

# **PHILIPPINE COASTAL RESOURCES UNDER STRESS**

**Selected papers from the Fourth Annual Common Property Conference  
held in Manila, Philippines, June 16-19, 1993**

**Edited by**

**Marie Antonette Juinio-Meñez and Gary F. Newkirk**

**Published by**

**Coastal Resources Research Network  
Dalhousie University  
Halifax, Nova Scotia, Canada**

**and**

**Marine Science Institute  
University of the Philippines  
Diliman, Quezon City, Philippines**

# Valuation of a Philippine Municipal Sea Urchin Fishery and Implications of Its Collapse

L. Talaue-McManus and K. P. N. Kesner  
Marine Science Institute  
University of the Philippines  
Diliman, Quezon City 1101, Philippines

## Abstract

The sea urchin *Tripneustes gratilla* had been exploited to near extinction from the reef flats of Bolinao, northern Philippines, to satisfy the demand of an export market for its roe. Although a closed fishing season was adopted in January 1989 to help maintain a lucrative but quickly deteriorating fishery, the natural population continued to decline. Averaged daily catch decreased from 30 kg roe in 1989 to 8 kg in 1992. Until 1992, the closed season was virtually not enforced, and the value of the catch per unit effort (CPUE) decreased from Philippine peso (P) 67.00 in 1987 to P43.00 in 1992 (approx. USD 1.00=P25.00). In December 1992, the municipal government passed an ordinance restricting the distribution of sea urchin roe to the local market because the industry had virtually collapsed.

With the collapse of the sea urchin industry, the buyers shifted to other kinds of trading or income activities, some of which were not based on produce from the sea. In the case of gatherers, however, they coped by shifting to the collection of other marine resources like seaweeds, octopus and fish. Such shift in harvest pressure might endanger the sustainability of other exploited resources which are as susceptible to local extinction as the sea urchins. To effectively address the need for reviving sea urchin populations and more importantly, that of managing the harvest pressure on the reef-based Bolinao fisheries as a whole, a comprehensive scheme of management including supplemental or alternative livelihood schemes, village-managed marine reserves and environmental education, among others, must evolve.

## Introduction

The sea urchin industry of Bolinao, Pangasinan in northern Philippines, is a case study of a communal resource exploited without regulation to satisfy the export market. Commercial harvest began in the 1970's. Roe was extracted from the sea urchin *Tripneustes gratilla* and was sold to Japan, Taiwan, Hong Kong and Korea (Trinidad-Roa and Pasamonte, 1988). By the late 1980's, the resource was overfished which prompted the municipal government in January 1989 to impose an annual closed fishing season from December to February, the period when reproduction is most pronounced. This intervention did not reverse the downward trend in catch nor the overfished status of the wild population.

In December 1992, the municipality called for an indefinite ban on export of sea urchin roe outside of the township which was meant to restrict commerce to a nonexistent local market. This was prompted by the absence of successful recruits into the fishery and the paucity of harvestable urchins in 1992. This paper attempts to a) assess the income loss resulting from the collapse of, and marketing restriction on the industry and b) to evaluate the impact of collapsed status of the industry on the sea urchin gatherers and buyers.

## Study Area and Methods

### *Valuation of Sea Urchin Roe*

For valuation of the sea urchin resource, catch and effort data were obtained from daily records of buyers in Silaqui Island (Fig. 1), one of two major landing sites until 1990. These records consisted of wet weights of sea urchin roe purchased from individual gatherers or groups for the period of 1986 to 1992. In 1990, roe was also being landed in a third site, Baareg. A comparison of catch and effort among the 3 landing sites (Silaqui, Lucero and Baareg) was done based on data gathered after 5 months in 1992. The parameters were converted into ranks and then compared using Kruskal-Wallis statistic (Siegel and Castellan, 1988). Market prices were adjusted for inflation to make them comparable across years.

