

Integrated Production of Abalone, *Haliotis asinina*, and Sandfish, *Holothuria scabra*, Through Community-Based Resource Enhancement (CBRE) in Molocaboc Island in Sagay Marine Reserve, Philippines

Nerissa D. Salayo, Jon P. Altamirano, Quenie S. Montinola,
Raisa Joy G. Castel, Rafael T. Barrido, Dianne Hope M. Tormon-West,
Roselyn N. Baylon, Nelbert G. Pacardo and Margarita T. Arnaiz

*Aquaculture Department, Southeast Asian Fisheries Development Center
(SEAFDEC/AQD), Tigbauan, Iloilo 5021, Philippines
ndsalayo@seafdec.org.ph*

Abstract

This study conducted participatory enhancement of abalone *Haliotis asinina* and sandfish *Holothuria scabra* stocks using hatchery-bred and reared seeds released in the shores of Molocaboc Island in multi-use buffer zone of Sagay Marine Reserve, Philippines. The Community-Based Resource Enhancement (CBRE) process, implemented continuously from 2006 to 2019, include social and biophysical preparation, formulation of fisheries management and governance strategies, release of hatchery-reared juveniles, monitoring and periodic assessment, and socioeconomic impact assessment.

CBRE was implemented through a tri-party collaboration involving fisherfolks, local government and research institutions. The abalone and sandfish enhancement procedures comprised of breeding in hatcheries, rearing of juveniles either in nursery facilities or net cages in coastal areas, and release in enhancement areas.

A total of 11,500 tagged abalone juveniles were released in 11 batches in a protected coralline site from 2011 to 2015. Monthly monitoring showed increase in abalone catch per unit effort (3 divers, 1 hour fishing) in the release site from 0–2 individuals during baseline in 2011 to up to 150 individuals until 2019, including spill-overs without tags. Meanwhile, 96,400 hatchery-bred and reared sandfish juveniles were stocked in floating netcages in 15 batches and later released in sea ranch where mean density increased significantly from 3 to 138 individuals/ha in 2015 to 2019. Gleaning should comply with locally instituted catch-size regulation to sustain the fishery.

Additional project activities include the construction and operationalization of a small-scale solar-powered hatchery on-site; freeze-drying trials of abalone meat to improve market reach; and initiatives to replicate the project in Lahuy Islands in Caramoan, Camarines Sur. Aquaculture, through seed production, therefore plays a key role in enhancement of threatened high-value species.

Resource enhancement benefitted the fisheries through participatory management and eventually provided spill-overs to supplement income of marginalized fishers.

Keywords: stock enhancement, abalone, sandfish, community-based resource enhancement, Philippines

Introduction

Fishing and gleaning in nearshore areas are often the last resort livelihood among the low-income households in coastal communities in the Philippines. Declining fish catch is commonly reported as a major problem in coastal villages (Muallil, *et al.*, 2014; Anticamara and Go, 2016; Servonnat, *et al.*, 2019). There is over-fishing in most coastal fisheries in the Southeast Asian Region due to poverty and increasing human population (Stobutzki, *et al.*, 2006; Salayo, *et al.*, 2008. For export commodities, increasing demand from importing countries drive some species to threatened status, and worst to depletion (Pauly, *et al.*, 1998; Sumaila, *et al.*, 2007; Gephart and Pace, 2015).

For these reasons, the Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC/AQD) and the Government of Japan Trust Fund (GOJ TF) initiated a program on Stock Enhancement of Threatened Species in Southeast Asia (SE Program) under the GOJ TF4 (2005–2009) to undertake studies on developing strategies for stock enhancement of high-value threatened species, such as abalone (*Haliotis asinina*) and sandfish (*Holothuria scabra*), that are economically beneficial for fishers in the Philippines and the Region. Through a SEAFDEC resolutions, AQD was mandated to implement the aquaculture-based component of the SE Program in view of its seed production technologies (Primavera, *et al.*, 2005). Hence, the capability-building component of the Program was identified to be conducted in a fishing community in the Philippines.

