**R E P O R T**

# A QUALITATIVE ASSESSMENT OF *Lontra longicaudis annectens* AQUATIC HABITATS IN ALVARADO, MEXICO

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(Received 12th June 2012, accepted 16th August 2012)

**Abstract:** A laboratory screening study following USEPA SW-846 test methods allowed the detection of organic compounds in the aquatic habitat of the Neotropical river otter (*Lontra longicaudis annectens*), in the Alvarado Lagoon System, Veracruz, Mexico. The compounds detected included 2-chlorocyclohexanol, phenylethylene glycol, benzophenone, ethanol-2-butoxyphosphate, styrene, *p*-xylene, ethylbenzene, *trans*-1,2-cyclohexanediol, di-2-ethylhexyl phthalate, benzeneacetaldehyde, hexadecane, tetracosane, docosane, triacontane, sitosterol, hexadecanoic acid, 1-eicosanol, chlorobenzene, and phosphorothioic acid trimethyl ester. Literature review showed a lack of data on the compounds´ potential effects on wildlife, although some of them could be considered harmful to the otters and their prey. The different compounds detected needs follow-up.

Keywords: *Lontra longicaudis annectens*, aquatic habitat, organic compounds, Alvarado Lagoon System.

## INTRODUCTION

The number of reports indicating the presence of *Lontra longicaudis annectens* in Mexican habitats increased in recent years (e.g., Maldonado and López-González, 2003; Carrillo-Rubio and Lafón, 2004; Guerrero-Flores et al., 2007; Macías-Sánchez and Hernández, 2007; Gallo Reynoso et al., 2008; Silva-López, 2009). However, little is known on the quality of the otter's aquatic environment. Some information has been presented by Gallo-Reynoso (1997), emphasizing that high concentrations of heavy metals such as lead, aluminum, zinc and tin, as well as organic chloride pesticides and its metabolites, are a major hazard to the otter's prey species, thus increasing the risks to *Lontra* due to the potential mixture effects of such elements. Records and observations confirming the otter's presence in the Alvarado Lagoon System, Mexico (Silva-López, 2009), underline the importance of evaluating its habitat and population, especially as regards to its aquatic environment. In a joint effort between our institutes and research unit, we conducted a laboratory screening study of water samples from eight lagoons of the complex, with the aim to detect organic compounds that may pose an environmental hazard to the otter and their prey. All of these lagoons are located along the Río Acula, which is allegedly far from the influence of the Rio Blanco and the pollutants this river carry from the upper-river, industrialized, highland cities of the interior.

## METHODS

### *Study site*

Water samples were obtained from the Clavellinas (13.13 ha), Tlalixcoyan (1,192 ha), La Flota (206.37 ha), Tacosta (86.21 ha), Sontecomapan (503.03 ha), Pajarillos (746.33 ha), Las Pintas (483.29 ha), and Alvarado (4,895.43 ha) lagoons. They all have been the object of several studies (e.g. Contreras E. and Castañeda L., 1995; Sauceda-Rodríguez, 1998; Sauceda-Rodríguez and Juárez-Eusebio, 1998; Contreras-Espinosa, 2010; Sauceda-Rodríguez and Silva-López, 2002; Gutiérrez-Mendieta, in prep.), especially as regards to the fishes and their physical-chemical parameters. The lagoons form part of the Alvarado Lagoon System, which is considered an area of critical importance by CIPAMEX, CONABIO (e.g., Arriaga-Cabrera et al., 1998, 2000), and the Ramsar Convention (Portilla-Ochoa et al., 2007). Several landscape units (LU) were recognized in the system (e.g., Silva-López, 2009); the Alvarado Lagoon forms part of the M1 (disturbed mangrove), while the remaining lagoons form part of the M2 (conserved mangrove) LU (Figure 1). The surrounding main vegetation type in the lagoons is the mangrove, with *Rizophora mangle*, *Laguncularia racemosa*, and *Avicennia germinans* as the dominant species, accompanied by small, dispersed populations of esparto (*Spartina spartinae;* pl. espartal), a halophyte and saline grass species. Other species present include: the palms *Sabal mexicana*, *Scheelea liebmannii*, and *Coccos nucifera*, near the few small villages; *Cyperus* sp. and *Typha dominguensis* as part of the aquatic flora; and *Pistia stratiotes* and *Eichhornia crassipes*, which in certain months of the year occur in massive concentrations on the water surface.

