Kuroshio Science **2**-1, 59-66, 2008

Marine Resources in Areas along the Kurushio in the Cagayan Valley Region, Philippines

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Abstract

The coastal waters of the Cagayan Valley Region, located along the flow of the Kuroshio Current have been known to contain some of the country's most diverse ecosystems enriched by nutrients leached from the land. Its waters are characterized by extensive seaweed and sea grass beds and coral reefs which support highly diverse aquatic organisms. However, recent climate change, population growth, rapid development of industries and technological advances have been noted to cause the deterioration of marine environments thus, depletion of coastal resources. In order to formulate academic insights towards coastal resource management through sustainable utilization of marine resources, this review paper presents the current situation of fishery resources in the coastal waters of the region located along the Kuroshio Current. A case study on the marine fisheries stock assessment in Babuyan Channel is also presented in this paper to provide an overview on the extent of resource utilization of one of the major fishing grounds in the region. Similar studies could be done to other fishing areas in order to evaluate their present status and future potential values as basis for the proper management, conservation and sustainability of their marine resources. Rehabilitation and conservation of seaweed and sea grass beds were suggested since they form part of the most important resources that have the potential to rehabilitate the entire ecosystem and make the marine ecosystem productive again saving it from further destruction brought about by excessive fishing activities.

Introduction

The Cagayan Valley Region is located at the northernmost tip of the Philippine Archipelago with a land area of 27,333 km^2 (DA-BFAR RO2, 2006a). It is divided into five provinces namely: Batanes, Cagayan, Isabela, Nueva Vizcaya and Quirino. The last two provinces are completely landlocked while the rest have coastal towns with an 872 km coastline covered by the Kuroshio Current. The region is bounded by two big mountain ranges in Northern Luzon, the Cordillera to the west and the Sierra Madre on the east. In the north part lies the Babuyan Channel and beyond is the China Sea. A detailed map of the Cagayan Valley Region is shown in Fig. 1.

The Batanes group of islands consists of six island municipalities surrounded with marine waters. It has approximately 45,000 ha of territorial waters which are a source of abundant fishery species (DA-BFAR RO2, 2006a).

Cagayan on the other hand, lies in the northeastern most part of Luzon and occupies the lower basin of the

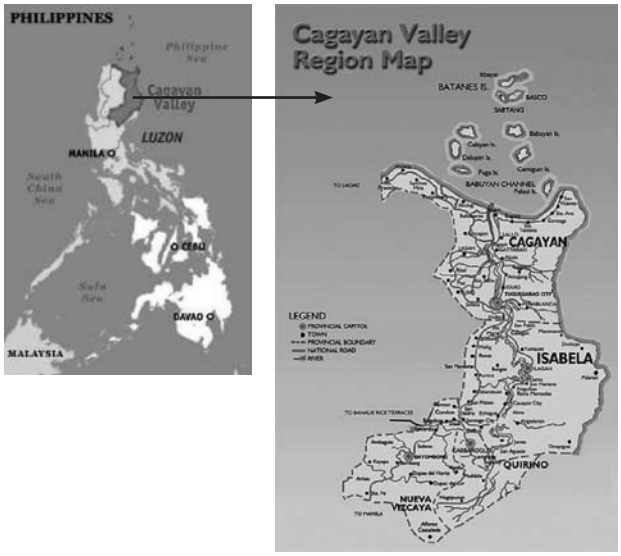

Fig. 1 Map of the Cagayan Valley Region

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Cagayan River. The province has vast expanse of valleys, open coastline on the north and an irregular one on the east facing the Pacific Ocean. The eastern coast is rugged and mountainous while the northern coastal areas are level. The western part is low and swampy.

The Province of Isabela is the biggest province of the region and the second largest province in the country. It has five coastal municipalities namely: Divilacan, Maconacon, Dinapigue, Palanan and San Mariano.

The two other provinces in the Cagayan Valley Region, Nueva Vizcaya and Quirino are landlocked. Nueva Vizcaya is geographically located at the southernmost part of Region 2 and is often referred to as the gateway to the Cagayan Valley. Meanwhile, Quirino Province lies in the southeastern portion of the Cagayan Valley.

