Rangia and Marsh Clams, *Rangia cuneata*, *R. flexuosa*, and *Polymesoda caroliniana*, in Eastern México: Distribution, Biology and Ecology, and Historical Fisheries

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Introduction

People have gathered Rangia and marsh clams along the eastern México coast (Fig. 1) since prehispanic times. The clam species are almeja gallo or rooster clam, *Rangia cuneata*; almeja casco or helmet clam, *R. flexuosa;* and almeja negra o prieta or black clam, *Polymesoda caroliniana* (Fig. 2). They form the basis for the most important clam fishery on this coast. Next to them in importance is the southern quahog, *Mercenaria campechiensis* (MacKenzie et al., 2002). *Rangia cuneata* is the principal species targeted by fishermen and has the highest economic value. *Rangia flexuosa* and *P. caroliniana* at times are targeted for harvesting, but many are retained for sale when harvested with *R. cuneata* (Ruiz, 1975; Baqueiro and Echevarría, 1997).

This paper describes the distribution, biology, and ecology of the Rangia and marsh clams as well as their harvests and marketing as food. The information was obtained from the literature and by interviewing clam industry fishermen, processors, managers of cooperatives, and government technicians, and by photographing relevant scenes in the States of Tamaulipas, Veracruz, Tabasco, and Campeche during 2004 and 2005.

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ABSTRACT—Rangia and marsh clams, Rangia cuneata, R. flexuosa*, and* Polymesoda caroliniana*, occur in brackish waters along México's eastern coast from the northern State of Tamaulipas to the southern State of Campeche. The clams were important to the prehispanic people in the southern part of the State of Veracruz, where they were used as food and as construction material. In modern times, they are harvested for food. The fishermen wade in shallow water and harvest the clams in soft sediments by hand. Annual landings of whole clams during a recent 5-yr period, 1998–2002, were 1,139–1,695 t. The only area with a substantial ongoing clam fishery is in the Lower Papaloapan River Basin, including Alvarado Lagoon, where as many as 450 fishermen are licensed harvesters. This fishery for the Rangia and marsh clams is the most important clam fishery along México's Gulf Coast.*

Distribution, Biology, and Ecology

Rangia cuneata ranges from Chesapeake Bay, Maryland, to México's Terminos Lagoon, and *R. flexuosa* is found from Louisiana to Terminos Lagoon, while *P. caroliniana* ranges from Virginia to the State of Campeche (Abbott, 1974; Ruiz, 1975). The two *Rangia* species and *P. caroliniana* are present in at least 16 estuaries along México's Gulf Coast from the States of Tamaulipas to Campeche (Table 1). Their main production area is in the Alvarado Lagoon and other small lagoons and channels that are part of the lower Papaloapan River area. Minor harvesting takes place in the Mezcalapa Lagoon and Tamiahua Lagoon, both in Veracruz (Echeverria et al., 2002).

Rangia cuneata and *P. caroliniana* have about the same shell length, 3–7 cm, when harvested, while *R. flexuosa* is smaller, 2.5–4 cm (Garcia-Cubas, 1981). Their valves are hard, subtriangulate, and inequilateral; their color ranges from black to light brown or yellowish. Their periostracum is fibrous and is usually eroded near the umbos which have a salmon-pink color. The shell interior is bluish white and the dorsal part is pinkish, sometimes with purple spots. The pallial line is tenuous (Garcia-Cubas, 1981). In *R. cuneata*, the posterior lateral tooth is long (LaSalle and De la Cruz, 1985). *Rangia flexuosa* is easily distinguished from *R. cuneata* by its short posterior lateral tooth (Garcia-Cubas, 1981). The three species occur in brackish waters. *Rangia cuneata* is most common in areas with salinities from 5–15‰ (Swingle and Bland, 1974). Its habitats have high water turbidity and soft substrates that consist of a mixture of sand, mud, and vegetation (Tarver, 1972). Its highest concentrations are in shallow areas less than 6 m deep. A decrease in density has been observed as depth increased from 2.5 to 4.6 m (LaSalle and De la Cruz, 1985). The two *Rangia* species inhabit subtidal zones, whereas *P. caroliniana* occurs in intertidal areas and in relatively small numbers in the shallow nearshore areas.

