

STATUS OF SCIENCE IN THE TUNA FISHERIES IN LAGONOY GULF



Plutomeo M. Nieves, Ph.D.
Fisheries Management Consultant
January 2014

STATUS OF SCIENCE IN THE TUNA FISHERIES IN LAGONOY GULF

Introduction

Fishing is still the largest extractive livelihood activity today with demands exceeding the catch. It also remains as an important source of protein, livelihood and export earnings for the Philippines with an estimated to 2.4 million tons equivalent to about 48% of the total fisheries production in 2010 (BAS 2011).

While Philippines is still considered a major tuna producer in the Western and Central Pacific Ocean (WCPO), with 2% and 28% contribution to the country's Gross Domestic Products (GDP) at current and constant prices, respectively (*Philippine Fisheries Profile, 2010*), the industry is also threatened by key issues which include resource depletion and environmental degradation endangering the present and future catch rates.

In Bicol Region, Lagonoy Gulf is a traditional fishing ground for yellowfin tuna (YFT) and tuna-like species. Based on the recent unpublished report of Annabelle Cruz-Trinidad of World Wildlife Fund for Nature (WWF-Philippines) done in the first quarter of 2012, tuna export market has not been established in Lagonoy Gulf (LG) due to its distance from major exporting Centers. However, there are a few buyers around who are interested to buy tuna intended for export market purposes. The same report highlighted that despite reports of overfishing and declining poverty situation in the areas surrounding LG, handline fishers for yellowfin tuna are earning way above Poverty Threshold Levels or the minimum income required or the minimum expenditure necessary to meet the food requirements and other non-food basic needs rose to P15,015. This means that a family of five would need at least P6, 256.25 a month in order to be considered as not poor (NEDA-Bicol). This information therefore confirms that tuna-fishery in LG is very much alive and the potential for export is great. It is for this reason that the WWF's Sustainability Program supports the sustainable management of the fisheries resources, in particular the tuna fishery of LG because the shift of interest of fishers from domestic to export market should be linked with responsible fishing practices including traceability features. To do this, a comprehensive analysis of existing data, publications and studies on the state of the tuna fisheries focusing on YFT in LG is necessary, hence, this report by the Consultant for the Partnership Programme Towards Sustainable Tuna (PPTST), a project of WWF-Philippines that works with Yellowfin Tuna Handline Fishers in two project sites, namely LG and Occidental Mindoro with the prime objective "... to strengthen the position and securing the livelihoods of small-scale Philippine fishers by establishing long-term market access, responsible fisheries management and by provision of a more selectively caught tuna product to market actors and environmentally aware consumers in Europe. The ultimate aim is the certification of these fisheries by the eco-labeling initiative of the Marine Stewardship Council (MSC)"

Lagonoy Gulf

Lagonoy Gulf (LG) is the largest fishing ground (3,701 km²) along the northeastern side of the Philippines. It is deep (800-1200 m in 80% of its area) where channels opening to the Pacific Ocean are entrenched. The major current system affecting the Philippines is the North Equatorial Current with flows westward across the Pacific, hits the eastern coast of the country and splits into northward and southward branches. The northward branch flows along the east coast of the Visayas and Luzon, moving to Taiwan and Japan known as the Kuroshio Current. The southward branch becomes the Mindanao Current, moving southward along the east coast of Mindanao.

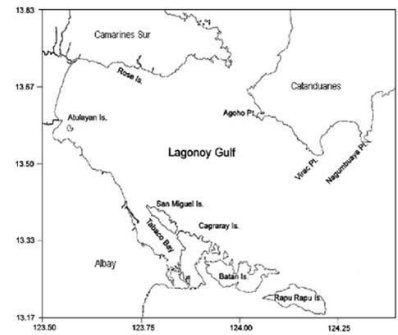


Figure 1. Map of Lagonoy Gulf

Its ecology and fishery are influenced by northeast monsoon (November-February "*Amihan*"), southwest monsoon (June-October "*Habagat*") and trade wind in summer (March, April and May). In terms of critical habitats, the Gulf's rich ecosystem consists of 17,000 has. of coral reefs, 8,300 has. seaweed - sea grass beds and 600 has. mangrove areas.

Due to its strategic location along the east of the Pacific Ocean, Lagonoy Gulf is a very interesting fishing ground. First, LG is partially engulfed by Catanduanes in the Northern Bicol Shelf (NBS) where the bifurcation of the equatorial current into the Kuroshio Current takes place. As such, LG is possibly a special zone for tuna larval drift and juvenile migration. However, the extensive fishery use is believed to extract undersized tunas from the stocks, altering migration and feeding patterns of tunas in the Philippine waters

The gulf is bordered by 15 coastal municipalities from the provinces of Albay, Camarines Sur and Catanduanes in the Bicol Region covering a coastline of 225 km with 7500 fishers depending on multi-species fisheries for their livelihood and employment. The Gulf is considered as the main source of tuna and tuna-like species in the Bicol region.

