Short Communication

Overexploitation of Abalone at Libong Island, Trang Province, Southern Thailand

Chanyut Sudtongkong and Suwat Tanyaros*

Department of Marine Science, Faculty of Science and Fisheries Technology,
Rajamangala University of Technology Srivijaya, Trang Campus, Sikao, Trang, 92150 Thailand.

Abstract

Abalone is generally known as a fishery resource of high economic value. The wild abalone from Libong Island is widely known for its potential as a cocktail-size and high-quality broodstock for hatcheries. The high market price and external demand have encouraged local fisherman to catch the wild abalone without proper management, resulting in a near extinction crisis in the abalone population in this area. The present evaluation of abalone management at Libong Island, Trang Province, Thailand, was conducted using local user perceptions. Sixteen performance indicators included effectiveness indicators, equity indicators, and sustainable indicators. These were measured to determine whether the abalone management activities had achieved the set objectives in terms of better conditions for abalone cultivation and sustainability. The results revealed that the abalone population has undergone degrading and decline due to lack of proper management measures in this area. The findings suggest that practical management is needed for the abalone population at Libong Island.

Keywords: abalone, management, sustainability, resource, Thailand.

1. Introduction

Abalone is a high-value species of gastropod mollusk distributed throughout the tropical and the temperate zones (Geiger, 2000). Three species of tropical abalone, *Haliotis asinina*, *H. ovina* and *H. varia* are indigenously found in Thai waters (Singhagraiwan and Doi, 1993). The donkey's ear abalone (*H. asinina*) is the most common species found in the waters surrounding Libong Island (Tang *et al*., 2005). Abalone fishing near Libong Island has been conducted by the local villagers for more than a decade. Overfishing and poor management by authorities have contributed to the decline of the abalone population in this area. Unfortunately, the abalone population in this area has reached a crisis point of near extinction. However, to date, no scientific data and research exist on the population and fishing pressure of

abalone in Libong Island waters in order to empirically verify the decline in the abalone population resulting from over-harvesting and lack of proper management measures. Therefore, evaluation of abalone management is needed for Libong Island. Such an evaluation regarding the effectiveness of abalone management is important for all stakeholders. It can provide necessary empirical data on whether community management practices have achieved their objectives in terms of better conditions for sustainability of the abalone resource. Generally, such an evaluation of coastal resources management (CRM) seeks to compare quantitative performance indicators, e.g. mollusk abundance, income, equity of benefit distribution, and community livelihood parameters, before and after implementation of management measures (Webb *et al*., 2004). However, given the lack of quantitative indicators before introducing management measures, it is difficult to evaluate the effects of management. In order to solve the problem of adequate data, qualitative input on local perceptions was used to evaluate whether the management measures had achieved the set objectives. Local perceptions

* Corresponding author.
  Email address: stanyaros@gmail.com

can provide in-depth information on the condition of coastal resources and management activities in a particular area and period. Thus, numerous researchers (Pollnac and Pomeroy, 2005; Pomeroy *et al.*, 1997; Webb *et al.*, 2004; Pomeroy *et al.*, 2005) have widely utilized local perceptions to evaluate CRM and the effects of protection management. This study evaluates outcomes of abalone management at Libong Island, southern Thailand, using local user perceptions. The aim of this research is to describe the management outcomes of the abalone population in this area. Based on this research, the abalone population tends to be degraded due to a lack of proper management measures in the area. The findings suggest that practical management is needed for sustaining the abalone population in the Libong Island waters.

2. Materials and methods

2.1 Research area

Trang province is located in southern Thailand between 7°15′-7°45′ N and 99°15′-99°45′ E on the coast of the Andaman Sea (Figure 1). The climate is tropical seasonal monsoon, with a rainy period from June to November and rainfall of 1,830–1,861 mm per year. The annual mean temperature of the study site was 27.5°C. Local tides have a semi-diurnal regime with maximum amplitudes of 2.9 m. Libong Island is an important island of Trang Province. Most of the villagers are fishers. The village area is surrounded by sea grass beds and coral reefs. The villagers have long depended on these significant coastal resources for their livelihood. Villagers still continue to utilize various types of fishery products for daily household consumption and for sale in the local market as a source of income.

2.2 Data collection

In order to assess the effectiveness of management outcomes of abalone management on Libong Island, the perceptions of the local community on the effectiveness of management practices and the conditions of abalone were evaluated. Thirty two respondents were selected through random sampling of the 2009 registry of villagers. Respondents were restricted to those born in the villages, or resident there for >20 years, and whose livelihoods were related to fisheries products, including the abalone. Sixteen performance indicators were grouped within three criteria of effectiveness: equity, efficiency, sustainability (Table 1). Those indicators were used to collect respondents' perceptions of different management outcomes. They were adopted from those indicators previously used to evaluate the outcomes of coastal management (Pomeroy *et al.,* 1997; Katon *et al.,* 1999; Webb *et al.,* 2004; Pomeroy *et al.,* 2005). In order to collect user perceptions, each respondent was asked a set of questions ranking the indicators (Table 1), using a ladder-like diagram with 10 steps, where Step 1 represented the worst possible situation and Step 10 the best possible situation. The method was used to evaluate differences between two time periods, 1999 and 2009, with respect to the same indicators.