Under the GOJ-TF4, the socioeconomics aspect of the capability-building component of the SE Program focused

on the ex-ante analysis of impacts of stock enhancement through a baseline survey and social preparation towards an integrated production of tradeable species such as abalone and sandfish. Under TF5 (2010-2014), the project dealt with strategies for managing enhanced resources through governance, stock release and participatory monitoring. Finally, under TF6 (2015-2019), the project was tasked to focus on the community-based integrated production of abalone and sandfish through seed culture, sea ranching and stock enhancement of these threatened species.

All throughout, this socioeconomics project was implemented through a tri-party collaboration between the organized group of fisherfolks, its local government, and SEAFDEC/AQD.

This paper therefore presents the summary of results of the socioeconomics project under the abovementioned phases of the GOJTF program. The series of activities implemented under the project evolved to be called the Community-Based Resources Enhancement (CBRE) process. It presents the chronology of activities and outcomes with emphasis on the integrated production of abalone and sandfish through stakeholder participation in stock enhancement activities.

The enhancement activities using hatchery-bred and reared juveniles of threatened high-value species primarily aims to restore its fisheries to provide supplemental income to marginal fishers while maintaining the health of the intertidal and reef environment (Bell, *et al.*, 2006). This CBRE process applied and developed in this socioeconomics project

aims to contribute to the improvement of governance of coastal resources in the Philippines and similar areas in Member Countries in Southeast Asia.

The study

This CBRE project was implemented with the community of fisherfolks in Barangay Molocaboc from 2006 to 2019. Barangay is a local term for village which is the smallest political unit in the Philippines. Molocaboc is located in the multi-use buffer zone of the Sagay Marine Reserve (SMR) under the jurisdiction of Sagay City in Negros Occidental province in central Philippines (Figures 1a and 1b). The SMR was promulgated in 1995 through Republic Act 9106 in order to protect and conserve the ecological, biological, scenic, scientific, and educational features of the area. The SMR is also covered by the National Integrated Protected Areas System (NIPAS) Act or the Republic Act 7586 of 1992 which aims to protect landscapes and seascapes in the Philippines. Abalones and sandfish are among the fishery resources in the SMR that have become overexploited and its fishery is threatened (Maliao *et al.* 2004; Salayo *et al.* 2016).

Molocaboc has 7,177 population who are mostly dependent on fishing for food and livelihood. Some fishers glean for high-value abalone and sandfish to supplement income from capture fishing but not for home consumption. Since the promulgation of the SMR which cover 32,000 ha water area, the no-take areas almost cover all of the fishing grounds, including the three reef areas, namely Carbin (no-take core zone), Panal (partially protected) and Molocaboc (multi-use zone). This buffer area in the fringes of a no-take reserve is critical for the sustenance and livelihood of traditional fishing households in Molocaboc.

The fishing ground surrounding the three main groups of islands called Molocaboc Daku, Molocaboc Diut and Matabas comprise the multi-use area in the eastern portion of the SMR (Figure 1b). Thus, the release site for abalone juveniles was determined to be in the 4,000 m² coral patches and rubbles located 2 km from the shore of Molocaboc Daku (Figures 1c and 1d). The rearing area for sandfish is in the sandy seagrass area 1 km from the same shoreline (already mentioned under selection and assessment of release site, 3rd sentence). Aside from the social preparation activities prior to 2011, the floating signages and buoys in the release site inform the fisherfolks of the no-take regulation in the area (Figure 1e).

Methods

Social preparation

The project started with social preparation activities involving the representatives of the fisheries stakeholders. A tri-party collaboration between the fisherfolks of Molocaboc Island, local government of Sagay City, and researchers of SEAFDEC/AQD was formed. The terms of collaboration were stipulated in the Memorandum of Agreement signed by all parties. Social preparation involving baseline socioeconomic survey of 80 fisherfolks and validation of the survey results were conducted in 2007. Information, education and communication (IEC) campaigns through meetings, seminars, fairs and festivals were implemented as needed to address low level of awareness about stock enhancement and fisheries management. Fisherfolks were organized in 2009 to form the Barangay Molocaboc Fisheries and Aquatic Resources Management Council (FARMC) in adherence to Fisheries Administrative Order 196, series of 2000

