E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2017; 5(6): 205-210

www.fisheriesjournal.com
Received: 26-09-2017
Accepted: 29-10-2017

Johannes MS Teteleptal
(a) Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science. Pattimura University, Ambon. Indonesia
(b) Maritime and Marine Science Center of Excellence. Pattimura University, Ambon, Indonesia

OTS Ongkers
(a) Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science. Pattimura University, Ambon. Indonesia
(b) Maritime and Marine Science Center of Excellence. Pattimura University, Ambon, Indonesia

JA Pattikawa
Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science. Pattimura University, Ambon. Indonesia

Correspondence
Johannes MS Teteleptal
(a) Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science. Pattimura University, Ambon. Indonesia
(b) Maritime and Marine Science Center of Excellence. Pattimura University, Ambon, Indonesia

Sustainability Status of Spiny Lobster (*Panulirus* sp.) Fishery in Latuhatat Waters, Ambon Island, Indonesia

Johannes MS Teteleptal, OTS Ongkers and JA Pattikawa

Abstract
Research to study sustainability and harvesting practices of rocky lobster *Panulirus* sp. at Latuhalat Water of Ambon Island was carried out between March to May 2014. Questionnaire was distributed to local lobster fisher and some local people considered to know the fishery well. Direct field observation was also carried out to study harvesting practices. Rapfish multi dimensional scaling analysis method was used to study lobster fishery sustainability whilst descriptive statistics was used to study harvesting practices. This study showed spiny lobster average sustainability was fair (45.18%) with economy sustainable dimension was even less (31.72%). The lobster fishery is still viable, but the production is steadily decline. No formal and informal (indigenous knowledge) fisheries management exercised in this spiny lobster fishery.

Keywords: sustainability status, harvesting practice, rock lobster, Ambon Island

1. Introduction
Indonesian fisheries statistical data of the year 2012 shows that spiny lobster was at fourth highest level in crustacean production after Penaues, Metapenaues and Macrobrachium. Statistical data production from FAO and GLOBEFISH also shows that since 1985, the demand on lobster from Japan increased steadily from year to year [1]. Lobsters are one of the most valuable and highly priced crustaceans in Indonesia, as well as an important export commodity. Potential market for the counties such as Japan and USA are still widely open [2, 3, 4]. From field observation, alive lobster in the local market is sold for up to USD 30 kg^{-1}, while in the local restaurant it was valued for up to USD 50 kg^{-1}.

There are approximately 149 species of commercially important lobsters known to occur in the Indian and Pacific Oceans, of which, 47 species belong to the family of Palinuridae [5]. Additionally, Phillips *et al* [6] stated that 11 species of family Palinuridae are found to distribute in Indian and West Pacific Oceans of which seven species are known to occur in Indonesian waters [2]. Those species are *Panulirus homarus*, *P. ornatus*, *P. penicillatus*, *P. longiceps*, *P. polyphagus*, *P. versicolor*, and *P.daypus.*

To date the only significant production of spiny lobsters from aquaculture has come from Vietnam. The positive experience of Vietnam has led to similar interest in Australia and Indonesia and is likely to spread elsewhere. Of particular significance is the positive impact the industry has on impoverished communities and the opportunity to extend such benefit to other poor areas [7, 8]. Though the market for this product is still widely open, globally a sign of production decreases has been reported in some areas as a result of high exploitation rate [9, 10, 11, 12, 13].

Harvest of lobster was also conducted at several parts in Maluku *i.e.* Kei and Tanimabr Waters of Southeast Maluku [14, 15, 16, 17, 18]. Study by Ongkers and Tuhumury [15] in Central Maluku concluded a high exploitation was occurred that lead to over exploitation of *P. penicilattus* and *P. versicolor*. In some parts of Western Seram, Southeast Maluku and Southwest Maluku, poisonous substance was used for harvesting the lobster (Personal communication).

Exploitation of lobster in Ambon Island was performed by traditional fishers and has been done for long time. For fisheries sustainable management, scientific information of this important marine resource should be adequate available. This research was conducted to investigate the sustainability status in multidimensional domains and harvesting practices of rock lobster (*Panulirus* sp.) in Latuhalat Waters, Ambon Island.