Studies on the fishery in LG are done by Silvestre et al., 1995; Soliman, 1995; Soliman and Dioneda, 2004 with reported fishery production of 33,380 MT which is about 11 mt/km²/yr (Soliman, 1995). However, the National Stock Assessment Project conducted by Bureau of Fisheries and Aquatic Resources (NSAP-BFAR) reported an estimated annual production of 37,012 MT per year (Olaño, *et.al.* 2003). Similarly, the Bureau of Agricultural Research (BAS) reported an annual of 7,700 MT in 1980 to more than 24,000 MT in 1992, making production statistics in the Gulf difficult to determine.

Monitoring conducted by NSAP monitoring covering July 1997- June 2002 confirms the prevalence of tunas (*Scombridae*) in the catch as shown in (Table 1). NSAP report also reveals that of the 89 fish families caught in LG, the *Scombridae* (tunas) and *Carangidae*, are the dominant species comprising some 72% of the catch. It should be noted also that aside from tunas, other species are also caught by hand lines which varies depending on the target species, this include tunas (large & small), dolphin fish, billfishes, and several demersal species.

Table 1 Percentage Composition of Tuna species caught in Lagonoy Gulf Monitored by NSAP covering the period July 1997-June 2002 (Olaño, et.al.2003)

Main Species caught	Percentage composition	Estimated Production By Species (MT)
Yellowfin tuna (<i>Thunnus albacares</i>)	51.22	18951.40
Skipjack (<i>Katsuwonus pelamis</i>)	16.91	6256.70
Dolphin fish or mahi - mahi (<i>Coryphaena hippurus</i>)	8.78	3248.60
Sailfish (<i>Istiopterus platypterus</i>)	5.30	1961.00
Wahoo (<i>Acanthocybium solandri</i>)	3.42	1265.40
Albacore (<i>Thunnus alalunga</i>)	2.24	828.80
Big eye tuna (<i>Thunnus obesus</i>)	0.88	325.60
Rainbow yellowtail (<i>Elagatis bippinulata</i>)	0.76	281.20
Marlin (<i>Makaira mazara</i>)	0.59	218.30
Others	9.89	3659.30
Yellowfin tuna (<i>Thunnus albacares</i>)	51.22	18951.40
Skipjack (<i>Katsuwonus pelamis</i>)	16.91	6256.70
Dolphinfish or mahi -mahi (<i>Coryphaena hippurus</i>)	8.78	3248.60

Overview of the Current State of Knowledge on Tuna Fisheries in Lagonoy Gulf

The tuna fisheries is the largest and most valuable fisheries in the Philippines during the mid-1970s when bamboo rafts (or payao, a fish aggregating device), were introduced and lead to the development of the tuna fishing industry in Lagonoy Gulf. Due to the effectiveness and efficiency of payao in attracting tuna, the time spent in searching and fishing was greatly reduced, both commercial and municipal fishers use payao. However, unstable tuna and tuna-like species production was experienced in the 1980s and 1990s (BFAR 1998).

In Lagonoy Gulf, municipal fishers predominantly use of handlines in catching adult yellowfin (110-150 cm) tuna that is reportedly known to occupy the deeper water column (Aprieto, 1995). On the other hand, commercial fishing boats such as purse seine "Kalansisi" is known to catch the surface aggregating juvenile tuna.

Tuna Fishing in the Gulf

Fishing for tuna has been a tradition among fishers living along 15 municipalities bordering the Gulf. Tuna and tuna-like species are the dominant species caught by its multi-species and multi-gear fisheries with approximately 7500 fishers depending on its fishery for their livelihood and employment. Tuna species comprise almost one half, or 46.05 percent of the catch by major fishing gears recorded from 1997 to 2002, specifically *Katsowonus pelamis* and *Thunnus albacares* for the last five years with an aggregate

of 868 mt (Olano, *et al.*, 2002). However, studies have shown that the fishery is threatened by unsustainable fishing methods predominantly *payao*-based fishing using ring net, bagnet, and gillnet which result in overharvesting of juvenile tuna species (Dioneda, *et al.*, 2004). Similarly, encroachment of commercial fishing vessels within the Gulf has made fisheries management complicated and resort to the overharvesting of juvenile tuna species.

