Review of bigeye and yellowfin tuna catches landed in Palawan, Philippines

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1 EXECUTIVE SUMMARY

A study mission was contracted by the WCPFC to investigate the source of recent estimates of bigeye and yellowfin tuna in the Philippines domestic fisheries. Annual catch estimates for skipjack, yellowfin and bigeye tuna are compiled for provision to the WCPFC by the Bureau of Agricultural Statistics (BAS). The Bureau of Fisheries and Aquatic Resources (BFAR), National Fisheries Research and Development Institute (NFRDI) conducts port sampling of key tuna landing centers independent of the BAS estimation process through the National Stock Assessment Project (NSAP). BAS estimates of tuna catch are based on the expansion of data gathered from interviews with key informants (fishermen, buyers and processors) at landing centers. In several provinces of the Philippines, BAS catch estimates of bigeye tuna, and to a lesser extent yellowfin tuna, appear unrealistically high in comparison to NSAP sampling data and based on expected species composition of the oceanic tuna species by gear types used in these provinces. To investigate the sources of these estimates and potential bias, the study team met with BFAR, BAS and NSAP representatives to gain a thorough understanding of the interview, sampling and expansion processes that are used to produce annual catch estimates. A province reporting unusually high bigeye and yellowfin landings in recent years was selected for site visits (Palawan, Region 4B).

The study recognized that the vessels landing catch in Palawan could be roughly categorized into 1) those that regularly land oceanic tuna species[3] having close access to deep oceanic waters and payaos (> 1000 m); 2) shallow coastal sites (<200 m) that tend to land a variety of coastal and neritic tuna or tuna-like species[4]; and 3) those that seldom or never land tuna. It was noted that certain landing centers servicing small vessels that fish almost exclusively in shallow coastal waters, had previously reported (to BAS) very high percentages of annual bigeye tuna in total tuna landings[5] suggesting the possibility of species identification problems or misunderstandings during the interview process.

The BAS estimation process uses a mix of probability and non-probability surveys at fishery landing centers with sample size dependent on available funding and manpower. The BAS "focused" sampling obtains catches by species and gear more comparable to the NSAP data collection protocol and indicates bigeye tuna landings at key landing centers comprises a fraction[6] of total yellowfin landings and certainly far below estimates based on the BAS non-probability surveys used for several landing centers that suggest bigeye tuna comprise over 50 per cent of oceanic tuna landings (the non-probability surveys rely on subjective interviews with key informants). The expansion of these information sources is then dependent on data collected from a Frame survey conducted at all landing centers by BAS on a bi-annual basis or when funding and manpower permits. The Frame survey provides an estimate on the total number of boats unloading per month and total volume of the tuna catch landed in the peak and lean seasons for every landing center. The landing center and interview data are then used with the Frame survey to produce estimates of total catch by species using an "expansion" process. The expansion process relies on the species composition of the sampled landing centers being representative of all BAS landing centers (for that province) and will result in bias in the estimates produced, if, for example, the sampled landing centers are not representative, or unreliable amounts of oceanic tuna species catch were reported by the informants, which was the situation identified in this study.

A number of issues related to the estimation process which may reduce the accuracy of oceanic tuna catch estimates were identified. **Section 12** summarizes these issues, the recommendations to address these concerns and the time frames for the proposed work to resolve the problems.

[3] bigeye, yellowfin and skipjack tuna as recorded by NSAP port sampling
[4] frigate tuna, bullet tuna, kawakawa, longtail tuna, wahoo, etc.
[5] bigeye tuna reported at greater than 50% of oceanic tuna landings
[6] around 1.5 – 3.5%

2 Background

The 2008 bigeye catch estimate provided by the Bureau of Agricultural Statistics (BAS) for the Philippines domestic tuna fisheries was 35,141 t., of which an estimated 34,000 t. came from the surface fisheries alone[7]. The Philippines surface fisheries bigeye catch for 2008 represents almost 50% of the WCPFC Conventional Area surface fisheries bigeye catch (which was 69,550 t. for purse seine, pole-and-line, troll and "other/unclassified" gears in 2008). The Fifth Regular Session of the WCPFC Scientific Committee (SC5) held in Vanuatu, 10-21 August 2009, reiterated its concerns on the uncertainty with the bigeye catch estimates from the Philippines domestic fisheries, particularly the potential effect this relatively large catch has on the regional bigeye stock assessments.

Relatively high catch estimates of yellowfin tuna from the Philippines domestic fisheries are also provided by BAS[8] and therefore of interest to the WCPFC-SC.

Given the importance of the Philippines domestic catch estimates of bigeye and yellowfin tuna, the WCPFC Secretariat contracted two fisheries specialists to conduct a brief study visit to review the estimation process for these tuna species, including a visit to key landing sites which appear to be the origin of high bigeye catches; the study was conducted in late October/early November 2009. Palawan in Region 4B was identified as an area with the relatively high bigeye (4,000+ t.) and yellowfin tuna (20,000 t.) catch estimates in recent years, so was selected for the study tour.

3 Scope of the study

With the approval, cooperation and collaboration of management and fisheries staff from BAS and Bureau of Fisheries and Aquatic Resources (BFAR), the WCPFC tuna fisheries specialists were contracted to investigate the sources of information and methods used to produce the bigeye and yellowfin tuna estimates for the Philippines domestic fisheries for the purpose of validating their reliability.

The study involved a visit to the Philippines to conduct the following work :

1. Two days to be spent in the offices of the Bureau of Agricultural Statistics (BAS), and the BFAR National Fisheries Research and Development Institute (NFRDI), Manila, to undertake the following work:
    - Presentation of the purpose of the study and plan the field visits;
    - General familarization of the available data and the methodology used to determine the estimates of bigeye and yellowfin tuna (BAS);
    - Conduct an in-depth review of the detailed data from the landing centers with relatively high bigeye and yellowfin tuna catch estimates - Palawan was identified as the area to focus on for this study with the expectation that recommendations for improvements could then be applied to other areas in the Philippines;
    - Construct a profile of the landing sites in Palawan which have potential high bigeye/yellowfin catch estimates, for example, number of active vessels fishing for tuna by gear, seasonal variations in active vessels, species composition of the catch, effort, CPUE, catch disposal, etc.
    - Presentation of the main outcomes of the study, with recommendations, and discussions with BAS staff how improvements could be made to the estimation process for bigeye and yellowfin

[7] BAS do not provide a breakdown of catches by gear, but the longline and large-fish handline fisheries accounted for about 1,200 t. of bigeye tuna in 2008, according estimates determined from the Bureau of Fisheries and Aquatic Resources (BFAR) National Stock Assessment Project (NSAP).

[8] In 2008, the Philippines surface fisheries yellowfin catch [148,000 t.] was around 32% of the WCPFC Convention Area surface fishery yellowfin catch [469,965 t.]

tuna catch, including, how to work towards the production of estimates by gear type, which could be achieved through a specific WCPFC annual catch estimates review meeting with all stakeholders participating;

2. Four days spent at selected landing/sampling sites which are the source of high bigeye and yellowfin catch estimates. Due to time constraints, a visit to only one region/province was possible (Palawan) with the expectation that any problems found could be applied to other regions. The work covered the following areas :
   - Review of BAS and BFAR monitoring programmes in Palawan according to suggested guidelines, including
     - Interviews with enumerators and supervisors;
     - Observation and audits of the sampling/survey processes, where possible;
   - Interviews with stakeholders in the Palawan fishery (e.g. fishers, traders, buyers) who provide the information to BAS in their surveys (i.e. the source of the catch information in the BAS system);
   - Expand on the profile of catch/effort information for the landing sites in the region visited (Palawan) (see bullet point in the previous section).
   - Attempt to obtain independent estimates based on the profile constructed of that region's landing sites.
   - Review and identify problems in the BAS and BFAR sampling methodologies and produce a list of suggestions for improvement.

3. Two-three days writing this report and preparation of a formal presentation to BAS and BFAR on the main outcomes of the study, including recommendations for improvements in the bigeye and yellowfin tuna catch estimates.

The tables and figures produced for this study have been organized in this report as Sections 13 and 14, respectively.

4 Geography, Demographics and Climate of Palawan

Palawan is an island province (14,896 km^2) of the Philippines located in the MIMAROPA[9] region to the west of the main Island[10] (**Figure 1**). Palawan is a long, narrow island lying north-east/ south west and has almost 2,000 kilometers (1,200 mi) of irregular coastline with roughly 1,780 islands and islets, rocky coves, and sugar-white sandy beaches. The central mountain range has heights averaging 3,500 feet (1,100 m) in altitude, with the highest peak rising to 6,843 feet (2,086 m) at Mount Matalingahan. The terrain is a mix of coastal plain, craggy foothills, valley deltas, and heavy forest interspersed with riverine arteries that serve as irrigation.

Palawan has the South China Sea bordering its western coast, the Sulu Sea to its east and Malaysia (Sabah, Sarawak) to the south. The Calamianes Group of Islands, to the northwest of Palawan consists of Busuanga Island, Culion Island, and Coron Island. Durangan Island almost touches the westernmost part of Palawan Island, while Balabac Island is located off the southern tip, separated from Borneo by the Balabac Strait. In addition, Palawan covers the Cuyo Islands in the Sulu Sea. The disputed Spratly Islands, located a few hundred kilometers to the west (in the South China Sea) is considered part of Palawan by the Philippines, and is locally called the Kalayaan Group of Islands.

[9] MIMAROPA consists of the provinces of Occidental Mindoro, Oriental Mindoro, Marinduque, Romblon and Palawan.
[10] www.en.wikipedia.org/wiki/Palawan

The central-east coast of Palawan is in close proximity to relatively deep areas of the Sulu Sea, with isobaths of 1,000m (and deeper) situated less than 10 kms from the shore in several areas, in particular, the main city of Palawan, Puerto Princesa (**Figure 1, bottom and Figure 2**). In contrast, relatively deep areas (e.g. indicated by the isobaths equal and greater than 1000m) off the west coast (South China Sea), and in the south-east and north-east, are much further from the coast (generally > 50 kms).

Palawan has a population of 892,660 (2007 census[11]), with a relatively high growth rate of around 3.5 per annum. The Palawan capital, Puerto Princesa City has a population of 210,000 and the land area of 253,982 hectares stretching over 106 kilometers long, and in parts across to the west coast, makes it the largest city in the Philippines in terms of total land area.

The Philippines has a tropical marine climate dominated by a rainy season and a dry season. The summer monsoon brings heavy rains to most of the archipelago from May to October, whereas the winter monsoon brings cooler and drier air from December to February.

During the months of April and May, and into early June, the Philippines experiences very calm wind conditions, but for the remainder of the year, the Philippines are under the influence of two general wind patterns. From about mid-June /July to early September, light-moderate winds from the north-west/southwest direction produce more than the usual amount of rain for the Philippines (i.e. the rainy season). September and October are transitional months when the north-west monsoon weakens and the Philippines then comes under the influence of the stronger north-east (trade) wind which is maintained until February-March.

5 Description of gears fishing for tuna in Palawan

5.1 General

Pelagic fishery landings into the Puerto Princesa and south-east Palawan area are produced by various hook and line gears and methods using manually hauled handline and troll lines, generally in close proximity to anchored payaos. Kite fishing, pelagic longline and vertical longline gears are not utilized. Small-scale bagnet gear targets small coastal pelagics and tuna-like species but ringnet and purse seine fisheries for tuna and skipjack are not locally developed. However, purse seine vessels from other areas do make seasonal visits to fish on payaos in the southwest Sulu Sea but do not land fishery products in Puerto Princesa. Some degree of gillnetting of pelagic species is reported but no tuna gillnet fishermen were interviewed during the study and available data (NSAP) suggest that oceanic tuna species catches are minimal.

The gear types can be broadly categorized into -

a. handline gear for large yellowfin and bigeye tuna;
b. handline gear for small yellowfin and bigeye tuna; and
c. a mix of handline and troll gear taking a mix of small and medium-sized pelagic and coastal pelagic species.

The information provided in this report was distilled from data collected by BFAR and BAS staff and from direct interviews with Palawan tuna fishermen with 8 months to 20 years of local handline fishing experience and pertains to hook and line fishing within approximately 80 nmi of Puerto Princesa, Aborlan and Narra. Within the Puerto Princesa area, interviews were conducted at tuna landing sites at Bagong

[11] http://visitpalawan.com/tag/palawan-population

Silang, Jacana, Fish Port Seaside (Matahimik), Tagburos and Santa Lourdes. Fishermen were also interviewed at the main wharf area of Narra and the tuna landing site called "Springside" at Aborlan.

5.2 Fishing grounds and fish aggregation

The Puerto Princesa area is well situated for tuna fishing with waters in excess of 1000 m occurring very close to the shore suitable for payao deployment and the aggregation of oceanic tuna species. Regions to the north and south of Puerto Princesa City (PPC) have wider shelf areas less than 200 m in depth that are unfavorable for oceanic species and large tuna in particular (see **Figure 1**). For this reason, fishing vessels based at Aborlan and Narra must travel much further to gain access to yellowfin and bigeye tuna. It was noted that tuna handline bancas from Narra and Aborlan relocate to the Puerto Princesa area during the peak large-fish (yellowfin tuna) season.

Tuna handline fishing generally occurs on anchored payaos within 5 to 12 hours steaming from the main landing sites. The total number of payaos in this region of the Sulu Sea is not well documented but two informants independently suggested that about 100 payaos were anchored in this fishing region. These units are the cylindrical steel type payao found throughout the southern Philippines and are deployed by large fishing companies with variable access available to Palawan handline fishermen. The informant at Narra specifically stated that they were not allowed to fish on these FADs and had to remain at least one mile away or fished open water areas using bait attraction lights.

However, small vessel access to coastal or littoral tunas is better in shallow coastal areas like Narra and Aborlan. Landings of longtail tuna (*Thunnus tonggol*), wahoo, jacks and frigate tuna (*Euthynnuus affinis*) as well as demersal species are important components of landings in these areas. About 30 shallow-water FADs were noted as being set by the Narra municipality in coastal waters for local fisheries development. Trolling on tuna schools found in association with whale sharks and dolphins was also noted as a fishing strategy in some areas.