Region 2 is classifies as having Type III and Type IV weather conditions wherein Type III is characterized by not very pronounced seasons, relatively dry from November to April and wet during the rest of the year (DA-BFAR RO2, 2006a). Type IV on the other hand is characterized by even distribution of rainfall throughout the year. Dry season lasts from March until July and the hottest conditions are experienced during April to June. From the latter part of June until August the weather is moderate with occasional rains.

1. Marine resources under the diverse ecosystem

The coastal waters of the Cagayan Valley Region have been known to contain some of the country's most diverse ecosystems complementing its pristine and beautiful beaches. Enriched by nutrients leached from the land, its waters are characterized by extensive coral reefs which support a highly diverse flora and fauna.

1) Fish, Crustaceans, Shellfish and Other High Value Marine Products

Various species of fish, crustaceans and shellfish thrive and are being caught commercially in the coastal waters of the region. Also, the conspicuous floras in the coastal environment include the dense mangrove forest covering a total area of 8,202 hectares, sea grass beds and seaweeds (DA-BFAR RO2, 2006a). Thus, the coastal waters and marine ecosystems of the Cagayan Valley have been providing a means of livelihood to many people, yielding a sustainable supply of goods—such as fish, crustaceans, shellfish, seaweeds and other marine products. Major and minor fishing grounds are shown in Table 1.

To date, there are 31,783 municipal fisherfolk in the region and around 170 commercial and 3,463 municipal fishing vessels are operating in the coastal waters (DA-BFAR RO2, 2006a). Ports were developed along the coastal municipalities to ease the transportation of goods. Fish landing sites are also strategically located in every coastal community. Table 2 shows a breakdown of the production of fishery products by sector in the region from 2001 to 2005. "Municipal" refers to fishing within the municipal waters (0-15 km from shore) using fishing vessels of three gross tons or less. On the other hand, "commercial sector" refers to the taking of fishery species by passive or active gear for trade, business or

Table 1. Fishing grounds in the coastal waters of the Cagayan Valley Region

Type of Fishing Ground	Batanes	Cagayan	Isabela
Major fishing grounds	South China Sea Pacific Ocean Balintang Channel	Babuyan Channel Balintang Channel Pacific Ocean	Pacific Ocean
Minor fishing grounds	Diora Bay Uyugan Bay Chadpidan Bay Valugan Bay Vasay Bay Sabtang Bay Bashi Channel		Bicobian Cove Palanan Cove

Table 2. Comparative fishery production of the Cagayan Valley Region

Sector	2001	2002	2003	2004	2005
Aquaculture (MT)	4,963.90	5,301.60	5,447.10	5,408.55	8,825.20
Commercial (MT)	14,297.00	16,190.00	16,019.00	15,916.43	15,913.00
Municipal (MT)	19,157.00	21,601.00	21,507.00	21,059.80	22,028.92
Total (MT)	**38,417.90**	**43,092.60**	**42,973.10**	**42,384.78**	**46,767.12**