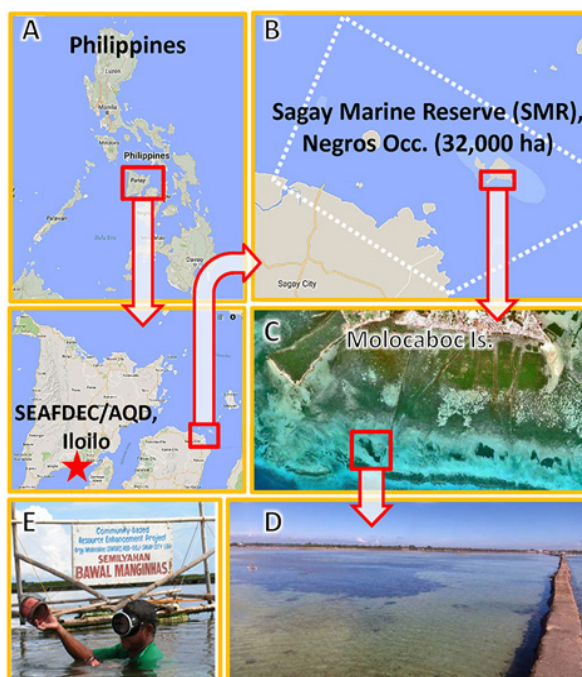


Figure 1. (A) Map of the Philippines showing the location of the study site in Negros Occidental (B) Coverage of Sagay Marine Reserve north of Sagay City; (C) Location of the Community-Based Resource Enhancement (CBRE) site on the southern shores of Molocaboc Island (source of 1A, 1B and 1C, Google Map); (D) Panoramic view of the CBRE site in coral area during low tide with exposed foot path leading to Molocaboc; (E) Signages in local dialect notify the public that “Gleaning is prohibited in this community-based breeding and nursery area”

of the Philippines’ Bureau of Fisheries and Aquatic Resources (BFAR). The rules and regulations for managing enhanced stocks of abalone and sandfish were determined by the tri-party collaborators. The abalone fisheries in Molocaboc was determined to comply with the locally promulgated Barangay Ordinance in 2010 on catch size regulation to guide gathering, trade and consumption. Meanwhile, sandfish fisheries would have to comply with the nationally instituted BFAR Administrative Circular No. 248, series of 2013 on size regulation for sea cucumber collection and trade.

Selection and assessment of release site

The location of the release site for stock enhancement (10.9457 N°, 123.5590 E°) in Molocaboc Daku, one of the component

islands of Barangay Molocaboc, was identified and an assessment of its suitability was done by all groups of stakeholders. The 4,000 m² release site for abalone juveniles is located in the coral area in the intertidal flats 2 kilometers from the shoreline alongside the 2 km × 1 m man-made cement structure where local island residents walk to take or alight from a boat during low tide. The rearing structures for sandfish such as floating hapa netcages, pens and sea ranch area were located in the sandy seagrass site adjacent to the abalone release site. Baseline sampling for the state of fisheries were determined from March to June 2011 for abalone, and in May 2015 for sandfish. Catch per unit effort (CPUE) for abalone was determined to refer to the number of individuals caught with bare hands by 3 local abalone divers in one-hour dive after an evening neap tide. Abalone divers use locally made foot

fins and guided by underwater flashlight. Sandfish density were determined by the number of individuals caught by hand per unit area gleaned during lowest tide following a neap tide.

Release and monitoring

The first release of diet-tagged hatchery-bred and reared (HR) abalone juveniles was done in June 2011 after the fourth and last month baseline sampling. Monthly monitoring after release of juveniles was conducted from July 2011 until August 2019, disrupted only when there is typhoon. Monitoring activities were conducted during evening neap tide when abalones are actively grazing for food carried by incoming tide and are out of the crevices of the corals where they inhabit. This avoids damages on the live corals and other substrates. The parameters monitored include CPUE and some morphometric parameters such as shell length (SL), body weight (BW), body mass index (BMI), sex and gonad stage of both the captured tagged hatchery-bred and reared abalones and the untagged individuals presumed to be those that recovered when the release site was protected against gleaners and those that are spill-overs. During these monthly monitoring activities, selected MOSRA (please spell out on first mention) members who are skilled abalone divers are involved in diving and measurement of morphometric parameters.