The feeding of *R. cuneata* and *P. caroliniana* is suspensivore and saprophytic, while *R. flexuosa* is microphagous, suspensivore, and saprophytic (Olsen, 1973, 1976; Garcia-Cubas, 1981). *Rangia cuneata* appears to obtain organic matter

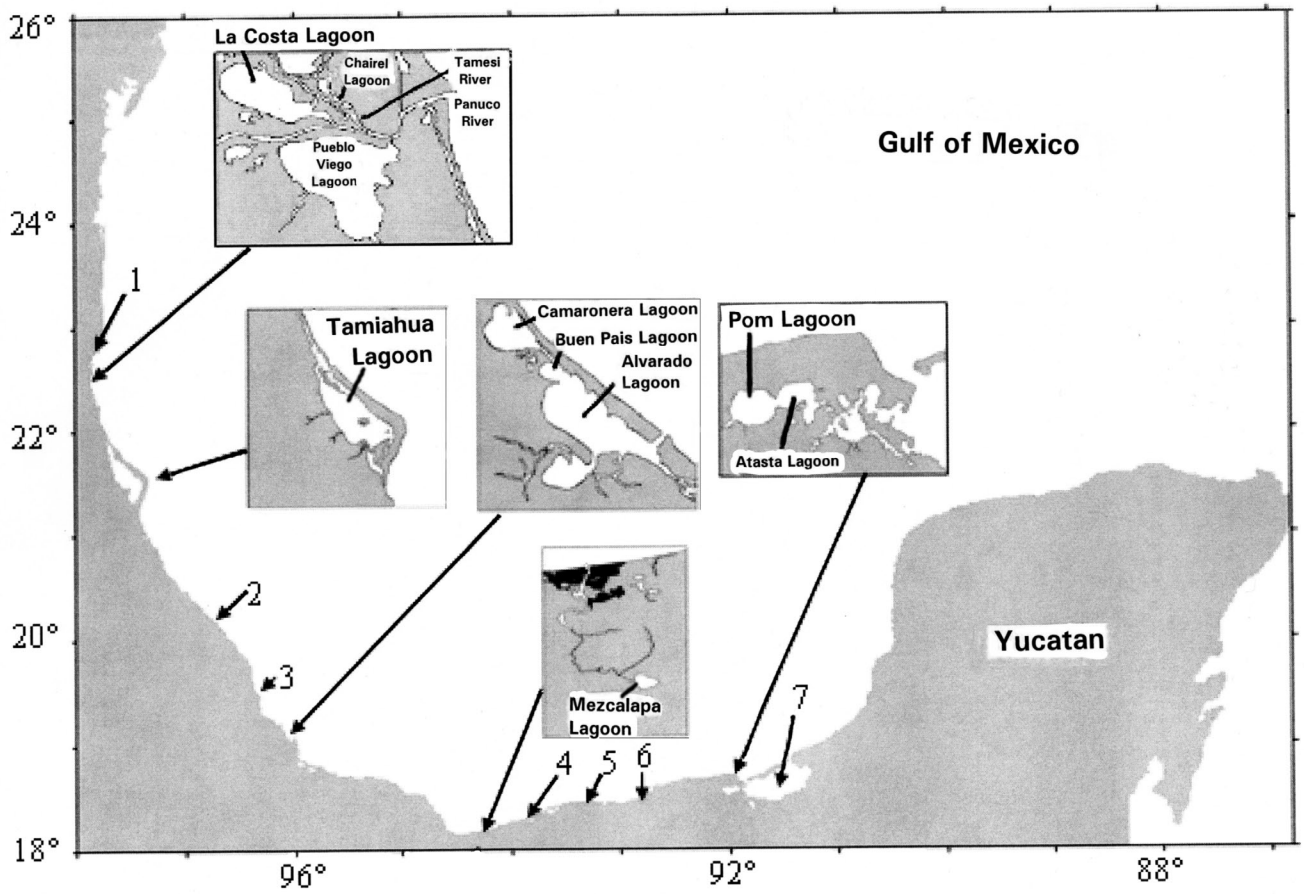

Figure 1.—Locations where Rangia and marsh clams are most abundant in eastern México. The numbers refer to the following lagoons: 1) San Andres Lagoon, 2) Grande and Chica Lagoons, 3) La Mancha Lagoon, 4) Carmen and Machona Lagoons, 5) Tupilco Lagoon, 6) Mecoacan Lagoon, and 7) Terminos Lagoon.

and phosphate from sediments by direct ingestion or by feeding on bacteria associated with the materials (Tenore et al., 1968).