2. Materials and Methods

The study was conducted between March to May 2014 at Latuhalat Waters of Ambon Island (Figure 1). Data for sustainability study were based on standard attributes for Rapfish Analysis [19, 20, 21, 22], and analyzed with RAPFISH (Rapid Appraisal for Fisheries Status), a multi-dimensional scaling, done through Microsoft Excel software. Sustainability criteria for sustainable management was applied according to Pitcher *et al*, 2009 [23]. Data were collected through a questionnaire distributed to local lobster fisher and some local people considered to know the lobster fishery practices at Latuhalat Village.

Direct observation was made to study harvesting practices, whilst interview was made to study indigenous knowledge and local fisher knowledge on sustainable fisheries management, and then analysis was made based on descriptive statistic [24].

Fig 1: Map showing sampling site (red square)

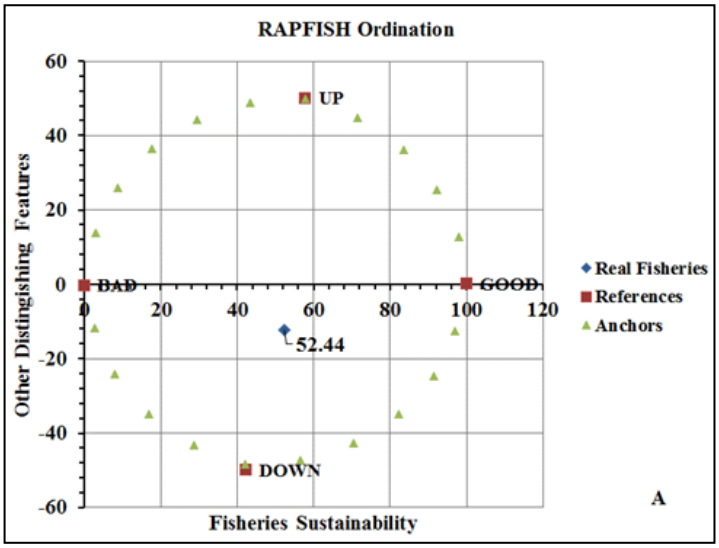
3. Results and Discussions

3.1 Sustainability status

Sustainable of local lobster fisher wellbeing will certainly depend on sustainable lobster resources. Analysis of lobster sustainability therefore is an important necessity tool for the management of that resources. In ecosystem approach to sustainable fisheries management, the management should be implemented covering three major dimensions *i.e.* bio-ecological, social-economy, and institutional [25, 26, 27]. In sustainability analysis, these three dimensions were further extended to six domains *i.e.* bio-ecology, social, economy, ethic, technology and institutional [19, 20, 23].

From sustainability analysis for bio-ecology dimension, it was found that lobster bio-ecology sustainability was 52.44% of 100%sustainable scale with stress value of 0.1430 and Root Square Correlation (R^2) of 0.9500.(Figure 2A.). The stress value under 0.20 signified the goodness of fit of this analysis and was considered to be liable. This sustainable status was considered fair sustain [23, 28].

Rapfish ordination and Monte Carlo scatter plot (Figure 2B) was performed to analyze the accuracy and validity corresponding to scaling procedure applied in Rapfish analysis. This analysis shows that the Rapfish analysis was quite accurate since anchor and reference fisheries did not move in Monte Carlo run [20].



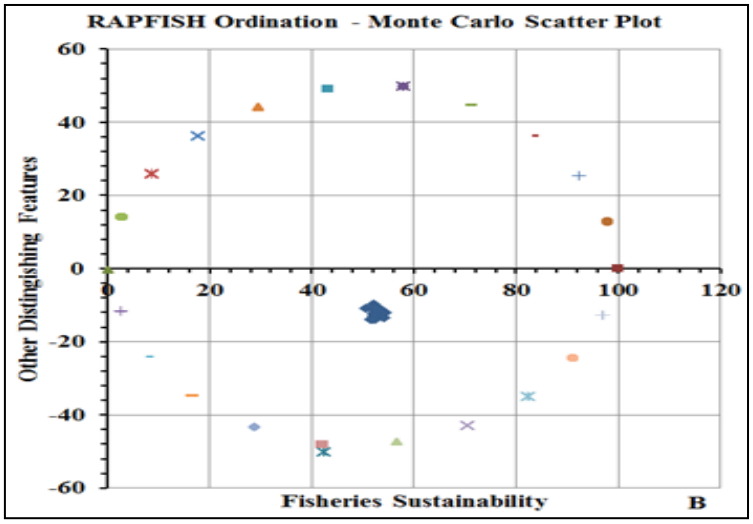


Fig 2: Ecology sustainability analysis (A), Monte Carlo scatter plot (B) of lobster fishery of Latuhalat Waters.