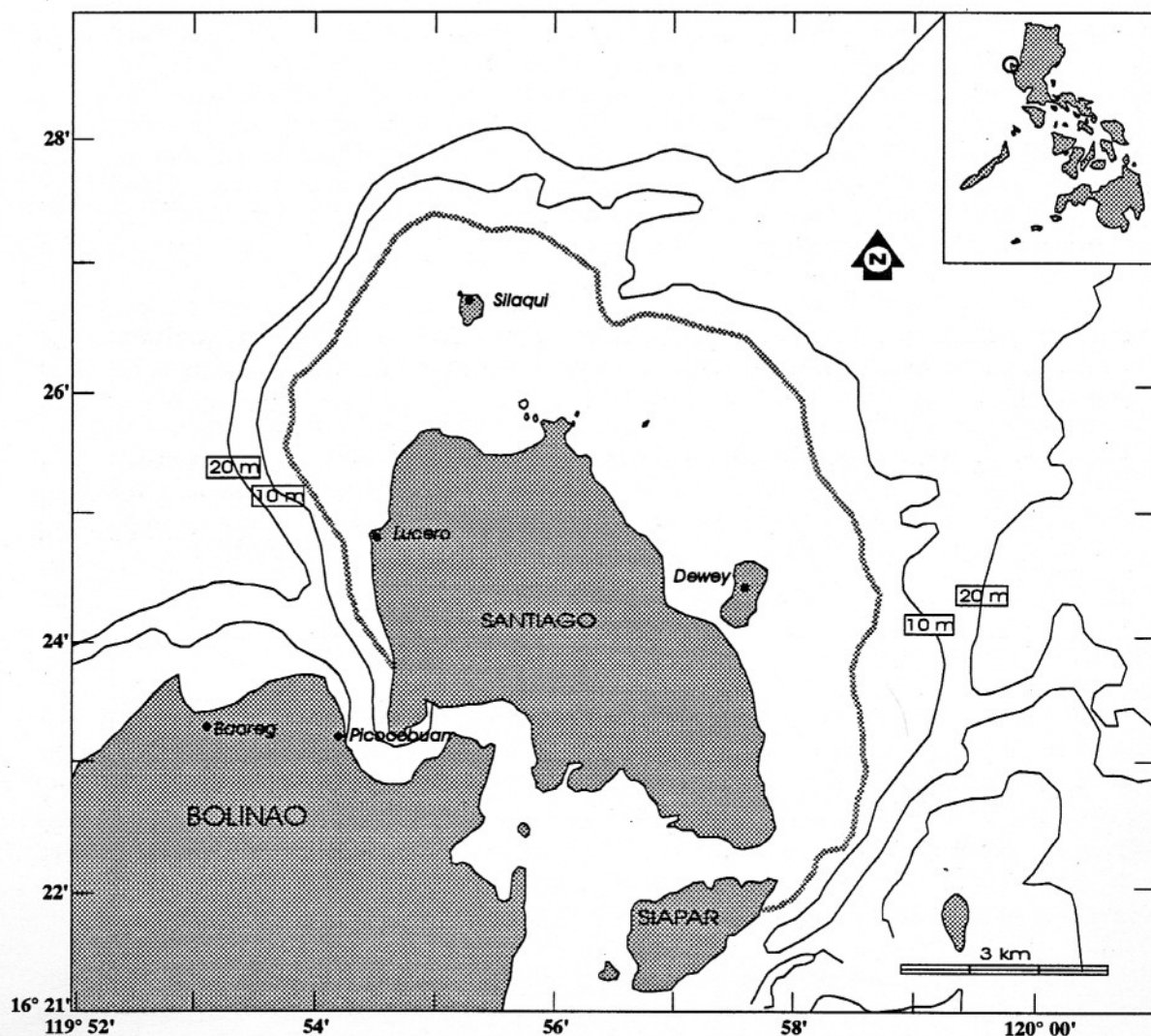


Figure 1. The Bolinao reef system. Silaqui and Lucero are two major landing sites for sea urchins. Baareg opened as a third site in 1991.

The gross income of gatherers in Silaqui was estimated using the amount and price of total landed catch and total effort for each year. An assumption was made that cost of any input such as fuel was reimbursed by the first-level buyers as indicated by interviews. The gross income of gatherers may therefore be considered as net income. For first-level buyers, a Philippine peso (P) 5.00 markup per kilo of roe and a fixed monthly income provided for by exporters was incorporated (approx. USD 1.00=P25.00). Their costs which included fuel for transport within Bolinao and preservatives were eventually paid for by third-level buyers or the exporters (as indicated in interviews). Thus for first-level buyers, their estimated gross income could also be considered as net profit. In the case of second-level buyers, their gross income was based on P5.00 mark-up of the price of first-level buyers and a fixed salary provided for by the exporters. Transportation cost in bringing the roe to Manila and the associated taxes were paid for by the exporters. As such, like the gatherers and the first level buyers, the second-level buyers earned their income from urchin roe trading as net income.

