# Occurrence of Pacific White Shrimp in Lower Laguna Madre, Texas

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*Abstract:* Current Texas law allows the culture of exotic and native penaeid shrimp in private waters under provisions of a Texas shellfish culture license. Because of superior growth and survival characteristics exhibited under pond culture conditions, the Pacific white shrimp (*Penaeus vannamei*) has emerged as the primary penaeid shrimp commercially cultured in Texas. Recently, shrimp believed to be Pacific white shrimp were collected by commercial shrimpers in the Brownsville, Texas, ship channel. These specimens were morphologically and biochemically compared to native northern white shrimp (*P. setiferus*) and to Pacific white shrimp from 2 sources: the Parita Gulf, near Panama City, Panama, and commercial rearing ponds, Palacios, Texas. Comparison of morphometric and meristic characteristics and soluble protein profiles isolated by isoelectric focusing confirmed the identification of these shrimp as Pacific white shrimp. Because these are exotics, investigations into potential ecological and economic impacts of the introduction into Gulf of Mexico waters are needed.

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The penaeid shrimp fishery is the most valuable commercial fishery in Texas. The fishery relies primarily on 3 species: brown shrimp (*Penaeus aztecus*), pink shrimp (*P. duorarum*), and white shrimp (*P. setiferus*). Consumer demand for shrimp both for food and bait has prompted extensive research into native and non-native penaeid shrimp culture (Latapie et al. 1972, Chamberlain and Lawrence 1983, Lawrence et al. 1985). Current Texas law allows culture of native and non-native penaeid shrimp in private waters by holders of a shellfish culture license and exotic shellfish culture permit (State of Texas 1990). The Pacific white shrimp (*P.*

*vannamei*) reportedly exhibits superior growth and survival over native species and has emerged as the primary aquaculture species in Texas. Pacific white shrimp are typically distributed in the eastern Pacific Ocean from northern Peru to Sonora, Mexico (Holthuis 1980).

Occurrence of exotic penaeids among geographic populations of native U.S. species has been reported: the Asian tiger prawn (*P. monodon*) and Pacific white shrimp have been reported in Georgia and South Carolina coastal waters. The occurrence of both species was attributed to release from mariculture facilities (Smith 1988, S.J. Hopkins pers. commun.). There are 7 facilities in Texas currently licensed to culture the Pacific white shrimp or other exotic shrimp. Five of these facilities are located adjacent to Texas coastal waters making inadvertent escape a distinct possibility.

Passage of Texas State Senate Bill 1507 and subsequent rules adopted by the Texas Parks and Wildlife Department (TPWD) Commission mandate the verification of occurrences of non-native species in Texas' public waters (TPWD Comm. Agenda Item 1989). Recently an unknown species of shrimp was reportedly collected by commercial bait shrimpers in the lower Laguna Madre, Texas. Research was initiated by the TPWD to verify this occurrence.

Similarities in coloration and morphology of native white shrimp and the unknown specimens necessitated a more accurate means of identification. Proteins isolated by isoelectric focusing have proven useful for fisheries management and law enforcement agencies as a means of identifying unknown species (Lundstrom 1977, 1979; Whitmore 1986). The objective of the present study was to morphologically and biochemically identify an unknown shrimp species found in Texas public waters to document its occurrence as required by TPWD Commission regulations (TPWD Comm. Agenda Item 1989).

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## Methods

### Specimen Collections

Unidentified shrimp were reportedly collected by commercial bait shrimpers in the Brownsville, Texas, ship channel during 1988 and 1989. Shrimp were given to Don Hockaday (Univ. Texas-Pan American, Coastal Studies Lab, Isla Blanca Park, South Padre Island) who forwarded the specimens to the TPWD. Native white shrimp ($N = 30$) used for comparative evaluation with the unknown specimens ($N = 10$) were collected from Matagorda Bay, Texas, using bag seine or trawl. Wild Pacific white shrimp ($N = 10$) used as control samples were collected by shrimp trawl from the Parita Gulf, near Panama City, Panama. Other control specimens ($N = 6$) were received from operators of a shrimp farm near Palacios, Texas.

### Identification

Shrimp were identified to species using the dichotomous key of Perez Farfante (1988). Sex and total length (mm) were determined for each specimen.

Shrimp subjected to biochemical analysis were placed on ice or frozen at 0 C and transported to the Perry R. Bass Marine Fisheries Research Station, Palacios, Texas, for processing. Muscle tissue was excised from lateral musculature of the first abdominal segment of thawed specimens. Tissues (diluted 1:1, deionized water: tissue) were homogenized and centrifuged at 10,000 rpm for 10 minutes at 4 C. The resulting supernatant was stored at −80 C until analysis.

Isoelectric focusing was performed on 0.25-mm polyacrylamide gels consisting of 2 ml of 29.1% (wt/vol) acrylamide and 0.9% N,N'–methylenebisacrylamide, 1.0 ml of ampholytes (0.8 ml pH 4–5, 0.2 ml pH 3–10; Serva Biochemicals, Westbury, N.Y.), 4.2 ml of deionized water and 0.8 ml glycerol. Gel solutions were degassed for 5 minutes. After aspiration, 50 $\mu$l of 10% TEMED were added to the gel solution. Polymerization was initiated by addition of 50 $\mu$l of 10% ammonium persulfate. The gel solution was then poured onto a GELBOND PAG film (FMC Bioproducts, Rockland, Minn.) placed on the lower section of a gel mold. The gel was allowed to polymerize for 1 hour.