The 2nd WPEA-Philippines NSAP Tuna Data Review Workshop in 2011 highlighted the relatively high catches of Albacore tuna from the handline fishery in Lagonoy Gulf in 2009 and 2010, allegedly attributed to the oceanographic and bathymetric features of area. However, no scientific evidence yet is available to confirm or reject this attribution. There is a dearth of information on the distribution and dynamic of tuna eggs and larvae in the gulf, hence, the need for detailed studies. No specific study ascertaining the spatial distribution of tuna eggs and larvae and the possible mechanism for their larval dispersion has been done in Lagonoy Gulf.

Fisheries Status

The Gulf have nine bays along its 221.08 km coastline which are the central fishing sites for 12 of the 15 species tunas and tuna-like fishes, small pelagic, crustaceans and shellfishes of sustenance fishing accounting for more than 90% of its 28,000-mt annual fish harvest.

Fishing inside the Gulf and risk off-shore to *Sirangan*, around 50 miles off the Province of Catanduanes. Annual fishery production of 28,000 MT in 1995 decreased to 20,000 MT in 2004 (Dioneda, *et al.*, 2004). More than 60% of the species caught in the Gulf are reef residents. The mean exploitation rate of commercial fish and invertebrate stocks is higher by 59.54% relative to optimum exploitation, indicating high fishing pressure (Dioneda, *et.al.*, 2004)

Fishing gears, gear units and catch rate in Lagonoy Gulf

With its multi-species fisheries, fishers by tradition have multiple gears primarily used for specific fishery and season. Table 1 presents the most frequently used fishing in LG.

Table 2 Fishing gear, gear units and total trips/unit based on 2004 RSA

Fishing Gear	RSA 2004		Total Trips/Unit
	No. of Units	%	
Hand lines	6,330	42.24	1,973.48
Seines	2,582	17.23	305.57
Gillnets	2,291	15.29	2,456.72
Barriers & Traps	1,240	8.27	1,410.01
Lift nets	1,113	7.43	1,315.53
Hand Instruments	1,086	7.25	746.24

Long lines	344	2.30	1,900.62
Total	14,986	100.00	10,108.17

Gear inventory identified 55 distinct types of fishing gears distributed along seven major gear categories namely hand lines, long lines, gillnets, lift nets, seines, hand instruments and barriers and traps. The use of purse seines, ring nets and hand lines usually accounts for over 75% of the annual tuna catch. The tuna catches in 2011 were caught by: purse seine, 48%; ring net, 26%; hand line, 10%; hook-and-line, 14% and other gears, 2% (5th Philippine/WCPFC Annual Tuna Catch Estimates Review Workshop, May 2012). Most of the boats operating near shore catch young tunas, as well as small pelagic fishes (i.e. roundscads, sardines, bigeyed scads and moonfish) which are harvested in the same surface fishing operation using net (Pagdilao, *et al.*, 1993; Barut, 1999).

A decline in the catch rate of tuna hand line was observed from 1994 to 2004 which went from 168.86 kg/trip to as low as 25.67 kg/trip (RSA, 2004 pls include in ref.), respectively. Consequently, the catch rate went down which also lower down the contribution of handline production from 16,822.33 mt in 1994 to 15,316.32 mt in 2004 (Dioneda, *et.al.*, 2004). In terms of catch composition, yellow-fin tuna (*Thunnus albacares*) contributed around 30.49% (7,943.84 mt) of the total production, followed by skipjack tuna (*Katsuwonus pelamis*) with 7.95% (2,072.17 mt). Other species such as *Thunnus obesus*, *Thunnus tonggol*, *Auxis thazard*, *Auxis rochei*, and *Euthynnus affinis* shared an aggregate production of 11.11% (2,890.80 mt).

Status of the Stock

All fin fishes assessed during the Post-Resource and Socio-economic Assessment (RSA) in 2004 resulted to high exploitation rates (E) with an average of $E=0.62$ ($E_{cur} = 0.62$). In fact, exploitation rates for *T. albacores* and *K. pelamis* are 0.51 ($E_{cur} = 0.51$) and 0.56 ($E_{cur} = 0.56$), respectively. These values show high exploitation rate of the stocks. Correspondingly, the yield-per-recruit analysis resulted to excess exploitation rate values of about 85.63% and 92.44%, respectively. The usual catch of the species are quite small than the length at first maturity; (*T. albacores*- $L_{50}=25.23$ cm vs. length at first maturity = 50.00 cm) and (*K. pelamis* – $L_{50}=18.27$ cm vs. length at first maturity= 40.00 cm). Peak recruitment period occurs during 2nd and 3rd quarter (Dioneda, *et.al.*, 2004).