In some zones of the Alvarado Lagoon, the mean density of *R. cuneata* was about 29/m^2; *R. refluosa*, 34/m^2; and *P. caroliniana*, 15/m^2 (Morales and Cruz Suáres, 2000). In Mezcalapa Lagoon, the *R. cuneata* density was 15/m^2 and *P. caroliniana* was 15/m^2 (Morales, 2004). The densities are lower than those reported in the United States, where harvesting does not occur: *R. cuneata* had a density of 26/m^2 in Lake Pontchartrain, Louisiana (Abadie and Poirrier, 2000); and 100/m^2 in a Mississippi marsh (Duobinis-Gray and Hackney, 1982). The lower densities in México may be due to commercial harvesting there.

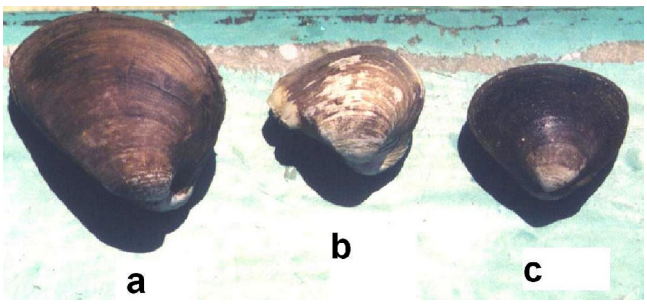

Figure 2.—A) Rooster clam, *Rangia cuneata*; B) helmet clam, *Rangia flexuosa*; and C) black clam, *Polymesoda caroliniana*. Photograph by Armando T. Wakida-Kusunoki.

In Alvarado Lagoon, *R. cuneata* spawn year-round, but mostly from February–July (Echeverria and Rodriguez, 1993). In Pom Lagoon, Campeche, where temperatures range from 22.0 to 30.5°C and salinities in summer are from 0 to 3‰, their spawning is during February–June and September–November (Rogers and Garcia-Cubas, 1981; Ortega-Salas, 1992).

During the summer rainy season, fresh water from coastal swamps enters Alvarado Lagoon and can reduce the salinity to nearly zero causing some of the clams to die (Garcia[1]). The epibiota on any clam shells lying on sediment surfaces include mollusks, barnacles, and tubicular polychaetes.

In México, *R. cuneata* is preyed upon by fish, including blue catfish, *Ictalurus furcatus;* freshwater drum, *Aplodinotus grunnieus;* spot, *Leiostomus xanthurus;* and also blue crabs, *Callinectes* spp., river shrimp, *Macrobrachium* spp., gastropods (including moon snails, *Polinices* spp.), and ducks, family: Anatidae. Within its overall range in the United States and México, *R. cuneata* is eaten by at least 17 fish species, 2 crab species, 2 gastropod species, and 8 duck species (references cited in LaSalle and De la Cruz, 1985).

Table 1.—Méxican lagoons where brackish water clams are reported.

State/lagoon	Brackish water clams	References
Tamaulipas		
San Andres	PC[1]	Covarrubias, 1988; Garcia-Cubas et al., 1990a
Chairel and Tamesi River	PC	Personal observation
Veracruz		
La Costa	PC	Segura, 1980
Pueblo Viejo	RF[2], PC	Reguero and Garcia-Cubas, 1993
Tamiahua	RC[3], RF	Garcia-Cubas, 1978; Gomez, 1984; Arroyo et al., 1985; Arroyo and Ortega, 1987; Portilla,1989; Echeverria et al., 2002
Tampamachoco	RF, RC	Reguero et al., 1991; Flores and Garcia-Cubas, 1986
La Mancha	RF	Flores-Andolais et al., 1988
Chica and Grande	RF	Garcia-Cubas et al., 1992
Camaronera	RF, RC	Reguero and Garcia-Cubas, 1991
Alvarado	RF, RC, PC	Reguero and Garcia-Cubas, 1989; Echeverria et al., 2002
Sontecomapan	RC, RF	Garcia-Cubas and Reguero, 1995
Mezcalapa	RC, PC	Echeverria et al., 2002; Morales, 2004
Tabasco		
Carmen-Machona	RF, RC, PC	Antoli and Garcia-Cubas, 1985
Tupilco-Ostón	RF	Garcia-Cubas and Reguero, 1990
Mecoacan	RF, RC	Garcia-Cubas et al., 1990b
Campeche		
Terminos system: Pom, del Este, Balchacan, and Panlau	RC, RF, PC	Garcia-Cubas, 1981