Electrode strips were soaked in 0.5 M acetic acid (anolyte) and 1.0 M sodium hydroxide (catholyte). Electrode strips were placed parallel to each other at opposite edges of the gel corresponding to the electrodes on the appartus.

Isoelectric focusing was carried out using an LKB 2117 Multiphor II electrofocusing apparatus powered by an LKB 2197 power supply, thermoelectrically cooled by an LKB 2219 Multitemp II thermostatic circulator (Pharmacia LKB Instruments, Gaithersburg, Md.). The gel was placed on the cooling platform over a thin layer of Triton X-100 (Pharmacia LKB Instruments) to ensure appropriate thermal conductance; focusing was performed at 10 C. Current (mA) was adjusted until a starting voltage of 200 volts was achieved; final voltage was limited to 1200 volts. Initial power was set at 4 watts. Gels were prefocused for 20 minutes to ensure establishment of a consistent pH gradient and to rid the gel of excess TEMED and ammonium persulfate. Protein extracts were loaded onto a sample application mask (2 $\mu$l capacity; Pharmacia LKB Instruments) and focused 20 minutes at which time the mask was removed. The gel was then focused until no decrease in resistance (mA) was observed for 15 minutes (approximately 3.5 hours).

After completion of the run, gels were fixed for 5 minutes in a solution of 4% sulfosalicylic acid and 12.5% trichloroacetic acid. Following fixation, gels were placed in a 50 ml wash solution consisting of 40% methanol and 10% glacial acetic acid for 5 minutes. Protein phenotypes were stained with a 5% Coomassie Blue R-250, 40% methanol, and 10% glacial acetic acid solution for 10 minutes. Gels were destained in wash solution until the background cleared. Gels were allowed to air dry.

Gels were scanned utilizing an Ultroscan XL Laser Densitometer employing LKB GelScan 2.0 software (Pharmacia LKB Instruments). Species were distin-

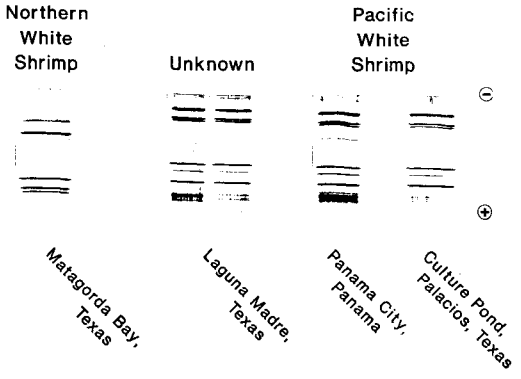


**Figure 1.** Protein banding patterns of northern white shrimp (*Penaeus setiferus*), unknown shrimp, and Pacific white shrimp (*P. vannamei*) subjected to isoelectric focusing in a high resolution (pH 4–5) acrylamide gel.

guished from one another by careful examination of protein profiles for shared and unique bands.

## Results and Discussion

Unknown specimens collected in Texas marine waters were morphologically and biochemically verified as Pacific white shrimp (*Penaeus vannamei*) (Perez-Farfante 1988). Pronounced differences existed between unknown and native female white shrimp; they were distinguished using structural differences in thelyca.

Isoelectric focusing of soluble muscle proteins permitted accurate identification of the 2 penaeid species (Fig. 1.). Muscle protein patterns were unique (diagnostic) for each species; the Pacific white shrimp (including the unknowns) exhibited numerous bands in the cathodal region of the gel which were absent in the native white shrimp. Densitometric scannings of gels further illustrated band location and absorbance differences between native white and Pacific white shrimp, as well as the correspondence between the unknown and Pacific white shrimp from Panama and a culture pond (Fig. 2).

Prior to this discovery there are no documented releases of Pacific white shrimp in coastal waters of Texas. However, subsequent to the initiation of the present study, samples of an unknown penaeid shrimp reportedly collected from sites in Matagorda Bay, Texas, have also been morphologically and biochemically verified as Pacific white shrimp (TPWD unpubl. data).

There are 3 possible sources of the Pacific white shrimp captured in the lower Laguna Madre. Two mariculture facilities are established in the vicinity: 1 is located adjacent to the capture site, the other approximately 16 km north. The unknown shrimp could have escaped from a Mexican culture facility. This seems unlikely, however, since the nearest known facility is located near La Pesca, Mexico, some 200 nautical kilometers from lower Laguna Madre, Texas.

Ecological and economic impacts of exotic penaeids introduced into wild populations are unknown. Interspecific hybridization with native species appears

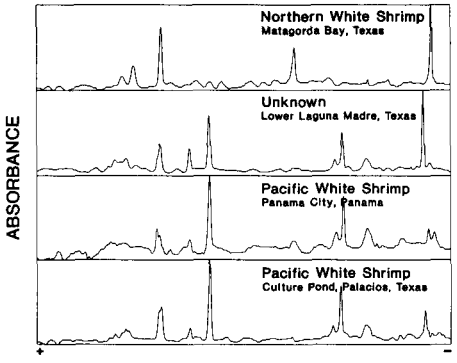


**Figure 2.** Densitometric tracings of sarcoplasmic proteins illustrating diagnostic banding patterns among white shrimp (*Penaeus setiferus*), unknown shrimp, and Pacific white shrimp (*P. vannamei*) subjected to isoelectric focusing in a pH 4–5 gradient. Band intensity is indicated by relative peak height. Migration distance is relative to anode (+) electrode strip.

unlikely (Bray et al. 1990); however, the potential for other ecological interactions (i.e., competition, disease transmission) exists and should be investigated.

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