# Blue Crab, *Callinectes sapidus*, Trap Selectivity Studies: Mesh Size

VINCENT GUILLORY and PAUL PREJEAN

## Introduction

Crab traps first appeared in Louisiana in the early 1950's and by the middle 1960's had replaced drop nets and trot lines as the dominant gear in the commercial blue crab, *Callinectes sapidus*, fishery (Guillory et al., 1996). Vinyl-coated 3.81 cm (1.5 inches) hexagonal or square mesh traps are currently used almost exclusively by commercial crab fishermen in Louisiana and along the Gulf of Mexico. There are, however, other commercially available wire meshes that could be used for crab traps. Mesh size selection is crucial because it determines the size composition of catch, and consequently the sublegal (<127 mm carapace width (CW)) to legal ratio. Unacceptable numbers of sublegal blue crabs will be retained if the mesh is too small; conversely, catch of legal blue crabs will be reduced if the mesh is too large.

A 10% tolerance of sublegal blue crabs is allowed in Louisiana (Guillory, 1996). The catch and subsequent sale of sublegal blue crabs have historically been a major enforcement problem in Louisiana. This problem has probably become even more prevalent in recent years because of several factors (Guillory, 1996): 1) increased fishing effort; 2) expansion of fishing areas into freshwater or shallow marsh habitats where sublegal blue crabs dominate; 3) adoption of traps constructed with 3.81 cm (1.5 inches) square mesh wire, which retains more sublegal blue crabs than the traditional hexagonal mesh wire traps; and, 4) removal of liability to dealers and processors of sublegal blue crab violations due to a change in legislative statutes.

Excessive undersize blue crab retention has been recognized since the introduction of traps (Green, 1952); however, research on blue crab trap efficiency (Isaacson, 1962; Eldridge et al., 1979; Guillory, 1989, 1990; Guillory and Merrell, 1993) has not considered mesh size. The objective of this study was to compare catch rates and sizes of blue crabs collected in traps with various mesh sizes and shapes.

## Methods

The study was conducted in the Terrebonne estuary, Terrebonne Parish, south-central Louisiana from March through July 1994. Shallow waters adjacent to emergent vegetation were sampled at four different sites: Houma Ship Channel (HSC), Bay Chaland (BC), Crooked Bayou (CB), and Lake Mechant (LM).

All traps were 60.9 cm (24 inches) in width and depth, 50.8 cm (14.5 inches) in height, and constructed of black vinyl-coated wire. Traps with 2.54 cm (1.0 inch) square mesh (2.54 SQ), 3.81 cm square mesh (3.81 SQ), 5.08 cm (2.0 inches) square mesh (5.08 SQ), 2.54 cm by 5.08 cm rectangular mesh (RECT), and 3.81 cm hexagonal mesh (HEX) were compared.

Traps were baited with approximately equal portions of fish and grouped in replicates when placed in the water. Traps were hauled approximately 24 hours after baiting. All blue crabs were measured in 10 mm CW size groups with reference to the minimum legal commercial size of 127 mm CW. Size group designations were the minimum value within the size range.

The inclusive dates, number of sampling runs (i.e. all traps fished for 24 hours), and number of replicates of each trap for each area were: HSC, 3/17/95 to 3/30/95, nine trips, six replicates; BC and CB, 4/27/95 to 6/17/95, 16 trips, two replicates; and, LM, 6/29/95 to 7/21/95, 11 trips, four replicates.

All data summaries and statistical analyses were conducted using SAS (1988). Catch rates by number (blue crabs/trap-day) and mean carapace width by trap type were examined for significant differences ($P<0.05$) using the General Linear Models procedure.

A carapace width-weight regression equation developed by Guillory and

The authors are with the Louisiana Department of Wildlife and Fisheries, P.O. Box 189, Bourg, LA 70343.

