

IDENTIFYING DETERMINANTS FOR DEVELOPMENT OF LIVE-MARKET GRADING STANDARDS FOR CRAWFISH

Reporting Period

January 1, 2011 – August 31, 2012

Funding Level Year 1 \$49,952
 Total..... \$49,952

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PROJECT OBJECTIVES

1. Survey major components of the supply chain for live procambroid crawfish to determine the desire for establishing grade standards, and to define the number of grades desired and potential size or weight limits (or other factors) for each grade.

2. Determine size distribution at harvest for live red swamp crawfish collected with standard commercial wire-mesh traps and graded using various bar spacing parameters over a December through June crawfish harvesting season.
 - a. Identify the body dimensions, weight, and maturity of the smallest crawfish captured by 0.75-inch and 0.875-inch coated square wire mesh traps.
 - b. Identify grader spacing parameters that will segregate crawfish (captured in 0.75-inch square mesh traps) into 3, 4, 5, and 6 different size grade categories.
 - c. Determine cross-sectional width dimensions and weight variances of immature and mature crawfish for each of the spacing parameters used in 2b.

3. Present findings of Objectives 1 and 2 to the crawfish aquaculture industry via workshops, educational programs, newsletters, etc. with recommendations for establishment of industry-wide adoptable grade standards.

ANTICIPATED BENEFITS

A lack of industry adopted grading standards for crawfish sales potentially hampers market expansion and leads to tension among sellers and buyers of crawfish in regards to what constitutes “quality”. To improve and expand markets for live crawfish,

acceptable grading standards are needed. This research was initiated to ascertain (by industry survey) the desire among the various participants of the supply chain for establishing grade standards, and to determine the need for number of grades and

potential size classifications for those grades. The research will also resolve many of questions relating to potential grading standards because of the changing morphology of crawfish as they mature. Crawfish are currently graded by size (i.e., width of the carapace) but are noted by count per pound (as with grades of shrimp). However, the weight of crawfish for a given size is highly dependent on maturity (unlike with shrimp) because weight changes for a given size based on morphology associated with

maturity. Therefore, this research will not only identify grader bar spacings necessary for several potential grade classifications, it will determine whether any of these systems will be compatible with grading bar spacing requirements that will not change with seasonal changes in crawfish morphometry. Findings of the survey and field research will be presented to the crawfish industry, with recommendations for potential grading standards that could be adopted by industry.

PROGRESS AND PRINCIPAL ACCOMPLISHMENTS

Objective 1. *Survey major components of the supply chain for live procambriid crawfish to determine the desire for establishing grade standards, and to define the number of grades desired and potential size or weight limits (or other factors) for each grade.*

University of Arkansas at Pine Bluff (UAPB)

Activity-1.1: *Identifying important crawfish markets through scanner data*

It is necessary to identify potential markets and the needs of the consumer before developing a standardized grading system. Increased understanding of trends in supermarket sales of crawfish has potential to assist the crawfish industry to refine grading strategies. The UAPB team has analyzed the market trends of the US crawfish retail market, including market shares, price fluctuations, promotional sales, and package size across several major regional cities. The analysis is based on store-level scanner data procured from the AC Nielsen Company. The dataset is composed of weekly data covering 52 US markets for the last 5 years, ending on June 12, 2010, for different seafood products that include freshwater crawfish. A.C. Nielsen data in the category of “frozen” were used to develop this descriptive analysis. The “frozen” category includes all frozen and chilled fish and seafood available in both prepared and unprepared forms usually found in refrigerated and frozen sections of supermarkets.

Crawfish products sold in the US supermarkets can be grouped into three frozen/chilled categories—entrée, breaded and unbreaded products. Breaded products do not show much product diversity, and their sales are mostly in Southern cities. Entrée products are the most diverse in terms of products sold, though they are sold in fewer cities than are unbreaded products. Cities with no sales of crawfish entrées during the last five years were: Des Moines, Las Vegas, Los Angeles, Omaha, Phoenix, Sacramento, Salt Lake City, San Diego, and San Francisco. Unbreaded products are sold by the largest number of brands, and have the largest regional distribution in terms number of cities with sales.