Production

Lagonoy Gulf production is dominated by tuna and tuna like pelagic species. Handline production is about 15,316.32 mt which constitute about 58.79% of the total production. Members of the family Scombridae (tuna and tuna-like fishes) contribute production of 14,417.81 mt. These frontline species contribute to more than 60% of the total fisheries production in 1994 (Soliman, *et.al.*, 1995). The National Stock Assessment Program (NSAP) of Bureau of Fisheries and Aquatic Resources (BFAR), Region 5, also reported that these pelagic fisheries mainstays contribute to more than 70% of the production for the period

1997 to 2002 (Olaño, 2003). However, production estimate from 1994 to 2004 decreased from 27,986.5 mt to 26,053.61 mt. (RSA, 2014).

Supply and Value Chain Analysis for Handline Tuna Fishery in Lagonoy Gulf

A recently concluded study on the supply and value chain analysis for handline Tuna fishery in Lagonoy Gulf was carried out by Annabelle Cruz-Trinidad of WWF during the 1st quarter of 2012. The supply and value chain analysis reveals important aspects concerning YFT fishing in the Gulf. Results obtained showed that despite reports of overfishing and declining poverty situation in the areas surrounding Gulf, YFT handline fishers are still earning Php _____ which is comparatively way above Poverty Threshold Levels of Php _____ and legislated wage rates of Php_____. Thus, sufficient economic incentives must exist for all supply nodes so that fishers are encouraged to shift to the export sector.

The study also showed that tuna handline fishers has adapted to the prevailing monsoon patterns in the region and has evolved in distinct type of operations. It is interesting to note that a typical handline fishery involves 1 to 2 fishers, a small outrigger boat with 10-16 Hp engine, and fishing trip duration of 6 to 7 hours daily during favorable weather. Moreover, the value distribution with domestic market as target consumer indicate a 60:40 sharing of margins and costs in favour of fishers viz. Casas and retailers. In essence, fishers contribute more value compared to the margins earned while "casas" and retailers contribute less value but yields three times return, at the minimum. It should be noted that this pricing transmission across the supply/value chain are tied up to the existing market structures and the various social entanglements that exist at the fisher/casa level including credit and filial relationships.

Status of Ecological Habitats and Marine Protected Areas (MPAs)

Major ecological habitats such as corals and coral reefs, sea grass and seaweed beds and mangrove forests are an important aspect in the tuna and associated fisheries in the Gulf. These areas are a crucial life-support system in every aspect of the life cycle of these fishes (citation). However, a study conducted by David *et al.*, (2005) and Mendoza *et al.*, (2000), showed declining living coral cover, sea grass and seaweeds biomass. Same also with the mangrove forest cover (Vega *et al.*, 1995). The decline of these habitats may have direct and indirect impact on the sources food tunas and tuna-like fishes and associated fishes in the area. The presence of several MPAs in the Gulf (5 in Albay, 2 in Cam Sur and 1 in Catanduanes) may serve an important function in the conservation and improvement of the fisheries in the Gulf due to the protection it offers from fishing and other extractive activities. However, due to non-stable political settings, MPAs in the entire Gulf are sacrificed.

Analysis of the State of Knowledge and Research Gaps

In Lagonoy Gulf, tuna research dates back during the Fisheries Sector Program (FSP) (1990–1995) where the Philippine Tuna Research Project (PTRP) was an integral component of FSP which collects stock assessment data and statistical monitoring program for tuna species around the country. Unfortunately PTRP efforts ended in 1995, but in 1997, the National Stock Assessment Program (NSAP)

was initiated and started to collect continuous scientific information on the fishery resources in the Gulf until now.

On the aspect of tuna stock in the Gulf, close to 500 fish species can be found in the Gulf where less than 100 species compose the commercial catches. Tunas and tuna-like fishes (i.e., mostly skipjack then yellow-fin) constitute about 50% of the total fishery production that recorded between 20,000 and 26,000 t/yr. (Source of info?). It is worth noting that the primary producers of tuna in the Gulf are small-scale tuna handline fishers found in coastal communities bordering the Gulf catching yellowfin, skipjack and bigeye tuna. They use of fish-aggregating device locally known as "*payao*" which are known to attract tuna and tuna-like species and therefore greatly reduced the time spent for searching and fishing this valuable species. The extensive use of '*payao*', however, may be rapidly removing undersized juveniles from the stocks and altering migration and feeding patterns of tunas in Philippine waters (Zaragosa, *et al.*, 2004). Swordfish and other species are noted by-catch and a as a target species in the tuna fishery but not included in the aggregated catches.

Recognizing the paramount importance of tuna resources as a highly migratory stock in the West Pacific Ocean and East Asia (Indonesia, Philippines and Vietnam), the West Pacific East Asia Oceanic Fisheries Management Project (WPEA-OFMP) initiated a project designed to strengthen national capacities and international cooperation on priority transboundary concerns relating to the conservation and management of tunas in 2010 organizations (Philippine Tuna Fisheries Profile., 2012). Under this project a tuna data and research inventory was conducted to record and assess available catch/effort data and biological data for the Philippines oceanic tuna fisheries from different sources gathered, managed and stored by various agencies and organizations including tuna researches conducted by academe, research institutes and various agencies/organizations (Philippine Tuna Fisheries Profile., 2012).