Rapfish ordination and Monte Carlo Scatter Plot analysis was also performed for social sustainability of spiny lobster of Latuhalat Waters. Figure 3 A shows social sustainability of this species. This figure shows that social sustainability of spiny lobster at Latuhalat Waters was 46.93 % of the 100% sustainability scale, and is considered less sustain. Stress value was 0.1423 with Square Correlation of 0.9500 signifying the validity of the test. This was also shown by Monte Carlo scatter plot (Figure 3B), where anchor and reference didn't move during Monte Carlo run.

Rapfish analysis, Rapfish ordination and Monte Carlo scatter plot was carried out for other remaining sustainable dimensions *i.e.* economy, technic, ethic and institutional. Table 1 displayed complete results of spiny lobster sustainability indices from Latuhalat Waters.

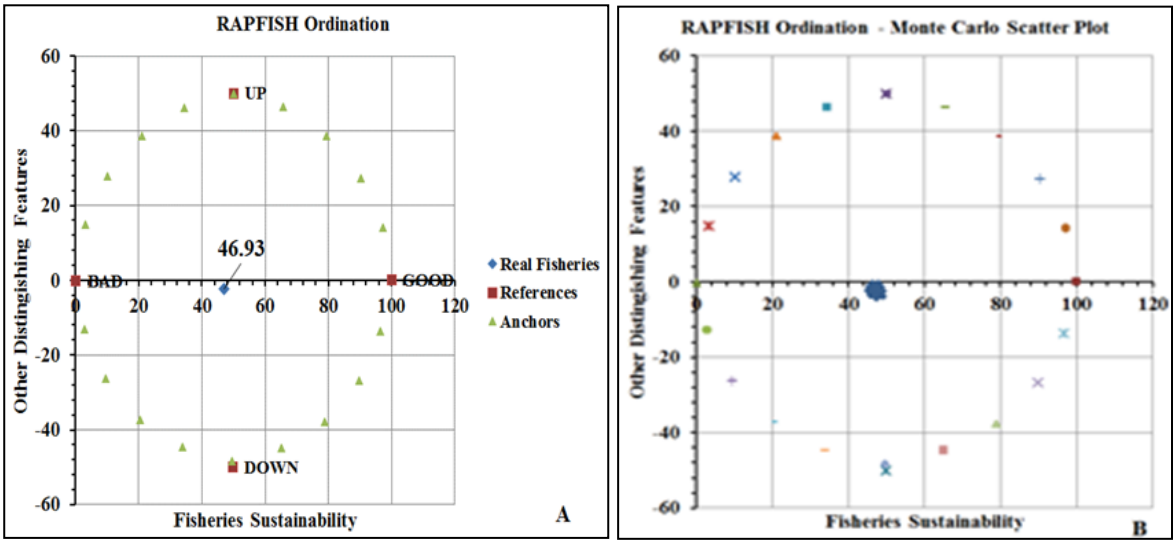


Fig 3: Social sustainability analysis (A), Monte Carlo scatter plot (B) of spiny lobster fishery of Latuhalat Waters.

According to sustainable classification category related to ecosystem approach to fisheries management [22, 23], overall sustainability of spiny lobster at Latuhalat Waters was considered as fair sustain. Among all six sustainable dimensions, institutional dimension is the lowest one and considered to be unsustain (29.55% from 100% sustainable scale). Sign of unsustain condition of lobster fishery in some parts of Ambon area had been reported before. Production of spiny lobster fishery in Tial, of Ambon Island, for example, had decreased both in number and size which probably due to high exploitation rate [15].

Table 1: Results of Rapfish analysis of painted spiny lobster *P. versicolor* fishery at Latuhalat Waters.

No	Sustainability Dimension	Sustainability. Status (%)	Leverage	RMS	Stress	R^2
1	Ecological	52.44	By catch	3.09	0.1430	0.9508
2	Social	46.93	Level of education	3.74	0.1423	0.9501
3	Economy	51.96	Market system	1.62	0.1499	0.9471
4	Ethical	65.31	Just governance	8.53	0.1377	0.9474
5	Technological	64.42	Change in vessel size	6.70	0.1424	0.9503
6	Institutional	29.55	Reporting	5.07	0.1426	0.9499
		51.77			0.1430	0.9493

Figure 4. shows all sustainability dimension status and their corresponding leverage attribute (in the bracket) of spiny lobster of Latuhalat Waters.