2.3 Data analysis

A paired comparison Wilcoxon match-pair signed rank was used as a statistical technique to compare the performance indicators between two time periods (before 1999 and the present, 2009). Statistical analyses were performed using SPSS 12.0 for Windows®.
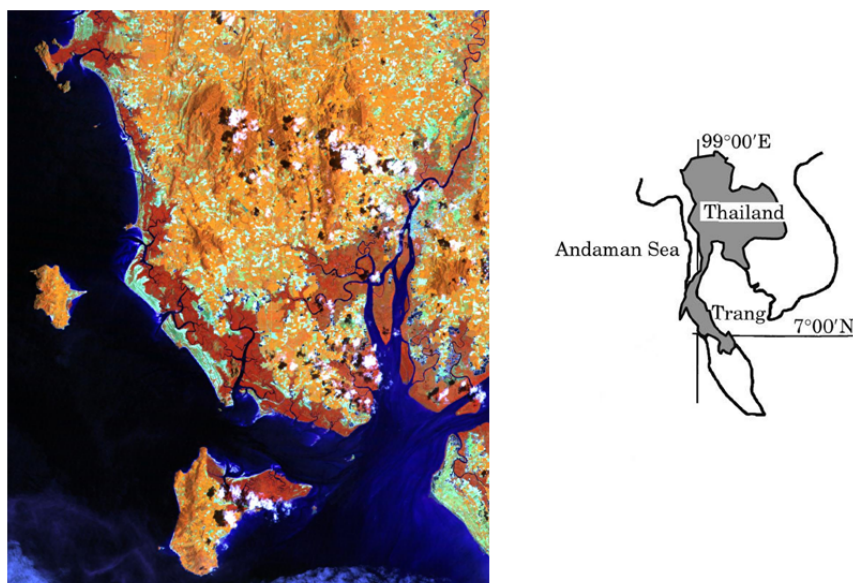

Figure 1. Map of the study site at Libong Island, Trang Province, Thailand.

Table 1. Set of performance indicators used to evaluate the outcomes of abalone management at Libong Island, Trang Province, Thailand.

Performance Indicators	Theme of question sets
Equity	
Ability to participate in community affairs	Level of involvement of villagers in community affairs in general
Ability to participate in abalone management	Level of involvement of villagers in abalone management
Fair allocation in abalone harvesting	Fair allocation of rights or ability to access and harvest abalone
Ability to influence community affairs	Level of bargaining power of villagers over decision making related to community affairs
Ability to influence abalone management	Level of bargaining power of villagers over decision making related to abalone management
Overall well-being of the household	Overall well-being of the household
Household income	Household income generated from fishery products
Income from the harvesting of abalone	Income from the harvesting of abalone
Efficiency	
Control over fishing gear for abalone harvesting	Level of bargaining power of villagers to control over fishing gear for abalone harvesting
Control over fishing areas of abalone-harvesting	Sense of villagers' power to control over fishing areas of abalone harvesting
Decision-making on rules concerning abalone	Level of bargaining power of villagers over decision making on rules concerning abalone
Speed in resolving conflicts concerning abalone management	Time of conflict solving related to abalone management
Sustainability	
Overall condition of abalone	General condition of abalone using the abundance of abalone as an index
Compliance with the relevant rules of abalone management	Compliance of villagers' behavior with operational-level rules
Knowledge related to ecology and management of abalone	Knowledge related to abalone
Exchange of information on abalone management	Information exchange between villagers and external sectors regarding abalone management

3. Results

A comparison of pooled data between the two periods by Wilcoxon signed-rank test is illustrated in Table 2. The results revealed that the quantitative performance indicators of equity issues had significantly decreased in comparison to the previous reference point ($p<0.05$), but the ability to influence community affairs and abalone management were shown to be non-significantly different ($p>0.05$). The respondents' ability to participate in community affairs and management were shown rights bargain to access even if these were not fairly distributed among the fishers in harvesting the coastal products. A decrease of the overall well-being of a household, household income, and income from abalone harvesting was displayed as an inequitable benefit to the fishers. All performance indicators of efficiency issues showed a non-significant decrease between the two periods ($p>0.05$). The

results indicated that the effectiveness of abalone management on Libong Island did not improve after rules and regulations pertaining to abalone management were enforced by the relevant offices. The villagers were not included in the decision-making process on establishing and enforcing the rules concerning abalone management. For sustainability outcomes, the results revealed that the overall condition of abalone and exchange of information for abalone management significantly decreased between the two periods ($p<0.05$). A decrease in the conditions of the abalone population is important evidence that the management practices for abalone in this area are ineffective. The villagers were required to learn and observe the relevant rules of abalone management and acquire knowledge related to ecology and management of abalone, but the knowledge and information for abalone management were not imparted by relevant offices.