Unbreaded crawfish product is the main category, contributing about 85% of the total crawfish market in terms of volume and about 70% of the market in terms of value. The market for unbreaded crawfish is concentrated in the southern region of the country. Among the 52 markets we have analyzed, New Orleans/Mobile has the maximum share (about 70%) of unbreaded crawfish sales in

supermarkets (Table 1). Three Texas cities, Houston, Dallas and San Antonio, are the other major markets for unbreaded crawfish; with Houston having about 13-14% of sales share and the other two about 3-3.5% each. The only two cities out of 52 cities that did not show sales of unbreaded crawfish in the five-year period were Portland and Seattle. But the sales of crawfish in non-southern cities are very limited. Though crawfish products have been sold in cities other than the traditional markets, they are yet to become established in the Western and Midwestern US. Promotional sale is an important crawfish marketing strategy. About 35% of unbreaded crawfish products were sold under some sort of promotion during the during last five years

(Table 1). New Orleans/Mobile also had the highest degree of promotion, with about 28-33% of products sold under promotion.

In terms of grading requirements, the unbreaded crawfish category could present more potential applications than other categories. Tail meat is the most dominant product form, with about 90-96% share of unbreaded crawfish sales. However, in the last two years, there is a gradual increase in the share of whole crawfish. Direct applications of potential grading systems are evident in the case of whole crawfish.

The most popular packaging size is 60-oz packages,

Product/City	Proportion (%) out of Total Sales in Individual cities					Proportion (%) of Promotional Sales out of Total Sales (lb)				
	2005/6	2006/7	2007/8	2008/9	2009/10	2005/6	2006/7	2007/8	2008/9	2009/10
Crawfish						33.3	35.2	38.3	32.0	34.0
New Orleans/Mobile	68.3	70.9	71.9	70.9	69.9	29.2	32.6	33.2	27.5	28.8
Houston	13.5	13.7	13.1	13.8	13.7	1.4	1.0	2.4	2.1	2.6
Dallas	3.3	3.5	3.7	3.5	3.8	0.9	0.8	1.4	1.2	1.5
San Antonio	3.2	3.2	3.1	2.8	2.8	0.0	0.1	0.6	0.4	0.3
Memphis	1.5	1.8	1.8	1.7	1.6	0.4	0.2	0.1	0.2	0.1
Jacksonville	1.2	0.4	0.7	1.3	1.3	0.1	0.0	0.0	0.1	0.1
Little Rock	1.0	0.8	0.8	0.9	0.8	0.3	0.1	0.2	0.2	0.2
Birmingham	0.5	0.5	0.8	0.8	1.2	0.1	0.0	0.0	0.0	0.0
St. Louis	0.6	0.7	0.5	0.8	0.6	0.1	0.1	0.0	0.3	0.2
Atlanta	0.6	0.6	0.5	0.1	0.1	0.0	0.0	0.1	0.0	0.0
Raleigh/Durham	0.2	0.5	0.4	0.3	0.4	0.0	0.0	0.0	0.0	0.0
Chicago	0.5	0.3	0.1	0.3	0.4	0.1	0.0	0.0	0.0	0.0
Orlando	0.5	0.1	0.2	0.4	0.5	0.0	0.0	0.0	0.0	0.0
Tampa	0.4	0.2	0.2	0.2	0.5	0.0	0.0	0.0	0.0	0.0
Kansas City	0.3	0.2	0.2	0.3	0.3	0.0	0.0	0.0	0.0	0.0
West Texas	0.2	0.3	0.3	0.3	0.3	0.0	0.0	0.1	0.1	0.1
Nashville	0.4	0.3	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0
Detroit	0.3	0.3	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0
New York	0.9	0.1	0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.0
Oklahoma City/Tulsa	0.2	0.4	0.1	0.1	0.2	0.0	0.0	0.0	0.0	0.0

and their share has increased over the years, to almost 90% of whole crawfish sales. The remaining sales are constituted by 80 oz, 48 oz and 20 oz. Among these 3 packages, only 80 oz packages have demonstrated consistent sales in all 5 years. Hence, it can be said that larger package sizes (3.75 lb or 60 oz, and 5 lb or 80 oz) form the most important package sizes.