Another major on-going research initiative on tuna directed towards the long term goal of secure the global market opportunities of artisanal tuna handline fisheries in the Philippines is the "Fishery Improvement and MSC-Certification of the Artisanal Hand-Lining Fishery for *Yellowfin Tuna* in the Gulf of Lagonoy and Mindoro Island in the Philippines", jointly implemented by WWF and Blueyou Consultancy supported by Coop / Bell Seafood (Switzerland) and Seafresh (Netherlands) in Partnership with the German Development Bank DEG aimed at realizing a better managed fishery rewarded by the Marine Stewardship Council (MSC) (Philippine Tuna Fisheries Profile, 2012).

The Gulf is also strategically bordered by three provinces where several State College and Universities (SUC's) are located: Bicol University Tabaco Campus (BUTC) in Tabaco City, Albay; Patido State University (ParSU), in Sangay, Camarines Sur and Catanduanes State University (CSU) in Virac Caanduanes. These universities have been have significantly contributed to fisheries education and R&D in the region. Bicol University through the Tabaco Campus in particular has contributed several papers concerning the resources and ecology of the Gulf:

1. Bobiles, R.U. 2003. Diversity of Fish Fry Species in Baybay Coast, Tiwi, Albay. Unpublished undergraduate thesis. Bicol University College of Arts and Sciences, Daraga, Albay.

2. Bradecina, R.G., V.S. Soliman, R.R. Dioneda, Sr, and N.R. Pelea. 2011. Profitability and resource rent of multi-gear fisheries in Lagonoy Gulf, Philippines. *Philipp. Agric. Scientist* 94(4):401-414. December 2011.
3. Dioneda,, R.L. Sr., Adote, A.A. , Bobiles, R.U., Reginaldo, R.S.Jr.. 2004b. Assessment of Milkfish Fry and Mud crab Juvenile Fisheries of Lagonoy Gulf, pp 70-90, In: Soliman, V.S., R.R. Dioneda, Sr, and N.R. Pelea (eds). 2004. Lagonoy Gulf Post-Resource and Socio-economic Assessment. Final Report Submitted to the Fishery Resource Management Project, Department of Agriculture-Bureau of Fisheries and Aquatic Resources, Quezon Avenue, Quezon City. Bicol Small Business Institute Foundation, Inc., Bicol University Main Campus, Legaspi City. 143 pp
4. Nieves, P. M., N.R. Pelea, R.G. Bradecina, M.A. Pereyra, Y. Morooka, T. Shinbo., and M.C. P. Rivero. 2009 Socio-economic conditions, the status of fisheries and agriculture and the adaptive capacities of households and communities in San Miguel Island, Albay, Philippines in the Kuroshio Sphere of Influence. *Kuroshio Science* 3(1):23-32.
5. Pelea, N.R. 2008. Post harvest processing, poverty among fishers, and fishery resources management in Lagonoy Gulf (Philippines). *Mem. Fac. Fish. Kagoshima University, Special Issue*, 2008.
6. Soliman, V.S., de Jesus, S.C., Basmayor, L.O. Dioneda, R.R., Dullesco, N.W. 1997.Coastal Resources Management Issues in San Miguel Island, Tabaco, Albay. *Research and Statistics Center, Bicol University, Legaspi City. R&D Journal, Vol. X, December 1997, pp121-20.*
7. Soliman, V.S. A.B. Mendoza, Jr. R.R. Dioneda, Sr., N.W. Dullesco. 2000. Marine fishery reserve site characterization project off Tiwi Coast, Tiwi, Albay Terminal Technical Report submitted to the Tiwi Municipal Government by the Bicol Small Business Institute Foundation, Inc. Legaspi City. 20pp.
8. Soliman, V.S. and Dioneda, R.R. 1998. Stock assessment of commercially important tunas, small pelagic and crustaceans in Lagonoy Gulf. Paper presented during the 5th National Symposium in Marine Science. October 17-19, 1999. UPMS, Diliman, Q.C.
9. Soliman, V.S. Nieves, P.M., Garces, L.R. and Sia, Q.P. III. 1995. Catch and Effort in LagonoyGulf Fisheries. *In* G. Silvestre, C. Luna, V. Soliman and L. Garces (Eds) *Resource and Ecological Assessment of Lagonoy Gulf*. ICLARM Technical Report.