5.3 Seasonality and environmental factors

Tuna fishing, particularly in offshore waters, is mainly influenced by wind and sea conditions in the Sulu Sea but catches are also influenced by the seasonal availability of large or small tuna and moon phase. Handline tuna fishing based from the Puerto Princesa area occurs throughout the March – October summer season characterized by no or light northwest/southwest winds and calm seas. Fishing effort drops off during the November – April season due to strong northeast tradewinds that create rough sea conditions. However, it was also noted that handline fishing for large tuna can be very poor in flat calm conditions with a little chop and wind being beneficial to the biting response.

Fishermen in Aborlan and Narra noted that their larger tuna handline bancas relocated to the Puerto Princesa area to fish for Citra Mina during the peak March – August tuna season. It was reported that Citra Mina provides ice to tuna vessels that land their catch at their processing facility at Santa Lourdes. During the remainder of the year these bancas return to their home ports and become basnigans, using bagnet gear to land a variety of anchovies, herring species, round scad, etc. closer to shore.

Large yellowfin and bigeye tuna are generally taken at night or early morning hours during the calm season (Mar-Oct). This may be related to peak spawning season and/or the fact that sub-surface handline fishing is very difficult in strong winds due to excessive drift or current. The Nov-Feb season was noted by one respondent as the time for daytime fishing for medium sized yellowfin (<20 kgs) and very small tuna using multiple hook gear. Another informant stated that March – June was the peak season for large yellowfin with mixed-size yellowfin available during the July – October period. Very small yellowfin and bigeye were noted being readily available on payaos in the Dec-Jan period. This would be logical if they were the local

recruitment of a summer spawning season for the large yellowfin and bigeye targeted during Mar-Oct season.

Night time handline fishing for large tuna depends on the use of bait attraction lights meaning that the new moon or periods of low moon volume are preferred. One fisherman noted that night handline fishing is conducted for about three weeks per month and is suspended for nine nights surrounding the full moon period.

5.4 Handline targeting large yellowfin tuna

Most of the tuna handline bancas operating out of the Puerto Princesa region are relatively small vessels carrying 3 – 6 crewmen (**Figure 3**). Typical trip length includes three nights of fishing plus transit times to and from the fishing grounds. Fishing for large tuna is conducted at night with bait attraction lights but fishing by these vessels can take place day and night. Vessels may remain at sea for up to one week but will terminate a trip if holds are filled, ice runs low or provisions become depleted. The large handline boats carrying several auxiliary vessels for individual handline operations ("*seriesans*") that are common in the General Santos/Moro Gulf/Celebes Sea region are not a part of the Palawan fishery, though these types of vessels are known to operate in portions of the eastern Sulu Sea (**Figure 4**).

Fishing is conducted almost exclusively on tuna schools within one nautical mile of anchored payaos that are generally set in at least 1000 m of water. However, fishermen in Aborlan reported that they do not have access to payaos and must remain at least one mile away from payaos and also operate at night in open water areas. Presumably their bait attraction lights are used to aggregate tuna as is the practice in the Hawaiian *ika shibi* fishery for large yellowfin tuna. Handline vessels will tie up to a payao to fish large tuna at night and also tie up to during the mid-day period to sleep and rest when jigging for small tuna can also occur. Pressure lamps are used at night to attract baitfish, squid and tuna. Fresh or live squid jigged by the fishers is the preferred bait for large tuna but round scad (*Decapterus* spp.), juvenile tuna or tuna-like species are also used. Heavy monofilament handlines are tied to a single tuna circle hook that is baited and set at approximately 30 – 50 fathoms at night. One set of handline gear was examined in Narra, consisting of a 170 kg monofilament mainline wrapped around a hand reel and attached to a 140 kg monofilament leader with a stainless steel swivel (**Figure 5**). The rig terminated in a hand twisted, two strand stainless steel leader attached to an 11/0 stainless steel circle hook. This gear type has remained essentially unchanged for decades.

One to three handlines are set per fisherman and attached to the vessel with a slip knot rigged to set the hook and then release under pressure. The fish are hauled manually, stunned with a bat and covered with ice or immersed in saltwater brine for preservation. It was noted that catch rates using this method peak from 0200 AM till early morning hours. This fishery is very similar if not identical to the *ika shibi* handline fishery in Hawaii that targets large yellowfin tuna during the summer spawning season with similar peak fishing times.

The night-time tuna handline fishery targets large yellowfin and lands fish that are generally greater than 30 kgs in size ranging up to 80 kgs. Large bigeye tuna of similar sizes were noted as a regular component of the fishery but always taken at lower rates compared to yellowfin. **Figure 6** shows typical yellowfin and bigeye tuna taken by this gear type at a landing site in Bagong Silang, Puerto Princesa.

A variation of this fishery was noted by an experienced fisherman in Puerto Princesa who described daytime handline fishing for medium sized tuna around 15 – 30 kgs on payaos. The gear and techniques are similar as those described for the night-time fishery without the use of bait attraction lights. Vessels deploy baited lines up-current from an anchored payao and drift past the payao waiting for a strike. This type of

fishing is similar if not identical to the Hawaiian "*palu ahi*" handline fishery that targets 10 – 30 kgs yellowfin and bigeye tuna on FADs and at natural aggregation sites around the Hawaiian Islands. Tuna handline fishermen consistently reported that they iced their catch after stunning with a blow to the head and always landed their catch whole. Large tuna examined during the survey bore this out with no signs of bleeding, spiking, gilling, gutting or processing of any kind (**Figure 7**).

5.5 Small-scale hook and line gears

Small tuna and tuna-like species (less than about 8 kgs) are taken by a variety of small-scale handline and troll gears. The major distinction in catches and catch rates appears to be linked to water depth, the presence of a payao and season. The majority of small yellowfin and bigeye tuna taken on this gear are fished in association with anchored payaos set in deep water. Handlines consist of artificial lures attached one per line or to dropper loops attached to a common mainline. The lures are usually colored fabric and bright twine tied to single "J" hooks. A typical rig may consist of twenty lures deployed with one terminal weight and must be actively jigged by the fisherman. This type of gear lands yellowfin tuna ranging from about 0.3 kgs to 5 kgs per piece. Juvenile bigeye tuna are commonly taken by this gear type but are seldom differentiated from similarly sized yellowfin (see **Figure 8**). The difficulty fishermen and processors have in discriminating the two species at this size is apparent. This type of gear is also used on tuna bancas targeting large tuna as a way to catch live bait and to supplement catches of medium sized tuna. Skipjack, frigate and bullet tunas (*Auxis* spp.) are also taken by this gear type.

Small-scale landings of tuna and tuna-like species are also taken by a variety of troll gear using a single lure per line or multiple lures on a single mainline. An interesting troll system was described in Tagburos where a mainline is suspended from the central mast of a banca that terminates in a float and weight that stretches the line tight. Up to twenty individual lures are attached to short branchlines attached to the mainline to target skipjack, kawakawa, longtail tuna and other pelagic and coastal pelagic species.

5.6 Catch composition and species identification

The large tuna handline gear targets yellowfin tuna that make up the bulk of landings. Large bigeye tuna are also taken in this fishery but respondents were consistent in noting that yellowfin tuna make up the bulk of the catch and that the proportion of bigeye in the total landings has also decreased over time. Almost all fishermen and processors were able to positively identify large yellowfin and bigeye tuna without difficulty. Offshore fishermen also noted a low bycatch of blue marlin, sharks (unidentified to species), mahi mahi and wahoo. All of these species are retained for sale.

Mixed catches of smaller tuna raised several concerns relevant to the study. In many locations, all small tuna are simply called "tuna" and not differentiated to species. When shown color digital images of small yellowfin and bigeye (<40 cm) in excellent condition, most fishermen could differentiate by species (see **Figure 9**). However it is doubtful if they could correctly differentiate the tuna species in Figure 7 that are more typical of landed catch. Another problem is that both species are often referred to with the same name of "*carao*" and regional differences in naming conventions further confuse the issue.

When shown a picture of medium-sized tuna (70-85 cm), one fisherman/processor noted his belief that the deeper bodied bigeye tuna was a female yellowfin tuna while the yellowfin pictured was the male. He also believed that all small tuna were born as bigeye tuna that later transformed into yellowfin. However, when asked directly most fishermen agreed that small yellowfin tuna are always more common than small bigeye tuna.

Longtail tuna (*Thunnus tonggol*) were usually referred to as "bluefin tuna" or mistakenly identified as yellowfin tuna (**Figure 10**). Wahoo (*Acanthocybium solandri*) were often referred to as tangigue, the local name for Spanish mackerel (*Scomberomorus commerson*) and also were referred to as "local tangigue".

A useful observation was that the species composition and individual size of the catch was generally a good indicator of catch location. Large yellowfin and bigeye tuna caught by handline gear come from offshore locations, usually but not always in association with payaos anchored in depths greater than 1000 m. Large mixed catches of small yellowfin and bigeye are likely caught on deepwater payaos but few were seen during the study. The presence of longtail tuna, kawakawa, *Auxis* spp., Spanish mackerel or wahoo indicated fishing grounds closer to shore typically on the shallow island shelf in less than 200 m depth though wahoo are taken in offshore areas as well.

5.7 Catch rates

Typical catch rates of large tuna in the offshore handline fishery during the high season reported as much as 6 – 10 large tuna per night of fishing with three nights of fishing a common trip length. Reported bigeye catch composition ranged widely from 2% (Jacana) to 30% (PPC-based Narra vessels) with a consensus that the proportion of bigeye was always lower than yellowfin and was perceived to be decreasing over the long term. It is difficult to assess the accuracy of these self-reported "average" bigeye proportions and landings which should be viewed with caution. Yamanaka (1989) reported the species composition from the large tuna handline fishery landing at Lion Beach in the late 1980s as 95% yellowfin, 3% bigeye and 2% billfishes, suggesting that the proportion of bigeye may not have changed a great deal. The BFAR NSAP sampling data (1997-2008) shows a similar species composition in the large-fish handline fishery as Yamanaka (1989), with no significant variation in bigeye species composition over time. Reported catch rates of small yellowfin and bigeye are highly variable but can be as high as hundreds of kgs per trip in the small-fish peak season.

6 Description of tuna landing sites in Palawan

6.1 General

The BAS regularly conducts a Frame survey of all landing sites in each region which is used as the basis for "expanding" (raising) the catch data collected from their surveys to obtain an estimate of catch by species for each province and region. The latest Frame survey conducted for Palawan was in 2007 and suggested that there were 539 municipal landing sites and around 66 commercial landing sites in Palawan (sourced from survey of commercial centers undertaken in 2008). However, due to limited resources, BAS and BFAR are only able to cover very few of these landing centers, but have attempted to obtain the best cross-section of representative landing centers as possible.

Table 1 provides a list of the landing sites in Palawan that are monitored through data collection by BFAR and/or surveys by BAS in recent years. The sections that follow provide more information on some of the key landing centers visited during this study.

6.2 Santa Lourdes

The Santa Lourdes wharf is the site used by the newly relocated Citra Mina fish processing plant (since early 2008) and therefore one of the main large tuna landing sites in Palawan, operating during the months March-October. The site is well described by available NSAP data (see **Table 10**) but prior to 2008, was only used for landings for a variety of small-scale gears fishing close to shore with little or no catch of oceanic tuna species (hence the difference in species composition in recent years). The Citra Mina site was not

visited during this study as the plant was not operating during this time of the year and the handline vessels based there had returned to their home ports (the large-yellowfin handline season had just finished).

6.3 Tagburos

This village is located on the shore of Honda Bay with some houses built out over the water where a variety of small-scale fishing vessels are moored or hauled out (**Figure 11**). There is no wharf and vessels sit on the bottom at low tide. The BAS informant at this site stated that the main fishing season was from Apr-Oct with fishing halted during the Nov-Feb time due to strong winds. Fishing is conducted by a reported 18 small banca type vessels that are usually one man troll or handline boats that operate in Honda Bay as far north as Roxas but within 10-15 km of shore. Payaos are too far offshore and not fished but they do search for and fish on bird schools, whale sharks and dolphin associated tuna schools. The small boats conduct one day trips and land basically anything they can catch. Tuna and tuna-like species are fished with single or multiple-hook troll gear. A mixed species catch was examined that is typical of this coastal fishery and consisted of skipjack (2), jacks (2), longtail tuna (6), kawakawa (2) and wahoo (2) (see **Figure 12)**. Yellowfin and bigeye tuna are seldom captured or landed at Tagburos. The NSAP data collection (1997-2008) provides an indication of the gears and species composition of the landed catch from this center (**Table 11**). The NSAP data suggests that yellowfin tuna have been a minor catch component of the troll (1.4%) and surface gillnet gears in the past, with no record of bigeye catch in the NSAP data collected since 1997.

6.4 Jacana (Bancao-bancao)

This landing center is the former site of the Citra Mina fish processing plant and still a significant landing area for handline tuna and pelagic species. Large yellowfin and some bigeye are taken on FADs about 3 hours distance from port. A mixture of small and medium sized handline bancas operate from Jacana but most are small boats with 1 – 3 man crews fishing for three nights per trip (**Figure 13**). Vessels moor out and often sit on the bottom at low tide. The main handline fishing season for large yellowfin tuna was stated as March-June with Jul-Oct productive for medium-sized yellowfin. The large tuna are unloaded at Jacana or at the Puerto Princesa fish port depending on which buyer financed the trip. Small tunas and tuna-like species taken with single or multiple hook handline and some troll gear are sold locally. Small yellowfin, bigeye, kawakawa and longtail tuna were observed for sale at roadside stalls at Jacana, apparently taken with multiple or single hook handline or troll gear (**Figure 14**). This site is well covered by the NSAP and BAS sampling and species composition (BFAR and BAS) and size composition data have been consistent over the years of data collection.