The net income of third-level buyers or the exporters was estimated using the following assumptions:

- a) Approximately 8% of the total landed catch was of good quality and was sold by third-level buyers outside of Bolinao but within the Philippines as boxed fresh roe costing P120 per 5 g.
- b) Approximately 80% of the total landed catch was sold as brined roe at a price with 34% mark-up over the gatherer's price. The remaining 12% of the landed catch was assumed not fit for trading by the time it reached the exporters.
- c) The aggregate cost of transportation within and outside of Bolinao, preservatives, salaries of first- and second-level buyers and tax levies were deducted from the income derived from trading of fresh and brined roe.
- d) The third-level buyer went through the trading chain to obtain the urchin roe. In addition, income per kg of fresh roe was also estimated from a different marketing arrangement which was set up by a Japanese exporter in Picocobuan. In this case, the exporter directly employed gatherers and shuckers, and did not go through the first- and second-level buyers to buy the roe. Estimates of total net annual income derived through this arrangement were not possible because of lack of data but the different marketing relationships were highlighted to show how profits were further maximized during the boom days of the industry (Talaue-McManus et al., 1991).

### ***Impact of a Collapsed Industry on Associated Manpower***

To evaluate how sea urchin gatherers and buyers were coping with an industry which had virtually collapsed, interviews of 12 buyers and 7 gatherers representing all three landing sites were conducted in May and August 1992. Another interview, albeit cursory, was conducted in January 1993 immediately after the imposition of the marketing restriction. From March to May, 1993, resource use of at least 12 sea urchin gatherers based in Silaqui were monitored to assess initial impacts of the market ban.

## **Results and Discussion**

### ***Resource Valuation***

Figure 2 summarizes the mean daily catch, effort and catch per unit effort (CPUE) for six years from

1987 to 1992. The amount of roe harvested was lowest in 1992 at about a daily mean total of 8 kg per day or about 0.7 kg per gatherer per day for Silaqui. The actual value of the CPUE decreased from P67.00 in 1987 to P43.00 in 1992 (Kesner and Talaue-McManus, 1992). The absence of sea urchin recruits in the fishing ground and the decline in the total catch and CPUE in 1991 and 1992 were clear indicators of a collapsed fishery.