Concerns on the sustainability of the tuna resource have emerged as tunas are very valuable fishery commodity in the country for domestic and export markets. The conference held at Bicol University Tabaco Campus last September 24, 2013 provide an avenue to discuss, plan and reach consensus toward formulating a research and development agenda for sustaining the tuna resource. Result of the conference and documentary analysis of points out to the following knowledge and research gaps:

1. Poor production statistics for tuna resources
 - a. Varying production estimates among research institutions such as NSAP, DA-BAS and Academe
 - b. Difficulty in data acquisition particularly NSAP data
 - c. Bait fishery

2. Inadequate data on biological studies on Tuna in Lagonoy Gulf:
 - a. Age based on stock assessment for tuna (otolith study)
 - b. Life cycle of tuna (e.g. Otolith study)
 - c. Growth overfishing, catching gravid YFT
 - d. Distribution of tuna eggs and larvae in LG
 - e. Validate whether the Lagonoy Gulf is nursery or breeding ground
 - f. Ecological effect of payao establishment

3. Law Enforcement Issues & Concerns:
 - a. Implementation of RA 8550 into municipal fisheries ordinances
 - b. IEC for policy research/implementation
 - c. Back-up resource management studies
 - d. Monitoring of vessels including those using active fishing gears in municipal waters.

4. Post-Harvest and Food Safety
 - a. Studies on transport and handling of YFT (through airport)
 - b. Lack of funds and training to cope with food safety standards
 - c. Extension services on post-harvest and food safety measures and practices

5. Resource Management
 - a. Declining catch and catch rates in municipal waters
 - b. Use of information available to back up resource management
 - c. Administrative and ecological aspects of networks of MPAs including offshore MPA
i.e. commercial water inside Lagonoy Gulf
 - d. Characterization of fisheries in Lagonoy Gulf (including the FADs)
 - e. Management of mix tuna fisheries using payao
 - f. Impact of MPAs to Tuna Fisheries
 - g. Payao as a tool for marine managed areas (e.g. Positive: attraction of large species and ban gears catching juvenile YFT)
 - h. Negative impact of global warming on spatial distribution of tuna resources in the Gulf
 - i. Strengthening fishery management systems

6. Socio-Economic

- a. Impact of oil deregulation law on fishing operation and on the fishing industry
- b. Limited fishing capacity (use mostly 16HP motor)
- c. Strong engagement of academe and fisherfolks towards sustainable tuna
- d. Social and political viability for Lagonoy Gulf as a Marine Managed Area (MMA)
- e. Lacking technical data/study for technical capability of small scale commercial fisherfolk
- f. Behaviour of fishers and community perception towards sustainability, food safety standards and Marine Stewardship Council (MSC) Certification.
- g. Use of indigenous knowledge

Recommended Priority Research Areas Towards Sound and Sustainable Fishery Management in Lagonoy Gulf

The recommended priority R&D for sound and sustainable fishery management in LG is shown in Table 3. According to Dr. Soliman, very few known studies are available for tuna in the gulf. If available, this was part of the fisheries assessment done under the FSP, RSA and FRMP projects. The focus however is on stock assessment rather than biological aspect of tuna fishery in the Gulf. On the other hand, a time series stock assessment dataset is also available at NFRDI under its NSAF Program.

Table 3 Tuna R&D Agenda for Lagonoy Gulf

Problems	Researchable Area	Expected Output
Inadequate biological data on Tuna fisheries in the Gulf	<ol style="list-style-type: none"> 1. Impact of MPAs to Tuna Fisheries 2. Age based on stock assessment for tuna (otolith study); 3. Stock (genetic) identity of YFT in and outside Lagonoy Gulf 	<ol style="list-style-type: none"> 1. Management options 2. Life cycle (migration path) of tuna 3. Stock ID of YFT in LG(e.g. bar coding, genetic variation)
Information on the distribution of tuna eggs and larvae in LG	Ichthyoplankton survey to characterize the spatial abundance and distribution of tuna larvae in LG	<ol style="list-style-type: none"> 1. Spatial abundance and distribution of tuna larvae in LG; 2. Policies and mechanisms to promote the optimal utilization and rational management of <i>payao</i>-based tuna fisheries in LG. 3. Validate whether the LG is Tuna nursery or breeding ground