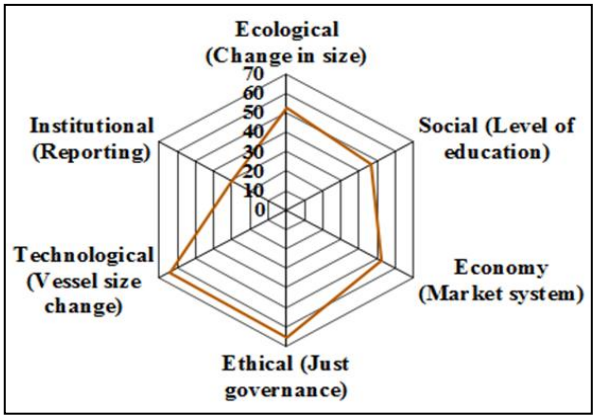


Fig 4: Kite diagram showing all spiny lobster sustainability dimensions index

3.2 Factors affecting sustainability

There are 55 attributes used in analyzing sustainability status of spiny lobster of Latuhalat Waters. Each of these attributes has an impact on sustainability dimension with different degree of impact. Leverage analysis [19, 20, 21] was performed to analyze which attribute contributes significantly to sustainability for each corresponding dimension. Figure 5 shows result of leverage analysis for all dimensions with its corresponding attribute.

Leverage analysis for ecology dimension shows that the most influential attribute affecting ecology sustainability is by catch. Spear is the main fishing gear in spiny lobster fishery at Latuhalat Waters. This fishing gear is a selective one but, the fisher may use it for non-target species as well or smaller spiny lobster which can affect their sustainability. For social sustainability dimension, level of education is the most significant attribute affecting the sustainability. Majority of local fisher of Latuhalat Village have slightly lower education level which contribute to their knowledge on sustainable fisheries management. The second attribute which also has an important effect on social dimension is consumer attitude towards sustainability. From observation and interviewed with local fisher, it was found that, consumer has very little attention on principles of sustainable fisheries.

From all 55 attributes use in this sustainable analysis, just governance of ethic dimension is the most highest one contributes to ethic sustainability. This attribute assesses the inclusion of fishers in management and governance of that fishery [20, 22]. From interviewed with local fisher, it was found that almost no fisheries management relating to lobster fishery at Latuhalat Village. There is some fisheries management implemented in fisheries management but with very little inclusion of local fisher. Other attributes from social dimension with its degree of contribution on sustainability of spiny lobster fishery can be seen in Figure 5.

Ecosystem approach to fisheries management assigned to sustain ecology integrity of the resources, socio-economy well-being of the community and maintain good governance [25, 26]. This study shows that institutional dimension is in unsustainable status with reporting which assesses accurate, transparent reporting of fishing activities and fish extracted to national/regional authority as the most sensitive attribute. Local fisher explained that there is no such mechanism in management of spiny lobster fishery.

3.3 Harvesting practices

Latuhalat Waters was one of the best lobster fishing area in Ambon Island for 20 to 25 years back [16]. The coastal area of this waters is predominantly dominated by extensive coral reefs which is the main habitat of spiny rock lobsters [30, 31]. Because of high demand and price for this product as well as economic necessity of local fisher, the lobster had been exploited extensively.

In ecosystem approach to fisheries management (EAFM), particularly in harvest strategy and harvest evaluation strategy, there should always be a conceptual management objectives operational objectives, performance indicators, stock assessment, monitoring and evaluation, legislation, stakeholder discussion [32, 33].