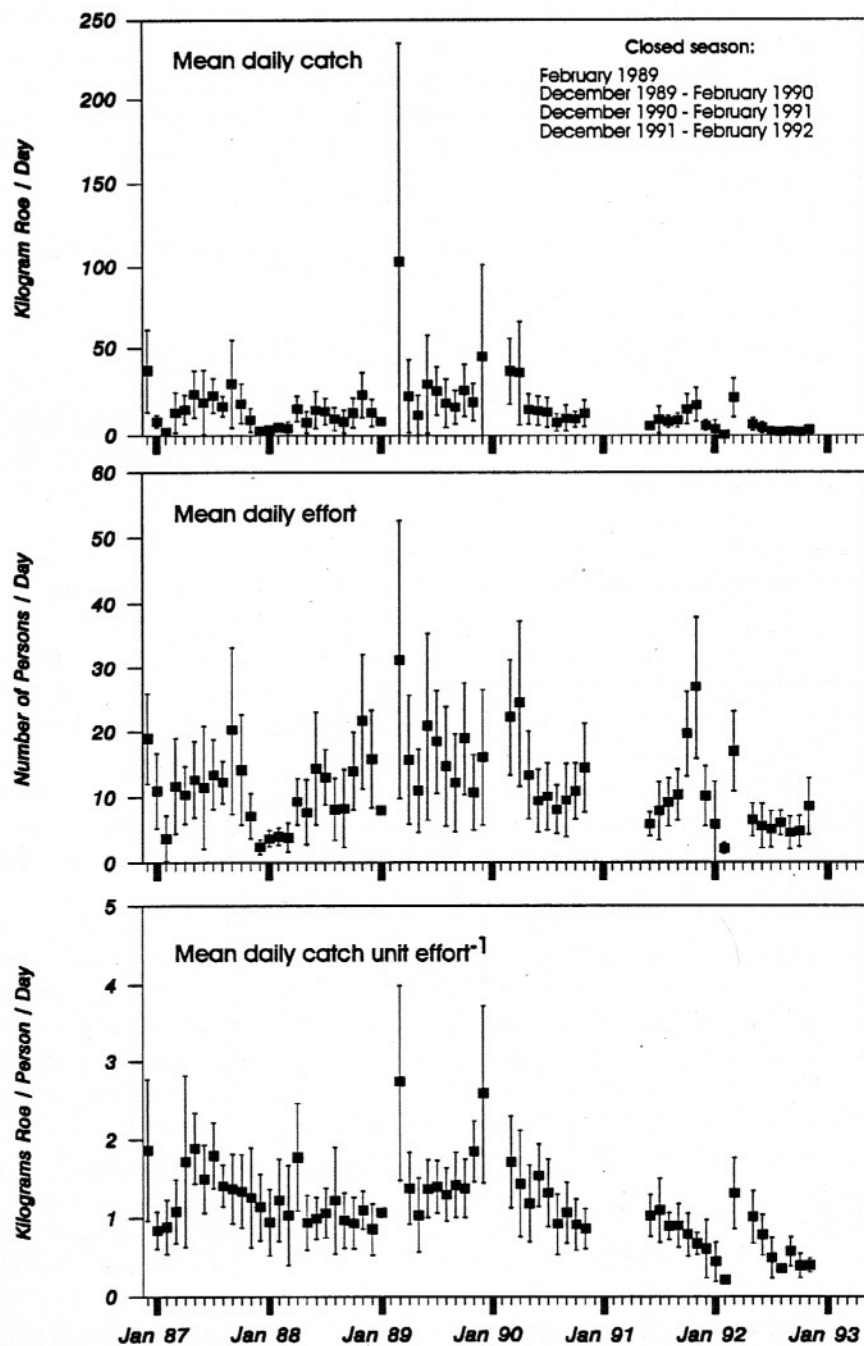


Figure 2. Catch and effort data on the sea urchin industry in Silaqui from 1987 to 1992.



Estimates of net income for Silaqui on an aggregate basis are shown on Table 1. In 1987 and 1988 when roe was not yet traded by third-level buyers as "fresh" roe in boxes, the gatherers contributed 70% of the total net income. From 1989 to 1992, the total net income reached an average of P5,000,000.00 with the trading of expensive fresh roe. During this time, the gatherers contributed 3% of the total income, and the third-level buyers 87 to 96%.

Table 1. Total net income estimates (Philippine peso) for gatherers and traders involved in the trading of sea urchin roe landed in Silaqui. Income from foreign markets were not included in the estimates (estimates were rounded off to the nearest 5).

Year	Catch (kg)	Price (P kg <sup>-1</sup> )	Gatherers	First-level buyers (n=3)	Second-level buyers (n=3)	Third-level buyers (n=2)	Total annual net income
1987	3,716	45.06	167,435	22,180	42,580	14,750	246,940
1988	2,795	75.79	211,855	17,575	37,975	29,665	297,075
1989	5,252	56.09	294,570	31,060	86,260	9,239,670	9,651,555
1990	3,021	63.12	190,705	21,105	135,105	5,287,845	5,634,765
1991	1,689	66.41	112,180	15,645	188,445	2,920,365	3,236,635
1992	1,020	65.00	66,285	12,300	185,100	1,719,790	1,983,475
Mean			173,840	19,980	112,580	3,202,015	3,508,410
Percent			5.0%	0.6%	3.2%	91.3%	100.0%

To better compare net incomes along the trading chain, Table 2 summarizes values on a per capita basis. Net income per capita of gatherers was highest in 1988. From 1989 to 1992, this income diminished, reflecting the decreasing resource base. During the period from 1987 to 1992, mean monthly income was P1,055. In contrast, capture of finfish earned a fisher a monthly income of P1,830 in 1990 (McManus et al., 1992).

First-level buyers obtained their highest incomes in 1989, during which their monthly salary contributed 35% of net income. As the catch decreased, the salary made up most of the income. In 1992, salaries were 80% of their net income and actual trading brought in only 20%. The second-level buyer, because of their high salary, did not have to depend on trading. Their salaries were 80 to 99% of net income.

Third-level buyers or exporters did not earn much in 1987 and 1988. During the period from 1989 to 1992, when boxed roe was traded outside of Bolinao but within the Philippines, net monthly income was close to P200,000. With decreasing catch, the net monthly income fell to P70,000 in 1992, which was still over 100 times that earned by a gatherer or first-level buyer and about 4 times the income of a second-level buyer.