For sandfish, the stocking of early juveniles under this project was done from August 2015 to August 2019. Selected MOSRA members stocked and maintained the juveniles which were reared sequentially in floating hapa netcages setup in polyvinyl chloride frames, bamboo stake pens and open sea ranch areas. Fisherfolks worked with researchers in the monthly monitoring of survival, weight and length of sandfish. School children were sometimes involved

in monitoring to improve awareness of stock enhancement and compliance to harvesting regulations. All fishing activities, including the gathering of abalone and sandfish, may continue outside of the no-take nursery and release site. However, fishers should comply with the >6 cm catch size regulation for abalone and the >320 g average live weight limit for sandfish

Results and discussion

Key activities and outcomes of the CBRE

The project started in mid-2006 through inception meetings within SEAFDEC/AQD to coordinate objectives and activities of different studies under the stock enhancement program. For this project on the capacity-building component of the stock enhancement program, the CBRE was implemented mainly through a tri-party collaboration of stock enhancement stakeholders. **Table 1** presents the chronology of key activities and corresponding objectives and results of each activity under the CBRE process. It also cites the literature that, in principle, guided these activities and objectives. The series of activities include:

- 1) social and biophysical preparation (establish stakeholder collaboration, baseline data collection and validation with stakeholders, information education and communication campaign, organization of stakeholders);
- 2) formulation of fisheries management and governance strategies (stakeholder capacity-building, consultative formulation of regulations for managing enhanced stocks);
- 3) release of hatchery-bred and reared

juveniles (site evaluation and selection, collection of broodstock and juvenile production, training on release strategies, participatory release);

- 4) monitoring and periodic assessment (determine practical parameters and success indicators); and
- 5) socioeconomic impact assessment (identify sustainable social, economic and environmental impacts).

Release of juveniles and monitoring results.

Figure 2 shows the CPUE during the monthly baseline sampling from February to June 2011 and during the monthly post-release monitoring from July 2011 to April 2019. The baseline sampling from March to June 2011 obtained 0-2 wild abalone individuals per unit effort. The low mean CPUE indicates that abalone used to exist but has become overfished in the release site. Considering the low CPUE, but with the availability of encrusting algae for food and branching corals *Porites* sp. for shelter, the site was selected for release of diet-tagged HB abalone juveniles that were produced and reared in SEAFDEC/AQD hatchery and nursery facilities. A total of 11,500 juveniles were released in 11 batches from June 2011 to April 2015. Release volumes and period were determined and limited by the availability of juveniles from the broodstock sourced from Panal Reef in SMR and brought to the SEAFDEC/AQD hatchery in Tigbauan, Iloilo. Monthly monitoring showed CPUE in the release site increased from 0-2 individuals during baseline sampling in 2011 to >150 individuals starting in 2017.

From 2011 to 2013, most samples were HR individuals. Thereafter until 2019, HR samples declined until majority (98-100%) were without tags or presumed spill-overs. Other fishers were never prevented from gleaning outside the release site and complied to the locally instituted >6 cm shell length catch-size regulation. Regulated harvesting in the release site started 2 years after first release and continued to sustain funds for CBRE operations.

Figure 3 shows the results of participatory monitoring of HR sandfish juveniles released in 15 batches from December 2015 to September 2019. A total of 96,400 individuals of <0.01 g size was stocked in floating hapa net cages; of which 15% reached >3g and released nursery pens; of which 13% were recovered and released in sea ranch at >20 g size. **Figure 3-B** shows the schedule of sandfish releases (blue bars) into the ranch. The number of animals released were dependent on the how many individuals grew >20g in the nursery pens every month. Overall, the mean density in sea ranch increased from 3 individuals/ha in 2015 to 138 individuals/ha in 2019, suggesting that the site was environmentally conducive for sandfish ranching. Meanwhile, **Figure 3-A** shows the profile of recovered sandfish during monthly monitoring with a reference line (red dotted line) at 320 g as the ideal minimum harvestable size. In as early as Feb 2017, a few harvestable individuals (black diamonds) already exceeded this line, while some much bigger (>500 g) individuals were even recorded in as early as May 2017. Although, some sandfish were already large enough to harvest, fisherfolk members were still adamant in collecting them for sale.