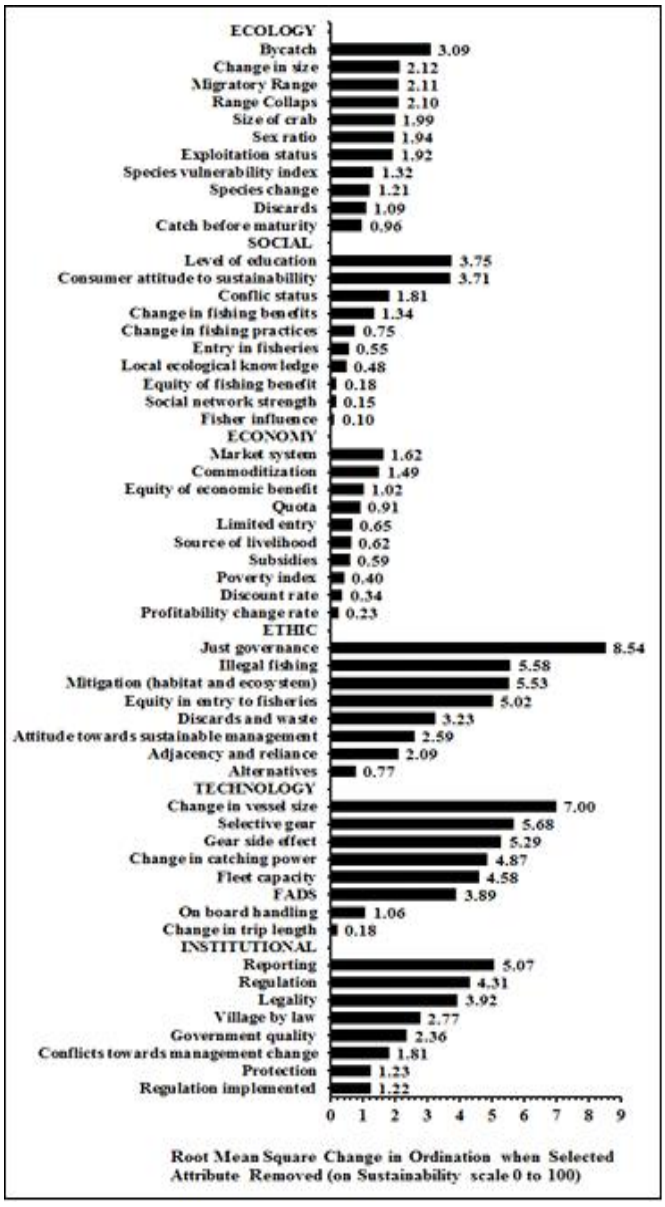


Fig 5: Attribute sensitivity analysis result of spiny lobster sustainability of Latuhalat Waters.

Even before the concept of EAFM come into practice, almost none all of these fisheries management tools been put into practice in lobster fishery at Latuhalat Village or even in Maluku. The harvesting practices run as usual without any management strategy, and has been conducted for many years. Local fisher knows almost nothing about the concept and objective of sustainable fisheries management. They

know very little about lobster management directive issued by the Ministry of Marine and Fisheries Affairs of the Republic of Indonesia [34, 35].

Sasi is an important indigenous knowledge on the management of natural resources in Maluku [36. 37, 38]. With regard to marine resources or *sasi laut* (*laut* = sea) there are regulations on the use of poisonous plants and other chemicals, destructive nets and gear such as the *bagan* (lift net). From this study, we found that there is no *sasi* applied for marine natural resources in Latuhalat. Study by Novczek *et al*., [36], Harkes and Novczek [37, 38] and Mosee *et al* [39] exclaimed that even though *sasi* has survived over approximately 400 years, it is in the process of dying out in various parts of the Moluccan Province.

All of local lobster fisher from this study site are categorized as being an artisanal fishermen with limited skill in fishing technique, low environmental knowledge, limited fishing gears and capital. The main fishing gear used is traditional spears, simple canoe equip with 5 horse power engine and simple goggle. Fishing ground used to be close to their village, but because of high exploitation rate and reduce of production, now they have to go further away from previous fishing area. Nowadays, the local lobster fisher do not go to do the fishing on the regular day as before, they only go when there is order from the buyer which is not constant. They can get an average of 5 kg lobster per trip per month, and for painted spiny lobster, the price was approximately IDR. 200.000,- kg^{-1}. According to the fisher, they can still make a living with this fishery but tend to decrease compared to 20 years before.

4. Conclusions

Overall sustainability of rocky lobster *Panulirus* sp. fishery was in fair sustainable scale with institutional dimension sustainability being unsustain. The local lobster fisher can still make a living from this fishery but the production tend to decrease steadily. No fisheries management strategy in this fishery as well as no indigenous management practices. There should be more study to be carried out in order to produce proper harvest strategy which will enable sustainable rocky lobster fisheries in Latuhalat Waters.

5. Acknowledgements

The authors would like to thank DP2M DIKTI Indonesia for funding research through SKIM MP3EI in 2014. We would also like to thank Winster Larwuy and Tiara Wattimury for their technical assistance in data collection.