In Picocobuan, Japanese exporters set up a system where roe was obtained directly from gatherers (Talaue-McManus et al., 1991). Because overhead cost was low, these exporters earned at least P17,000 for every kilogram of good quality roe which was traded within the Philippines and much more if traded overseas.

(Table 3). Despite the high returns, this labor arrangement existed for only 2 years. By paying gatherers on a per piece basis, it encouraged the collection of even the smallest juveniles which did not contain harvestable quantities of roe, hence exacerbating the already overexploited condition of the resource base.

Table 2. Monthly per capita net income (Philippine peso) of gatherers and traders involved in the trading of sea urchin roe in Silaqui Island for the period 1987-1992. For the first- and second-level buyers, their net incomes included the fixed salaries provided for by the third-level buyer (estimates were rounded off to the nearest 5).

Year	No. Gatherers	Net Income Gatherers	No. First-level Buyers (Salary)	Net Income First-level Buyers	No. Second-level Buyers (Salary)	Net Income Second-level Buyers	No. Third-level Buyers	Net Income Third-level Buyers
1987	12	1,165	3 (300)	815	3 (2,000)	2,515	2	615
1988	11	1,605	3 (300)	690	3 (2,000)	2,390	2	1,235
1989	20	1,230	3 (400)	1,130	3 (5,000)	5,730	2	384,985
1990	15	1,060	3 (500)	920	3 (10,000)	10,420	2	220,325
1991	12	780	3 (600)	835	3 (15,000)	15,235	2	121,680
1992	11	500	3 (600)	740	3 (15,000)	15,140	2	71,660
Mean		1,055		855		8,570		133,415

Table 3. Estimation of net income earned by exporters (third-level buyers) based in Picocobuan (1990 to 1991).

<b>Gross income for every 1 kg of sea urchin roe:</b>	<b>P19,200</b>
Collectors, 100 urchins x P2.00 per piece	200.00
Shucker, P120 per day	120.00
Preservatives, P50 kg <sup>-1</sup>	50.00
Transport Fee, P1.50 kg <sup>-1</sup>	1.50
Transport to Manila	300.00
Packaging, P10 per box x 160 boxes	1,600.00
Total cost	2,300.00
<b>Net income for every 1 kg of sea urchin roe:</b>	<b>P16,900</b>

Assumptions about every kg of sea urchin roe:

- About 20% was not of export quality.
- The remaining 80% was for export.
- Boxed fresh sea urchin roe weighing 5 g was sold for P120.00.

Total net income derived from roe landed in Silaqui amounted to P250,000 in 1987; P9,600,000 in 1989; and close to P2,000,000 in 1992 (Table 1). To extrapolate this for all of Bolinao, two other landing sites (Lucero and Baareg) were taken into account. Kruskal-Wallis statistics computed from a comparison of catch, effort and CPUE in the three sites over five months in 1992 indicated no significant differences among sites (Table 4). While the test was not sensitive to differences among site parameters unless they were extremely large (Siegel and Castellan, 1988) and the time feature of the data was relatively short, the statistics provided a basis for extrapolating estimates made for Silaqui to cover the sea urchin trade for the whole town.

Table 4. Comparison of catch, effort and catch per unit effort at three landing sites for sea urchin roe for the period May to September 1992.

Parameter	Lucero	Baareg	Silaqui	Kruskal-Wallis Statistics $KW_{comp}/KW_{\alpha=0.05}$
Mean monthly total catch (kg)	117.3 $\pm$ 102.9	135.2 $\pm$ 60.4	60.5 $\pm$ 48.0	3.38/ 5.78
Mean monthly total effort (no. fishers)	45.2 $\pm$ 34.6	20.5 $\pm$ 15.0	28.9 $\pm$ 10.2	2.16/ 5.78
Mean monthly CPUE (kg/ fisher/ mo)	2.6 $\pm$ 1.2	8.2 $\pm$ 5.2	1.9 $\pm$ 1.0	1.71/ 5.78

The annual mean net valuation of the sea urchin harvested in Bolinao based on trading within the Philippines was estimated to be P7,900,000 for the period 1987 to 1992, 5% of which was earned by gatherers, 0.6% by first-level buyers, 3% by second-level buyers and 91% by third-level buyers (Table 5). Because of marketing arrangements and laws which allowed for its export outside of Bolinao, the value accrued to Bolinao-based labor was only 9% of total net income generated by the industry. Furthermore, the export-oriented market and the concomitant economic incentives of rapid and massive exploitation, exacerbated the overexploited status of the resource until its virtual collapse. While only the income earned by gatherers, first- and second-level buyers made up the generated wealth which remained in Bolinao, the worth of harvested sea urchin should include income generated throughout the trading chain from the site of collection to the foreign export market. In this study, resource valuation was based solely on income generated from the local market.