6.5 Bagong Silang

Two fish landing sites in the Bagong Silang area were visited. The first site appeared to be active in the landing of mixed demersal species and it is highly doubtful that large tuna could be landed here due to the distance from the water. A mixed catch of snappers, groupers and other demersal species was observed. On the shoreline a tuna landing site built out over the water was visited where large handline tunas are regularly landed. Yellowfin and bigeye typical of the fishery were being held in ice slurry and were examined (**Figure 15**). The NSAP cover the landing site where the vessels targeting the large tunas land their catch and this is reflected in the summarized species composition data (**Table 6**). The volume of catch from this landing center is clearly smaller than at Jacana and St. Lourdes.

6.6 Puerto Princesa Fish Port (Seaside or Matahimik)

Large tuna are landed at the main Fish Port wharf at Puerto Princesa at a modern concrete wharf and pier. A six man handline banca was observed unloading and one of the crew was interviewed. The vessel had been operating 12 hours south of Puerto Princesa on three payaos anchored in deep water. The trip had produced 40 yellowfin of about 12 – 35 kgs each. The vessel uses handline gear either at night for large tuna during the peak Mar-Oct season or fish daytime during the Nov-Feb season for medium-sized yellowfin. Smaller tuna are also fished with multiple hook handline gear during the Oct-Mar period. Yellowfin were graded onboard the vessel by removing a core sample of meat that was examined for color, fat content and texture (**Figure 16**). Tuna suitable for export were weighed on the dock where NSAP sampling took place (**Figure 17**). Fish rejected for export or higher end processing were retained onboard as were all fish less than 16 kgs that were slated for local sales. This practice may have implications for size sampling bias in some data sets. Monitoring of this site through NSAP has only recommenced recently after a hiatus of about 6 years. In the past, this site has been referred to as Matahimik-Pier, PPC fish port and Seaside in the NSAP data. The species composition in the past has been consistent, with large yellowfin dominating the catch with about 2-3% bigeye tuna (**Tables 8 and 9**).

6.7 Aborlan

The Miguel fish buying station at Aborlan (Creekside) was visited and the BAS informant interviewed. This site is located on a small tributary that feeds into the Sulu Sea at a point where a broad shallow shelf separates the coast from deep water. Around 100 small one-man boats operate in the Aborlan area similar to the banca pictured in **Figure 18**. These vessels operate in coastal waters that result in landings of longtail tuna, frigate tuna, bullet tuna, kawakawa, wahoo and carangids that are sold locally to two large traders and some smaller outlets. These vessels use single or multiple hook troll gear.

About 30 larger tuna handline bancas are located in this area. Most of them relocate to Santa Lourdes during the main tuna season of Mar-Aug where they gain access to free ice supplied by the Citra Mina processing plant in return for landing their yellowfin and bigeye catch to the plant. These boats are manned by 3-5 man crews, fish at night with bait attraction lights.

This particular fish buyer was not familiar with, nor able to identify bigeye tuna from pictures provided. This is likely due to the shallow coastal species available locally and the relocation of the larger tuna handline boats to Santa Lourdes during the offshore tuna season. This landing site is not covered by the NSAP.

6.8 Narra

The southernmost landing site visited during the study was Narra where a modern cement wharf is located in a clean bay (**Figure 19**). The H-M Fish Buyer site on the beach at Narra was visited where a BAS informant was interviewed. He stated that about 20 handline bancas are based in this area but relocate to Santa Lourdes to fish for Citra Mina like the vessels from Aborlan. Apparently the free ice provided by Citra Mina is a good incentive and is more economical than trucking catch north for processing. A typical six GRT banca was anchored directly offshore from the H-M facility. This vessel engages in the seasonal handline fishery for Citra Mina. During the remainder of the year it reconfigures to operate as a bagnet vessel landing anchovies and herring that are dried and variety of coastal pelagic including round scad (**Figure 20**).

Other fishing ports south from Narra (Espaniola, Brooks Point, Batarasa) were not visited during the study. However, due to their remote location from processing and shipping locations it is doubtful that large yellowfin and bigeye tuna are landed at these sites. However, small tunas and tuna-like species are probably targeted seasonally. This landing site is not covered by the NSAP.

7 Summary of information available on tuna catches landed in Palawan

Due to the considerable number and wide distribution of landing centers throughout Palawan, it has been impossible to cover all landing sites with a monitoring programme given the resources available, but the BAS and BFAR have attempted to select what they understand to be the most representative and important landing centers in order to obtain the best estimates of catch (BAS) and representative data for science (BFAR) possible.

The following sections provide an overview the BAS and BFAR (NSAP) data collection systems and information collected from the monitoring programmes by BAS and BFAR in Palawan. Valestros (2002) and Lopez (2000) provide a detailed explanation of the data collection systems developed and implemented by BAS and BFAR (NSAP), respectively.

7.1 BAS data

BAS took over the responsibility for producing fishery catch estimates from BFAR in 1988, although BAS and BFAR still collaborate to a certain extent in finalizing the estimates. Due to the constraints on resources to cover all fishing landing centers, BAS conducts a mix of probability and non-probability surveys, with the sample sizes dependent on funds for that year. The probability surveys comprise data collection using a two-stage stratified random sample, with the province (e.g. Palawan) as the domain, the fish landing centers as the first stage units and the fishing boat trips as the second stage units. Landing centers are stratified into (i) "certainty" – the top producing fish landing center in the province (i.e. Jacana Beach prior to 2008), (ii) the major fish landing centers and (iii) the other fish landing centers. The probability surveys include the requirements for catch to be recorded by species and gear, and provide more detailed and accurate information than the non-probability surveys which only require subjective monthly catch estimates by species (and not gear) from key informants (operators, fishermen and traders) from selected landing sites. The data collected from the non-probability surveys are used to determine the percentage change from the same quarter in previous years, which is then used to produce the estimate for the current year. Further information on the BAS methodology can be found in Valesteros (2002).

Given that there are 8,800 landing sites in Philippines, BAS can only cover a very small percentage with the available funding hence the application of the current sampling methodology. The BAS Frame survey is a fundamental activity and is conducted when there are funds available, but at best, on a two-yearly basis only. The BAS landing-center Frame data provides an estimate on the total boats unloading per month and total volume of the catch landed in the peak and lean seasons for every landing center, and is used in the total catch estimation ("expansion" process. The 2007 Frame survey indicated there were 539 municipal landing sites and around 66 commercial landing sites in Palawan (sourced from survey undertaken in 2008).

In 2008, the coverage of BAS Commercial landing centers in Palawan was 0% for Stratum #1 (focused; not enough funds) and about 10% for the non-probability surveys of major and minor commercial landing centers.

In 2008, the coverage of BAS Municipal landing centers in Palawan was 0% for Stratum #1 (focused; not enough funds) and about 1-2% for the non-probability surveys of major and minor municipal landing centers. The coverage of the non-probability surveys is therefore very low and with insufficient coverage may be prone to bias. The following information was provided for the study.

- Summary list of all Palawan landing center information collected from the Frame survey of 2008 (Commercial landing centers) and 2007 (Municipal landing centers)
- The landing sites covered by BAS surveys (Strata 1, 2 and 3)

- Data from selected monthly monitoring of fish unloadings from traditional (municipal) landing centers in Palawan
- Estimated volume of Tuna Unloadings from Commercial landing centers in Palawan (2006)
- Volume of tuna catch by species by region and province (Municipal and Commercial sectors)

BAS data collection at the Jacana Beach commercial landing center in 2007 was undertaken according to the "certainty" or "focused" protocol, and the yellowfin and bigeye tuna species composition reflects what we would expect to see from the handline vessels landing based on first-hand review of the landing center during the study and comparison to the NSAP data (**Table 2**). The BAS data collection at the Tagburos municipal landing center in 2007 also used the focused sampling protocol and the catch volumes and species composition of yellowfin and bigeye tuna is what we expect to see from this landing center based on information obtained for this study (**Table 3** – no bigeye catch in the troll or other small-scale gears that operate close to shore).

The expanded annual tuna species catch estimates for Palawan (commercial and municipal landing centers) using the probability, non-probability survey data and application of the frame data is provided in **Table 4**. The yellowfin (17,331 t.) and bigeye (4,333 t.) tuna catches for 2007 are considerably higher than the values for the top producing landing centers I Palawan (provided in Tables 2 and 3), and the proportion of bigeye to yellowfin is also considerably higher. **Table 5** provides a breakdown of annual tuna catches by species for the non-probability survey sites in Palawan for recent years. The source of this information are the key informants in each landing center. There are a number of anomalies in these data that are difficult to explain based on the general understanding of relative volumes and species composition by gear covering the oceanic tuna catches, including the NSAP data. The main anomalies are:

- The overall tuna catch at Narra for 2008 comprised more than 50% bigeye tuna, which is very unusual for any fisheries in the Philippines or any other known tuna fishery in the western equatorial Pacific. Based on NSAP and other data collection systems, the bigeye tuna catch should usually be clearly less than the yellowfin tuna catch which is not the case for this landing center, according to the informants' responses. This anomaly also applies to the following points on the catch for other Palawan landing centers based on informants' responses.
- Likewise in Tagburos, the informants list the bigeye tuna as being 73.4% of the total oceanic tuna catch (skipjack+yellowfin+bigeye) for 2008, but the NSAP sampling data collection has yet to report any bigeye tuna catch at all over the past four years. Also, based on interviews during this study, the main gear type used (troll) operated in relatively shallow coastal waters and seldom caught yellowfin or bigeye tuna as they did not venture into oceanic waters where these species would be more likely to be caught and where deepwater payaos are located. If they did operate in areas with oceanic tunas, their troll gear would not be an efficient gear type for bigeye (which is the situation reflected in the NSAP data).
- In Taytay (north-east Palawan), the informants indicated that the bigeye catch was 100% of the total oceanic tuna catch, but we are not aware of what gear is used. In any event, Taytay is located at least 100km from the nearest 200 m isobath, so any fishing by small craft from Taytay would be restricted to relatively shallow waters where you would not expect to catch bigeye tuna.
- In San Vicente (north-west Palawan), the reported bigeye catch by informants is greater than 60% of the total oceanic tuna catch. As in Taytay, we are not aware of what gear is used, but the area where bigeye would expected to be caught is far from the landing center (> 60 km), so not readily accessible by small craft.

Since the informants responses are a fundamental input to the expanded catch estimates, these anomalies should be resolved as soon as possible.

7.2 NSAP data

One of the main aims of the Bureau of Fisheries and Aquatic Resources (BFAR) is to ensure the sustainable management of aquatic resources in the Philippines, which requires national assessment of resources as a basis for formulating management option. The National Stock Assessment Project (NSAP) was established in 1997 as a result of the need to standardise and ensure the continuity of data collection from the variety of Philippines fisheries, which then feed into the management process. The data collection system was based on a system implemented by the Indo-Pacific Tuna Programme (IPTP) which operated in the Philippines and other Asian countries during the 1970s and 1980s.

Data are collected at ports of unloading only. This means that the spatial and temporal components of the catch and effort are restricted to the trip level only (i.e. not at the fishing operation level). Due to the extent of the fisheries in the Philippines, and the human and financial resources available, it has been impossible to cover all landing centres throughout the Philippines, and the most efficient sampling strategy possible, aimed at covering the largest and most representative landing centers, has been taken into account in the design of the NSAP. Fourteen regional offices of BFAR-NFRDI are responsible for managing the data collection at landing centers in their region. The species and size composition of the catch, and effort data collected from the NSAP are considered to be most accurate available for the fishing gears sampled throughout the Philippines landing centers since it is primarily collected for scientific purposes and the data are collected by trained enumerators with some education in fisheries biology and species identification. The catch species and size composition data therefore represent invaluable information that can be applied to the overall catch estimates compiled by the Bureau of Agricultural Statistics (BAS) to obtain the most reliable estimates of catch by species for each fishing gear type. An NSAP database system has been developed to enter the data in a consistent format and produce summarized reports (see SPC-OFP, 2005). The NSAP data collection system attempts to have representative (but not complete) coverage of port sampling days within the month at a particular landing centre, and the coverage of vessels sampled for each gear on each sampling day and landing centre. There is a standard sampling schedule for NSAP – the sampling day is scheduled every after two-days in each landing site regardless of Saturdays, Sundays and Holidays and the database system takes this into account to produce summarized reports of the expanded (raised) catch estimates.

NSAP sampling has occurred in Palawan since 1997, although no landing center has been covered for all years during the period 1997-2008. Due to resource constraints, only landing centers in Puerto Princesa City have been covered by NSAP, so no detailed information for sites elsewhere in Palawan are covered by the NSAP data, and therefore NSAP coverage in Palawan is very low. Unlike other Philippines regions, where for example the Philippines Fisheries Development Authority (PFDA) monitor all landings and other cannery/industry information are available, there appears to be no other information on catches available from Palawan. However, some data are potentially available from the one local processing plant (Citra Mina) and provincial export data for Palawan.

Tables 6-10 and **Figures 21-27** in Sections 13 and 14, respectively, provide summary information of the species and size composition data collected by the NSAP in Palawan landing sites for over the past 10-12 years and can be used to contrast the information provided through interviews during the study visit (see Sections 4 and 5 above).

In general, those landing centers which service handline vessels targeting large yellowfin tuna have similar species composition for yellowfin (typically > 90% by weight) and bigeye tuna (around 2-6%) in the peak season (March-October), according to the NSAP data. In the off-season (November-February), the NSAP handline data includes the use of the multiple hook-and-line gear by these vessels, and skipjack and other species are more prevalent in the catch, and the size composition of all tunas are much smaller (see **Figures 21-26**). The NSAP size composition data for Matahimik (PPC fish port) and Jacana in the off-season reflect

this change in fishing strategy and species and size composition in the catch. A point to note with **Table 10** for Sta. Lourdes is the clear change in species composition to large yellowfin and bigeye in 2008, when the Citra Mina processing plant began operations. Prior to 2008, the hook-and-line catch monitored by NSAP at this center contained mainly demersal species, with no catch of yellowfin or bigeye at all. The catch sampled at Matahmik from vessels using the multiple hook-and-line gear comprise small fish (**Figure 23**) and the species composition of the bigeye catch (1.9%) is similar to the vessels catching large fish. NSAP sampling of the troll and demersal hook-and-line gear (listed as "hook-and-line") which are gears used throughout the smaller towns of Palawan outside of Puerto Princesa, has been regularly undertaken at Tagburos, but yellowfin tuna only accounts for 1.4% of the total catch with no bigeye tuna encountered by NSAP samplers at all in the period 2005-2008 covering the period that the troll gear was monitored. Over 100 fish species have been recorded by NSAP samplers at this landing center for the 'hook-and-line' category over the years suggesting that a variety of fishing methods (bottom-fishing, surface) have been used. Skipjack comprises the main catch in recent years for the troll gear.

