IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF PUERTO RICO

JUANITA SANCHEZ (ON BEHALF OF MINOR CHILD DEBORA RIVERA-SANCHEZ) *et al.*,	
Plaintiffs,	
VS.	Case No. 3:09-cv-01260-SEC
UNITED STATES OF AMERICA, *et al.*,	
Defendants.	

AFFIDAVIT OF ARTURO MASSOL-DEYA

STATE OF PUERTO RICO

COUNTY OF PUERTO RICO;

Before me, the undersigned Notary, personally came and appeared Arturo Massol-Deyá, who after being first duly sworn makes this statement:

My name is Arturo Massol-Deyá, and I have personal knowledge of the matters contained within this Affidavit. I am an environmental scientist graduated with a Ph.D. from Michigan State University. Currently I am a professor at the University of Puerto Rico - Mayagüez and the principal investigator of research activities conducted in my laboratory (1994-present).

Since 1999 I have been directing a series of scientific studies pertaining to heavy metal accumulation in terrestrial and marine plants collected at the former bombing range in eastern Vieques. Agricultural plants and primary consumers such as goats in the civilian area in Vieques were also studied. Our research team has published several

scientific reports of our findings including *Biomagnification of Carcinogenic Metals in Crab Tissue, Vieques, Puerto Rico* (1999); *Trace Element Composition in Forage Samples: Vieques vs. Puerto Rico* (2000); *Toxic Metals in Vegetation at Civilian Zone* (2001); *Herbivorous: additional evidence of heavy metal mobilization through the food web* (2004); *Heavy metal assessment in Organic Farms at Finca Luján, Vieques* (2008). Publications in peer-reviewed journals include:

- Massol-Deya, A. and E. Diaz. 2003. Trace elements composition in forage samples from various anthropogenically impacted areas in Puerto Rico. Carib. J. Sci. 39:215–220.
- Massol, A., D. Pérez, E. Pérez, M. Berrios, and E. Díaz. 2005. Trace elements analysis in forage samples from a US Navy bombing range (Vieques, Puerto Rico). Int. J. Environ. Res. Public Health. 2(2):263-266.

The concentration of acid-extractable elements from biological samples was determined by standard air-acetylene flame detection in an atomic absorption spectrophotometer. My trace element lab at UPR is qualified to perform such tests, and I am qualified to conduct this analysis through my education, degrees, training, and my lengthy experience (A copy of my *Curriculum vitae* is attached to this Affidavit as Affidavit Exhibit 1).

Our findings demonstrate the accumulation of heavy metal above normal and safe levels in plants, crops, marine plants, crabs and other bioindicator species in the ecosystem. Specifically, plants in Vieques were found to have up to 10 times more lead (Pb) and 3 times more cadmium (Cd) than samples from reference locations in mainland Puerto Rico. This study indicates the potential for dangerous metal contamination in crop

yields such as chili pepper, pigeon peas, squash, mango and yucca. Other metals that were detected in excessive amounts were nickel (Ni), cobalt (Co), magnesium (Mn) and copper (Cu).

These levels could not be explained naturally, and indicated a likelihood of bioaccumulation through air exposure of polluted dust to the civilian zone. After the closure of the bombing range in 2003, progressive reduction in heavy metal content has been observed, thus indicating that air exposure was a key pathway for dispersion of military pollutants and uptake by plants elsewhere.

Directly at the bombing range, we found 10 to 20 times more cadmium in crab tissue samples than mainland Puerto Rico and 80 times higher than crabs on east and west coasts of U.S. The levels of cadmium exceed FDA's "levels of concern" and were 1,000 times higher than World Health Organization's "tolerable ingestion maximum dosage". Furthermore, goats on Vieques were found to have 24-50 times more lead in hair samples than those sampled on the mainland.