The amount of wealth generated by the sea urchin industry of Bolinao was extremely high. However, because of marketing arrangements and laws which allowed for its export outside of Bolinao, the cash accrued to Bolinao-based labor was minimal. Ironically, such arrangement allowed for the overexploitation of the resource and its eventual collapse.



Table 5. Estimates of net income loss for the town of Bolinao resulting from the collapse of the sea urchin industry. Estimates for Silaqui were multiplied by the appropriate number of landing sites since the Kruskal-Wallis statistics indicated no significant differences among landing sites.

Year	No. of Landing Sites	Net Income for Silaqui	Net Income for Bolinao
1987	2	246,940	493,880
1988	2	297,075	594,150
1989	2	9,651,555	19,303,105
1990	2	5,634,765	11,269,525
1991	3	3,236,635	9,709,910
1992	3	1,983,475	5,950,425
Mean		3,508,408	7,886,832

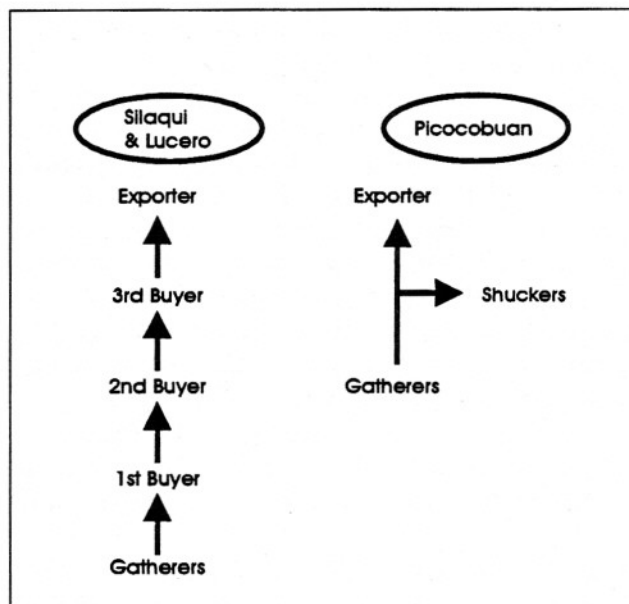
The valuation made in this study underscores a number of points which must be taken into account in resource management of commercially valuable products and most specifically, those which are highly demanded by the export market. First, a thorough analysis of market and labor arrangements should be made before legitimizing commercial scale harvest. Second, tariff mechanisms must maximize returns to on-site labor force. For example, village-level enterprises may be organized and people trained to take on the tasks of gathering, processing and marketing to fulfil both the local and foreign markets. This way, generated wealth remains in the municipality and economic incentives, coupled with appropriate legislation, may be easily enhanced to achieve sustainability of the resource. In Bolinao, the municipality levied nominal taxes, P1.50 for every kilogram of roe exported from the town and P250 a year for a permit to collect sea urchins. Through such nominal fees, the municipality legally condoned the overexploitation of the resource. Third, legal mechanisms must not only stipulate taxes for collection and transport, but must also provide levies for processing and packaging for both the local and foreign markets. This way, taxes could in fact regulate harvest and redistribute returns more equitably.

#### *Effects of Industry Collapse on Associated Personnel*

The personnel structure of the sea urchin industry is shown in Figure 3A. The left hand diagram illustrates labor relations in the two major landing sites (Silaqui and Lucero) from 1986 to 1992 before the marketing restriction was imposed in December 1992. Gatherers collected the sea urchins during two to six hours of foraging, after which they brought the catch to shore where they and their family shucked the urchins for their roe. Most of these were processed with brine while some choice gonads were kept fresh and directly sold to a first-level buyer. The latter traded the roe to second- and third-level buyers, the arrangement allowing for a natural accumulation of the catch for sale to Manila-based exporters.