The NSAP size data for yellowfin and bigeye tuna (**Figures 21-26**) indicates there are two modes: one (predominant) mode of large fish greater than 90cm, which is evident for the handline catch landed in the peak season (March-October), and a smaller component of small fish in the range 20-40cm, essentially coming from the multiple hook-and-line and troll gears.

Figure 27 shows the monthly yellowfin catch rate trends and catch volumes from handline vessels landing at the Jacana Beach landing center, which is the most consistent NSAP data collection point in Palawan over the past 12 years. The highest volume of catches are taken in the peak season (March-October), although catches of yellowfin are taken year-round. The CPUE varies throughout this time series, with some high catch rates (but small volumes) taken in the off-season, but overall there is no clear trend with an average of about 150-170kgs per day in the peak season.

7.3 An estimate of yellowfin and bigeye catch from the NSAP data

While the NSAP data only covers a small percentage of landing centers in Palawan, it provides some important parameters that can be used to obtain an estimate of the yellowfin and bigeye tuna catch - catch rate trends, species and size composition, effort measures, vessel numbers. An estimate of yellowfin and bigeye tuna catch in Palawan has been attempted, given the following assumptions:

- The large-fish handline landing centers in Puerto Princesa are covered by the NSAP (and BAS) monitoring and therefore provide a reliable estimate of large yellowfin and bigeye catch;
- There are no large-fish handline landing centers outside Puerto Princesa since the markets/processing plants are in Puerto Princesa and it is easier for these vessels to base themselves in Puerto Princesa during the peak season, with no motivation for landing their catch elsewhere. This advice was provided during the study visit (see Sections 5.7, 5.8);
- The gears taking oceanic tuna species outside Puerto Princesa City are likely to be mainly troll and multiple hook-and-line, with very minor catches coming from the small-scale net fisheries. Deep water, where oceanic tuna are likely to be taken, is much further away from the coast in the areas outside of the Puerto Princesa City, so there are unlikely to be large catches of oceanic tuna in these areas, and neritic tuna species (Kawakawa, frigate, bullet and longtail tuna) are expected to dominate the catch of these gears in these areas. Also, given that the troll gear is at the surface and not necessarily on payaos, bigeye catches are expected to be very rare (which is evidenced in the Tagburos NSAP data).

The total tuna catch landed at Jacana and Sta Lourdes in 2008, according to raised NSAP data, was 622 t. for yellowfin and 34 t. for bigeye tuna; given that there is the potential for ad hoc landing of large yellowfin

elsewhere in Puerto Princesa City, this estimate could be expanded optimistically) to 1,000 t. and 50 t. for yellowfin and bigeye tuna, respectively. The estimate for yellowfin and bigeye tuna outside of Puerto Princesa is more problematic, but would not be considered to be greater than the catch within PPC based on our assumptions, so an optimistic total catch for Palawan could be in the order of 2,000 t. for yellowfin and 100 t. for bigeye tuna, which is at least an order of magnitude less than BAS estimates for these species in Palawan in recent years.

8 Issues identified by the study

This section deals with the issues identified in the data collection systems and the tuna catch estimates produced for Palawan after review of available information and interviews with BFAR and BAS staff and people of interest in the Palawan fishery (fishers, operators, traders, etc.).

8.1 Bigeye / Yellowfin tuna species identification

In general, the BFAR and BAS field staff have a good understanding of the differences between bigeye and yellowfin tuna, including differentiation of juveniles in fresh condition, although there may be some difficulties in identifying juveniles in poor condition or when markings have faded, so the provision of further guidelines on species identification for fish in poor condition is suggested. The fishers interviewed were also able to readily differentiate and identify yellowfin and bigeye tuna in most cases. However, it appears that informants involved in landing centers that service craft that are restricted to shallow-water fishing (and therefore may not experience bigeye catches) have some difficulties correctly identifying and differentiating the tuna species. This situation is also exacerbated since there is no differentiation of small yellowfin and bigeye tuna in the local terminology (i.e. they are both referred to as "*carao*") and no economic motivation for separating the catch of these and other species of small tuna in most instances.

Outside of Puerto Princesa City, the fishing areas for small craft appear to be restricted to relatively shallow waters since the deeper water is located further from the coast[12]; in the shallower waters frequented by the small craft, yellowfin and bigeye tuna would not typically be found and it appears that, in at least one case, the catch of longtail tuna (which is very prevalent in certain periods of the year) could have been mistakenly recorded as yellowfin or bigeye tuna. Also, small bigeye tuna would not be expected to be taken in open water areas or areas other than in association with a payao or floating object by the gears employed. The review of the BAS non-probability survey data lists abnormally high bigeye catches in all landing centers surveyed outside Puerto Princesa City (see Section 6) and clearly suggests that the informants concerned have mistakenly referred to bigeye tuna, when a neritic tuna species catch would have been expected.

Since the expanded (raised) catch estimates are reliant on the informants responses via the BAS non-probability surveys in Palawan, this is a critical problem which should be resolved as soon as possible.

8.2 Coverage of BAS and BFAR data

The coverage of data collection by BAS and BFAR is very low, and therefore affects the reliability of the estimates. The amount of resources required to improve the coverage to an adequate level is currently beyond the budget of both bureaus, despite assistance from WCPFC through the IPDCP and in the coming years through the GEF WPEA OFM. Given the lack of resources and funding, continual review of the data collection systems should be undertaken to ensure they are efficient and accurate in obtaining the best estimates possible.

[12] with the possible exception of Roxas but this site was not visited during the study

8.3 Expansion of BAS survey data to produce estimates

The BAS catch estimates rely on the information collected in the Frame survey and since there is no indication of the tuna catch in each landing center from the frame survey, there could be significant bias in the catch estimation if the sample landing centers are not representative of the entire Frame. For example, in Palawan, if our assumptions are correct (i.e. there are only minor catches of oceanic tuna species outside Puerto Princesa City), then the current method of expansion in the BAS estimation process would result in a significant over-estimation of the catch of yellowfin and bigeye tuna (in conjunction with the issue raised in Section 7.1).

At the moment, the BAS estimation process raises the catches from the survey data according to the proportion of the number of landing centers sampled in that stratum (major or minor) to the **total number** of landing centers provided in the frame. However, this does not take into account the relative catches at each landing center in the frame which would be a better method of estimation (i.e. weighting the expansion process by catch and not the total number of landing centers).

However, it would be far better and strongly recommended to take into account the relative catches of the oceanic tuna species by gear at each landing site in the Frame survey data collection and then use these data in the expansion process (i.e. expand the catch of **tuna by species** from the sampled landing centers to the total catch estimates in the Frame survey) to estimate the oceanic tuna species. Indeed, if the Frame survey were to accurately collect the catches of oceanic tuna species for each landing center, this would be a very useful basis for the annual catch estimates.

8.4 Availability of other sources of data for the BAS validation process

The BAS validation process uses additional sources of data to refine their estimates. In places like General Santos City, the PFDA, NSAP and fishing industry data provide valuable inputs into the BAS estimation process and the estimates of tuna species catch are considered reliable, but similar data do not exist in Palawan. Summarized data from the Citra Mina processing plant and the breakdown of provincial exports for tuna would be two useful sources of validating catches of large yellowfin, if they can be obtained by BAS.

9 Conclusions and Recommendations

There are 8,800 landing centers throughout the Philippines and the mandate of both BAS and BFAR is to monitor all fisheries, and not just the landing sites which service vessels unloading the oceanic tuna species catch, and this task therefore presents a significant challenge to both government bureaus. Despite the magnitude of work required, some progress has been made in recent years to improve the estimates of tuna catches in the Philippines, in particular the work done to prepare and provide annual tuna catch estimates by species and gear to the WCPFC by the Philippines for the first time ever in 2009. This study was envisaged to be another step in the process of improving tuna catch estimates and we hope that the BAS and BFAR can implement the recommendations that follow (in consultation with the WCPFC) as soon as possible.

In recent years, the WCPFC have sourced funds to assist both BAS and BFAR improve their estimates and biological data collection for tuna fisheries in the Philippines and the recommendations that follow are envisaged to focus the priority for short- to mid-term funding towards the ongoing improvement of the

processes involved in estimating oceanic tuna catches in the Philippines. However, it is also strongly recommended that both bureaus consider incorporating the mechanisms described in the recommendations into their core work since it involves an obligation that the Philippines must satisfy as a member of the WCPFC, that is, the provision of representative tuna catch estimates by gear and species on an annual basis.

The approach in this study was to concentrate on the perceived problems with the Philippines bigeye and yellowfin catch estimates at the "micro" level, that is, by dealing with the fisheries, landing centers and estimates from one province only with elevated reported bigeye landings (i.e. Palawan). However, given the short time available for this study, it was not possible to visit enough of the landing centers outside Puerto Princesa City to conclusively answer all the questions and it is acknowledged that some potential problems could have been overlooked. Nonetheless, the issues identified here are critical to the estimates for bigeye and yellowfin tuna catches in the Philippines and should be resolved to ensure more reliable catch estimates are produced in the future.

The following sections provide recommendations for resolving some of the problems found by this study. **Section 12** provides a summary of the issues identified in this study, the recommendations for action, the agencies involved and the suggested time frame for the required work.

9.1 Resolving problems with informants' responses to the BAS non-probability survey

Section 8.1 describes the problems that were encountered in the informants' responses to the BAS non-probability survey. On review of these problems, the following recommendation and action is suggested:

RECOMMENDATION 1. The BAS enumerators need to have the knowledge and resources necessary to identify potential bias/errors in the informants' responses to the non-probability surveys with respect to bigeye, yellowfin and skipjack tuna catches. Specifically, the following is required:

R1.1 WCPFC specialists will produce a basic species identification sheet that will assist BAS enumerators to (i) determine the differences between bigeye and yellowfin tuna and (ii) assist in the education of informants on the difference of bigeye, yellowfin and skipjack tunas to other tuna species, both during the quarterly surveys and the collection of the Frame survey data.

R1.2 WCPFC specialists will produce guidelines on species composition and volume of the bigeye, yellowfin and skipjack catch BY GEAR TYPE, which will assist BAS enumerators to:

(i) obtain an understanding of what might be expected for the landing center where the survey is conducted,
(ii) validate the responses provided by informants with respect to the proportion of bigeye, yellowfin and skipjack tuna in catch estimates and overall volumes provided, and
(iii) educate the informants on any problems they might have in the difference of bigeye, yellowfin and skipjack tuna catch, etc. compared to the other tuna species

R1.3 BAS, with technical support from BFAR, will conduct training courses for their enumerators in how to refer and use the species identification and tuna catch guidelines resource material produced by the WCPFC specialists.

R1.4 BAS (with assistance from BFAR and WCPFC) obtain an indication of the broad area fished by those vessels landing catch outside of Puerto Princesa City and cross-check with basic information on the ocean depths and payao use to determine whether oceanic tuna would be expected in the catch. This work is planned to be conducted as a part of the pilot Frame survey of Palawan.

Appendix 2 provides a draft version of the tuna species identification guide for BAS enumerators and Appendix 3 provides a draft version of the guidelines on species composition and volume of the bigeye, yellowfin and skipjack catch BY GEAR TYPE in Philippines fisheries.

9.2 Resolving problems in the expansion (raising) of data to produce tuna catch estimates (BAS)

Section 8.3 describes the potential problems found in the methodology for expansion (raising) data to produce tuna catch estimates. On review of these problems, the following recommendation and action is suggested:

RECOMMENDATION 2. The BAS, in collaboration with the BFAR and the WCPFC, enhance the collection of information in the FRAME SURVEY to cover the estimated oceanic tuna species catch by gear. If the breakdown of total oceanic tuna catch by gear is not possible, then at least, a total tuna catch for each landing centre is required. This implementation will ensure that the heterogeneity of oceanic tuna catch across all landing centers is covered in the expansion process (for example, it will take into account the landing centers with zero or very low oceanic tuna catch).

As a minimum requirement, the additional fields to be collected in the FRAME SURVEY for each landing center are

(i) total skipjack, yellowfin and bigeye landed catch in the peak season and the lean seasons, and
(ii) the volume of large tuna (yellowfin and bigeye tuna) catch in the peak season and the lean seasons

This information must be collected to obtain more accurate estimates of tuna catch. Appendix 4 shows the current and required information to be collected in the FRAME SURVEY.

In the longer term, it is strongly recommended that the FRAME SURVEY include the collection of skipjack, yellowfin and bigeye proportions by GEAR TYPE, SPECIES and SIZE CATEGORY (large and small) for each landing center.

Since the changes to the FRAME SURVEY are critical to obtaining more accurate estimates, BAS and WCPFC should liaise to determine how an updated FRAME SURVEY can be conducted as soon as possible so that estimates for 2009 (to be produced in 2010) can use the new FRAME. In this respect, the following provides a list of what may need to be considered (in order of work to be done) :

- The work to be done redesigning the new FRAME data collection forms, revisions to data collection manuals and training of enumerators to collect the new information, etc.
- Training of BAS staff to use the resource material for tuna species identification and guidelines to review the informants responses to tuna species catch.
- Requirements for undertaking a pilot FRAME SURVEY at Palawan.
- Resources required to conduct the new FRAME as soon as possible
- The resources/funds required to change the BAS database system and data processing systems to accommodate the additional information in the FRAME database
- Any other work required to fully implement the additional fields into the FRAME database.
- Conduct the pilot FRAME SURVEY at Palawan, acknowledging that it will take a long time due to the remote locations of landing centers throughout this province
- If funds are required and where the funds might be sourced in the short-term
- If funds are required and where the funds might be sourced in the long-term

RECOMMENDATION 3. The BAS modify the methodology in their expansion calculations for their non-probability surveys to take into account the following:

(i) In general, the expansion of the sampled landing centers catch to produce an estimate of catch for all landing centers in the stratum should use the sum of all CATCH from all landing centers to the CATCH at the sampled centers, and not the relative NUMBERS of landing centers;

(ii) Specifically for the estimates of skipjack, yellowfin and bigeye tuna, the expansion of the sampled landing centers tuna catch to produce an estimate of tuna catch for all landing centers in the stratum should use the sum of all TUNA CATCH from all landing centers (collected in the new FRAME survey) to the TUNA CATCH at the sampled centers, and not the relative NUMBERS of landing centers.