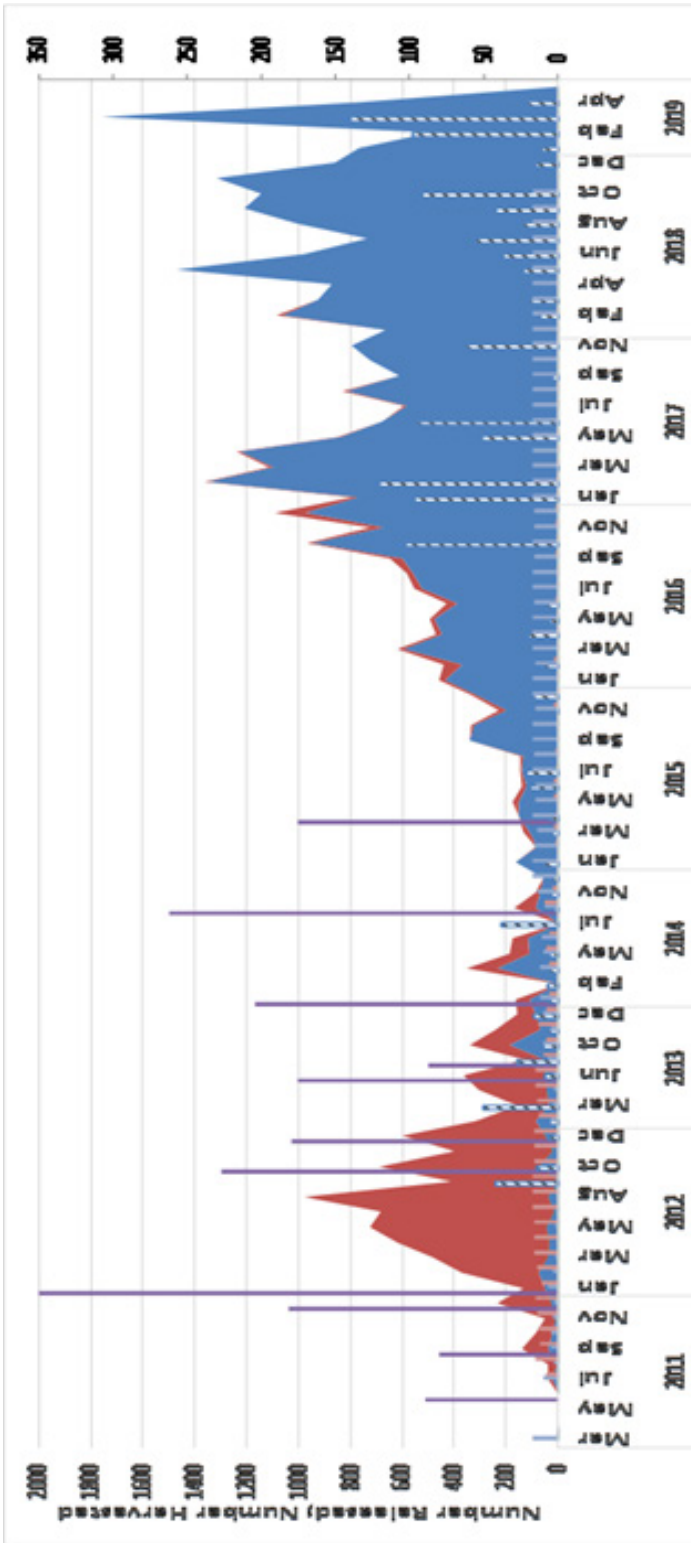


Figure 2. Baseline CPUE, release of juveniles, and monthly monitoring of CPUE of wild and recaptured HR abalone, in the CBRE release site in Molocaboc Daku, Sagay Marine Reserve, Negros Occidental, Philippines, from March 2011 to April 2019. (the cumulative or total number of released or harvested wild and HR abalones (light green color) is not visible in the figure; perhaps no need to have the text and figures in bold to make them more visible)