*ABSTRACT—Catch rates and sizes of blue crabs,* Callinectes sapidus, *were compared in traps with 2.54 cm (1.0 inch), 3.81 cm (1.5 inches), and 5.08 cm (2.0 inches) square mesh, 2.54 by 5.08 cm rectangular mesh, and 3.81 cm hexagonal mesh. Catch of legal blue crabs by number was significantly greater in the traditional hexagonal mesh trap than in all other trap types. Sublegal catch by number was highest (34.1–63.3% of total) in the 2.54 cm and 3.81 cm square mesh and rectangular mesh traps and lowest in the 5.08 cm square mesh trap. The hexagonal mesh trap had significantly lower catch rates of sublegal blue crabs than all other trap types except the 5.08 cm square mesh. Mean size of blue crabs by trap type exhibited an inverse pattern to that shown by catch of sublegal crabs. The most effective trap to maximize legal catch and minimize sublegal catch was the 3.81 cm hexagonal mesh trap followed by the 5.08 cm square mesh trap.*

Hein (1995)[1] was used to convert blue crab size to weight. The average catch rate by number in each 10 mm size group was multiplied by the calculated weight at the midpoint of the size group to yield the average catch rate by weight. This method was considered adequate to compare pooled data without statistical evaluation for significant differences.

## Results

### Number and Weight of Crabs

Catch rate of legal blue crabs by number was greatest in HEX traps and lowest in 5.08 SQ and RECT traps (Table 1). Legal catch rate was significantly greater in HEX traps than in other traps; no other trap combinations were significantly different.

Sublegal catch rate by number was significantly greater ($P<0.0001$) in the 2.54 SQ trap and significantly lower ($P<0.0001$) in the 5.08 SQ trap than in other traps (Table 1). Sublegal catch rate was significantly lower ($P<0.0001$) in the HEX trap than in all traps except the 5.08 SQ trap. Sublegal catch rate in the 2.54 SQ, 3.81 SQ, and RECT traps ranged from 63.1 to 76.1% of the total (Table 2). The 5.08 SQ trap was the only trap with less than the allowable sublegal tolerance of 10%. The catch rate of sublegal blue crabs in the hexagonal mesh trap was reduced 46.2% from the 3.81 cm square mesh trap; these two traps are commonly used by commercial fishermen.

Overall catch rate by number varied significantly among all traps except the 3.81 SQ and RECT traps (Table 1). Highest numbers were taken in the 2.54 SQ trap and lowest numbers in the 5.08 SQ trap.

**Table 1.—Mean sublegal (SL), legal (L), and total (TOT) catch per effort by number (CPENO) and mean size (mm carapace width) by trap type and probability levels between trap types (2.54SQ, 3.81SQ, and 5.08SQ = 2.54, 3.81, and 5.08 cm square mesh; RECT = 2.54 by 5.08 cm rectangular mesh; HEX = 3.81 cm hexagonal mesh).**

| | | Trap Type | | | |
|---|---|---|---|---|---|
| Item | Mean | 3.81SQ | RECT | 5.08SQ | HEX |
| SL CPENO | | | | | |
| 2.54 SQ | 10.95 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| 3.81 SQ | 5.38 | | 0.2370 | 0.0001 | 0.0001 |
| RECT | 4.68 | | | 0.0001 | 0.0001 |
| 5.08 SQ | 0.16 | | | | 0.0066 |
| HEX | 1.86 | | | | |
| L CPENO | | | | | |
| 2.54 SQ | 3.43 | 0.6666 | 0.2970 | 0.6628 | 0.0174 |
| 3.81 SQ | 3.56 | | 0.1306 | 0.3729 | 0.0432 |
| RECT | 3.10 | | | 0.5315 | 0.0006 |
| 5.08 SQ | 3.29 | | | | 0.0043 |
| HEX | 4.23 | | | | |
| TOT CPENO | | | | | |
| 2.54 SQ | 14.38 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| 3.81 SQ | 8.93 | | 0.1477 | 0.0001 | 0.0007 |
| RECT | 7.78 | | | 0.0001 | 0.0385 |
| 5.08 SQ | 3.12 | | | | 0.0009 |
| HEX | 5.99 | | | | |
| SIZE | | | | | |
| 2.54 SQ | 112.0 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| 3.81 SQ | 122.9 | | 0.5027 | 0.0001 | 0.0001 |
| RECT | 122.1 | | | 0.0001 | 0.0001 |
| 5.08 SQ | 146.0 | | | | 0.0001 |
| HEX | 133.8 | | | | |