[1] PC=*Polymesoda caroliniana.*
[2] RF=*Rangia flexuosa.*
[3] RC=*Rangia cuneata.*

Historical Uses

Prehispanic people in southeastern México used the meats of the clams for food and their shells as construction material (Stark, 1977, 2001; Stark[2]). Ethnographers have noted the use of the clams as the primary material of cement in southern Veracruz (Stark[2]). Jimenez Badillo (1991) found evidence that the shells of *R. flexuosa* and *P. caroliniana* were carried inland and used as offerings in the Templo Mayor (main temple) of Tenochtitlan (prehispanic México City).

In recent decades, the clams have been harvested at least lightly along the entire coast from Laguna Madre in Tamaulipas to Terminos Lagoon in Campeche (Baqueiro and Echevarría, 1997), but currently nearly 99% of the commercial landings are from Alvarado Lagoon. In the early 1980's, Pom Lagoon, Campeche, was the major clam producing area, but its stocks have declined in abundance. Sediments in Pom Lagoon range from silty sand to silty clay.

In Pom Lagoon, clams were harvested from boats with scrape (dip) nets, which consisted of a wooden pole 3–5 m long that had at one end a rectangular metal frame with attached mesh bag. The frame was 50 cm wide and 20 cm high; the mesh size was 1.5 cm (Fig. 3). To gather the clams, the fishermen anchored their boats, and pushed their scrape nets 10–15 cm into the soft bottom, then pulled the nets toward themselves through the sediments, lifted the nets, rinsed out the sediments, and finally brought them into the boats and emptied the clams into containers (Fig. 4, 5).

Figure 3.—Fisherman with scrape net for harvesting Rangia and marsh clams in Pom Lagoon, Campeche, 1985. Photograph by Victor A. Rivera Roman.

After the fishermen harvested like this for several years, the clams became scarcer. To maintain their catches, the fishermen modified their method by pushing the scrape nets into the bottom sediments, tying the end of the poles to their boats, and dragging them behind

[1] Garcia M., S. Clam fisherman, Alvarado, Veracruz. Personal commun., July 2004.

[2] Stark, B. L. Professor, Arizona State University, Personal commun., March 2004.

Figure 4.—Fishermen harvesting Rangia and marsh clams with scrape nets in Pom Lagoon, Campeche, 1985. Photograph by Victor A. Rivera Roman.

Figure 6.—The plastic box is supported at the water surface by Styrofoam and is nearly full of Rangia and marsh clams, Alvarado Lagoon. Rubber balloons cover the fisherman's fingers. Photograph by Armando T. Wakida-Kusunoki.

Figure 5.— Fishermen in Pom Lagoon unloading their Rangia and marsh clams, 1985. Photograph by Victor A. Rivera Roman.

for several minutes to fill the nets with clams (Baqueiro and Echeverria, 1997). In 1981, about 310 people harvested *R. cuneata* in Campeche (Uribe-Martinez, 1983). Since the middle of the 1990's, the State of Veracruz has far exceeded Campeche in clam landings.

Current Harvesting Gear and Methods

About 450 people are licensed to harvest clams in Alvarado Lagoon (personal commun. SAGARPA). The numbers who actually harvest in any one day are undocumented. Most harvesters are men, 18–50 years old, but some women and children harvest also. Nearly all clam fishermen work individually, as few belong to cooperatives. They have relatively low incomes, about 200 pesos (US$18.75)/day.

Fishermen go to and from the Alvarado Lagoon harvesting beds in wood and fiberglass boats. The boats, about 7.6 m long, are propelled by 45–60 hp outboard motors, and each carries up to nine fishermen. Clam buyers share boat expenses (costs of motors and fuel) with the fishermen.