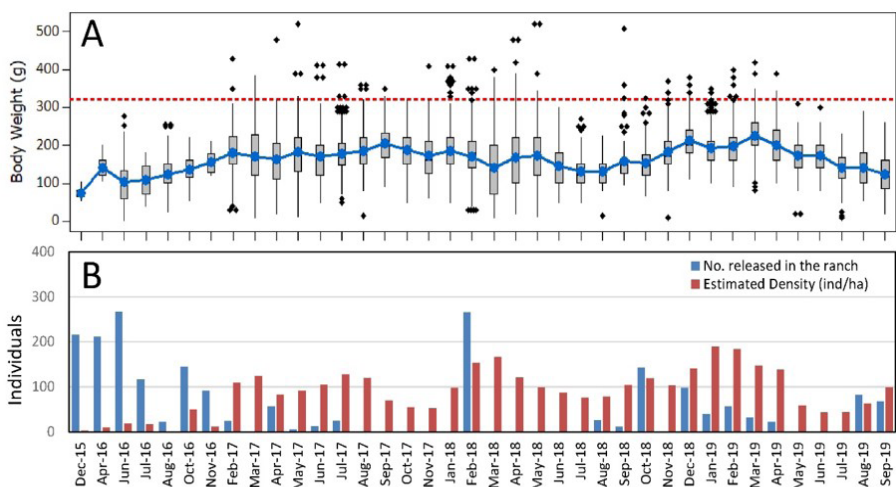


Figure 3. Sandfish population profile at the Molocaboc Dacu Sea Ranch from Dec 2015 to Sept 2019, showing (A) the box plot size profile of recovered sandfish (gray boxes indicating 25 % and 75 % percentile; whiskers lines as upper and lower limits; Blue dots connected by blue line represent the Mean; black diamonds are individual sandfish that are in the lowest and highest extremes), and (B) the number of sandfish released (sizes of >20g, blue bars) into the ranch with estimated density of recovered sandfish (red bars)

Participation of fisherfolks

The fisherfolk members of the BFARMC, later known as MOSRA, primarily protected the CBRE project site by guarding the area day and night against encroachment and destruction of the enhancement site.

Figure 4 shows an overall fluctuating and slightly declining trend in the number of man-days per month volunteered by fisherfolks in guarding the site. Initially, participation was low at around 20 man-days in 2011, suggesting that there were about 10 days in a month when no one is guarding the site. Participation increased in some months in 2012 and 2013 when there are more than 30 man-days guarding in a month or more than 1 person guarded the release site on some days and nights. But it continuously declined gradually until 2019 with less than 20 man-days per month dedicated in guarding the site. Sustaining voluntary participation is most often variable and a constraint in

community-based fisheries undertakings. Often, reasons for non-participation in guarding the site, especially in the evening, are prioritization of fishing activities to obtain cash income, typhoon and cold months from October to January.

Complementary activities

During the course of monthly participatory monitoring of abalone and sandfish in the enhancement site, other activities were periodically conducted such as:

- 1) organizational meetings with other stakeholders, including local traders, school children and parents;
- 2) annual election of MOSRA officers; and
- 3) periodic harvesting and selling of harvest generate funds for MOSRA as a project exit strategy.

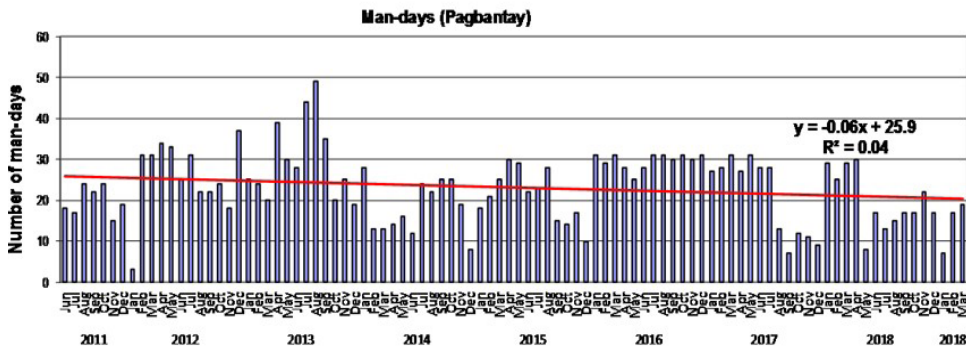


Figure 4. Number of man-days per month spent by fisherfolk-members in protecting the CBRE project site, Molocaboc, Sagay Marine Reserve, Negros Occidental, Philippines, from June 2011 to March 2019. Note: When man-days per month is greater than 30, it suggests that more than 1 person guarded the release site in a day and night

Table 1. Highlights of CBRE project activities and results from July 2006 to December 2019, Sagay City, Philippines