Analyses were conducted at the Analytic Resolution Support Services´ Unit from Universidad Veracruzana (SARA, by its initials in Spanish), at Xalapa, Veracruz, Mexico. Extractions using a liquid-liquid extraction method were performed on the water samples. Extraction was done by mechanical shaking with methylene chloride using the modified EPA 8270B SW-846 method (USEPA 1986). Extraction was carried out with a 50 mL aliquot of dichloromethane in a 1 L separatory funnel, and the process was repeated two more times with fresh solvent.

The extracts were concentrated by evaporating the solvent; a 1 mL final aliquot was collected for qualitative analysis with GC-MS in a gas chromatograph (Hewlett-Packard GCD PLUS G1800-B) and HP-5 capillary column (5%-phenyl)-methylpolysiloxane (30 m; 0.25 mm i.d.; 0.25 μm film thickness). Oven temperature was held at 50°C for 1.0 min, ramped to 280°C at 20°C/min and held for 1.0 min, a helium flow rate of 1.0 mL/min. Each component was identified on the basis of its retention time and by comparing its mass spectrum (70 eV) in the HP-Chemstation-NIST MS, versión A.00.00-1995 library.

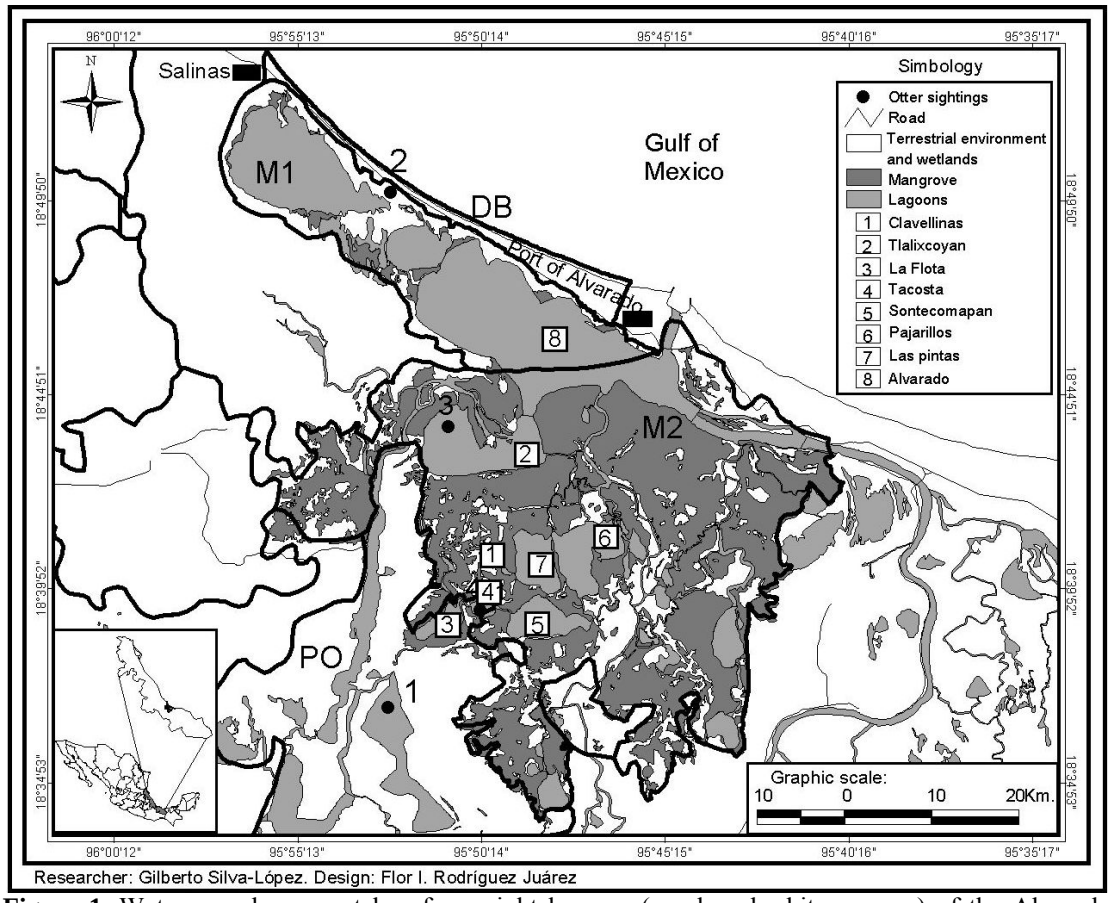


**Figure 1.** Water samples were taken from eight lagoons (numbered white squares) of the Alvarado Lagoon System. They all belong to the M1 (disturbed mangrove) and M2 (conserved mangrove) landscape units (base map modified from Silva-López, 2009).

## RESULTS AND COMMENTS

The compounds found in the samples included: 2-chlorocyclohexanol; phenylethylene glycol; benzophenone; ethanol-2-butoxyphosphate; styrene; *p*-xylene; ethylbenzene; *trans*-1,2-cyclohexanodiol; di-2-ethylhexyl phthalate; benzene acetaldehyde; hexadecane; tetracosane, docosane, triacontane; sitosterol; hexadecanoic acid; 1-eicosanol; chlorobenzene; and phosphorothioic acid trimethyl ester. These compounds may enter the environment through a wide variety of potential sources including water chlorination products, the disposal of products that contain them (*e.g.*, automotive antifreeze, as in the case of phenylethylene glycol), resins and herbicides, oil and gas byproducts, tints, insecticides, paints, softeners and plasticizers, fuels, latex, plastics, fats and fat removers, lubricants, cosmetics, and so on.