6. References

1. FAO. Putting into practice the ecosystem approach to fisheries. Rome, FAO, 2005, 76.
2. Junaidi M, Cokrowati N, Z Abidin Z. Reproductive aspects of socky lobster (*Panulirus* sp.) at Bay of Eka Waters, Lombok Island. Jurnal Kelautan. 2010; 3:1, 29-35 (In Indonesia).
3. Boesono S, Anggoro S, Bambang AZ. Fishing rate and profit analysis of lobster *Panulirus sp)* gill net fishery at Kebumen District, Central Java. Jurnal Saintek Perikanan. 2011; 7.1:77-87 (In Indonesia).
4. Bakhtiar NM, Solichin A, Saputra SW. Growth and mortality rate of rock lobster *Portunus homarus* at Cilacap Waters, Central Java. Journal Pengelolaan Sumberdaya Perairan. 2013; 4:1-10 (In Indonesia).
5. Holthuis LB. FAO species catalogue. Vol. 13. Marine lobster of the world. An annotatedand illustrated catalogue of species of interest to fisheries known to date. FAO FisheriesSynopsis. 1991; 125(13):Rome 292.
6. Phillips BF, Cobb JS, George RW. General biology. In: The biology andmanagement of lobster. Cobb J. S., Phillips B. F. (eds), Academic Press, New York, 1980, 1-82.
7. Jones CM. Tropical spiny lobster aquaculture development in Vietnam, Indonesia and Australia. Journal of the. Marine Biology Association India. 2010; 52:2, 304-315.
8. Petersen EH, Phuong TH. Tropical spiny lobster (*Panulirus ornatus*) farming in Vietnam – bio economics andperceived constraints to development. Aquaculture Research. 2010; 41:10. 634-642.
9. Acosta CA, Robertson DN. Comparative Spatial Ecology of Fished Spiny Lobsters *Panulirus argus* and Unfished Congener *P. gutatus* in an Isolated Marine Reserve at Glover's Reef Atoll, Belize. Coral Reefs. 2003; 22:1-9.
10. Fadragas OM. Assessment of the Spiny Lobster (*Panulirus argus* Latreille, 1804) in Northeastern Cuban Waters. In. The United Nations University. Fisheries Training Programme, 2005.
11. Hearn A, Murillo JC. Life history of the red spiny lobster *Panulirus penicillatus* (Decapoda: Palinuridae), in the Galapagos Marine Reserve, Ecuador. Pacific Science. 2008; 2:191-204.
12. FAO. State of the world fisheries and aquaculture. Fisheriesand aquaculture department, Food and agriculture organization (FAO) of the United Nations, Rome, 2010, 197.
13. Thangaraja R, Radhakrishnan RV. Fishery and ecology of the spiny lobster *Panulirus homarus* (Linnaeus, 1758) at Khadyapatanam in the southwest coast of India. Journal of the Marine. Biology Association. India. 2012; 54:2, 69-79.
14. Sumiono B, Iskanda B. Rock lobster (*Panulirus* spp.) at Kai and Tanimbar Waters. Jurnal Penelitian Perikanan Laut.Balitkanlu. Jakarta, 1993, 73 (In Indonesia).
15. Ongkers OTS, Tuhumury SF. Population characteristic of rocky lobster *Panulirus penicillatus*, at Tial Waters, Ambon Island. Research Report, 1995 (In Indonesia).
16. Pattikawa JA, PW Hahully. Study on distribution and fecundity of *Panulirus* spp. at Latuhalat Waters. Research Report. Faculty of Fishery and Marine Scince. Pattimura University, 1993 (In Indonesia).
17. Ongkers OTS, Pattiasina BJ, Tetelepta JMS, Natan Y, Pattikawa JA. Some biological aspects of painted spiny lobster (*Panulirus versicolor*) in Latuhalat waters, Ambon Island, Indonesia. AACL Bioflux. 2014; 7:6, 469-474.
18. Key AS. Species diversity and size distribution of rocky lobster (*Panulirus* spp.) at Haya Waters, Sub-district Tehoru, Central Maluku Regency. Faculty of Fishery and Marince Sciences. Pattimura University. 2013, 63. (In Indoesia).
19. Pitcher TJ, D Preikshot. RAPFISH: a rapid appraisal technique to evaluate the sustainability status of fisheries. Fisheries Research. 2001; 49:255-270.
20. Kavanagh P, TJ Pitcher. Implementing Microsoft Excel Software for Rapfish: atechnique for the Rapid Appraisal of Fisheries Status. Fisheries Centre ResearchReports, University of British Columbia, Canada. 2004; 12:2, 1-75.