Fishermen know the locations where each of the clam species is most abundant, and they harvest the species requested by the buyer. Harvests are by hand picking. The fishermen cover their fingers with small latex balloons to protect them against cuts from shells (Fig. 6). They leave their boats to wade in the water and feel for the clams in the bottom sediments with their fingers (Fig. 7). The clams are placed in floating plastic boxes tethered with a thin line to the clammers' waists (Fig. 8). They harvest each day for about 5 h (usually from about 9 a.m.–2 p.m.). Each gathers about 60 kg (1,500 clams)/day (Garcia[1]). Fishermen sort the clams, putting the *R. cuneata*, *R. flexuosa*, and *P. caroliniana* into separate bags on board the boats before they arrive ashore (Fig. 9, 10, 11). The largest harvests are between September and February. They decrease after the lenten season, because the demand for clams falls.

In the De La Costa Lagoon, Tamesi River, and Chairel Lagoon near Tampico, Tamaulipas, two or three fishermen harvest clams for sale (Fig. 12, 13). In this area, the most common species harvested is *P. caroliniana*.

Landing Statistics

Official statistics gathered by México's Federal government lump together all the clam species[3] (Mackenzie et al., 2002), and therefore landings of the different species of brackish water clams cannot be determined (Fig. 14). Pech et al. (1995) reported that the landings composition in Alvarado Lagoon were about 50% *R. cuneata*, 33% *R. flexuosa,* and 17% *P. caroliniana*. During the period 1985–2002, annual production of clams ranged from 624 to 2,945 t, with an average of 1,299 t. Campeche landings fell from 1,389 t/year to less than 100 t/year from 1985 to 2002, while Veracruz landings increased from an average of 377 t/year during 1985–1988 to 1,389 t/year during 1990–1992.

The production decline in Campeche may have been caused by increased harvest owing to the Méxican govern-

[3] CONAPESCA. 2002. Anuario estadistico de pesca. SAGARPA (Secretaria de Agricultura, Ganaderia, Desarrollo Rural, Pesca y Alimentación). http://www.sagarpa.gob.mx/conapesca/planeacion/anuario2002.

Figure 7.—Harvesting Rangia and marsh clams in Alvarado Lagoon. Photograph by Armando T. Wakida-Kusunoki.

Figure 8.—Floating box full of Rangia and marsh clams, Alvarado Lagoon. Photograph by Armando T. Wakida-Kusunoki.

Figure 9.—Sorting the species of Rangia and marsh clams, Alvarado Lagoon. Photograph by Armando T. Wakida-Kusunoki.

Figure 10.—Fishermen unloading their harvests of clams, Alvarado Lagoon. Photograph by Armando T. Wakida-Kusunoki.

ment raising harvest quotas from 20 to 34 t/week. The market-sized clams may have been depleted. Besides harvesting, though, environmental changes that resulted from bottom dredging when a gas pipeline was installed in the Pom Lagoon may have been partly responsible for the reduced abundance of the clams in Campeche (Solis-Ramirez, 1994; Baqueiro and Echeverria, 1997). Similar abundance declines of *R. cuneata* occurred in other estuaries where shell dredging or construction and improvements of deepwater navigation channels have taken place (Harrel, 1993; Abadie and Poirrier, 2000).

Marketing

Rangia and marsh clams have a muddy taste and thus people do not eat them often. Fishermen's families eat them about once a week. The clams are prepared in soups containing boiled rice and in cocktails (Garcia[1]). The soups may also include blue crabs, shrimp, oysters, fish, or squid, besides the clams. This is a traditional food preparation in Alvarado and has the name, "arroz a la tumbada."

Nearly all the harvested clams are trucked to México City, while small quantities are distributed to markets in Veracruz City and in towns nearby in Veracruz (Morales[4]). Brackish water clams are sold in the shell by weight. Buyers prefer *R. cuneata* with shell lengths of 2–5 cm. In 2004, buyers paid fishermen 8.00–10.00 pesos (US$0.70–0.86)/kilo(25–30 clams) for *R. cuneata* and 1.50–2.00 pesos (US$0.13–0.17)/kilo(30–40 clams) for *R. flexuosa* and *P. caroliniana* (20–30 clams). The clams are sold in food markets and outdoor fish markets in México City. *Rangia cu-*

[4]Morales, R. Technician, Centro Regional de Investigación Pesquera, Veracruz. Personal commun., July 2004.