The formula for the stratum would be as follows :

Fish catch estimates of all sample landing centers in one stratum are added and then expanded using the raising factor C_t / s_t to get the month's total for the stratum.

$$Y_{st} = \sum_{i=1}^{n} Y_{LCMi} \times \frac{C_t}{s_t}$$

Where

Y_{st} = Estimate of tuna catch (stratified by large/small) in the stratum

Y_{LCMI} = Estimate of tuna catch (stratified by large/small) in the sample landing centers in a month

C_t = Total tuna catch (stratified by large/small) from landing centers in a stratum

s_t = Tuna catch (stratified by large/small) from sample landing centers in a stratum

Ideally, this calculation should be enhanced to take into account the tuna catch by GEAR and SPECIES in the long term.

9.3 Other general recommendations

The variety of fishing techniques covered under the handline/hook-and-line gear type in the BAS and BFAR/NSAP data collection may need to be reviewed to clearly differentiate catch and effort data for scientific purposes. This might involve separation using one or several of the following factors:

- Primary target species
- Type of gear (i.e. differentiate troll and multiple hook-and-line from large-fish handline gear)
- Separation by size of tuna (i.e. those trips catching large tuna vs small tuna)

Our assumptions regarding the perceived low catch of yellowfin and bigeye tuna outside of Puerto Princesa City by the small-scale gears need to be checked by the enhanced BAS Frame survey and also some ad hoc NSAP sampling at several landing centers elsewhere in Palawan.

The catch estimate validation process conducted by BAS in Palawan should also consider the availability of other sources of data that can be used to obtain more reliable estimates of oceanic tuna catches, for example,

- Catch by species data from tuna receipts at the CITRA MINA wharf or processing site
- Provincial export information for tuna

The Annual PHILIPPINES/WCPFC TUNA STATISTICS REVIEW MEETING provides a useful mechanism for reviewing and discussing the latest Philippine tuna catch estimates to be provided to the WCPFC. This meeting would provide the ideal venue for discussing progress in resolving the issues raised in this study, so its continuation is strongly recommended.

10 Acknowledgements

The WCPFC Specialists greatly appreciated the attention and assistance provided during their visit in the Philippines, and in particular, Mr Noel Barut, Ms. Elaine Garvilles and Mr Val Borja from BFAR, who were fully dedicated to the study during the visit, and Director Romeo Recide of BAS who made his staff and offices fully accessible to the study.

All staff members from both BFAR and BAS that were encountered during the visit were very helpful and willing to understand the issues and the problems which is an important first step in resolution process. Special appreciation is expressed to Ms Myrna Candelario and Ms Adoracion Garciano who went out of their way to assist in the work and readily made themselves available to accompany the WCPFC Specialists on their field trips. The Directors and Assistant Directors from both bureaus acknowledged the importance of the issues related to the study topic and those senior managers/administrators that were in the country, readily made themselves available for meetings with the WCPFC Specialists.

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12 RECOMMENDATIONS

Summary list of issues identified by the study, recommended action and time frame for resolution

Issue	Recommended Action	Responsible	Time Frame
Bigeye / Yellowfin tuna species identification and discrimination from other tuna or tuna-like species (**Sections 8.1 and 9.1**)	Produce a TUNA SPECIES ID sheet that will assist BAS enumerators with their informant interviews on a quarterly basis and during the Frame survey.	WCPFC Specialists	Draft version produced in this report. Review and finalise before December 2009.
	Produce a set of guidelines for BAS enumerators showing the expected species composition and catch volumes of oceanic tuna species, depending on gear type, style of fishing, area of fishing, etc., to be used with their informant interviews on a quarterly basis and during the Frame survey.	WCPFC Specialists	Draft version produced in this report. Review and finalise before December 2009.
	Consider what needs to be done to translate the species identification sheet and guidelines.	BFAR, BAS, WCPFC	1st Quarter 2010
	Provide BFAR and BAS with detailed identification training guides for the positive identification of yellowfin and bigeye tunas in various conditions.	WCPFC Specialists	Three guides have been provided to BAS and BFAR that cover yellowfin and bigeye in fresh, frozen and damaged condition.
	BAS, with technical support from BFAR, will conduct training course for their enumerators in how to refer and use the species identification and tuna catch guidelines resource material produced by the WCPFC specialists	BAS and BFAR	1st Quarter 2010
	BAS and BFAR obtain an indication of the broad area fished by those vessels landing catch outside of Puerto Princesa City and cross-check with basic information on the ocean depths to determine whether oceanic tuna would be expected in the catch	BAS and BFAR	To be conducted as a part of the BAS Frame survey of Palawan landing centers Completed by 4th quarter 2010
Coverage of BAS and BFAR data (**Section 8.2**)	Appropriate application of available funds (e.g. Philippine government, WPEA OFM, etc.) to achieve most efficient data collection possible	WCPFC, BFAR, BAS	WPEA OFM – annual work plan reviews Ongoing
Expansion of BAS survey data to produce estimates (**Sections 8.3 and 9.2**)	Update the BAS Frame survey data collection to include (i) total skipjack, yellowfin and bigeye tuna catch in peak and lean season for each landing center, and (ii) the total catch of "large tuna" (yellowfin and bigeye tuna) in peak and lean seasons	BAS	January 2010
	Determine the work required to conduct a pilot Frame survey of Palawan as soon as possible, and incorporate this work into the WPEA OFM work plan for 2010.	BAS and BFAR	January 2010
	Conduct the pilot Frame survey in Palawan	BAS	1st half of 2010 ??
	Use data collected from pilot Frame Survey in Palawan to produce revised estimates of oceanic tuna species for Palawan. This process will undertake the "expansion" of the sampled landing centers catch according to TUNA CATCH from all landing centres (according to FRAME) and not by proportion of NUMBER of landing centers sampled to total landing	BAS	Late 2010 ??

Issue	Recommended Action	Responsible	Time Frame
	centers.		
Availability of other sources of data for the BAS validation process (**Sections 8.4 and 9.3**)	BAS and BFAR to investigate the possibility of obtaining catch data from Citra Mina and export data for tuna from the relevant authorities to use in the validation process.	BAS and BFAR	1st and 2nd quarter 2010
Annual catch estimates by gear (**Section 9.3**)	Continue to improve the annual catch estimates of tuna for the Philippines domestic fisheries by GEAR and SPECIES for provision to the WCPFC.	WCPFC, BAS, BFAR, PFDA, industry and other stakeholders	Annual catch estimates review meeting in Manila April/May 2010
Review progress of recommendations	Review progress on the recommendations from this study.	WCPFC, BAS, BFAR, PFDA, industry and other stakeholders	Annual catch estimates review meeting in Manila April/May 2010

13 TABLES

Table 1. List of fish landing centers monitored by BFAR and BAS in Palawan, 2006-2008

Landing Center	Gears	Major Tuna site[13] ?	Monitoring
Jacana (Bancao-bancao)	Handline	Yes Large YFT target	BAS focus, BFAR NSAP
Matahmik/PPC Fish Port/Seaside	Handline/Hook-and-Line	Yes Two styles of handline (large-YFT target and small-fish target)	BFAR NSAP, BAS focus
Bagong Silang	Handline/Hook-and-Line	Yes Several styles of handline (large-YFT target and small-fish tuna and non-tuna target)	BFAR NSAP
Tagburos	Bottom gillnet, Bottom set long line, Encircling gillnet, Fish corral, Gillnet, Handline/Hook-and-Line, Long line, Spear gun, Surface gillnet	No Major catch of SKIPJACK from troll with some minor catches of YFT. Gillnet takes very small catches of YFT.	BFAR NSAP, BAS focus
Anilawan	Beach seine, Bottom gillnet, Bottom set long line, Fish corral, Gillnet, Handline/Hook-and-Line, Jigger, Spear gun, Surface gillnet, Troll line	No Very small catches from Surface Gillnet only.	BFAR NSAP
Barimbing	Beach seine, Bottom gillnet, Bottom set long line, Drift gillnet, Gillnet, Handline/Hook-and-Line, Jigger, Ring net, Stationary liftnet, Surface gillnet	No Some catch of Yellowfin from surface gillnet. Very small catches of Skipjack from Surface Gillnet and a Southern Bluefin From Gillnet ?	BFAR NSAP
Human	Bottom gillnet, Crab trap, Drift gillnet, Fish corral, Gillnet, Handline/Hook-and-Line, Pataw-pataw, Push net, Ring net, Spear gun, Stake trap, Stationary liftnet, Trawl	No Very small catches from Gillnet only.	BFAR NSAP
Katumbal	Bamboo Trap, Beach seine, Bottom gillnet, Bottom set long line, Crab trap, Drift gillnet, Fish corral, Gillnet, Handline/Hook-and-Line, Jigger, Man pushnet, Pataw-pataw, Push net, Ring net, Stationary liftnet, Surface gillnet	No tuna at all !	BFAR NSAP
Sta. Lourdes / Magarwat	Large YFT catch from Handline/Hook-and-Line since 2008 ? Before then, Beach seine, Bottom gillnet, Bottom set long line, Crab Lift Net, Crab trap, Drift gillnet, Encircling gillnet, Fish corral, Fish liftnet, Gillnet, Hibas-hibas, Liftnet, Ring net, Spear gun, Stake trap, Stationary liftnet, Surface gillnet, Trawl	Yes Since 2008, when the Citra Mina plant opened nearby, this has become a major tuna landing center for the large-YFT handline fleet fishing from March-October. Prior to 2008, the Handline gear took species other than tuna (a different style of fishing – troll/multiple handline by smaller craft). Minor catches from Gillnets and Ringnet.	BFAR NSAP, BAS

[13] According to data collected under the BFAR NSAP project

Landing Center	Gears	Major Tuna site[13] ?	Monitoring
Uliran, Panacan, Narra	Bagnet, Multiple handline, etc.	No Handline vessels catching large YFT come from this town, but are based in Sta. Lourdes during the fishing season	BAS non-probability
Abo-abo, Sofronio, Espanola	??	??	BAS non-probability
Pulot Shore, Sofronio, Espanola	??	??	BAS non-probability
Alimanguan, San Vicente	??	??	BAS non-probability
Silangan, Tigman, Aborlan	??	??	BAS non-probability
Pancol, Taytay	??	??	BAS non-probability
New Agutaya, San Vicente	??	??	BAS non-probability
Pier, Liwanag	??	??	BAS non-probability
Panindigan, San Vicente	??	??	BAS non-probability
Poblacion, Taytay	??	??	BAS non-probability
Barangay 1, Roxas	??	??	BAS non-probability

Table 2. Commercial fisheries catch estimates for 2007 for Region 4B (Source : BAS IPDCP Terminal Report 2007, May 2008)

	Jacana - Bancao Bancao Hook-and-line Unloadings				Palawan (all gears)				Region 4B (all gears)			
QTR	YFT	%	BET	%	YFT	%	BET	%	YFT	%	BET	%
1	38	100%	0	0%	145	64%	80	36%	346	79%	91	21%
2	81	100%	0	0%	1,700	86%	275	14%	1,916	87%	279	13%
3	48	97%	1	3%	1,600	85%	290	15%	1,731	84%	334	16%
4	6	100%	0	0%	1,000	86%	168	14%	1,082	78%	306	22%
	174	99%	2	1%	4,445	85%	813	15%	5,076	83%	1,011	17%

Notes

1. Hook and line at Jacana represent the only data collected in Palawan (monthky volume of unloading)

Table 3. Municipal fisheries catch estimates for 2007 for Region 4B (Source : BAS IPDCP Terminal Report 2007, May 2008)

	Tagburos, Aplaya				Palawan				Region 4B			
QTR	YFT	%	BET	%	YFT	%	BET	%	YFT	%	BET	%
1	3	100%	0	0%	1,200	43%	1,600	57%	1,547	47%	1,755	53%
2	0	100%	0	0%	7,100	88%	990	12%	7,406	86%	1,228	14%
3	0	100%	0	0%	3,600	94%	230	6%	3,950	93%	284	7%
4	0	100%	0	0%	986	58%	700	42%	1,154	59%	816	41%
	4	100%	0	0%	12,886	79%	3,520	21%	14,057	77%	4,082	23%

Notes

1. Hook and line at Tagburos represent the only data collected in Palawan (monthly volume of unloading)

Table 4. Philippines domestic yellowfin and bigeye annual tuna catch estimates, 2004-2007 (Source : BAS)

	Palawan				Philippines - Region 4B				Philippines			
YEAR	YFT	% of PH	BET	% of PH	YFT	% of PH	BET	% of PH	YFT	% of WCP-CA	BET	% of WCP-CA
2004	13,439	12%	*2,500*	13%	15,746	14%	2,800	14%	110,848	29%	*20,000*	13%
2005	14,786	13%	2,537	12%	16,521	14%	2,537	12%	114,027	26%	21,686	15%
2006	19,409	17%	4,230	14%	21,150	19%	4,230	14%	113,397	26%	29,471	20%
2007	17,331	13%	4,333	13%	19,132	14%	5,093	15%	134,492	30%	34,216	24%

Table 5. Volume of estimated tuna unloadings (kgs) by species from municipal landing centers, sourced from data collected through the BAS non-probability survey, 2006-2008. Relatively high bigeye tuna catches/species composition have been highlighted.