Table 3. Major and minor marine products in the Cagayan Valley Region

Type of Commodity	BATANES		CAGAYAN		ISABELA	
Major Commodities	**Common Name**	**Scientific Name**	**Common Name**	**Scientific Name**	**Common Name**	**Scientific Name**
	anchovy	*Stolephorous commersonii*	shrimp	*Nematopalaemon tenuipes*	snapper	*Lutjanus spp.*
	snapper	*Lutjanus spp.*		*Penaeus spp./Acetes spp.*	yellowfin	*Thunnus albacares*
	grouper	*Epinephelus spp.*	anchovy	*Stolephorous commersonii*	oceanic bonito	*Katsuwonus pelamis*
	fusilier	*Caesio spp.*	tuna and tuna	*Auxis thazard/Thunnus spp.*	tuna and tuna like	*Thunnus spp.*
	flying fish	*Cypselurus spp.*	like fishes		species	
	trevally	*Carangoides spp.*	hairtail	*Trichiurus spp.*	scad	*Decapterus spp.*
	scad	*Decapterus macrosoma*	snapper	*Lutjanus spp.*	salmon	*Elegatis spp.*
		Selar crumenopthalmus	scad	*Decapterus macrosoma*	hairtail	*Trishiurus spp.*
	tuna and tuna	*Thunnus spp.*		*Selar crumenopthalmus*	grouper mackerel	*Epinephelus spp.*
	like species		slipmouth	*Gazza minuta*		*Scomber/*
	sardine	*Sardinella spp.*	squid	*Loligo duvaucceli*	blue marlin	*Rastralliger spp.*
	marlin	*Makaira spp.*	mullet	*Mugil/Valamugil spp*	sardine	*Makaira nigricans*
	lobster	*Panulirus spp.*	lobster	*Panulirus spp.*		*Sardinella ssp.*
	cuttlefish	*Sepia spp.*	herring	*Herklotsichthys quadrimaculatus*		
			mackerel	*Rastrelliger brachyosoma*		
			dolphin fish	*Coryphaena hippurus*		
			ell	*Anguilla spp.*		
			oyster	*Crassostrea spp.*		
Minor Commodities	mackerel	*Rastralliger/Scomber spp.*	flying fish	*Cypselurus spp.*	caesio	*Caesio spp.*
	octopus	*Octopus bulgaris*	goatfish	*Upeneus/Parupeneus spp.*	parrot fish	*Scarus spp.*
	goatfish	*Upeneus/Parupeneaus*	stingray	*Elegatis spp.*	leather jacket fish	*Meuschenia spp.*
	coconut crab	*spp.*	octopus	*Octopus vulgaris*	various aquarium	
	various	*Birgus latro*	gourami	*Trichogaster spp.*	fishes	
	aquarium fishes		milkfish fry	*Chanos chanos*		
			crabling	*Scylla spp.*		
			grouper fry	*Epinephelus spp.*		
			siganid fry	*Siganus spp.*		
			various			
			aquarium fishes			