Table 2. Median indicator scores of respondents at Libong; *p* values refer to the significance of a Wilcoxon match-pair signed rank test.

Performance indicators	1999	2009	*p*-value
Equity issues			
Ability to participate in community affairs	5.0	2.5	<0.05
Ability to participate in abalone management	5.0	1.0	<0.001
Fair allocation in abalone harvesting	7.0	2.0	<0.05
Ability to influence community affairs	2.0	2.0	>0.05
Ability to influence abalone management	1.0	1.0	>0.05
Overall well-being of the household	7.5	5.0	<0.001
Household income	8.0	5.0	<0.001
Income from the harvesting of abalone	4.5	1.0	<0.001
Efficiency issues			
Control over fishing gear for abalone harvesting	3.0	2.0	>0.05
Control over fishing areas of abalone harvesting	5.0	2.0	>0.05
Decision-making on rules concerning abalone management	5.0	2.5	>0.05
Speed in resolving conflicts concerning abalone management	3.0	2.5	>0.05
Sustainability issues			
Overall condition of abalone	8.0	2.0	<0.001
Compliance with the relevant rules of abalone management	6.5	5.5	>0.05
Knowledge related to ecology and management of abalone	2.0	2.0	>0.05
Exchange of information on abalone management	2.0	1.5	<0.05

4. Discussion

Where no previous scientific data and research on fishery resources and management exist regarding a decline in the target species due to overexploitation and lack of proper management measures, evaluating the actual perception of the local community is a useful method to assess the fishery conditions and the effectiveness of management practices. Therefore, the quantitative performance includes equity, efficiency and sustainability indicators used to evaluate the perceptions of the local community on the effectiveness of the management process and performance in abalone fishery in this study. The perceptions regarding equity in connection with participation in abalone management by the local community were shown to have decreased compared to the previous time. This result indicated that the fishers were responsible for decimating the abalone resource without participatory management or with less involvement. The reduction in equity in the fair allocation of abalone harvesting in this area seem to indicate a lack of fisher discipline in catching abalone. This led to a reduction in income from abalone harvesting and overall well-being of the households. The reduction in most equity indicators indicated a lack of participation by the community and fishers in the management of the abalone resource. Participation can contribute positively to fishery management performance (Hanna, 1995). The perception of the local community regarding the efficiency indicators at present indicated they were lower than in the past. Findings suggested that there were fewer rules for

control over abalone harvesting in this area. The effectiveness of abalone management did not improve after rules were enforced by the relevant officers. It is difficult to remedy inefficient control of abalone fishery on Libong Island and restore it to a healthy level. Consequently, proper management efficiency is required for sustainable achievement. Findings indicate that in the perception of Libong residents, the abundance of abalone significantly decreased as compared with the earlier reference point. Evidence for a decline in the abalone population through overexploitation is accumulating from a variety of regions in the world where the price is sufficiently high to encourage fishing. The sedentary existence of adult abalone and their tendency to aggregate suggest that abalone fisheries are vulnerable to overfishing (Breen, 1992). This suggestion has been reinforced by the decline in several abalone fisheries (Tegner *et al.*, 1992). A high catch rate of abalone at Libong Island was encouraged by demand and market prices from outside the island. Fishers bear responsibility for decimating the abalone resource because they catch too many abalones, often undersized. The *H. asinina* found in Libong waters is a year-round spawning species, but if the animals are removed from the sea before they have a chance to reproduce, they do not have sufficient offspring. Findings indicate a need for investigating restorative and remedial management actions. Recently, there are reportedly fewer wild abalones in Libong Island waters. As a consequence, the natural restoration by the remaining abalone in this area would take a number of decades to reach a healthy level in the abalone resource. The implementation