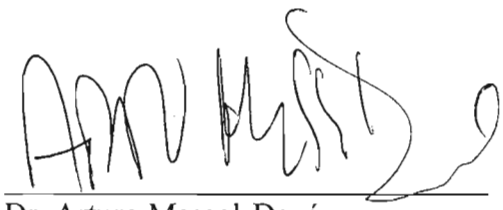
With regard to grazers, goats sampled on Vieques were also found to have 5-7 times more cadmium, 6 times more cobalt, and 5 times the level of aluminum than those collected on the Puerto Rican mainland. These goats feed primarily on pasture grass, including *Panicum Maximum* which has been described by our research group as a metal accumulator in Vieques.

In the marine ecosystem, levels of lead detected in *Syringodium filiforme* at Salina Bay (southern coast of the bombing range) indicate the dispersion of metals throughout the marine food chain. In 2001, differences were significantly higher ($p<0.5$) at the bombing range for lead, copper, nickel and cobalt. The content of lead however, cannot

be explained solely as a result of a natural process. The oceanic pH limits the solubility of many metals, including lead, and metals must be dissolved in order to be available for the marine plants to accumulate the metals in their tissues. At Salinas Bay, the USEPA Discharge Monitoring Reports from 1984-1999 identified excessive concentrations of lead, with occasional average levels of up to 5 mg/L as well as deviations in pH. These parameters enhance metal bioavailability, thus increasing uptake by marine life including endangered species such as Manatees (*S. filiforme* is commonly known as Manatee grass). Furthermore, heavy metals in water samples were undetected when military operations did not take place. Samples of *S. filiforme* obtained in 2004 showed lower concentrations ($P<0.5$) of cobalt, copper, nickel and lead to those levels observed in 2001. Therefore, military maneuvers were mainly responsible for increased exposure of heavy metals to marine life.

Based on field information, heavy metals are being actively mobilized through the base of the food chain and being passed through to higher ecological groups such as grazers, marine wildlife and most likely the population of Vieques. It is well documented in the scientific literature that once pollutants reach the base of the food chain, the problem is no longer local and limited to the source of impacts, but a regional one with significant long-term consequences to the ecosystem and all of its inhabitants.

FURTHER, AFFIANT SAYETH NOT.



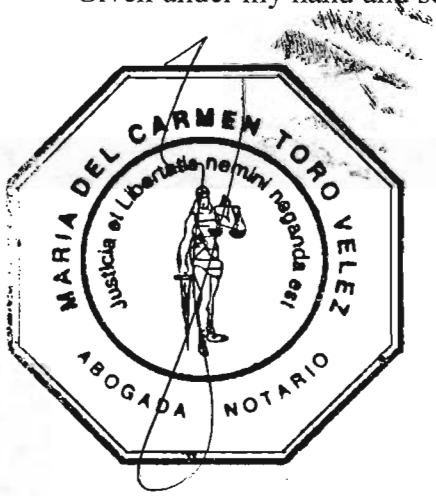
Dr. Arturo Massol-Deyá

STATE OF PuertoRico

COUNTY OF Mayagüez :

I, the undersigned Notary Public, in and for the said State and County, hereby certify that Arturo Andrés Massol-Deyá, whose name is signed to the foregoing Affidavit, and who is known to me, acknowledge before meont his day that, being informed of the contents of said Affidavit, she executed same voluntary on the day the same bears date.

Given under my hand and seal this the 10 day of June, 2009.



María del Carmen Toro Vélez
Notary Public

My Commission Expires: NEVER
My Commission Never expires; in Puerto Rico a Notary Public must also be an Attorney. The commission expires only upon retirement or disbarment.

BIOGRAPHICAL SKETCH: ARTURO A. MASSOL

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Professional Preparation

University of Puerto Rico, Humacao	Microbiology	B.S. - 1990
Michigan State University	Microbial Ecology	Ph.D. - 1994

Appointments

2002-Present:	University of Puerto Rico, Professor
1997-2002:	University of Puerto Rico, Associate Professor
1994-1997:	University of Puerto Rico, Assistant Professor
1992-1994:	Michigan State University, Research Assistant
1991-1992:	Michigan State University, Teaching Assistant

Selected Publications

Massol-González, A., A. Andromache-Johnnidis, A. Massol-Deyá. 2008. The Evolution of Casa Pueblo, Puerto Rico: From Mining Opposition to Community Revolution. Gatekeeper, 137b:1-20.