**Table 2.—Percent sublegals and catch per effort by weight (CPEWT) in grams by trap type (SL=sublegal, L=legal, TOT=total, 2.54SQ, 3.81SQ, and 5.08SQ = 2.54, 3.81, and 5.08 cm square mesh, respectively; RECT = 2.54 by 5.08 cm rectangular mesh; HEX = 3.81 cm hexagonal mesh).**

| | Trap Type | | | | |
|---|---|---|---|---|---|
| Item | 2.545Q | 3.81SQ | RECT | 5.08SQ | HEX |
| CPEWT-SL | 735.5 | 607.2 | 382.2 | 14.3 | 169.9 |
| CPEWT-L | 519.2 | 550.5 | 478.3 | 560.0 | 672.2 |
| CPEWT-TOT | 1,252.7 | 1,157.7 | 860.5 | 574.3 | 842.1 |
| Percent SL | 76.1% | 63.3% | 65.1% | 5.0% | 34.1% |

Statistical differences in sublegal and legal catch rates between traps within areas were similar to the pooled data, with the exception of LM, where no significant difference in legal catch rate was found between any trap. Since the lowest overall catch rates were also found at LM, the density of blue crabs may have been too low for trap saturation effects attributed to high densities of sublegal blue crabs (Guillory and Merrell, 1993) to influence catch rates of legal blue crabs.

The catch rates by weight by trap type are given in Table 2. Weight of legal blue crabs was highest (20% greater than any other trap) in the HEX trap, followed by the 5.08 SQ and 3.81 SQ traps. Overall weight was greatest in the 2.54 SQ and 3.81 SQ traps because of high numbers of sublegal blue crabs.

### Size

Mean size was significantly lower ($P<0.0001$) in the 2.54 SQ trap and significantly higher ($P<0.0001$) in the 5.08 SQ trap than other traps (Table 1). Mean size in HEX traps was significantly greater ($P<0.0001$) than other traps except the 5.08 SQ trap.

Catch per effort per size group for each trap are tabulated in Table 3. The modal peaks for each mesh type were 97 mm CW for the 2.54 SQ trap, 107 mm CW for 3.81 SQ and RECT traps, 127 mm CW for the HEX trap, and 137 mm CW for the 5.08 SQ trap. The size range of retained blue crabs was identical in all traps except the 5.08 SQ trap.

The HEX trap, the most common trap historically, was considered as a control to compare carapace width frequency distributions. Except for the 5.08 SQ trap, the carapace width frequency distributions for the experimental traps reflected higher retention in size groups below 127 mm CW and decreased catch rates above 127 mm CW. The 5.08 SQ trap yielded decreased catch rates of sublegal and small legal (127–136 mm CW) blue crabs and increased catch rates in larger blue crabs (≥137 mm CW) than in HEX traps.

---

[1] Guillory, V., and S. Hein. 1995. Lateral spine variability and weight-size and carapace width-size regressions in blue crab (*Callinectes sapidus*). Unpubl. Manuscr. on file at La. Dept. Wildl. and Fish., P. O. Box 189, Bourg, LA 70343.