Source: DA-BFAR RO2, 2006a

Table 4. Dominant seaweeds in Batanes and Cagayan coastal waters

BATANES		CAGAYAN	
Scientific Name	**Scientific Name**	**Scientific Name**	**Scientific Name**
Gracilaria canaliculata	*Struvea anastomosans*	*Gracilaria canaliculata*	*Dictyota cervicornis*
G. edulis	*Dictyosphaeria cavernosa*	*G. arcuata*	*D. dichotoma*
G. eucheumoides	*Avrainvillea obscura*	*G. edulis*	*D. mertensii*
G. manilaensis	*Clorodesmis fastigiata*	*G. eucheumoides*	*Hydroclathrus clathratus*
Caulerpa lentillifera	*C. hildebrandtii*	*G. manilaensis*	*Hormophysia cuneifromis*
C.microphysa	*Udotea argentea*	*G. salicornia*	*Turbinaria ornate*
C. racemosa	*U. orientalis*	*Caulerpa racemosa*	*Liagora ceranoides*
C.serrulta	*Bornetella nitida*	*C.cupressoides*	*L. farinose*
C. taxifolia	*Neomeris annulata*	*C. lentillifera*	*Actinotrichia fragilis*
Sargassum cristaefolium	*N. vanbosseae*	*C. serrulta*	*Galaxaura apiculata*
S. hemiphyllum	*Hormophysia cuneifromis*	*C. microphysa*	*G. obtusata*
S.ilicifolium	*Turbinaria ornate*	*C. sertularioides*	*G. rugosa*
S. oligocystum	*Porphyra crispate*	*Sargassum cristaefolium*	*G. fasciculata*
Mcrodictyon okamurae	*Yamadaella caenomyce*	*S.polycystum*	*G. oblongata*
Cladophora prolifera	*Liagora ceranoides*	*S.siliquosum*	*G. subverticillata*
C. quisumbingii	*L. farinose*	*Porphyra crispata*	*Galidiella acerosa*
Chamaedoris orientalis	*Asparagopsis taxiformis*	*Codium geppi*	*Grateloupia filicina*
Cladophoropsis membranacea	*Actinotrichia fragilis*	*C. tenue*	*Halimenia durvillaei*
Valonia utricularis	*Galidiella acerosa*	*C. arabicum*	*H. formosa*
Bryopsis plumosa	*Carpopeltis formosana*	*C. edule*	*Amphiroa foliacea*
Codium geppi	*Grateloupia filicina*	*Enteremorpha compressa*	*A. fragilissima*
C. arabicum	*Halimenia durvillaei*	*E. flexuosa*	*Cheilosporum cultratum*
Padina boryana	*H. formosa*	*Cladophora quisumbingii*	*Mastophora rosea*
P. austalis	*Amphiroa fragilissima*	*Padina boryana*	*Portiera hornemannii*
Galaxaura filamentosa	*Cheilosporum cultratum*	*P. australis*	*Rhodopeltisnborealis*
G. fasciculata	*C. jungermannioides*	*P. japonica*	*Ceratodictyon spongiosum*
G. oblongata	*Mastophora rosea*	*P. minor*	*Gelidiopsis intricata*
G. marginata	*Portiera hornemannii*	*Jania ungulata*	*Eucheuma denticulatum*
G. obtusata	*Rhodopeltisnborealis*	*Wrangelia argus*	*E. gelatinae*
G. rugosa	*Gelidiopsis intricata*	*Polysiphonia upolensis*	*Kappaphycus cotonnii*
G. subfruticulosa	*Plocamium telfairiae*	*Ulva lactuca*	*K. striatum*
Amphiroa anceps	*Eucheuma gelatinae*	*U. pertusa*	*Hypnea cercornis*
A. dimorpha	*Kappaphycus striatum*	*U. recticulata*	*H. charoides*
Jania adhaerens	*Hypnea cercornis*	*Anadyomene plicata*	*H. valentiae*
J. ungulata	*H. charoides*	*Chaetomorpha crassa*	*Claudea batanensis*
J.capillacea	*H. valentiae*	*Boergesenia forbesii*	*Acanthophora aokii*
J.decussato-dichotoma	*Champia parvula*	*Boodlea composita*	*A. spicifera*
J. ungulata	*Centroceras clavulatum*	*Dictyosphaeria cavernosa*	*Botrychia binderi*
Plocamium costatum	*Claudea batanensis*	*Valonia aegagropila*	*B. tenella*
Carpopeltis affinis	*Acanthophora aokii*	*V. ventricosa*	*Chondria armata*
C. maillardii	*A. muscoides*	*Halimeda cylindracea*	*Digenea simplex*
Ceramium flaccidum	*A. spicifera*	*H. discoidea*	*Laurencia cartilaginea*
Herposiphonia subdisticha	*Amansia glomerata*	*H.macroloba*	*L. papillosa*
Polysiphonia upolensis	*Botrychia binderi*	*H. opuntia*	
Enteromorpha clathrata	*B. tenella*	*H. taenicola*	
E. compressa	*Digenea simplex*	*H. tuna*	
E. flexuosa	*Laurencia cartilaginea*	*H. velazquezii*	
Ulva lactuca	*L. intermedia*	*H. bikinensis*	
U. pertusa	*L. obtusa*	*Avrainvillea obscura*	
Chaetomorpha crassa	*L. palisada*	*Clorodesmis fastigiata*	
Boergesenia forbesii	*L. papillosa*	*C. hildebrandtii*	
Boodlea composita	*L. tronoi*	*Udotea orientalis*	
Halimeda fragilis	*Leveillea jungermannioides*	*Bornetella nitida*	
H. macroloba	*Neurymenia fraxinifolia*	*Neomeris annulata*	
H. opuntia	*Chamaedoris orientalis*	*Acetabularia dentate*	
H. tuna	*Cladophoropsis membranacea*	*Scinaia moniliformis*	
H. velazquezii	*Carollina frondescens*	*Halicoryne wrightii*	

Source: Trono, 2004; Trono, 1997

profit beyond subsistence or sports and using fishing vessels with more than three gross tons. The aquaculture sector involves fishery operations engaged in all forms of raising and culturing fish and other fishery species in fresh water, brackish and marine areas. An increase in aquaculture production was noted while commercial and municipal productions which are mainly dependent on the productivity of coastal waters have made no significant increase (Republic Act 8550).

Major species caught in the commercial sector are roundscad, anchovy, tuna and other tuna-like species. The list of major and minor fishery products that are being commercially caught in the coastal waters of each province is presented in Table 3. Danish seine, drift filter net and round haul seine are among the fishing gear that are productive. Municipal resources consist mostly of fishes such as sardines, anchovies, frigrate tuna and the like. Invertebrates like shrimps, squids and crabs also contribute significantly to the production. Fishing gear that is being used is generally simple, low cost and easily operated by fishermen using motorized or non-motorized fishing boats. The most common fishing gear includes drift gillnet, multiple hand line, bottom set gillnet, troll line, trawl, and others.