Average price of whole products has fluctuated over the years, with a dip in the last two years. The

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Activity 1.2: (a) *Focus group discussion with the wholesale buyers and producers of the crawfish industry.*

The UAPB team conducted an organized focus group discussion with the crawfish wholesale buyers and producers in Crowley, Louisiana in October, 2011 to identify major markets for survey and to determine important issues that the industry is greatly concerned about. The focus group discussion revealed that the demand for live crawfish is increasing, local market of Louisiana prefers graded product, but the market trends and consumers' preference for crawfish outside the traditional market area are still relatively unknown. Some of the issues of concern for the crawfish industry are: grading is expensive; the smallest size becomes a waste product if they cannot mix them with other sizes for sale; if customers pay a premium of more than \$0.25 to \$0.50/lb for a graded product, then the standardized grading system would work well. The industry representatives are interested to know the price gaps between different size categories.

Activity 1.2: (b) *Conduct surveys of retail store and restaurant managers to know their perception and willingness to pay for the graded crawfish products.*

The study has followed a stakeholder driven approach. Based on the recommendation of the

cheapest pack is the 80 oz package. The most popular package, i.e. the 60 oz package, is priced considerably higher than the 80 oz package.

Fifty-five brands of unbreaded crawfish were sold in the market during the last five years, out of which 11 brands sold whole unbreaded crawfish products. Sales of crawfish entrées sales have been growing at a high rate. There were 25 crawfish entrée products in the markets, and they contributed almost 30% of total crawfish sold in 2009-2010.

focus group discussion reported above, the UAPB team conducted surveys in two major crawfish markets (Houston and Baton Rouge) and in four emerging markets (Little Rock, Memphis, Atlanta and St. Louis). We used the list of seafood restaurants and retail stores in each of these cities as sampling frames, and randomly selected 21 seafood stores and 24 restaurants from these six selected cities. Surveys of store/restaurant managers were conducted through face to face interview using a pre-tested interview schedule.

We have found that January-June is the main crawfish selling season for retail stores, whereas February-May is the peak season for restaurants. There are various crawfish products available in the market. Crawfish whole boil followed by crawfish live are the dominant products in retail stores. In the restaurant sector, crawfish live is the most demanded product during the peak season. The survey results indicate that the demand for live crawfish has been increasing. Retail store/restaurants managers' most preferred packet size to buy is 25 to 35 lb/sac for live crawfish, 1 to 5 lb/pack for whole frozen, and 1 lb/box for tail meat.

Grading of domestic live crawfish are done based on length and size (weight per count). There are two main grades based on length: category 1: (3 to

4 inch), and category 2: (mixed). The main size-based grades are: 10 count/lb (jumbo), 10 to 15 count/lb (selected/medium), and 16 to 20 count/lb (mixed). Around 43% of store managers and 58% of restaurant managers indicate that the sales of live crawfish vary significantly with its size and length. The price difference between graded and mixed size category in retail stores ranges from \$0.34/lb to \$1.00/lb. In restaurants, the price varies from \$0.99/lb to \$1.50/lb (Fig. 1a). On average, 35% of retail store managers are willing to pay an extra \$0.38/lb, and 50% of restaurant managers are willing to pay an extra \$0.86/lb for obtaining the standard size graded crawfish (Fig. 1b). Fifty eight percent of stores' managers prefer the U.S product and are willing to pay higher prices for the domestic

(USA labeled) products. Crawfish consumers come from all major ethnic and income groups in the country. About 81% of the crawfish customers buy/consume crawfish on a regular basis. Most managers claim that consumers from areas outside the traditional markets are not very familiar with crawfish products, implying the importance of promotional/awareness activities for market expansion. A majority of the managers indicate that the price of crawfish is greatly influence by seasonality of supply. Survey results show that there is potential to expand the market for graded crawfish, but the feasibility of establishing a grading standard may be hampered due to seasonal variability in size and availability, related high cost, and unawareness of the consumers about the grade.