**Table 3.—Catch rates by number by 10 mm carapace-width size groups by trap type (HEX = 3.81 cm hexagonal mesh; 2.54 SQ, 3.81 SQ, and 5.08 SQ = 2.54, 3.81, and 5.08 cm square mesh, respectively; RECT = 2.54 by 5.08 cm rectangular mesh).**

| | Catch rates(no.) by trap types | | | | |
|---|---|---|---|---|---|
| Size group | HEX | 2.54 SQ | 3.81 SQ | 5.08 SQ | RECT |
| 67–76 | 0.01 | 0.85 | 0.02 | 0 | 0.04 |
| 77–86 | 0.01 | 1.30 | 0.06 | 0 | 0.02 |
| 87–96 | 0.06 | 1.94 | 0.26 | 0.01 | 0.19 |
| 97–106 | 0.17 | 2.76 | 1.25 | 0.03 | 1.23 |
| 107–116 | 0.55 | 2.40 | 2.21 | 0.06 | 1.73 |
| 117–126 | 1.03 | 1.69 | 1.58 | 0.07 | 1.47 |
| 127–136 | 1.57 | 1.58 | 1.46 | 0.58 | 1.35 |
| 137–146 | 1.16 | 0.94 | 1.06 | 1.12 | 0.81 |
| 147–156 | 0.85 | 0.51 | 0.61 | 0.86 | 0.53 |
| 157–166 | 0.36 | 0.28 | 0.28 | 0.48 | 0.27 |
| 167–176 | 0.18 | 0.09 | 0.12 | 0.16 | 0.10 |
| 177–186 | 0.06 | 0.01 | 0.02 | 0.08 | 0.03 |
| 187–196 | 0.04 | 0.01 | 0.01 | 0.01 | 0.01 |

## Discussion

The carapace width frequency distributions reveal that the size range of blue crabs retained by each trap type was similar, although the relative abundance by size group differed between traps. Significant differences were found in catch rates of legal and sublegal blue crabs and mean sizes between traps. As compared to the standard HEX trap, the 2.54 SQ, RECT, and 3.81 SQ traps retained excessive numbers of sublegal blue crabs while the 5.08 SQ trap had a significant reduction in catch of legal blue crabs. The HEX trap was the most efficient trap in terms of maximizing legal catch and minimizing sublegal catch; however, the unculled catch still exceeds the 10% sublegal tolerance. The 5.08 SQ trap was the next most efficient trap.

The reduction in sublegal catch, while maintaining legal catch, through optimum mesh size selection would accrue many benefits to the fishery. First, catch rates of legal blue crabs may increase immediately because of trap saturation effects that occur due to excessive retention of sublegal blue crabs (Guillory and Merrell, 1993) and later because of decreased fishing and handling/trap confinement mortalities on smaller blue crabs. Increased catches of legal-sized decapods have been demonstrated in traps where escape vents were used to reduce sublegal catch (Krouse and Thomas, 1975; Fogarty and Borden, 1980; Brown, 1982; Guillory and Merrell, 1993). Injuries or stress to sublegal blue crabs that may occur during trap confinement or during onboard culling would be reduced. Over half of blue crabs caught in traps have damaged body parts (Eldridge et al., 1979); injuries may result in smaller molt increments in various decapods (Van Engel, 1958; Davis, 1981). Physiological stress, dehydration, and gill damage due to air exposure during onboard culling may result in delayed mortalities to decapods (Lyons and Kennedy, 1980; Brown and Caputi, 1983; Hunt et al., 1986).

Second, ghost fishing mortality would be reduced because of decreased catches of sublegal blue crabs. Mortalities in ghost traps averaged 25.8 blue crabs/trap for one year (Guillory, 1993) and 17.3 blue crabs/trap for 3 months (Arcement and Guillory, 1993). Mortality in vented traps was about one-third that of unvented traps because of a reduction in sublegal blue crab catch (Arcement and Guillory, 1993).

Third, fishing efficiency of commercial fishermen would be increased because of a reduction in onboard culling time.

## Acknowledgments

The following individuals assisted with field work or trap construction: Willard Dupre and Jerry Merrell.