Meanwhile, a number of high value marine products are also found in the coastal waters of Cagayan. It has been noted that sea cucumber of various species (at least 30 species), sea urchin and abalone thrive in the area particularly in Sta. Ana coastal waters (DA-BFAR RO2, 2006a).

2) Seaweed resources

The coastal waters of the Cagayan Valley Region still have pristine seaweed resources not fully exploited by the populace living near the area. While there has been no intensive assessment on seaweed resources along the coast of Isabela, around 151 species have been identified by Trono (1997, 2004) in the coastal waters of Batanes and Cagayan (Table 4). There are at least 4 orders, 14 families, 24 genera and 53 species of Class Chlorophyceae. Class Phaeophyceae has 3 orders, 4 families, 6 genera and 15 species. On the other hand, there are at least 12 orders, 21 families, 42 genera and 76 species in Class Rhodophyceae. Many of these have economic importance. Some can be eaten raw like the *Caulerpa, Codium, Porphyra, Laminaria, Gracilaria* and many other seaweeds. Some can be used as fish bait and some others can be used as a component of antibacterial, antifungal medicines and for industrial purposes. Among these seaweeds, only *Gracilaria* is being dried and traded commercially. Table 5 shows the seaweed production in the region. Production consists of wild gathering and

Table 5. Seaweed production in Cagayan Valley Region

Year	Production (MT)	Area (ha)
1995	150.00	gathering from wild
1996	10.80	gathering from wild
1997	2.30	gathering from wild
1998	84.62	gathering from wild
1999	114.42	gathering from wild
2000	135.13	gathering from wild
2001	148.08	gathering from wild
2002	230.00	gathering from wild
2003	493.68	wild and aquaculture (50)*
2004	6.63	wild and aquaculture (1)*
2005	946.56	wild and aquaculture (74)*
2006	1,140.77	wild and aquaculture (77)*

Source: DA-BFAR RO2, 2006b *Aquaculture

is utilized mainly for food or sold in fresh form by local residents except in the municipality of Buguey, Cagayan where tonnage of dried *Glacilaria* is being shipped out from the province for industrial purposes. Note that production from 1995 to 2002 mainly depended on wild stock and *Gracilaria* production in aquaculture was introduced beginning only 2003, thus increasing the production thereafter. Nonetheless, other culturable species are also being introduced now to the non-traditional areas of the region like *Eucheuma* species (DA-BFAR RO2, 2006a).

All these seaweeds formed part of the coastal ecosystem along the Kuroshio current's area of influence. At present, utilization of these seaweeds is low and can be said to have contributed to recruitment of fish and other aquatic organisms in the area. However, recent climate and environmental changes could have affected the growth of some of these seaweeds.

2. Case study: Marine Fisheries Stock Assessment in the Babuyan Channel

1) Fish production

The Babuyan Channel is the most important fishing ground in the Cagayan Valley Region. It has a coastline length of around 154 km and has a total area of approximately 477,550 hectares. The northern part of the channel extends to the islands of Fuga, Camiguin, Dalupiri, Calayan and the Babuyan Group of Islands converging with the Pacific Ocean on the east and the south China Sea on the west. The center of the channel, within the territorial waters of the Municipality of Aparri is estuarine in nature where the Cagayan River, the largest and longest river in the Philippines drains to this

fishing ground (Fig. 1). The depth of the channel ranges from 5 fathoms to 564 fathoms. As of 2005, a total of 16,526 registered fishermen from 108 coastal barangays of the ten coastal municipalities are utilizing the fishing ground employing various types of commercial and/or municipal fishing gear. There are 2890 fishing boats (94%) that fall under the municipal fisheries and 170 fishing boats (6%) in commercial fisheries. Divided by type, 2483 (83%) are motorized and 507 (17%) are non-motorized. Commercial and municipal production from 1999 to 2004 are shown in Fig. 2.