21. Rapfish Group. Standard attributes for Rapfish analyses: evaluation fields forecological, technological, economic, social and ethical status. Fisheries Centre, UBC, Vancouver, 2006, 5.
22. Pitcher TJ, ME Lam, C Ainsworth, A Martindale, K Nakamura, RI Perry *et al*. Improvements to Rapfish: a rapid evaluation technique for fisheries integrating ecological and human dimensions. Journal of Fish Biology. 2013; 83:865-889. doi:10.1111/jfb.12122.
23. Pitcher TJ, D Kalikoski, K Short, D Varkey, G Pramoda. An evaluation of progress in implementing ecosystem-based management of fisheries in 33 countries. Marine Policy. 2009; 33:223-232.
24. Nichols J. Introduction to descriptive statistics. Mathematics Learning Center. University of Sydney. NSW, 2006, 38.
25. FAO. Fisheries management 2: The ecosystem approach to fisheries. FAO Technical Guidelines for Responsible Fisheries. Rome, FAO. 2003; 4(Suppl 2):88.
26. Cowan Jr, JH Rice, JC Walters, CJ Hilborn R, Timothy E, Essington TE, *et al*. Challenges for Implementing an Ecosystem Approach to Fisheries Management. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science. 2012; 4:496-510.
27. Staples D, Brainard R, Capezzuoli S, Funge-Smith S, Grose C, Heenan A, *et al*. Essential EAFM. Ecosystem Approach to Fisheries Management Training Course. For Trainers. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand, RAP Publication. 2014/13; 1:318.
28. Cisse A, Blanchard F, Guyader O. Sustainability of small-scale fisheries: integrated assessment in French Guiana. Marine Policy. 2014; 44:397-405.
29. Chau NM, NTB Ngoc, LT Nhan. Effect of different types of shelter on growth and survival of *Panulirus ornatus* juveniles. Proceedings of an international symposium: Spiny lobster aquaculture in the Asia–Pacific region. Nha Trang, Vietnam, 2008, 85-88.
30. De Lestang S, N Caputi, J How, R Melville-Smith, A Thomson, P Stephenson. Stock Assessment for the West Coast Rock Lobster Fishery. Fisheries Research Report. Departmentof Fisheries, Western Australia. 2012; (217):200.
31. Holland DS. Management Strategy Evaluationand Management Procedures: Tools for Rebuilding and Sustaining Fisheries. OECD Food, Agriculture and Fisheries Working Papers, 25, OECD Publishing. doi: 10.1787/5kmd77jhvkjf-en. 2010, 66.
32. Sloan S, Smith T, Gardner C, Crosthwaite K, Triantafillos L, Jeffriess B, *et al*. National Guidelines to Develop Fishery Harvest Strategies. FRDC Project No. 2010/061. 2014, 70.
33. Anonimous. Ministry of Marine Affairs and Fshery of the Republic of Indonesia. Decree No. 1/PERMEN-KP/2015 (In Indonesia) 2015.
34. Anonimous. Ministry of Marine Affairs and Fshery of the Republic of Indonesia. Decree No. 56/PERMEN-KP/2016 (In Indonesia), 2016.
35. Nikijuluw VPH. Community-based fisheries management (*sasi*) in Central Maluku. Indonesian Agricultura; Research and Development Journal. 1995; 17:2. 33-39.
36. Novaczek I, IHT Harkes, J Sopacua, MDD Tatuhey. An Institutional Analysis of Sasi Laut in Maluku, Indonesia. ICLARM Tech. Rep. 2001; 59:327.
37. Harkes I. An Institutional Analysis of *Sasi* Laut, a Fisheries Management System in Indonesia. Proceeding of the International Workshop on Fisheries Co-Management. 2003, 94.
38. Harkes I, I Novaczek. Presence, performance, and institutional resilience of sasi, a traditional management institution in Central Maluku, Indonesia. Ocean & Coastal Management. 2002; 45:237-260.
39. Mosse JW, JMS Tetelepta, R Letsoin. Hawear, the Indigenous Heritage of Kei Community: Their Existence in the Changing World. Paper presented at International Small Island Confrence. ISIC9th Tual, Langgur. Southeast Maluku, Indonesia.