A different structure was adopted by Japanese exporters in Picocobuan from 1990 to 1991 (right hand diagram, Fig. 3A). Gatherers were directly employed and paid per whole urchin. Shuckers were given an 8-hour daily rate. This allowed for specialization of functions between collectors and shuckers. The latter indicated that the catch contained a significant number of immature urchins which were harvested anyway

A.



B.

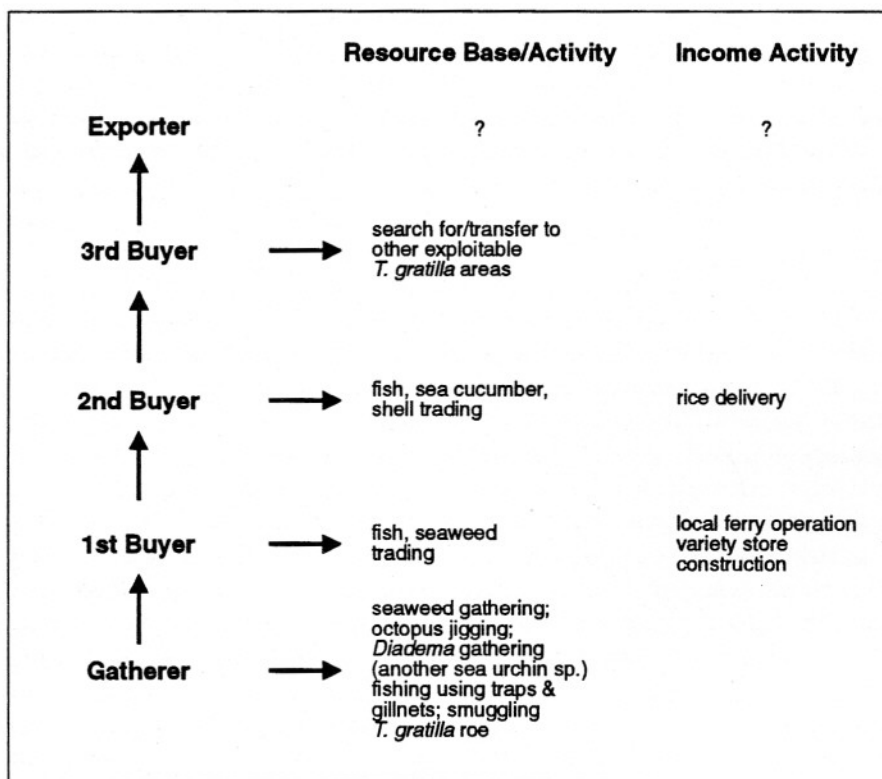


Figure 3. A. Labor arrangement in Silaqui and Lucero from 1986 to 1992, in Picocobuan from 1989 to 1991 before marketing restriction. B. Shifts in occupation or activity as a result of the market ban.

since gatherers got paid regardless of urchin size. Thus, this labor arrangement, which provided for an incentive by increasing the income of gatherers through indiscriminate harvest, contributed to the rapid decline of the resource base. By late 1991, the exporters closed down their operations which were no longer economically viable.

Figure 3B summarizes the shifts in occupation or activity by gatherers and buyers immediately after the restriction to the local market was passed. Gatherers, who were generally multi-resource based (i.e. opportunistic), simply gathered other resources such as seaweeds (e.g. *Caulerpa*), octopus and fish caught using traps or gillnets, among others. First- and second-level buyers presumably included other resources in the list of produce they would usually buy, or augmented income through other activities like running a variety store or becoming a part-time construction worker. The third-level buyers searched for other exploitable sea urchin beds in other parts of the country. There was no data collected on the effect of the ban on exporters. However, a reasonable assumption would be that Manila-based exporters must have established contacts with buyers from other areas to make their business a viable one. Thus, a likely consequence of the export ban would be to fill the void in product volume with harvest from other areas or with other marine products. An interview with a Bolinao-based employee of a Korean exporter indicated that her task included determining what produce, including dried squids and octopuses, was available in commercial quantities.

Thus, it seems as if gatherers, buyers and exporters had the resilience to cope with the export ban because they were all multi-resource based. The export ban hopefully allows the remaining individuals of *T. gratilla* to propagate and repopulate the area. However, this leads to an increase in fishing pressure on other harvested species, since sea urchin gatherers maintain their occupations as harvesters. While it was urgent to protect the sea urchins, a longer-term protection for all harvested resources in the area must be conceptualized. Otherwise, the shift in harvest pressure might endanger the productivity of other exploited resources that are as susceptible to local extinction.