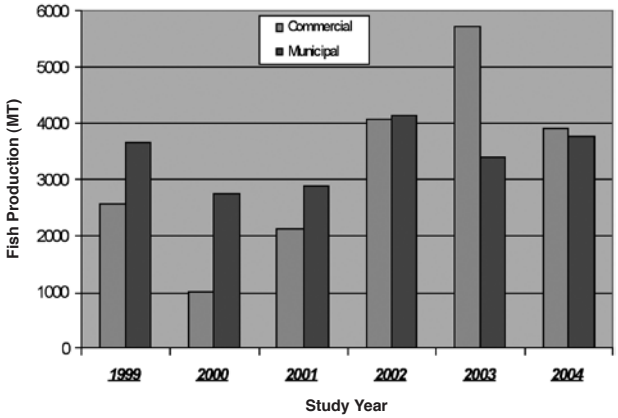

Fig. 2 Estimated commercial fish production at Babuyan Channel - April 1999 to March 2004 (Source: Villarao, Palolan & Aragon, 2006)

Estimated annual fish production for commercial fisheries from 1999 to 2004 decreased for the first two years while an increase in the production was observed from 2001 to 2003 but a gradual decrease was observed in 2004. Low production was noticed in the first-two years because of inclement weather which occurred in the later part of 1999 and early 2000, frequent typhoons that hit the province, suspension of the issuance of Commercial Fishing Vessel and Gear Licenses to Danish Seine operators and the vigilant enforcement of the provisions of Fisheries Administrative Order 201 prohibiting active gear to from being operated within municipal waters by a composite team from the Bureau of Fisheries and Aquatic Resources, law enforcers and the local government unit(LGU) concerned. However, operation of Danish Seine had resumed and intensified by June 2001 which contributed to the high commercial production during the later years. However, overuse of such gear could have affected the production of fish in the succeeding year, thus a noticeable decrease in 2004 production was observed. Commercial fishing gear operating in the Babuyan Channel during the study includes Danish Seine – having an accumulated production of approximately 34 percent of the total commercial fish production, Drift Filter Net (30%), Round Haul Seine (22%), Purse Seine (5%), Ring Net (4%) and Beach Seine accounted for the remaining catch (4%).

Municipal fisheries production data also showed a decreasing trend during the first two years, and on increasing trend from the third to fourth year. It followed the trend of the commercial production except that there was a decreased in 2003. The increase was mainly due to the catching efficiency of fishing gears, particularly trawl (26% of the total municipal fish production), troll line (22%), drift gillnet (10%), multiple handline (9%), beach seine (8%) and spear gun (8%) coupled with the expansion of the fishing area. High production in troll line and drift gillnet is attributed to gear shifting and modification to suit the seasonality of catchable species. Activities in commercial fishing could have affected the production of the municipal sector.

2) Major species of fish

A total of 83 families of vertebrates consisting of 187 genera and 459 species and 10 families of invertebrates composed of 19 genera and 34 species were identified. Dominant vertebrates and invertebrates are shown in Fig. 3.

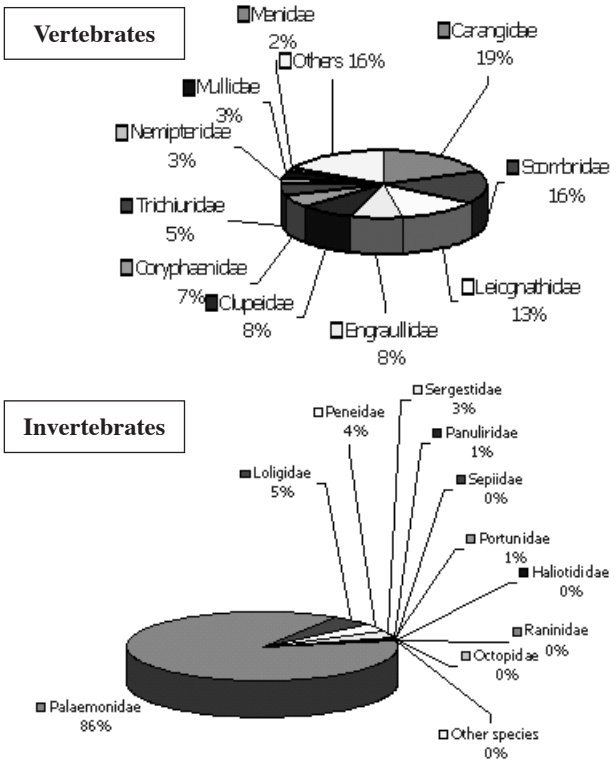

Fig. 3 Percentage distribution of Vertebrate and Invertebrate families caught along Babuyan Channel (Source:Villarao, Palolan & Aragon, 2006)