Year	Activities and Objectives	Result Highlights
2006	Project inception and collaboration agreement (Agbayani <i>et al.</i> , 2000)	Site visit and project briefing between collaborators such as Sagay City local government at the barangay and city levels, Molocaboc fisherfolks and SEAFDEC/AQD researchers.
2007	Survey of fishery stakeholders to gather baseline data (Bell <i>et al.</i> , 2006)	Survey revealed low-level of awareness of stock enhancement (17% of respondents). Key informant discussions with local government stakeholders showed willingness to collaborate towards CBRE in barangay Molocaboc.
2008	Stock enhancement information dissemination and campaign (Capinpin <i>et al.</i> , 1998; Bell <i>et al.</i> , 2006; Okuzawa <i>et al.</i> , 2006)	Conducted on-site seminar series on biology and life cycle of threatened abalone and sandfish, and opportunities for stock enhancement and other aquaculture technologies
2009	Organization and capacity-building of fisherfolks and other stakeholders (Jentoft 1989; Pomeroy <i>et al.</i> , 2001; Mahon <i>et al.</i> , 2008)	Fisherfolks organized as Barangay Molocaboc Fisheries and Aquatic Resources Management Council (BFARMC) compliant with FAO 960 of the BFAR and with guidance from PAMB-SMR.
2010	Participatory formulation of regulations for the management of enhanced stocks (Tringali <i>et al.</i> , 2008)	Promulgation and implementation of the Barangay Molocaboc Ordinance 01-Series of June 2010 on the gathering, harvesting, trade and consumption of abalone, with emphasis on the >6 cm catch size regulation and live local trade of abalone.

Year	Activities and Objectives	Result Highlights
2011	Baseline assessment of release site, stock release and monitoring (Gallardo <i>et al.</i> , 2003; Prince 2004; Lebata-Ramos <i>et al.</i> , 2013)	Baseline assessment of the release site showed its overfished status with CPUE at 0-2 abalone individuals. Diet-tagged 2.4 cm mean size hatchery-reared abalone juveniles were released periodically in no-take demarcated site; and sandfish juveniles were stocked in floating nets in the intertidal flats located 2 km from the shoreline of Molocaboc island. Fisherfolks guard and protect the released stocks with logistics support from the LGU.
2012	Strengthen governance of released stocks (Nasuchon and Charles, 2010)	The abalone catch size regulation promulgated at the barangay level in 2010 was upscaled by the Protected Area Management Board of SMR to be a Sagay City-wide regulation.
2013	Establish regulated harvest protocol for abalone	CPUE during monthly sampling showed increasing proportion of >6 cm harvestable sizes, hence harvesting protocol and standards were determined and practiced.
2014	Mid-project socioeconomic impact assessment (Lorenzen <i>et al.</i> , 2013)	Survey of fisherfolks and traders showed improved understanding and support for stock enhancement. Local government renewed and enhanced support to CBRE project.
2015	Re-establish sandfish nursery and sea ranch activities, continue monitoring of abalone to follow through spill-overs	Survey of suitable sandfish sea ranch sites conducted with fisherfolks. Stocking of sandfish juveniles resumed and actively engaged fisherfolks in rearing and monitoring in cages, pens and sea ranch. Eleventh and final release of abalone juveniles on April 2015 but continued monthly monitoring until 2019 to evaluate performance of the released stocks together with recovered wild stocks and spill-overs.
2016	Continuous monitoring of sandfish sea ranch and regulated harvesting of abalone	Determined sustainable regulated harvest protocol and standards to generate funds for organization and operations. Re-organization of BFARMC into Molocaboc Sea Ranchers Association (MOSRA).
2017	Reinforcing fisherfolk entrepreneurship and replication of CBRE sites for abalone and sandfish	Participated in sustainable seafood campaign of high-end hotels to develop entrepreneurial skills of MOSRA fisherfolks. Initiated CBRE replicates in Molocaboc Diut and Lahuy Islands in Camarines Sur in collaboration with Partido State University, local government of Caramoan and fisherfolks
2018	Sustaining stock enhancement through seed production start-up in solar-powered hatchery	Zero recovery of tagged HR abalone and all catches are untagged individuals during monitoring from March 2018 onwards. Hatchery constructed and training on operations initiated. Freeze-drying trials to explore abalone product forms conducted but results need improvement.