### ***Management Options***

From the point of view of resource valuation, steps to maximize returns to gatherers and low-level buyers and to effectively distribute profits throughout the trading chain, were made. However, it would be shortsighted to make them outside more comprehensive management context, which should take into account the management of the entire harvest fisheries in the municipality. Finfish resources have shown indications of overexploitation with diminishing size at maturity and low densities of small-size fish (McManus et al., 1992). For selected invertebrates like the sea urchin, virtually zero recruitment or extremely low densities indicated that wild populations were near extinction (Juinio-Meñez et al., 1995). Given such scenario, a logical recommendation would be to decrease harvest pressure. A possible approach may be to organize capture fishers to switch to supplemental or alternate income-generating activities, including sea farming of appropriate organisms such as carrageenan-containing seaweeds, giant clams and rabbit fish, among others. Technologies for these have been developed. Land-based processing of products such as soap and other household commodities may also help alleviate fishing pressure (Montaño et al., 1994). Finally, traditional activities in Bolinao including rope-making from hemp plant and mat-weaving may be encouraged. The viability of such enterprises needs to be determined in the degree of their social acceptability, availability of raw materials and skilled labor(which may be trained if otherwise), seed capital, market, and distribution networks.

While supplemental or alternate livelihood systems may address the economic issues of overfishing,

proactive conservation of critical coastal and marine habitats should remain high in the management agenda. The establishment of village-level marine reserves, where wild populations may be protected from harvest to enhance recruitment and the establishment of breeding populations, must be seriously undertaken for the fisheries to be revived and eventually sustained. A long-term foundation of village-managed reserves is a heightened sense for the environment which could be nurtured through a vigorous informal and participatory program of environmental education. Organized communities with high environmental consciousness and viable economic options should be able to manage their natural resources sustainably.

In retrospect, the failure of closed seasons and marketing bans to sustain the sea urchin industry underscored the futility of single-resource management and the urgency of a holistic scheme of community-based coastal zone management. The incentive, provided for by an insatiable export market which was left unregulated, was sufficient to decimate the resource base which could have been sustainably utilized to benefit local communities. It is hoped that the collapse of such a major fishery should augur the evolution of an appropriate resource management to reverse the pattern for the highly diverse multi-species and multi-gear fisheries of the Bolinao reefs.

## References

- Juinio-Meñez, M. A., N. Macawaris and H. Bangi, 1995. Potentials of sea urchin culture as a resource management strategy. In A. R. Juinio-Meñez and G. F. Newkirk (Eds.), *Philippine Coastal Resources Under Stress*, Coastal Resources Research Network, Halifax, Canada; and Marine Science Institute, University of the Philippines, Manila, Philippines, pp. 219-227.
- Kesner, K. P. N. and L. Talaue-McManus, 1992. Sea urchin fishery in Bolinao, Pangasinan, Philippines: An assessment of catch, effort and yield three years after the adoption of an annual closed season. Paper presented at the Second National Symposium in Marine Science, November 1992, Tawi-Tawi, Philippines.
- McManus, J. W., C. L. Nañola, Jr., R. B. Reyes, Jr., and K. P. N. Kesner, 1992. Resource Ecology of the Bolinao Coral Reef System. *ICLARM Studies and Reviews* 22, International Center for Living Aquatic Resources Management, Manila, Philippines, 117 p.
- Montaño, N. E., A. Siringan and L. Talaue-McManus, 1994. Coastal-based processing technologies: A tool in coastal zone management. Paper presented during the Third National Symposium in Marine Science, May 1994, Miag-ao, Philippines.
- Siegel, S. and N. J. Castellan, Jr., 1988. *Nonparametric Statistics for the Behavioral Sciences*. McGraw-Hill Book Co., Singapore, 399 p.
- Talaue-McManus, L. T., E. D. Gomez, J. W. McManus, and A. Juinio, 1991. Sea urchin management in Bolinao, Pangasinan, Philippines: Attempts on sustainable use of a communal resource. Paper presented at the at the Third Annual International Common Property Conference, September, 1991, Manitoba, Canada.
- Trinidad-Roa, M. and J. N. Pasamonte, 1988. Population and culture studies of sea urchins in Bolinao, Pangasinan. Annual Project Report.