During the first-two year study period, *Nematopalaemon tenuipes* (spider shrimp) topped the production data with 39 percent of the total production, *Gazza minuta* (toothpony) with five percent, *Coryphaena hippurus* (dolphinfish) with four percent, *Stolephorous commersonii* (Commerson's anchovy) with three percent while *Selar crumenopthalmus* (big-eye scad) produced a catch of three percent of the aggregate production for the two-year period (Fig. 4).

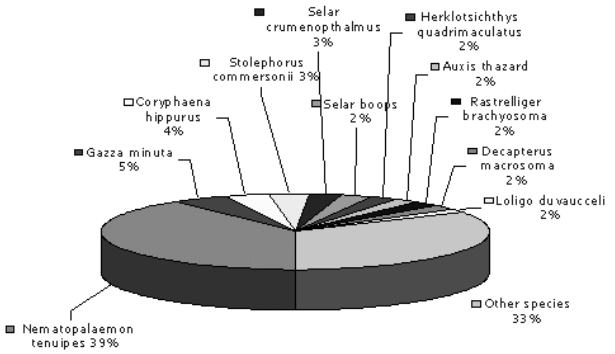

Fig. 4 Major species caught at Babuyan Channel (1999-2001)
(Source: Villarao, Palolan & Aragon, 2006)

Nematopalaemon tenuipes, locally known as "Aramang" is one of the most dominant native fishery products in the Cagayan Valley, particularly at Aparri, Cagayan. This species is seasonally abundant and caught by Drift Filter Net particularly when the waters are turbid. The significant catch of Aramang is also attributed mainly to the gear modification, market availability and regulation measures established and agreed upon by Fishermen-Operators and the LGU of the municipality of Aparri, Cagayan.

Table 6 shows the length distribution of ten commercially important species caught in the Babuyan Channel. Most of the species caught, which are representatives of the pelagic, demersal and reef-associated species, are caught before their first maturity. This indicates that these species were not able to contribute to the recruitment process before they were caught, which explains the depletion of these resources.

Meanwhile, nine species out of the ten commercially important fish species analyzed exhibited E values exceeding 0.5 (Fig. 5). These are *Auxis thazard, Herklotsichthys quadrimaculatus*, *Decapterus macrosoma*, *Selar boops*, *Coryphaena hippurus*, *Stolephorus commersonii*, *Rastrelliger brachysoma*, *Gazza minuta* and *Auxis rochei*. Their exploitation rate ranges from 0.53 to 0.59. These values show that these stocks are already exploited beyond the sustainable level, an indication of "growth overfishing".

The results obtained correspond with the findings that these species are also caught before their first maturity based on the collected length frequency data, an indication of "recruitment overfishing", which will eventually result in depletion.

3) Sustainable yield vs. sustainable effort

Theoretically, fishermen gain by increasing their fishing effort but only up to a certain level. Beyond that level, i.e., the Maximum Sustainable Yield or MSY with its corresponding Maximum Sustainable Effort (fMSY), the renewal of the resource cannot keep pace with the removal caused by fishing at which point, any further increase in exploitation level causes yield to fall (Gayanilo & Pauly, 1997).

Fig. 6 shows just the estimated MSY in the Babuyan Channel based on the data generated from 1999 to 2004. For Schaeffer's model, the estimated MSY was at 7242 metric tons (MT) at fMSY of 27547 gross tons (GT). This shows that if the maximum sustainable effort of 27547 GT annually were to be maintained producing a total of 7242 MT annual fish production, the channel could provide an optimum annual yield of fish and other invertebrates, and the resources could still reproduce and at the same time be utilized without the danger of depletion. For Fox's model, the estimated MSY of the Babuyan Channel is 7460 MT of fish and other invertebrates at fMSY of 20065 GT.