Inadequate information on tuna- <i>payao</i> fishery	1. Studies on tuna- <i>payao</i> fishery in LG 2. Management of mix tuna fisheries using <i>payao</i>	Clear understanding of the socio-economic and ecological effects of <i>payao</i>
Inadequate information on bait fishery	Studies on bait fishery in LG	ID of potential tuna bait;
Inadequate dataset on		
Social and political viability for Lagonoy Gulf as a Marine Manage Area (MMA)	Studies along determination of social and political viability for Lagonoy Gulf as a Marine Manage Area (MMA) with emphasis on the administrative and ecological aspects of networks of MPAs including offshore MPA i.e. commercial water inside Lagonoy Gulf	Lagonoy Gulf as a Marine Manage Area (MMA)
Inadequate information on: 1. Community perception of the resource. 2. Behaviour of fishers towards sustainability 3. Use of indigenous knowledge	Socio-economic studies on community perception of tuna resources; resource sustainability and indigenous knowledge;	Community & fisher's awareness about tuna resources and resources sustainability
Inadequate post-harvest technology	Development & improvement of post-harvest technology including transport & handling	Value adding technology
Effect of climate change on migratory pattern of YFT	Mapping/GIS of migratory pattern	Map of migratory pattern of YFT

Way forward and the immediate steps to make things work for the benefit of all stakeholders is to forge a formal partnership between LGU-NGA-Academe-WWF and Industry to encourage responsible and sustainable fishing in LG, in particular tuna fishing.

It is likewise recommended that appropriate and adequate logistics be provided to translate program, projects and activities into realistic output which will result to inclusive outcome. This requires the participation of DA-BAR, DA-BFAR, NFRDI, DOST, PCAARRD, DENR, SUC's, WWF, and other donor agency supportive to the cause of responsible fisheries and sustainable development.

References

Aprieto, V.L. 1995. Philippine Tuna fisheries-yellow fin tuna and skipjack. University of the Philippine Press, Quezon City, Philippines

- Amedo, C. L. A., Villanoy, C. L., and Udarbe-Wlaker, M. J. 2002. Indicators of upwelling at the Northern Bicol Shelf. University of the Philippines in the Visayas Journal of Natural Science, 7: 42–52.
- BAS (2011) Fisheries Statistics of the Philippines. 2008-2011. Volume 19. Fisheries Statistics Division, BAS, Dept, of Agriculture, Quezon City, Philippines. 404p.
- Babaran R.P. 2004. Philippine policies on fishing methods and gears: Implications to fisheries, pp. 18-22, In: WWF-SSME Program 2004, Towards and Improved Philippine Fisheries Code: An analysis of the capture fisheries provisions. WWF Sulu-Sulawesi Marine Eco-region Program, WWF-Philippines, Quezon City, 80 pages
- Bacordo, R.S., Dickson, A.C. Nepomuceno, L.T. and R.V. Ramiscal, 2012. Composition, Distribution and Abundance of Fish Eggs and larvae in the Philippine Pacific Seaboard and Celebes Sea with Focus on Tuna Larvae (Family: Scombridae)
- BFAR, 1998. Fisheries Profile. Bureau of Fisheries and Aquatic Resources, Quezon City, Philippines.
- Bobiles, R.U. 2003. Diversity of Fish Fry Species in Baybay Coast, Tiwi, Albay. Unpublished undergraduate thesis. Bicol University College of Arts and Sciences, Daraga, Albay.
- Bradecina, R.G., V.S. Soliman, R.R. Dioneda, Sr, and N.R. Pelea. 2011. Profitability and resource rent of multi-gear fisheries in Lagonoy Gulf, Philippines. Philipp. Agric. Scientist 94(4):401-414. December 2011.
- Campos, W.L. and Alino, P.M. 2007. Recent advances in the management of marine Protected Areas in the Philippines, Kurushio Science, 2:29-34
- Campos, W.L., P.D. Beldia, h.M.P. Noblezada, and J.C. Asis. 2007. Investigating biodiversity corridors in the Sulu Sea. Distribution and Dispersal of Fish larvae. Semiannual report submitted to Conservation International Phil., UP Visayas, Miag-ao, Iloilo, Philippines, 31 p.
- Collette, B.B. and C.E. Nauen, 1983. FAO Species catalogue, vol. 2. Scombrids of the worlds. An annotated and illustrated catalogue of tunas, mackerels, bonitos and related species known to date. *FAO Fish. Synop.*, 125 (2), Rome: 137 p.
- DA-BFAR 2004. In turbulent seas: The Status of Philippine Marine Fisheries. Coastal Resource Management Project of the Department of Environment and Natural Resources, Cebu City, Philippines, 378 p
- Dioneda, R.L. Sr., Adote, A.A., Bobiles, R.U., Reginaldo, R.S. Jr.. 2004b. Assessment of Milkfish Fry and Mud crab Juvenile Fisheries of Lagonoy Gulf, pp 70-90, In: Soliman, V.S., R.R. Dioneda, Sr, and N.R. Pelea (eds). 2004. Lagonoy Gulf Post-Resource and Socio-economic Assessment. Final Report Submitted to the Fishery Resource Management Project, Department of