		Expanded Volume of catch by landing center					
		BIGEYE		YELLOWFIN		SKIPJACK	
Landing Center	Year	KG	%	KG	%	KG	%
Uliran, Panacan, Narra	2006	59,590	36.1%	105,350	63.9%	0	0.0%
	2007	47,650	30.7%	107,398	69.3%	0	0.0%
	2008	146,716	53.8%	107,149	39.3%	18,833	6.9%
Silangan, Tigman, Aborlan	2006	0	0.0%	98,342	100.0%	0	0.0%
	2007	2,240	2.6%	82,768	97.4%	0	0.0%
	2008	12,667	19.1%	53,759	80.9%	0	0.0%
Sta. Lourdes, PPC	2006	0	0.0%	53,273	100.0%	0	0.0%
	2007	2,150	4.6%	24,667	52.7%	20,000	42.7%
	2008	16,034	8.6%	104,318	55.9%	66,133	35.5%
Aplaya, Tagburos, PPC	2006						
	2007	0	0.0%	4,430	100.0%	0	0.0%
	2008	4,100	73.4%	750	13.4%	736	13.2%
Pancol, Taytay	2006	0	0.0%	0	0.0%	4400	100.0%
	2007						
	2008	5,681	100.0%	0	0.0%	0	0.0%
Alimanguan, San Vicente	2006	18,125	63.3%	10,529	36.7%	0	0.0%
	2007	17,231	64.6%	9,454	35.4%	0	0.0%
	2008	82,809	68.3%	33,860	27.9%	4,500	3.7%
Barangay 1, Roxas	2006	22,359	44.6%	4,211	8.4%	23,561	47.0%
	2007						
	2008						
Barangay 4, Roxas	2006	3,367	9.3%	70	0.2%	32,896	90.5%
	2007						
	2008						
New Agutaya, San Vicente	2006						
	2007	2,178	76.5%	670	23.5%	0	0.0%
	2008	17,869	78.8%	3,803	16.8%	995	4.4%
Sigpit, Pancol, Taytay	2006	0	0.0%	51,081	48.2%	54,879	51.8%
	2007						
	2008						

Table 6. Species composition of catch landed from handline/hook-and-line vessels at Bagong Silang (Source; BFAR/NFRDI NSAP, 2005-2008)

Monitoring				
START	END	Species	Total estimated catch (MT)	%
2005	2008	Thunnus albacares	148.548	68.2%
2005	2008	Katsuwonus pelamis	47.399	21.8%
2005	2006	Thunnus obesus	6.391	2.9%
2005	2008	Thunnus tonggol	4.880	2.2%
2005	2008	Euthynnus affinis	4.124	1.9%
2005	2006	Xiphias gladius	2.712	1.2%
2005	2008	Auxis thazard thazard	1.274	0.6%
2005	2006	Carcharhinus sp.	1.072	0.5%
2005	2008	Coryphaena hippurus	0.382	0.2%
2005	2008	Thunnus thynnus	0.377	0.2%
2005	2008	Sphyraena barracuda	0.172	0.1%
2006	2006	Caranx ignobilis	0.171	0.1%
2005	2008	Ectodus descampsii	0.106	0.0%
2005	2008	Caranx sexfasciatus	0.076	0.0%
2005	2008	Auxis thazard brachydorax	0.053	0.0%
2005	2008	Auxis rochei rochei	0.028	0.0%
2005	2008	Makaira mazara	0.000	0.0%

Table 7. Species composition of catch landed from handline vessels at Jacana Beach (Bancao Bancao) (Source; BFAR/NFRDI NSAP, 1998-2008, but some years were not covered)

Monitoring				
START	END	Species	Total estimated catch (MT)	%
1998	2008	Thunnus albacares	1370.553	87.1%
1998	2008	Katsuwonus pelamis	61.804	3.9%
1998	2008	Thunnus obesus	29.374	1.9%
2005	2008	Auxis rochei rochei	23.914	1.5%
1998	2008	Euthynnus affinis	20.884	1.3%
1998	2008	Xiphias gladius	14.410	0.9%
1998	2008	Auxis thazard thazard	11.824	0.8%
2005	2008	Coryphaena hippurus	11.032	0.7%
1998	2008	Thunnus alalunga	4.039	0.3%
2005	2008	Sphyraena barracuda	3.404	0.2%
1998	2008	Istiophorus platypterus	3.249	0.2%
2005	2008	Carcharhinus sp.	2.440	0.2%
1998	2008	Makaira mazara	2.271	0.1%
2005	2008	Carcharhinus limbatus	2.241	0.1%
1998	2008	Acanthocybium solandri	1.883	0.1%
2005	2008	Makaira indica	1.565	0.1%
2005	2008	Scomberomorus commerson	1.105	0.1%
2006	2007	Thunnus atlanticus	1.036	0.1%
2005	2008	Caranx ignobilis	1.006	0.1%
1998	2008	Elagatis bipinnulata	0.771	0.0%
1998	2002	CARCHARHINIDAE	0.558	0.0%
1998	2002	CORYPHAENIDAE	0.492	0.0%
2006	2007	Characidae	0.478	0.0%
2005	2008	Caranx sexfasciatus	0.466	0.0%
2005	2005	Alopias pelagicus	0.447	0.0%
2006	2007	Characidium alipioi	0.312	0.0%
2006	2008	Thunnus tonggol	0.305	0.0%
2005	2008	Auxis thazard brachydorax	0.257	0.0%
2005	2008	Aprion virescens	0.199	0.0%
1998	2002	MOBULIDAE	0.177	0.0%
2005	2008	Carcharhinus albimarginatus	0.163	0.0%
2005	2008	Lepidocybium flavobrunneum	0.067	0.0%
1998	2002	SPHYRAENIDAE	0.053	0.0%
2005	2008	Caranx lugubris	0.021	0.0%
1998	2002	SCOMBRIDAE	0.016	0.0%
2005	2008	Gymnosarda unicolor	0.013	0.0%

Table 8. Species composition of catch landed from handline vessels at Matahimi-Pier (Source; BFAR/NFRDI NSAP)

Monitoring				
START	END	Species	Total estimated catch (MT)	%
1997	1999	Thunnus albacares	108.217	53.3%
1997	1999	Katsuwonus pelamis	70.089	34.5%
1997	1999	Auxis thazard thazard	6.839	3.4%
1997	1999	Euthynnus affinis	6.186	3.0%
1997	1999	Thunnus obesus	3.864	1.9%
1997	1999	Auxis rochei rochei	3.190	1.6%
1997	1999	Others	3.104	1.5%
1997	1999	CORYPHAENIDAE	0.752	0.4%
1997	1999	Elagatis bipinnulata	0.587	0.3%
1997	1999	CARCHARHINIDAE	0.141	0.1%
1997	1999	Xiphias gladius	0.123	0.1%
1997	1999	Decapterus macarellus	0.064	0.0%

Table 9. Species composition of catch landed from handline vessels at PPC Fish port – Matahimik (Source; BFAR/NFRDI NSAP)

Monitoring				
START	END	Species	Total estimated catch	%
2001	2001	Thunnus albacares	144.874	95.8%
2001	2001	Thunnus obesus	4.563	3.0%
2001	2001	Katsuwonus pelamis	0.776	0.5%
2001	2001	Xiphias gladius	0.413	0.3%
2001	2001	CARCHARHINIDAE	0.249	0.2%
2001	2001	CORYPHAENIDAE	0.128	0.1%
2001	2001	Acanthocybium solandri	0.095	0.1%
2001	2001	Thunnus alcaranes	0.072	0.0%
2001	2001	SPHYRAENIDAE	0.034	0.0%

Table 10. Species composition of catch landed from handline vessels at Sta. Lourdes (Source; BFAR/NFRDI NSAP)

Monitoring				
START	END	Species	Total estimated catch	%
2008	2008	Thunnus albacares	326.005	52.4%
2008	2008	Thunnus obesus	21.808	3.5%
1998	2002	Nemipterus hexodon	3.272	0.5%
1998	2002	Plectropomus leopardus	2.242	0.4%
1998	2002	Lutjanus argentimaculatus	2.123	0.3%
1998	2002	Lethrinidae	2.105	0.3%
1998	2002	Euthynnus affinis	2.100	0.3%
1998	2002	Aprion virescens	1.889	0.3%
1998	2008	Sphyraena barracuda	1.809	0.3%
1998	2002	Epinephelus areolatus	1.554	0.2%
1998	2002	Nemipterus furcosus	1.416	0.2%
1998	2002	Aphareus rutilans	1.362	0.2%
1998	2008	Caranx sexfasciatus	1.196	0.2%
1998	2002	Caranx lugubris	1.167	0.2%
1998	2002	Plectorhinchus pictus	0.935	0.2%
1998	2002	Cephalopholis miniata	0.930	0.1%
1998	2002	Lethrinus lentjan	0.813	0.1%
1998	2002	Carangidae	0.792	0.1%
2008	2008	Xiphias gladius	0.786	0.1%
1998	2008	Scomberomorus commerson	0.720	0.1%
1998	2002	Carcharhinidae	0.670	0.1%
2008	2008	Carcharhinus limbatus	0.623	0.1%
1998	2002	Lutjanus fulviflammus	0.472	0.1%
1998	2002	Caranx ignobilis	0.468	0.1%
1998	2002	Dasyatis kuhlii	0.467	0.1%
1998	2002	Epinephelus amblycephalus	0.450	0.1%
2008	2008	Acanthocybium solandri	0.382	0.1%
1998	2002	Serranidae	0.369	0.1%
2002	2002	Nemipterus bathybius	0.324	0.1%
2008	2008	Katsuwonus pelamis	0.252	0.0%

Table 11. Species composition of catch landed from Troll and other hook-and-line vessels at Tagburos (Source; BFAR/NFRDI NSAP)

Monitoring				
START	END	Species	Total estimated catch (MT)	%
2000	2008	Katsuwonus pelamis	76.025	57.7%
2005	2008	Euthynnus affinis	19.109	14.5%
2005	2008	Thunnus tonggol	7.114	5.4%
2005	2008	Auxis thazard thazard	6.968	5.3%
2005	2008	Scomberomorus commerson	3.301	2.5%
1997	2008	Caranx sexfasciatus	1.947	1.5%
2000	2008	Caranx ignobilis	1.944	1.5%
2005	2008	Thunnus albacares	1.810	1.4%
1997	2008	Sphyraena barracuda	1.164	0.9%
1997	2001	Lutjanus vitta	1.141	0.9%
2005	2008	Acanthocybium solandri	1.009	0.8%
1997	2001	Lethrinus lentjan	0.743	0.6%
1997	2001	Nemipterus hexodon	0.552	0.4%
2005	2008	Auxis thazard brachydorax	0.527	0.4%
1997	2001	Scolopsis monogramma	0.509	0.4%
1997	2001	Lethrinus microdon	0.501	0.4%
2005	2008	Coryphaena hippurus	0.449	0.3%
1997	2001	Lutjanus quinquelineatus	0.415	0.3%
2005	2008	Auxis rochei rochei	0.415	0.3%
2005	2008	Megalaspis cordyla	0.404	0.3%
2005	2008	Labeo alluaudi	0.319	0.2%
1997	2001	Serranidae	0.288	0.2%
1997	2001	Nemipterus furcosus	0.284	0.2%
1997	2001	Lutjanus lutjanus	0.281	0.2%
1997	2001	Sphyraena obtusata	0.269	0.2%
2005	2008	Caranx sp.	0.252	0.2%
1997	2001	Dasyatis kuhlii	0.247	0.2%
1997	2001	Epinephelus merra	0.223	0.2%
2005	2008	Istiophorus platypterus	0.210	0.2%
1997	2001	Lethrinus miniatus	0.202	0.2%
1997	2001	Lutjanus fulviflammus	0.201	0.2%
1997	2001	Lutjanus decussatus	0.180	0.1%
1997	2008	[Others]	2.797	2.1%

14 FIGURES

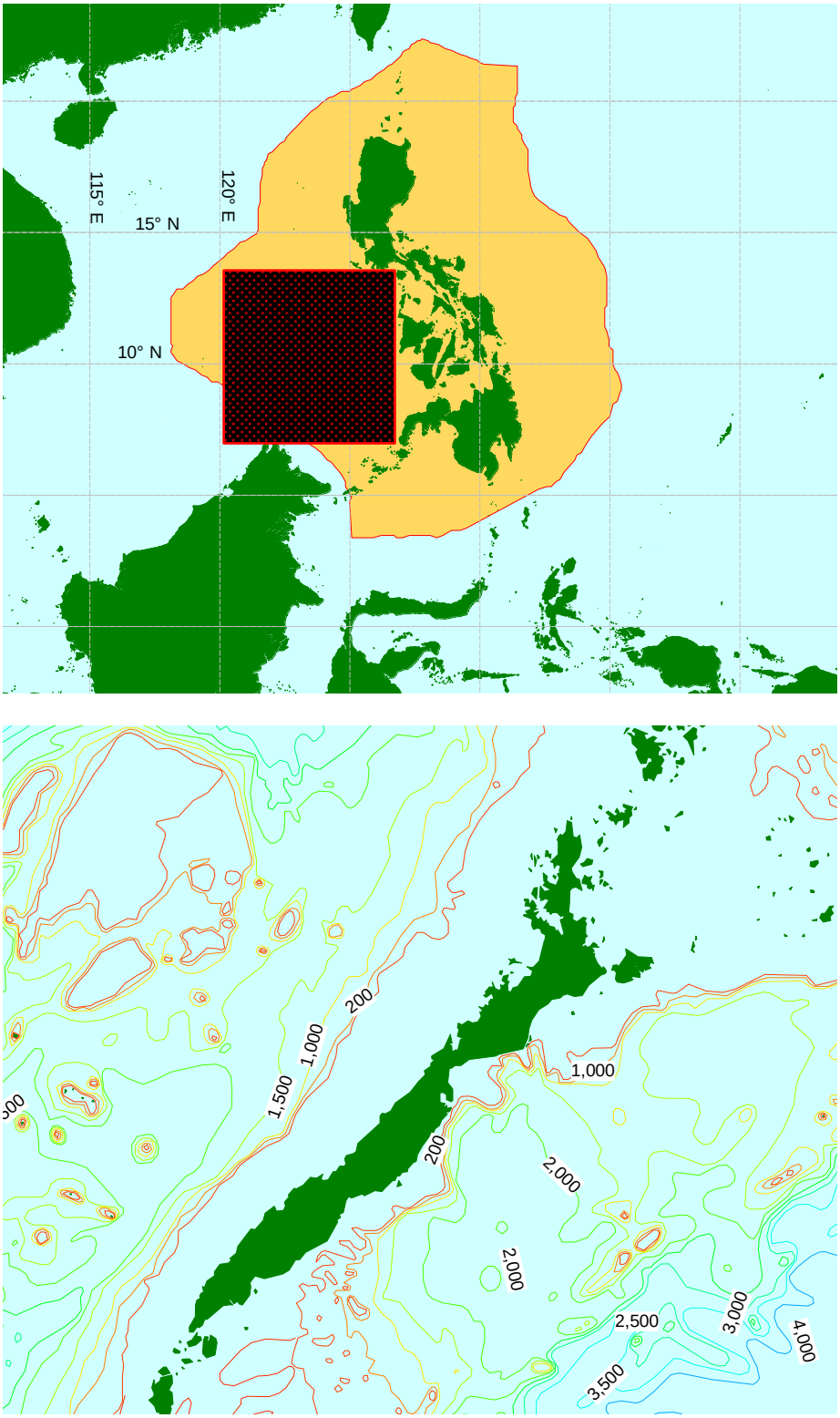

Figure 1. Map of the Republic of the Philippines, highlighting the approximate Exclusive Economic waters and Palawan Island (TOP), and the bathymetry around Palawan (BOTTOM)