The above information however, is not yet conclusive, since, data series of ten years or more are needed to have a reliable estimate. It is alarming to note however, that the fishing effort exerted at the channel during the first two years (1999 & 2000) of the study period far exceeded the fMSY, hence the downward trend of production. Also in 2002, 2003 and 2004 production already exceeded MSY above the optimum level.

3. Towards sustainable fisheries production

The Bureau of Fisheries and Aquatic Resources of the Philippines was mandated by law to ensure the rational and sustainable development, management and conservation of fisheries and aquatic resources in the Philippine waters including the Exclusive Economic Zone and the adjacent seas. With the current condition of the coastal waters of the Cagayan Valley Region, various strategies have to be formulated and implemented to ensure resource sustainability. However, this requires full management support from different institutions particularly on various aspects of research on marine biology, environmental science, environmental manage-

ment and marine resources bio-prospecting.

Since, the major species are already within the critical range of exploitation, some measures have been taken to rehabilitate the area, such as the establishment of Fish Sanctuaries and Artificial Reefs which are presently the focus of the Coastal Resources Management Program of the Bureau. Being located at the base of the food chain, providing food and niches to many aquatic organisms, seaweeds or seagrasses should be rehabilitated and conserved to contribute more to the production or recruitment of fish and other aquatic organisms in the area.

Also, though prohibition of the utilization of gear such as Danish Seine and the like may not be practically feasible, practical solutions should be implemented through technological research and development to minimize potential negative impacts of such gear. Stricter implementation of Fisheries Administrative Orders and other fishery laws and intensification of support and strengthening of Fisheries and Aquatic Resources Management Councils and fisherfolk organizations as counterparts in adopting coastal resource management concepts and principles is also needed. In addition, zonification/demarcation of respective municipal waters and establishment of marine protected areas by local government units according to resource utilization and management must be done. Continued monitoring and the conduction of stock assessment in other fishing grounds are deemed necessary to accumulate time series data, which is the minimum requirement for the analysis of the Maximum Sustainable Yield and Total Allowable Catch, and to determine effective management measures to be enforced.

Conclusion

Based on the case study, it is also recommended that biological studies must be carried out and be incorporated during data gathering to monitor the fecundity and spawning season of the major species which will serve as basis for the formulation and imposition of management strategies or measures.

Moreover, there are some indigenous species of flora and fauna that have been found thriving in the coastal waters of the Cagayan Valley Region. Notably, Nematopalaemon tenuipes, locally known as "Aramang" is one of the most dominant native fishery products in the Cagayan Valley, particularly at Aparri, Cagayan that needs further biological studies. Rapid assessment of the seaweeds and seagrass resources particularly along the coast of Isabela would be necessary also to identify potential indigenous resources that contain bioactive compounds for industrial and medical applications. Meanwhile, the effects of environmental and climatic changes on the flora and fauna along the coast would be worth studying. It has been said before that vast amounts of Porphyra are being gathered particularly along the coast of Sta. Ana, Cagayan. Various species of sea cucumber are also said to thrive in the area. Such studies would shed light on the depletion of resources and would provide practical and effective conservation measures for our marine resources.

References

Department of Agriculture-Bureau of Fisheries and Aquatic Resources(DA-BFAR RO2.2006a). Regional Fisheries Profile. DA-BFAR RO2:, Cagayan, Philippines.

_____.2006b. Roadmap of Seaweeds. DA-BFAR RO2: , Cagayan, Philippines.

Gayanilo, F.C. Jr. and D. Pauly (eds.),. 1997. FAO-ICLARM Stock Assessment Tools (FiSAT) Reference Manual. FAO Computerized Information Series (Fisheries) No. 8. Rome, FAO. 262p.

Republic Act 8550. The Philippine Fisheries Code of 1998.

Trono G., 1997. Field Guide and Atlas of the Seaweed Resources of the Philippines. Bookmark, Inc.: Makati, Philippines.

_____. 2004. Guide and Atlas of the Seaweed Resources of the Philippines. Vol.2. Bureau of Agricultural Research: Quezon, Philippines.

Villarao P, Palolan L, Aragon M., 2006. Marine Fisheries Stock Assessment in Babuyan Channel – April 1999-2003. DA-Bureau of Fisheries and Aquatic Resources Regional Office No. 2:, Cagayan, Philippines.