In reviewing sources of information on these compounds (*e.g.*, from the US Center for Disease Control and Prevention, the US Environmental Protection Agency,

and the European Chemical Bureau, and several papers), we noted a lack of data on their potential effects to wildlife. Information in these reports generally relates to the compounds´ effect on humans, with notes on test results performed on laboratory animals. Nevertheless, information gathered suggests some of these compounds may pose a threat to the otters and their prey. The Pesticide Action Network (http://www.pesticideinfo.org/Detail_Chemical.jsp?Rec_Id=PC35605) has indicated, for example, that the ethanol-2-butoxyphosphate, a compound that may survive treatment at water pollution control plants and at drinking water treatment plants (Henderson et al., 2001), may represent acute toxicity to humans and aquatic organisms. The toxicity of ethylbenzene has also been evaluated in laboratory experiments with the fathead minnow (*Pimephales promelas;* Cyprinidae), causing 50% mortality of the fish (Geiger et al., 1986). The European Food Safety Authority (EFSA, 2009) reported that liver and kidney were the primary target organs of benzophenone toxicity in rats and mice, causing liver adenomas in the mouse and a spectrum of adverse kidney adenoma responses in rat, including hyperplasia and nephropathy. It has been observed that exposure to environmental estrogens (endocrine disruptive chemicals) such as styrene may directly disrupt the male mice reproductive tract around the pubertal period (Takao et al., 2000). While some investigations suggest the actual adverse effects of several compounds can be debated (*e.g.*, Brown et al., 2000), information reviewed suggests more detailed studies regarding the assessment of the risk from exposure to these compounds are warranted.