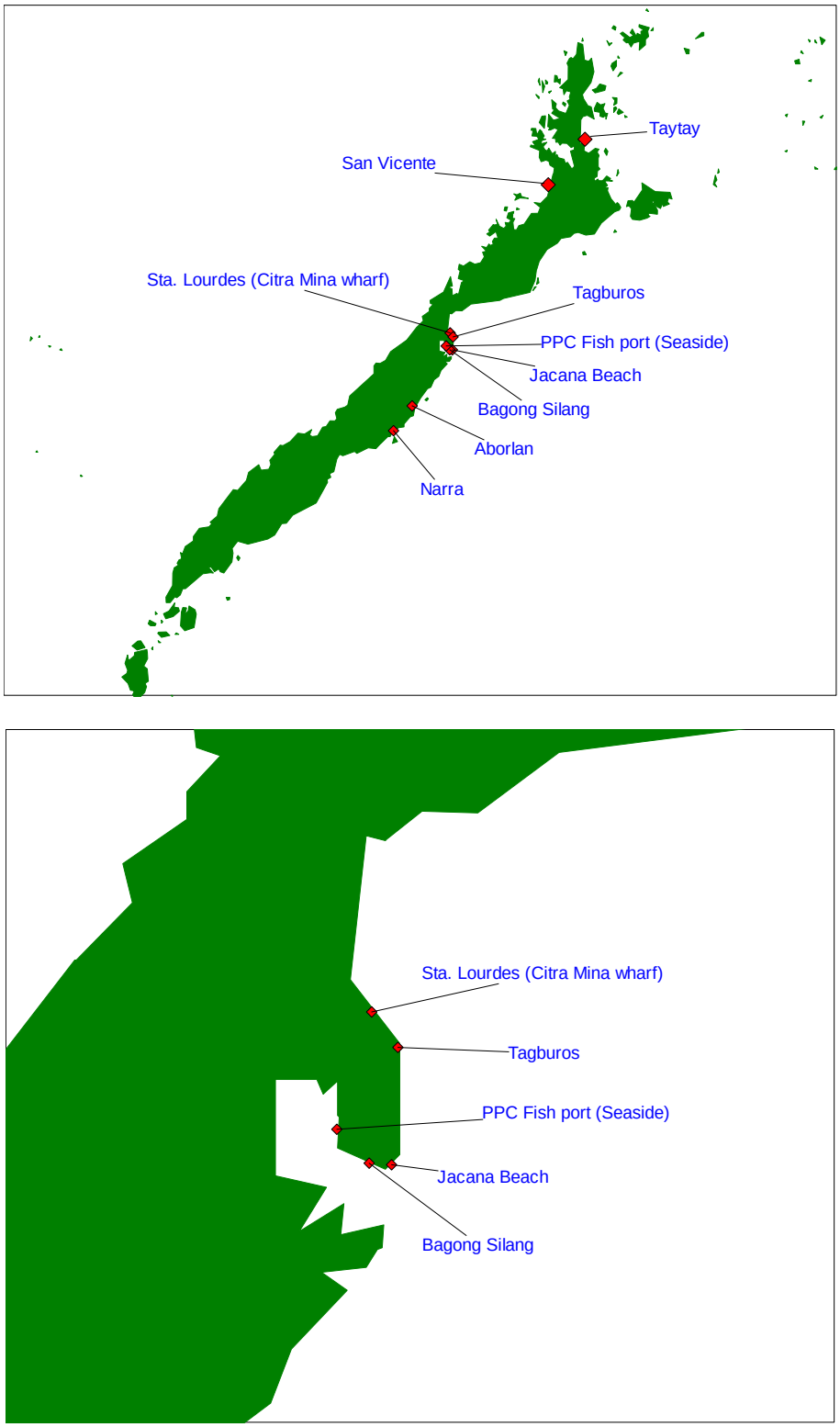

Figure 2. Map of Palawan (TOP) and Puerto Princesa/Honda Bay area (BOTTOM) showing the landing centers visited during this study

Figure 3. Six man banca unloading handline caught yellowfin tuna in Puerto Princesa

Figure 4. Large handline mothership with auxiliary fishing skiffs operating in the eastern Sulu Sea.

Figure 5. Simple handline gear for large tuna rigged with a single circle hook

Figure 6. A typical yellowfin (left panel) and bigeye tuna (right panel) taken by night-time tuna handline gear

Figure 7. Yellowfin tuna (111 cm) from the offshore handline fishery are landed in whole, iced condition

Figure 8. Small yellowfin (top) and bigeye tuna (bottom) of around 35-37 cm commonly caught with multiple hook handline gear on payaos

Figure 9. Small yellowfin (top) and bigeye tuna (bottom) of around 35 cm in fresh condition showing body markings and live coloration

Figure 10. A typical longtail tuna (*Thunnus tonggol*) taken by mixed hook and line fisheries operating in coastal areas

Figure 11. A mix of small fishing vessels at Tagburos, north Puerto Princesa area

Figure 12. Fresh fish landing and sampling station at Tagburos (left) and typical mixed coastal troll catch

Figure 13. Typical medium sized handline tuna banca, at Jacana

Figure 14. Fresh kawakawa (*Euthynnus affinis*) for sale roadside at Jacana

Figure 15. Tuna landing site at Bagong Silang, Puerto Princesa area

Figure 16. Tuna grading onboard tuna banca at the Puerto Princesa Fish Port

Figure 17. NSAP sampling on the wharf at Seaside, Puerto Princesa

Figure 18. Typical one man multi-purpose fishing vessel at Aborlan, SE Palawan

Figure 19. The main wharf at Narra and fishing vessels moored to the south of the wharf

Figure 20. Combination 6 GRT tuna banca and bagnet vessel (left) and typical bagnet haul of herring drying at Narra

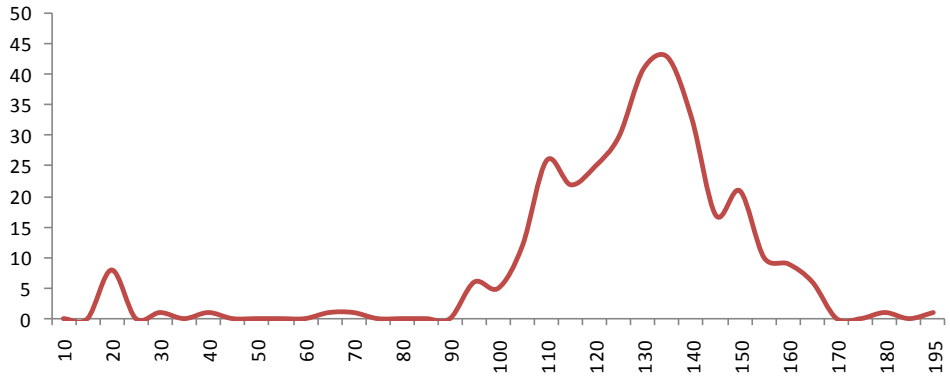

Figure 21. Size composition of yellowfin catch sampled from handline/hook-and-line vessels landing at Bagong Silang (source: NSAP sampling, 2005-2008)

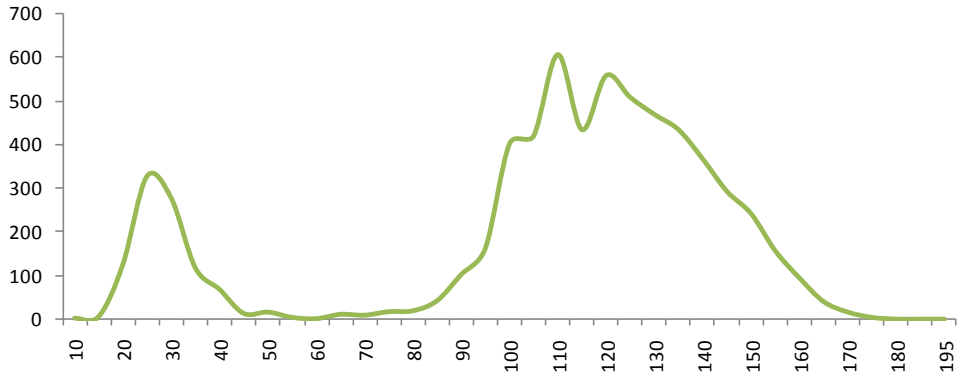

Figure 22. Size composition of yellowfin catch sampled from handline/hook-and-line vessels landing at Jacana (source: NSAP sampling, 1998-2008)

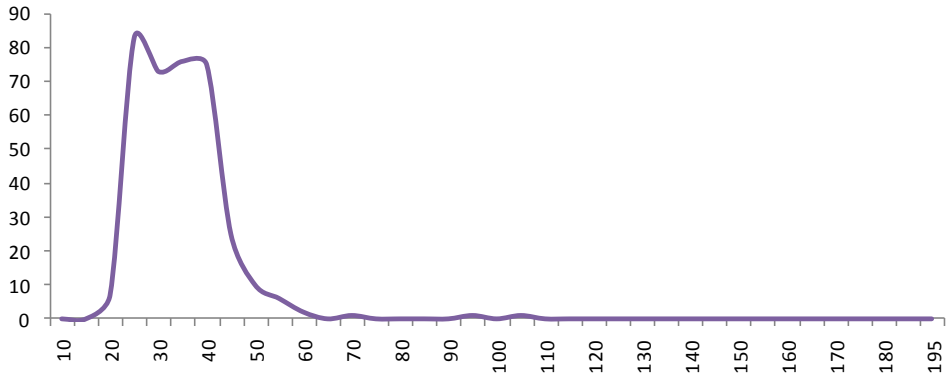

Figure 23. Size composition of yellowfin catch sampled from handline/hook-and-line vessels landing at Matahimik (PPC fish port) **(source: NSAP sampling, 1997-1998)**

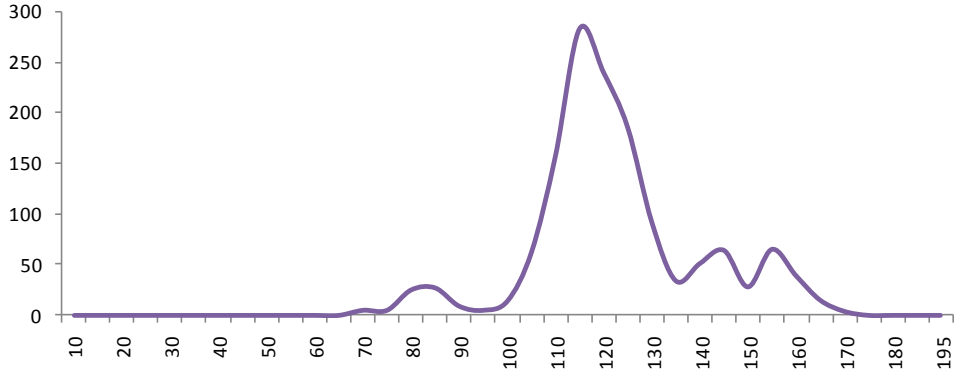

Figure 24. Size composition of yellowfin catch sampled from handline/hook-and-line vessels landing at PPC Fish Port - Matahimik (source: NSAP sampling, 2001)

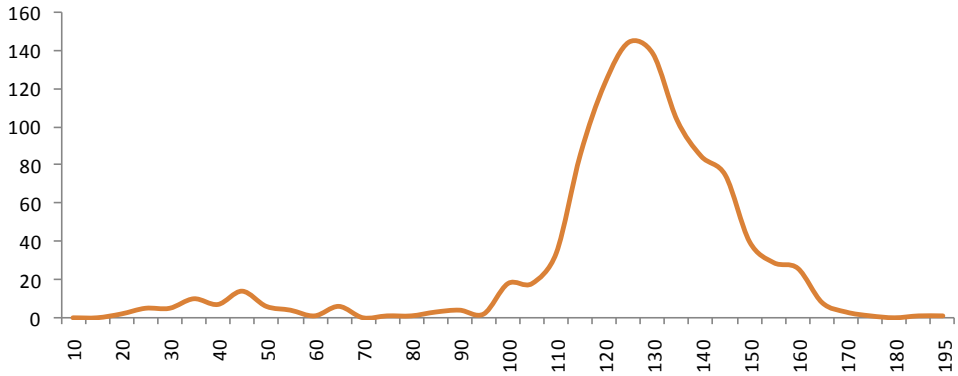

Figure 25. Size composition of yellowfin catch sampled from handline/hook-and-line vessels landing at Sta. Lourdes (source: NSAP sampling, 2008)