Agriculture-Bureau of Fisheries and Aquatic Resources, Quezon Avenue, Quezon City. Bicol Small Business Institute Foundation, Inc., Bicol University Main Campus, Legaspi City. 143 pp

- Fowler, A.M., Leis, J.J. and I.M. Suther. Onshore-offshore distribution and abundance of tuna larvae (Pisces: Scombridae: Thunnini) in near-reef waters of the Coral Sea, Fish. Bull. 106:405-416
- Nieves, P. M., N.R. Pelea, R.G. Bradecina, M.A. Pereyra, Y. Morooka, T. Shinbo., and M.C. P. Rivero. 2009 Socio-economic conditions, the status of fisheries and agriculture and the adaptive capacities of households and communities in San Miguel Island, Albay, Philippines in the Kuroshio Sphere of Influence. *Kuroshio Science* 3(1):23-32.
- Nishikawa Yasuo and Rimmer, David W.; Identification of Larval Tunas, Billfishes and other Scombroid Fishes (Suborder Scombroidei): an Illustrated Guide; CSIRO Marine Laboratories, REPORT 186; Commonwealth Scientific and Industrial Research Organization, Marine Research Laboratories GPO Box 1538, Hobart, Tas. 7001, Australia; 1987
- Noblezada, M. M. P., and Campos. L. 2008. Spatial distribution of chaetognaths off the northern Bicol Shelf, Philippines (Pacific coast). – *ICES Journal of Marine Science*, 65: 484–494
- Marten, G.G. and J.J. Polovina. 1982. A comparative study of fish yields from various tropical ecosystems. *ICLARM Conf.Proc.* 9:255-285.
- Olaño, V.L., M.B. Vergara and F.L. Gonzales. 2003. Assessment of Lagonoy Gulf Fisheries in Region V. Paper presented at NSAP National Evaluation on December 3-5 2003.
- Pelea, N.R. 2008. Post harvest processing, poverty among fishers, and fishery resources management in Lagonoy Gulf (Philippines). *Mem. Fac. Fish. Kagoshima University, Special Issue*, 2008.
- Preliminary assessment of the handline fishery in Bicol Region, Philippines. Report Prepared for the "Preliminary Assessment of the Handline (Banca) Fisheries in the Philippines (FIS/2009/033), Project funded by the Australian Centre for International Agricultural Research (ACIAR)
- Smith, PE and S, Richardson, 1977. *FAO Standard Technique for Pelagic Fish Larvae Surveys*
- Soliman, V.S., de Jesus, S.C., Basmayor, L.O. Dioneda, R.R., Dullesco, N.W. 1997. Coastal Resources Management Issues in San Miguel Island, Tabaco, Albay. *Research and Statistics Center, Bicol University, Legaspi City. R&D Journal, Vol. X, December 1997, pp121-20.*
- Soliman, V.S. A.B. Mendoza, Jr. R.R. Dioneda, Sr., N.W. Dullesco. 2000. Marine fishery reserve site characterization project off Tiwi Coast, Tiwi, Albay Terminal Technical Report submitted to the Tiwi Municipal Government by the Bicol Small Business Institute Foundation, Inc. Legaspi City. 20pp.
- Soliman, V.S. and Dioneda, R.R. 1998. Stock assessment of commercially important tunas, small pelagic and crustaceans in Lagonoy Gulf. Paper presented during the 5th National Symposium in Marine Science. October 17-19, 1999. UPMS, Diliman, Q.C.

- Soliman, V.S. Nieves, P.M., Garces, L.R. and Sia, Q.P. III. 1995. Catch and Effort in LagonoyGulf Fisheries. *In* G. Silvestre, C. Luna, V. Soliman and L. Garces (Eds) Resource and Ecological Assessment of Lagonoy Gulf. ICLARM Technical Report.
- Vera and Hipolito, 2006. The Philippines Tuna Industry: A Profile. ISBN 81 902957 2 1.
- Villanoy C. 1995. Oceanography of Lagonoy Gulf. *In* Resource and Ecological Assessment of Lagonoy Gulf. International Center for Living Aquatic Resources Management. Tech. Rep. 000.000
- WEST PACIFIC EAST ASIA OCEANIC FISHERIES MANAGEMENT PROJECT WPEA OFMP, 2012. *Philippine Tuna Fisheries Profile*. November 2012 Bureau of Fisheries and Aquatic Resources, National Fisheries Research and Development Institute. Republic of the Philippines and Western and Central Pacific Fisheries Commission, 82p.
- Zaragoza, E.C., Pagdilao, C.R. & Moreno, E.P. 2004b. Fisheries for tuna and other large pelagic fishes. pp. 38–41. *In*: DA-BFAR, 2004, q.v.