Among the species that could be potentially affected by these compounds are some animals reported as prey to the otters at other sites (Gallo-Reynoso, 1997; Santiago-Plata et al., 2007; Platt and Rainwater, 2011; Gallo-Reynoso, 2007), all of which have been reported at the Alvarado Lagoon System (*e.g.*, Raz-Guzmán et al., 1992; Sauceda-Rodríguez et al., 1994; Altamirano-Álvarez et al., 1995; Guzmán-Guzmán, 1998; Cruz-Carretero and Ruelas-Inzunza, 1998)

Previous reports underline the importance of studies on the effects of contaminants to the otter and its aquatic habitat (*e.g.*, Gutleb et al., 1993; Mason, 1993; Röchert, 1989). In our assessment, the detection of ethanol-2-butoxyphosphate, styrene, ethylbenzene, and benzophenone, among others, suggest the threats to the aquatic habitat of the *perro de agua* (local name of the otter) in these landscape units of the lagoon system could be more diverse than expected (e.g., Guentzel et al., 2007). The wide number of different compounds detected needs follow-up; industrial products and byproducts could be harmful to habitat quality in the short-, mid-, and long-term, and they are appearing in the Alvarado Lagoon System at low human population levels (i.e., density of 11.76 inhabitants/km$^2$ in the M2 LU; Silva-López et al., 2010).

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## RÉSUMÉ

## UNE ÉVALUATION QUALITATIVE DES HABITATS AQUATIQUES DE *Lontra longicaudis annectens* À ALVARADO, MEXIQUE.

Une étude prospective de laboratoire sur la base des expériences de la USEPA SW-846 a permis de détecter des composés organiques dans l'habitat aquatique de la loutre de rivière Néotropicale (*Lontra longicaudis annectens*), dans le réseau lagunaire d'Alvarado, dans l'Etat de Veracruz au Mexique. Les composés ont été identifiés comme étant: le 2-clorociclohexanol, le phényléthylèneglycol, la benzophénone, le 2-butoxy-1-phosphatoéthanol, le styrène, le *p*-xylène, le *trans*-1,2-ciclohexanediol, le 2-éthylhexylphtalate, le 2-phénylacéthaldéhyde, le *n*-hexadecane, le n-tétracosane, le docosane, le *n*-triacontane, le sitostérol, l'acide hexadecanoïque, le 1-éicosanol, le chlorobezène et triméthylester de l'acide phosphorothioïque. La consultation d'études sur cette question a révélé un manque de données sur les effets potentiels de ces composés dans la vie sauvage, bien que certains puissent être considérés comme nuisibles aux loutres et à leurs proies. L'étude des composés détectés doit être poursuivie.

## RESUMEN

## UNA VALORACIÓN CUALITATIVA DE LOS HÁBITATS ACUÁTICOS DE *Lontra longicaudis annectens* EN ALVARADO, MÉXICO.

Un estudio prospectivo de laboratorio que siguió los métodos de prueba de la USEPA SW-846 hizo posible la detección de compuestos orgánicos en el hábitat acuático de la nutria de río Neotropical (*Lontra longicaudis annectens*), en el Sistema Lagunar de

Alvarado, Veracruz, México. Los compuestos detectados incluyeron al 2-clorociclohexanol; feniletilenglicol; benzofenona; etanol-2-butoxifosfato; estireno; *p*-xileno; etilbenceno; *trans*-1,2-ciclohexanodiol; di-2-etilhexil ftalato; acetaldehido benceno; hexadecano; tetracosano, docosano, triacontano; sitosterol; ácido hexadecanoico; 1-eicosanol; clorobenceno; y el trimetil éster del ácido fosforotioico. La revisión de literatura mostró una falta de datos sobre los efectos potenciales de estos compuestos en la vida silvestre, aunque algunos podrían ser considerados dañinos para las nutrias y sus presas. Los compuestos detectados deben seguir siendo estudiados.