Figure 11.—Hut where fishermen keep their bags of Rangia and marsh clams, Alvarado Lagoon. Photograph by Armando T. Wakida-Kusunoki.

Figure 12.—Fisherman rinsing mud and sand from his Rangia and marsh clams, Tamesi River, Tamaulipas. Photograph by Armando T. Wakida-Kusunoki.

Figure 13.—Fisherman unloading his daily harvest of Rangia and marsh clams, Tamesi River, Tamaulipas. Photograph by Armando T. Wakida-Kusunoki.

neata are sold to the wholesale trade for 18.28 pesos (US$1.60)/kilo whereas *R. flexuosa* and *P. caroliniana* sell for 7.15 pesos (US$0.62)/kilo (Anonymous[5]). In public markets, *R. cuneata* frequently sell for 18–25 pesos (US$1.55–2.20)/kilo, while *R. flexuosa* and *P. caroliniana* sell for 6–9 pesos (US$0.68–0.70) (SIIM, 2004). In markets in Ciudad Del Carmen, Tabasco, and Veracruz City, marsh clams sell for 11.1–13.9 pesos (US$0.90–1.25)/kilo. The price of a typical plate of seafood soup with rice, including four clams with other fish products, is about 60 pesos (US$5.22) in a restaurant in the city of Alvarado, Veracruz. The clams are used also in preparing "paella," a traditional Spanish-culture dish.

Future Prospects

The México Government increased its financial support of fishermen groups to carry out development projects beginning in 2003. Clam fishermen are encouraged to propose ideas and marketing strategies to increase their incomes. The goal is to improve economic conditions in the fishing villages.

More information is needed about the ecology of the brackish water clams as an aid in increasing and maintaining their production. Future research should concentrate on a better understanding of 1) conditions surrounding recruitment, 2) predation upon the clams, and 3) the ecological requirements of each clam species. Clam production might be increased by making population-abundance surveys in all the coastal lagoons, to determine whether high abundances of clams are present in them.

Southern Quahog Fishery

Southern quahogs also occur in some of the same estuaries as the Rangia and marsh clams, but only in high salinity areas (MacKenzie et al., 2002). They are most abundant in Laguna Madre, Tampamachoco Lagoon, Carmen Lagoon, Tupilco Lagoon, Mecoacan Lagoon, Terminos Lagoon, and near Isla Arena. They are harvested on a commercial scale mainly in Carmen Lagoon. Fishermen harvest them at wading depths. They feel for the quahogs with their feet, collect them by hand, and place them in plastic boxes that are floated by empty soda bottles and Styrofoam similar to those used in the Rangia and marsh clam fishery. Each fisherman

[5]Anonymous. 2004. Mollusks, cephalopods y rajas congealed. www.infopesca.org/libres/info10 2004/Moluscos.pdf

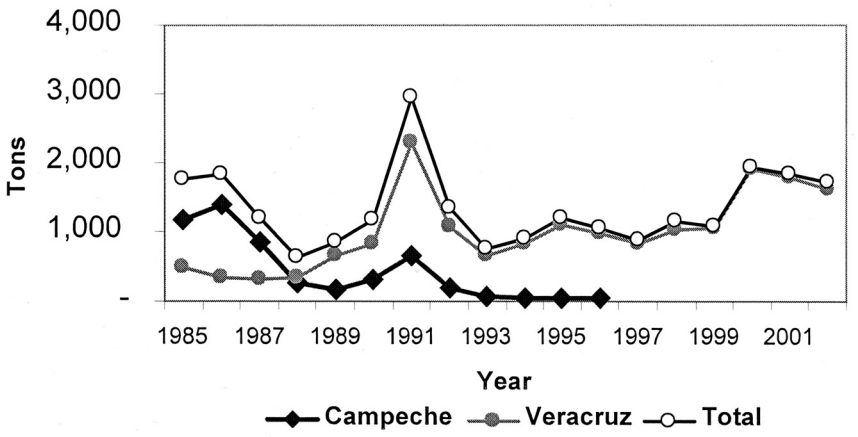

Figure 14.—Landings of clams (whole weight in tons) by state in eastern México (text footnote 3).

usually gathers 200–250 quahogs/day. The quahogs are sold whole and then shipped by truck on a small scale to various cities, where they usually are served in cocktails, in soups, or in their shells after being broiled.

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