## Literature Cited

Arcement, G., and V. Guillory. 1993. Ghost fishing in vented and unvented blue crab traps. Proc. La. Acad. Sci. 56:1–7.

Brown, C. G. 1982. The effect of escape gaps on trap selectivity in the United Kingdom crab (*Cancer pagurus* L.) and lobster (*Homarus gammarus* [L.]) fisheries. J. Cons. Cons. Int. Explor. Mer 40:127–134.

Brown, R. S., and N. Caputi. 1983. Factors affecting the recapture of undersize western rock lobster (*Panulirus longipes cygnus* George). Proc. Indo-Pac. Fish. Counc. 14: 139–154.

Davis, G. E. 1981. Effects of injuries on spiny lobster, *Panulirus argus*, and implications for fishery management. Fish. Bull. 41(1):21–27.

Eldridge, P. J., V. G. Burrell, Jr., and G. Steele. 1979. Development of a self-culling blue crab pot. Mar. Fish. Rev. 41(11–12):21–27.

Fogarty, M. J., and D. V. Borden. 1980. Effects of trap venting in gear selectivity in the inshore Rhode Island American lobster, *Homarus americanus*, fishery. Fish. Bull. 77:925–933.

Green, J. C. 1952. Effectiveness of crab traps in South Carolina. Bears Bluff Lab., Contrib. No. 14, 12 p.

Guillory, V. 1989. An evaluation of different escape vents in blue crab traps. Proc. La. Acad. Sci. 52:29–34.

———. 1990. Effects of escape vents on catch rates of premolt blue crabs. Proc. La. Acad. Sci. 53:20–28.

———. 1993. Ghost fishing in blue crab traps. N. Am. J. Fish. Manage. 13:457–466.

———. 1996. A management profile of the blue crab, *Callinectes sapidus*. La. Dep. Wildl. Fish., Fish. Manage. Plan Ser. 8, Pt. 2, 34 p.

Guillory, V., and J. Merrell. 1993. An evaluation of escape rings in blue crab traps. La. Dep. Wildl. Fish., Tech. Bull. 44, 29 p.

Guillory, V., P. Prejean, M. Bourgeois, J. Burdon, and J. Merrell. 1996. A biological and fisheries profile of the blue crab, *Callinectes sapidus*. La. Dep. Wildl. Fish., Fish. Manage. Plan Ser. 8, Pt. 1, 210 p.

Hunt, J. H., W. G. Lyons, and F. S. Kennedy, Jr. 1986. Effects of exposure and confinement on spiny lobster, *Panulirus argus*, used as attractants in the Florida trap fishery. Fish. Bull. 84(1):69–76.

Isaacson, P. A. 1963. Modifications of Chesapeake Bay commercial crab pot. Commer. Fish. Rev. 25(1):12–16.

Krouse, J. S. 1978. Effectiveness of escape vent shape in traps for catching legal-sized lobster, *Homarus americanus*, and harvestable-sized crabs, *Cancer borealis* and *Cancer irroratus*. Fish. Bull. 76:425–432.

Krouse, J. S., and J. C. Thomas. 1975. Effects of trap selectivity and some population parameters on size composition of the American lobster, *Homarus americanus*, catch along the Maine coast. Fish. Bull. 73:862–871.

Lyons, W. G. and F. S. Kennedy, Jr. 1980. Effects of harvest techniques on sublegal spiny lobsters and on subsequent fishery yield. Proc. Gulf Caribb. Fish. Inst. 33:290–300.

SAS, Inc. 1988. SAS introductory guide for personal computers, release 6.03 edition. SAS Institute Inc., Cary, N. C., 111 p.

Van Engel, W. A. 1958. The blue crab and its fishery in Chesapeake Bay. Part 1. Reproduction, early development, growth, and migration. Commer. Fish. Rev. 29(6):6–17.