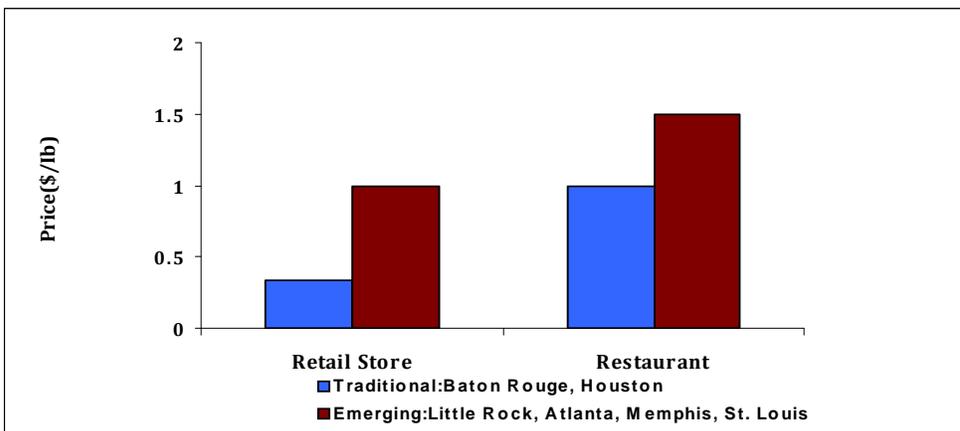


Fig. 1a. Price difference between graded and mixed size crawfish.

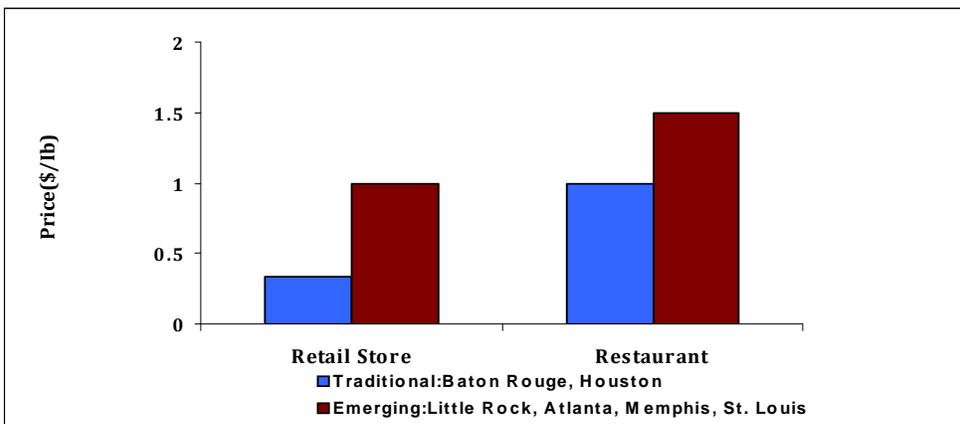


Fig. 1b. Managers' willingness to pay for graded crawfish product.

Objective 2. *Determine size distribution at harvest for live red swamp crawfish collected with standard commercial wire-mesh traps and graded using various bar spacing parameters over a December through June crawfish harvesting season.*

Louisiana State University Agricultural Center

Sub-objective 2a. *Identify the body dimensions, weight, and maturity of the smallest crawfish captured by 3/4-inch and 7/8-inch coated square wire mesh traps.*

Daily harvest data, whereby crawfish were sorted into 3 grade categories (Large = <15 count/lb, Medium = 16-21 count/lb, and Small = >21 count/lb), was organized by trap type when traps were constructed of either 3/4-inch or 7/8-inch square mesh wire. The daily yield of smallest crawfish within the small grade category harvested with 3/4-inch traps occurred in February and averaged 37.5 count/lb or 12.1 grams (g) each. Yields of the smallest crawfish captured with 7/8-inch traps occurred in June and averaged 31 count/lb or 14.6 grams – a 21% increase in the minimum average size from those captured with the smaller mesh traps. Virtually all crawfish in both cases were immature and were composed of an approximate equal mixture of males and females. These average weights correspond to a carapace width and height of 17.1 and 20.0 mm for crawfish weighing 12 g and a carapace width and height of 17.7 and 21.1 for crawfish weighing 14.5 g. The total length (rostrum to

tail) for these two sizes of crawfish is approximately 7.7 and 8.0 cm, respectively.

Results at a glance...

- *This research has provided valuable information regarding biological feasibility of establishing standard size grades in crawfish, and offers insight into possible grade categories for several potential systems of classifying graded crawfish for markets. Moreover, marketing surveys have determined that demand for USA-produced crawfish is increasing, with premiums of from \$0.34 to \$1.00 per pound warranted for the larger sizes in the marketplace.*

Sub-objective 2b: *Identify grader spacing parameters that will segregate crawfish (captured in 3/4-inch square mesh traps) into 3, 4, 5, and 6 different size grade categories.*

Two hundred and twelve crawfish representing various sizes (weights), maturity status, and both sexes were measured for carapace width and height and overall length. Preliminary grading of crawfish at various bar spacings with a variable fish grader (Fig. 2) revealed that carapace width was the best indicator for determining grader bar spacing. Arbitrary grade categories for each of 4 grading systems (6-, 5-, 4-, and 3-grade systems) were determined for this study (Table 2) based on

observations and discussions of previously used grading categories by some in the industry. These were established to represent a range of possible/practical standards and were used solely for testing purposes. Based on carapace width measurements and measurements of fixed grader bar spacing of the fish grader, settings were established that closely matched the biological data for each grade category within the chosen grade systems.