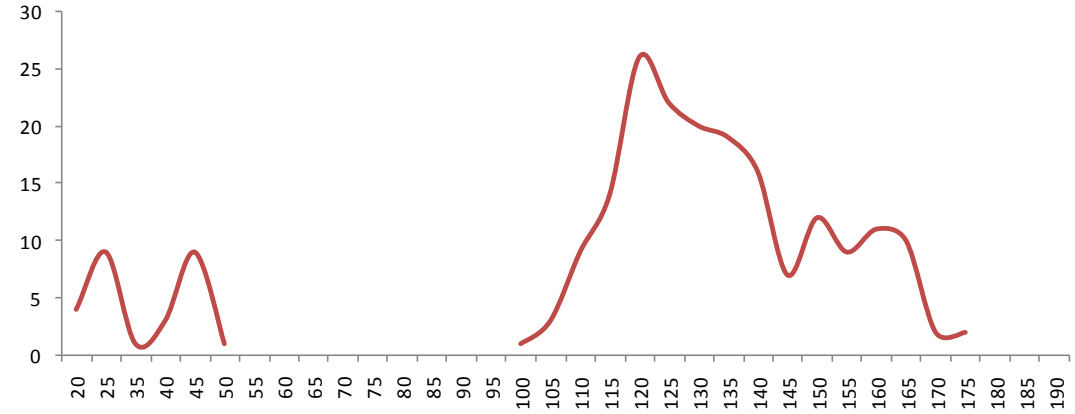

Figure 26. Size composition of bigeye catch sampled from handline/hook-and-line vessels – all landing sites combined (source: NSAP sampling, 1998-2008)

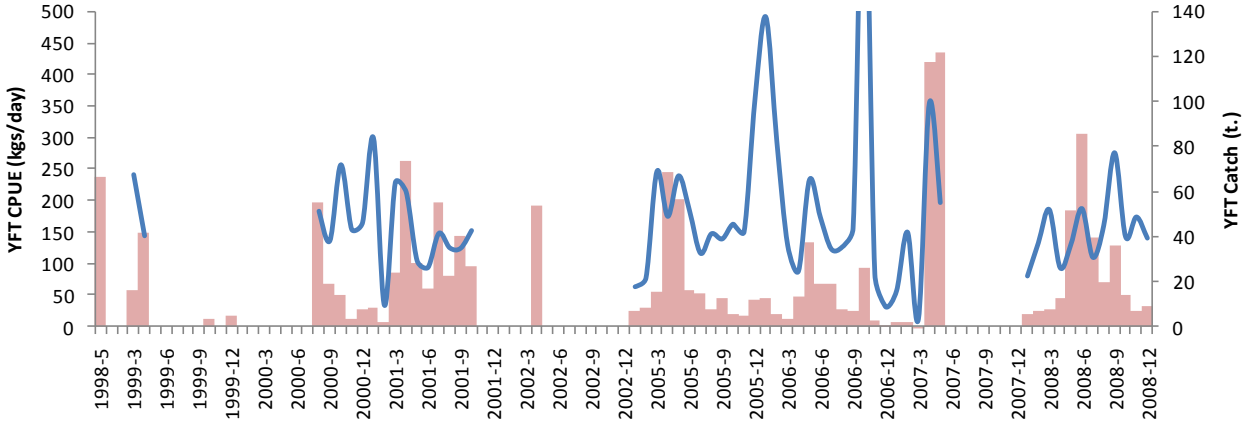

Figure 27. Monthly trends in yellowfin tuna CPUE (kgs/day- blue line) and catch (metric tonnes- histogram plots) from handline vessels landing at Jacana beach (source: NSAP sampling, 1998-2008)

15 CONTACTS

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Eric Odsinada, Statistician I (accompanied us to Narra and Aborlan)
Oscar Gatpandan, Point person, crops

16 ITINERARY

Monday, 26th October 2009	AM	• Meeting with Dr Jose Ingles • BFAR offices – Palawan trip planning meeting, general discussion; report outline; etc.
	PM	• BAS meeting (presentation of trip purpose; review of bigeye and yellowfin estimates with BAS regional staff from Palawan/Region 4B, Zamboanga-Region 9 and ARMM); General discussions • BFAR meeting with assistant Director (Gil Adora)
Tuesday, 27th October 2009	AM	• Flight to Palawan • Planning meeting with BAS and BFAR staff (Palawan)
	PM	• Landing center visit and interviews – BAGONG SILANG • Landing center visit and interviews – JACANA BEACH • Sales office of CITRA MINA
Wednesday, 28th October 2009	AM	• Landing center visit and interviews – JACANA BEACH • Landing center visit and interviews – PPC Fish port (Seaside) • BFAR Office visit • Palawan Agriculture (Fisheries) Provincial office visit
	PM	• [Report writing] • Landing center visit and interviews – TAGBUROS • Landing center visit and interviews – SANTA LOURDES
Thursday, 29th October 2009	AM	• [Travel to NARRA 2.5 hours] • Landing center visit and interviews – NARRA • Visit to Municipal office
	PM	• Landing center visit and interviews – ABORLAN (Springside) • Visit to Municipal office • [Travel back to Puerto Princesa 2.5 hours]
Friday, 30th October 2009	AM	• Flight to Manila
	PM	• Review of material and report writing (BFAR offices)
Saturday, 31st October 2009	AM	• Review of BAS raw data and available BFAR/NSAP data for Palawan; compilation of information
	PM	• Report Writing and preparation for BAS presentation
Sunday, 1st November 2009	AM	• Report Writing and preparation for BAS presentation
	PM	• Report Writing and preparation for BAS presentation
Monday, 2nd November 2009	AM	• Visit to Subic Bay landing center • Review of draft report and BAS Presentation
	PM	• Visit to Navatos landing center • Final review of draft report and BAS Presentation
Tuesday, 3rd November 2009	AM	• Meeting with BAS – presentation of study outcomes and recommendations
	PM	• Meeting and discussions with BFAR; wrap-up.

17 APPENDICES

17.1 APPENDIX 1 Interview questions guide

1. Knowledge/Experience of person interviewed

1.1. Type of work and relationship with fishing
1.2. Experience/knowledge of the fishery,
  1.2.1. What are you familiar with ...
    1.2.1.1. a particular landing site,
    1.2.1.2. fishing gear and techniques
    1.2.1.3. Landed tuna catch
    1.2.1.4. Catch disposal, etc.
1.3. Knowledge of yellowfin vs bigeye (needs to undertake the species identification quiz)

2. Current information on gears and fishing techniques used to catch tunas

2.1. Ask for specific details on fishing techniques/methods **for each gear**
  2.1.1. Gear
  2.1.2. How this gear is used within the trip – describe any seasonal trends
  2.1.3. Specifically, what are the differences between the Handline and hook-and-line vessels catching large yellowfin and those generally catching smaller YFT and SKJ – what are the differences in techniques (since these should be separated in the scientific data)
  2.1.4. Fishing time (night/day/how many days) – describe any seasonal trends
  2.1.5. Bait
  2.1.6. Fishing Area – describe any seasonal trends
  2.1.7. Shallow vs Deep
  2.1.8. FAD vs non-FAD
  2.1.9. Typical target species

3. Catch information

3.1. Catch/effort information for the gears used
  3.1.1. Crew/Manpower per vessel – are there fluctuations, or is this typical... number of crew, number of lines
  3.1.2. Catch per trip (capturing seasonality)
  3.1.3. Fishing days per trip
  3.1.4. Trips per month (taking into account seasonality)
  3.1.5. Average Catch per trip (also reference to BAS and NSAP data – captures seasonality)
  3.1.6. [Average Catch per fishing day (can be calculated above, but ask anyway)
  3.1.7. Typical species composition.

4. Historical perspective

[Ask similar questions as in 2. And 3. above, but from a historical perspective – perhaps the questions can be asked at the same time as getting information on the current situation...]

4.1. Specific questions related to historical changes for each gear ...
  4.1.1. Changes in fishing techniques by gear over time ?
  4.1.2. Particularly good or bad years ?
  4.1.3. Changes in catch levels through time (what do they think caused this ?)
  4.1.4. Changes in fishing activity through time (what do they think caused this ?)

5. Catch disposal

5.1. What are the markets for the catch ?
  5.1.1. Include information on grading...

17.2 APPENDIX 2 Common tuna species identification sheet for BAS enumerators and informants

Tuna caught by Hook and Line Gear

Yellowfin Tuna – Handline or troll, deep water, often on payaos but not always

Bigeye Tuna – Handline or troll, deep water, almost always on a payao or drifting log

Longtail Tuna – Troll, shallow water, not usually caught on payaos

Skipjack Tuna – Troll or handline, medium to deep water, can be on or off payaos

Mackerel Tuna – Troll, shallow to medium water, usually not on payaos

Bullet Tuna – Troll or handline, shallow to medium water, usually not on payaos

Note: all of the tuna types here are also caught by ringnet and purse seine boats on payaos

V1 Nov 2009

17.3 APPENDIX 3 Guidelines for evaluating the tuna species catch (draft)

1. Review the informants responses to the non-probability survey
    a. Check the proportions of YELLOWFIN, BIGEYE and SKIPJACK tuna catch
    b. Usually, there should not be more BIGEYE than YELLOWFIN
    c. If there are SKIPKACK and/or YELLOWFIN catch, but no BIGEYE catch, you may need to confirm with the informant if any BIGEYE was encountered (for some gears, it is very likely that no BIGEYE were caught, but it is important to verify in any case)

2. Based on your review of the informants responses, you can ask the following questions
    a. What GEAR TYPE(s) are used to catch the YELLOWFIN, BIGEYE and SKIPJACK ?
    b. What was the fishing area for the catch the YELLOWFIN, BIGEYE and SKIPJACK for each GEAR TYPE ?
    c. Are payaos fished? How deep are they anchored and how far from the coast are the payaos?
    d. Are any oceanic tuna species the target for that GEAR ?
    e. Were adult and/or juvenile tuna taken ?
    f. Can you differentiate the tuna species ? - oceanic from neritic ? each tuna species ? adult and juvenile ? (use the tuna quiz and other educational resource material)

Based on the informants' responses to these questions and the guide below, you should discuss the estimates with the informant and revise his estimates to more accurately reflect the catch breakdown of tuna, if necessary. Note that it is equally important to ensure that any bigeye catch is accurately recorded if it occurred than over-estimating the bigeye catch.

Guide for responses

- HANDLINE (single hook) and fishing in shallow waters (< 200 m depth to bottom of ocean)
    - This type of fishing is not expected to occur
- HANDLINE (single hook) and fishing in deep waters (> 200 m), typically in the vicinity of payaos
    - Large yellowfin should be the dominant part of the catch (>90% typically) with some bigeye catch (1-5%) but very rare skipjack catch (not targeted)
- TROLL gear and fishing in shallow waters (< 200 m)
    - Very few oceanic tunas should be encountered at all. Perhaps some skipjack and very rare catches of yellowfin. The catch would be dominated by neritic species.
- TROLL gear and fishing in deeper waters (> 200 m)
    - Expect skipjack and/or yellowfin to be the highest catch of tuna, and very rare or no bigeye catch at all.
- MULTIPLE HOOK-AND-LINE and fishing in shallow waters (< 200m) or bottom-fishing
    - Unlikely to have a large oceanic tuna species catch (skipjack and some yellowfin, if at all). The catch would be dominated by neritic species, or dermesal species, if bottom-fishing.
- MULTIPLE HOOK-AND-LINE and fishing in deep waters (> 200m)
    - Expected to have catch of yellowfin, skipjack and bigeye tuna, but yellowfin catch is expected to be greater than bigeye catch.
    - This type of gear is used by the larger vessels that have trips of more than one day. This gear is often used in the off-season by the handline vessels that target large YFT.
- ENCIRCLING NETS and fishing in shallow waters (< 200 m)
    - Very few oceanic tunas should be encountered at all. Perhaps some skipjack and minor catch of yellowfin. The catch would be dominated by neritic species.
- ENCIRCLING NETS and fishing in deeper waters (> 200 m)
    - Payaos fished or NOT fished ?

- Small bigeye only expected to be caught on deep-water payaos
- Small pelagics may dominate the catch if they are the target. Otherwise, for large seiners and ringnet vessels targeting the oceanic tunas, Skipjack will typically be the highest catch of the oceanic species (> 60%), followed by yellowfin (~30%) and then bigeye (< 10%).

17.4 APPENDIX 4 Suggested enhancement of the BAS Frame data collection

Republic of the Philippines
Department of Agriculture
BUREAU OF AGRICULTURAL STATISTICS

LISTING/UPDATING OF MUNICIPAL FISH LANDING CENTERS

Region	MIMAROPA
Province	PALAWAN

					PEAK SEASON				LEAN SEASON			
NO.	MUNICIPALITY	SITIO	BARANGAY	NAME OF LANDING CENTER	NO. OF BOATS UNLOADING/DAY	VOLUME OF ALL FISH UNLOADED/DAY	VOLUME OF TUNA (SKJ+YFT+BET) UNLOADED/DAY	VOLUME OF LARGE TUNA (YFT+BET) UNLOADED/DAY	NO. OF BOATS UNLOADING/DAY	VOLUME OF ALL FISH UNLOADED/DAY	VOLUME OF TUNA (SKJ+YFT+BET) UNLOADED/DAY	VOLUME OF TUNA (SKJ+YFT+BET) UNLOADED/DAY
1	Puerto Princessa City	Panaguman	Marufinas	Panaguman	2	6	0	0	2	3	0	0
2	Puerto Princessa City	Tulayan	Marufinas	Tulayan	2	6	0	0	2	4	0	0
3	Puerto Princessa City	Sabang	Cabayugan	Sabang Aplaya	6	48	0	0	3	13	0	0
4	Puerto Princessa City	Centro	New Pangganan	New Pangganan	5	46	0	0	3	10	0	0
5	Puerto Princessa City	Purok Mangingiso	Langogan	Mangingisida	30	1,500	1,000	950	30	700	200	0
6	Puerto Princessa City	Centro	Binduyan	Centro	20	150	0	0	10	50	0	0
7	Puerto Princessa City	Talabigan	Binduyan	Talabigan	20	600	0	0	10	5	0	0

"**Large tuna**" : Yellowfin and bigeye tuna > 10 kgs or 80 cm in length