Massol-González, A., E. González, A. Massol-Deyá, T. Deyá Díaz, and T. Geoghegan. 2006. Bosque del Pueblo, Puerto Rico: How a fight to stop a mine ended up changing forest policy from the bottom up. Policy that works for forests and people no. 12. International Institute for Environment and Development, London. 130pp.

Rodríguez-Martínez, E., E.X. Pérez, C.W. Schadt, J. Zhou, and A. Massol-Deyá. 2006. Microbial Diversity and Bioremediation of a Hydrocarbon-Contaminated Aquifer in Vega Baja, Puerto Rico. International Journal of Environmental Health. 3(3):292-300.

Massol, A., D. Pérez, E. Pérez, M. Berrios, and E. Díaz. 2005. Trace elements analysis in forage samples from a US Navy bombing range (Vieques, Puerto Rico). Int. J. Environ. Res. Public Health. 2(2):263-266.

Massol-Deyá, A., R. Muñiz, M. Colón, J. Graulau, and N. S. Tang. 2005. Microbial Community Structure of Pentachlorophenol Contaminated Soils as Determined by Carbon Utilization Patterns. Caribbean Journal of Science 41:138-146.

Massol-Deya, A. y E. Diaz. 2003. Trace elements composition in forage samples from various anthropogenically impacted areas in Puerto Rico. Carib. J. Sci. 39:215–220.

Massol-Deya, A., R. Weller, L. Rios-Hernandez, R. F. Hickey, and J. M. Tiedje. 1997. Succession and convergence of biofilm communities in fixed-film reactors treating benzene, toluene, and p-xylene contaminated groundwater. Applied and Environmental Microbiology. 63:270-276.

Massol-Deya, A., J. Whallon, R. F. Hickey, and J. M. Tiedje. 1995. Channel structures in aerobic biofilms of fixed-film reactors treating contaminated groundwater. Applied and Environmental Microbiology. 61:769-777.

Tiedje, J. M., S. M. Thiem, A. Massol-Deya, J. O. Ka, and M. R. Fries. 1995. Tracking Microbial Populations Effective in Reducing Exposure. Environmental Health Perspectives. 103:117-120.

Massol-Deya, A., J. Whallon, R. F. Hickey, and J. M. Tiedje. 1994. Biofilm architecture: a fortuitous engineering feature. ASM News. 60(8):467 and cover.

Synergistic Activities

Service to Community, CasaPueblo de Adjuntas
Management Board, Bosque del Pueblo de Adjuntas
CasaPueblo/Smithsonian Institution (2002)
NSF Microbial Observatory Panel (2002)
Environmental Quality Board of PR (2001-present)
Health Department of PR (2003-present)

Collaborators and Other Affiliations

(i) Collaborators and co-editors

T. Hazen (LBNL), C. Criddle (Stanford), J. Whallon (MSU), F. Loeffler (GTech), Elba Diaz (UPR), James Tiedje (MSU), Robert Hickey (MSU), J. Zhou (UO), Allan Devol (UWash), Larry Forney and Eva Top (UIdaho).

(ii) Graduate and Postdoctoral Advisors

James Tiedje and Robert Hickey (MSU)

(iii) Thesis Advisor and Postgraduate-Scholar Sponsor

Graduate students advised: Rhynna Soto (1997), Carlos Rodriguez (1998), Patricia Orfila (1997), Leticia Torres (2000), Ricardo Rossy (2001), Rubin Muniz (2002), César Cordero (2003), Silvia Ara Rojas (2004), Rogelinda Barraza (2005), Enid Rodríguez (2006), Gina Rodríguez (2007), Sonia Bailon (2007), Alejandro Caro (2008), Alexis Valentín (2009), Gloried Toledo (present), Katherine Carrero (Present), Lorainne Rodríguez (present). Postdocs advised: Dr. Ricardo Maggi.