Figure 2. Size grading of crawfish was accomplished in the boat at harvest with a variable fish grader. Grader was adjusted for different size categories.

Table 2. Target crawfish grade (count per pound) and nearest settings on the fish grader (based on crawfish carapace width measurements) for the categories within each numbered grade system. Also presented are the average size (count per pound) and percentage maturity for crawfish harvested and graded according to the various grader bar spacings for each grade category within the 6-, 5-, 4-, and 3-grade system. Averages were determined for each month of harvest and for the season. Yellow highlight indicates averages that fall outside of the targeted range.

Number of Grades in System	Target Grade (Cnt/lb)	Nearest Setting (mm)	March		April		May		June		Seasonal	
			% Mat	Cnt/Lb	% Mat	Cnt/Lb						
6	< 10	< 26.3	71.7	8.7	84.9	9.8	47.2	9.6	88.9	10.8	72.6	9.6
	10 - 14	23.0 - 26.3	47.7	12.9	55.5	12.4	35.7	13.0	68.6	14.0	49.5	12.9
	15 - 19	20.8 - 23.0	44.1	17.8	63.0	17.1	35.1	16.6	50.7	16.9	47.2	17.1
	20 - 24	19.1 - 20.8	44.9	23.0	41.1	21.2	28.4	20.6	48.2	21.3	40.0	21.9
	25 - 29	17.8 - 19.1	25.9	28.7	41.4	27.7	43.2	24.9	42.3	24.8	39.6	26.5
	> 29	> 17.8	34.4	35.0	27.8	35.7	41.0	32.3	32.7	30.1	33.9	33.0
5	< 12	< 24.6	69.6	11.2	80.4	10.2	48.2	10.6	92.7	10.4	69.9	10.5
	12 - 17	21.5 - 24.6	39.7	17.3	48.4	15.2	60.1	15.1	61.1	14.6	51.4	15.6
	18 - 23	19.9 - 21.5	43.1	18.9	44.7	18.9	54.7	19.8	46.2	19.2	47.4	19.2
	24 - 29	17.8 - 19.9	35.3	25.8	41.0	25.8	44.6	24.1	49.3	23.6	41.5	25.2
	> 29	> 17.8	20.7	36.5	34.1	36.6	43.0	31.4	39.7	31.1	35.8	33.9
4	< 12	< 24.6	77.3	10.5	78.5	10.5	45.8	10.9	76.4	11.1	67.1	10.7
	12 - 18	20.8 - 24.6	39.8	17.3	46.4	17.4	47.1	15.7	53.3	15.7	46.2	16.6
	19 - 25	19.1 - 20.8	39.7	23.5	43.1	23.5	49.9	21.3	41.5	21.1	44.3	22.6
	>25	> 19.1	40.9	26.1	46.1	26.1	48.4	26.0	38.1	26.1	44.7	26.0
3	< 12	< 24.6	58.1	10.7	60.1	10.7	53.2	10.8	73.1	11.2	59.6	10.8
	12 - 21	19.9 - 24.6	50.2	17.0	52.9	16.8	52.7	16.1	43.5	17.0	51.1	16.6
	> 21	> 19.9	24.7	31.9	27.9	29.9	49.8	25.0	40.4	24.2	36.8	27.6

Sub-objective 2c: *Determine cross-sectional width dimensions and weight variances of immature and mature crawfish for each of the spacing parameters used in 2b.*