of an alternative management scheme using abalone stock enhancement measures and an associated community-based fishery management scheme is needed in order to restore the abalone population in this area. Abalone stock enhancement measures have been implemented for several years in New Zealand (Schiel, 1993), Japan (Kitada, 1999), and South Africa (Godfrey, 2003). The Department of Fishery (DOF) of Thailand must in future play a significant active role in technical support for abalone stock enhancement at Libong Island. The hatchery-breed, juvenile *H. asinina* can be introduced into their natural habitat in the island. It would require several years of reproduction before reaching a healthy level. Fishery-independent monitoring on a regular basis will be essential to assess that recruitment, abundance density, and a range of size-classes are present to allow a controlled level of harvest to be sustainable. One of the key elements for operating a successful ranching operation would be to ensure that no fishing occurs. This would protect and aid the recovery of wild stocks, and ensure the sustainability of seeded and wild populations. From this perspective, stock enhancement applied in conjunction with a community-based fishery management system would appear to be a possible appropriate management tool. Japan is an example of a highly effective system of community fisheries management operated by fisheries cooperatives (Nickerson, 1998). Community-based management may well be a process that can empower local communities on Libong Island to manage their resources by allowing individuals in the community to contribute to decisions that affect local resources. The major benefit of community-based management is the development of strategies compatible with the unique environment, specific resources, and in the cultural, social and historical context of the local areas.

5. Conclusion

Overexploitation and lack of proper management measures have contributed to a marked decline in the abalone population at Libong Island. Findings indicated that there was a distinct lack of participation by the community and fishers in the management of the abalone resource. There were fewer regulations in force and adhered to for abalone harvesting. Abalone stock enhancement measures, pursued in conjunction with a community-based fishery management scheme, are likely what is needed for abalone restoration in this area.

Acknowledgements

References

Breen, P.A. 1992. A review of models used for stock assessment in abalone fisheries. In Abalone of the World: Biology, Fisheries and Culture, S.A. Shepherd, M.J. Tegner and S.A. Guzmân del Prôo, editors. Blackwell, Oxford, pp. 253-275.

Geiger, D.L. 2000. Distribution and biogeography of the *Haliotidae* Gastropoda: Vetigastropod world-wide. Bollettino Malacologico. 35, 57-120.

Godfrey, B.P. 2003. The potential of abalone stock enhancement in the Eastern Cape Province of South Africa. Master Thesis, Rhodes University, Grahamstown, South Africa.

Hanna, S.S. 1995. User participation and fishery management performance within the Pacific Fishery Management Council. Ocean & Coastal Management. 28, 23-44.

Katon, B.M., R.S., Pomeroy, L.R. Garces and Salamanca, A.M. 1999. Fisheries management of San Salvador Island, Philippines: A shared responsibility. Society & Natural Resources. 12, 777-795.

Kitada, S. 1999. Effectiveness of Japan's stock enhancement programmes: current perspectives. In Stock Enhancement and Sea Ranching, B. Howell, E. Moksness and T. Svâsand, editors. Fishing News Books, Oxford, pp. 103-131.

Nickerson, D.J. 1998. Community-Based Fisheries Management in Phang-nga Bay, Thailand. Proceedings of the national workshop on community-based fisheries management. Phuket, Thailand.

Pollnac, R.B. and Pomeroy, R.S. 2005. Factors influencing the sustainability of integrated coastal management projects in Philippines and Indonesia. Ocean & Coastal Management. 48, 233-251.

Pomeroy, R.S., Pollnac, R.B., Katon, B.M. and Predo, C.D. 1997. Evaluating factors contributing to the success of community-based coastal resource management: the Central Visayas Regional Project-l, Philippines. Ocean & Coastal Management. 36, 97-120.

Pomeroy, R.S., Oracion, E.G., Pollnac, R.B. and Gaballes, D.A. 2005. Perceived economic factors influencing the sustainability of integrated coastal management projects in the Philippines, Ocean & Coastal Management. 48, 360-377.

Schiel, D.R. 1993. Experimental evaluation of commercial-scale enhancement of abalone *Haliotis iris* populations in New Zealand. Marine Ecology Progress Series. 97, 167-181.

Singhagraiwan, T. and Doi, M. 1993. Seed Production and Culture of a Tropical Abalone, *Haliotis asinina (L.)*. Department of Fisheries. Ministry of Agriculture and Cooperatives, Thailand.

Tang, S., Popongviwat, A., Klinbunga, S., Tassanakajon, A., Jarayabhand, P. and Menasveta, P. 2005. Genetic heterogeneity of the tropical abalone (*Haliotis asinina*) revealed by RAPD and microsatellite analyses. Journal of Biochemistry and Molecular Biology. 38, 182-190.

Tegner, M.J., Demartini, J.D. and Karpov, K.A. 1992. The California red abalone fishery: a case study in complexity. In Abalone of the World: Biology, Fisheries and Culture. S.A. Shepherd, M.J. Tegner and S.A. Guzmân del Prôo, editors. Blackwell, Oxford, pp. 370-383.

Webb, E.L., Maliao, R. J. and Susana, S.V. 2004. Using local user perception to evaluate outcomes of protected area management in the Sagay Marine Reserve, Philippines. Environmental Conservation. 31, 138-148.