17,400	45.7-76.2
286B-06	9,520,000	137.2-167.6
285A-03	7,640	45.7-76.2
17A-05	7,690	370.9-375.8

Maximum concentration of p,p'-DDT per sediment core for the Passaic River. Sub-surface sediment concentrations exceeded the ER-M by one to several orders of magnitude.

CONCLUSIONS

- DDT exceeded estuarine sediment guidelines for protection of benthic organisms.
- Maximum subsurface p,p'-DDT was observed adjacent to the Diamond Alkali Plant. While the Arthur Kill also represents a source condition, no subsurface sediments were available in our database for comparison. Further investigation of this latter source should be undertaken.
- Mummichogs in the Passaic River show maximum contribution from total DDT adjacent to the Diamond Alkali Plant. These concentrations were up to an order of magnitude higher than at other stations.
- Passaic River blue crab DDT demonstrated significant differences in bioaccumulation by tissue type; differences were not removed by lipid adjustment. These findings support the analysis of whole body or multiple tissues to confirm exposure and determine risk.
- p,p'-DDT is still a significant contributor to total DDT in fish tissues in the Passaic River. Total DDT poses a risk to fish, birds and mammals in the Newark Bay Complex and greater NY/NJ Harbor.
- Tissue results for Mullica River DDD, DDE, and DDT contribution to total DDT present a different pattern relative to the Passaic River representing a system with much lower concentrations of total DDT and therefore lower risk. Species home range, trophic status and localized sources more likely influenced observed patterns.
- Tissue total DDT concentration gradients for the Newark Bay Complex and the NY/NJ Harbor area were less pronounced than expected given the orders of magnitude differences in surface sediment concentrations.
- Further studies should be considered to evaluate the contribution of o,p'- and p,p'-DDD, DDE and DDT to total DDT in tissue residues and the implications for toxic effects in addition to the presence and extent of source conditions.