Crawfish were subjected to each grader bar spacing directly as they were emptied from traps over the course of a production season (Fig. 3). For the first part of this sub-objective, a random sample of the smallest crawfish retained by each grader setting and the largest crawfish passing through each setting was collected (on 2-week intervals) and weighed and assessed for sex and maturity. Data was summarized by month and a seasonal average was calculated. Using these data to represent crawfish sizes that fall at either end of the target category when graded, we can determine if a theoretical batch of crawfish, uniform in size and maturity but at the extreme ends of each grade category, might fall outside of the targeted grade. The results indicated that monthly

averages were smaller than the targeted minimum size for a category 5 times in the 6-grade system, 3 times in the 5-grade system, 3 times in the 4-grade systems, and 2 times in the 3-grade system. Likewise, there were 1, 4, 1, and 0 monthly category averages that represented averages larger than the targeted grade for the 6-, 5-, 4-, and 3-grade systems, respectively. Only 1 seasonal grade average was outside (under) the targeted size for a category. It should be noted that all averages outside of the targeted range in this exercise were outside of the range only by small fractions when expressed in count per pound – likely due to the slight difference in actual bar spacings from the desired nominal spacing.

Figure 3. Size grading in crawfish is accomplished according to width of the carapace.



For the second part of this sub-objective, crawfish were subjected at harvest to each grader bar setting every other week. Crawfish that passed through the grader at each setting were then placed in holding tanks and graded again after 3 hours. Each batch of crawfish within the holding tanks was subjected to the next grader setting corresponding to the appropriate target standard and no crawfish were subjected to more than the initial grading and one other after the 3 hour reprieve. Crawfish falling into each grading category encompassed a range of sizes (and maturity status) within the spectrum of the two grader settings at time of harvest. Average weight and % maturity were determined for each grade category and this is presented in Table 2 by month of harvest and as a seasonal average. While there were 3 monthly averages slightly outside of the target range, all of the seasonal averages were within the desired grade ranges for category within each grading system tested. Small adjustments in grader

bar settings could possibly reduce or eliminate the undesirable results. It should be noted though that resulting count per pound averages were all within the desired ranges for the 3 and 4 grade system categories. This is likely due to a wider range of individual crawfish sizes contained within each category, which tends to mitigate influences on weight per carapace width as maturity is reached. In conclusion, these results suggest that setting grader bar spacings to closely correspond with the carapace width of crawfish within the desired size ranges, within reason, can achieve suitable results for sorting crawfish by size, even when weight per given carapace width is influenced by physical changes as crawfish mature. Moreover, it is likely that grading standard results will be easier to achieve and less influenced by morphological differences in crawfish if grade categories encompass a wider range of individual sizes when contrasted to a narrow range.

Objective 3. *Present findings of Objectives 1 and 2 to the crawfish aquaculture industry via workshops, educational programs, newsletters, etc. with recommendations for establishment of industry-wide adoptable grade standards.*

Preliminary findings regarding market scanning data and crawfish grading biometrics were presented to interested individuals via office and farm visits, and were discussed during a workshop of principal crawfish wholesale buyers/brokers. A partial

summary of field grading results was made available to interested parties via a report published online and in print. Final comprehensive results will be distributed by a variety of means.

IMPACTS

The impact of this research has provided confirmation that dimorphism associated with maturity in crawfish can impact results of grading operations based on exterior measurements (specifically carapace width) of the animal. However, tangible evidence is presented that suggests satisfactory results can be achieved in grading crawfish by size if precise grader bar spacings are used and if grade standards are kept to a manageable number while avoiding narrow ranges in the acceptable sizes within a grade category.

This is all predicated on grading crawfish at a time when they are less likely to grab and hold onto one another while grading, thereby giving the cleanest grades possible. This information, including the arbitrary target grade specifications used in this study, should be an asset and basis for discussion for the industry when deciding if and what grading standards are needed industry wide.

PUBLICATIONS, MANUSCRIPTS OR PAPERS PRESENTED

McClain, W.R., and J.J. Sonnier. 2011. Key biometrics associated with size grading of live crawfish at harvest. Ann. Res. Rpt., Rice Res. Stn., La. Agri. Exp. Stn., L.S.U. Agricultural Center, 103:263-272.

Yasmin S, M. M. Dey, and K. Singh. 2012. Identifying determinants for development of live-market grading standard for crawfish. Presented at 25th Annual UAPB Research Forum organized by the University of Arkansas at Pine Bluff, on March 7, 2012 at University of Arkansas at Pine Bluff, Arkansas, U.S.A.

Yasmin S, M. M. Dey, and K. Singh. 2012. Perception of store and restaurant managers about crawfish, and their willingness to pay for graded crawfish products. Poster presented at the Field Day (stakeholders event) organized by the Aquaculture/Fisheries Center of the University of Arkansas at Pine Bluff, on October 4, 2012.