Year	Activities and Objectives	Result Highlights
2019	Project impact assessment and performance evaluation (Prince 2004; Perez-Rufaza <i>et al.</i> , 2008; Lorenzen <i>et al.</i> , 2013; Barclay <i>et al.</i> , 2016)	Preliminary results of survey of 300 project stakeholders, including abalone and sandfish gleaners and traders, MOSRA members and non-members and local government officers, indicate appreciation of the increased catch of abalone and sandfish that supplemented cash income of marginal fishers, and improvement awareness of stock enhancement as fisheries management strategy.

The project also implemented other activities as recommended during annual program reviews, such as construction and operationalization of a hatchery to train local fisherfolks in seed production to sustain stock enhancement.

The hatchery was solar-powered because there was no electricity supply in Molocaboc but pumping of sea water is supported by a petrol-powered generator. Initial hatchery runs need improvement in areas such as spawning frequency and performance, natural food production (i.e. *Navicula* sp. diatoms) and settling efficiency. Other tasks also involved initiation to replicate the CBRE together with other collaborators in similar suitable sites.

Conclusion and recommendations

The CBRE project in Molocaboc Island within the multi-use buffer zone of the SMR has overall achieved its objectives. Nursery culture of abalone and sandfish in the on-site hatchery were demonstrated to fisherfolks. Sea ranching of sandfish juveniles were done after advance nursery in floating hapa cages and rearing in pens in seagrass area; and stock enhancement of abalone juveniles were carried out in coral patches in the intertidal flats fronting the residential area of the island community.

Securing the ranching and enhancement sites from poachers are real challenges in poverty-stricken and overfished coastal areas. The day-to-night engagement of fisherfolks organized as Molocaboc Sea Ranchers Association (MOSRA), from being warden and co-managers together with the local government, enabled the rehabilitation of overfished abalone and sandfish population. Abalone CPUE in the release site and density of sandfish in sea ranch increased after release of juveniles.

The recovery of stocks can be attributed to:

- 1) socially prepared and responsive stakeholders, primarily the organized fisherfolks and the local government at the barangay and city levels;
- 2) formulation, implementation and compliance to bottom-up abalone fishery regulation, primarily the >6 cm shell length catch regulation for abalone, and some level awareness of the nationally instituted sea cucumber catch regulation arising from the information dissemination activities of this CBRE project;
- 3) availability of appropriate release protocol for hatchery-reared abalone and sandfish seed stocks spawned from remaining locally-sourced broodstock;

- 4) participation of fisherfolks, together with researchers, in monthly monitoring of the CPUE and morphometric growth parameters of abalone and sandfish;
- 5) logistical and governance support of the local government at the barangay and city levels;
- 6) compliance of stakeholders such as fishers, gleaners and traders to the catch size (>6 cm shell length for abalone) regulation instituted by the community and supervision of the fisherfolk association and the local government in implementing the ordinance; and
- 7) appreciation and local dissemination of the preliminary project outcomes witnessed by the participating stakeholders and beneficiaries such as gleaners whose catch increased due to spill-over from released stocks.

Aquaculture therefore plays a key role in the rehabilitation of threatened high-value species. Seed production technology and appropriate release strategies should be available to support any stock enhancement initiative. Research on breeding and nursery techniques for threatened aquatic species, especially the targeted economically important and tradeable commodities should be supported at the onset of indicators of overfishing of some resources.

Sea ranching and stock enhancement are high investment and long-term strategies to address depletion of fishery resources. However, these are sustainable strategies

when collaboratively conducted with stakeholders who are willing to share their available resources categorized either as:

- 1) research funds from government and partner institutions;
- 2) logistics and governance support from local government; and 3) manpower and local knowledge of the resources among fisherfolk stakeholders. More so, resource enhancement projects do not only provide spill-overs to supplement the income of the most marginalized gleaners without fishing boats in fishing communities.

It also provided opportunities in terms of enriching the indigenous knowledge of fisherfolks with science-based enhancement procedures shared by researchers through participatory activities. Overall, the collaborative CBRE process applied in this project benefited the fishing environment. There was shared management of the resources between the relevant local government and the fisherfolks. The latter were eventually transformed from being resource users to sea ranchers.

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