

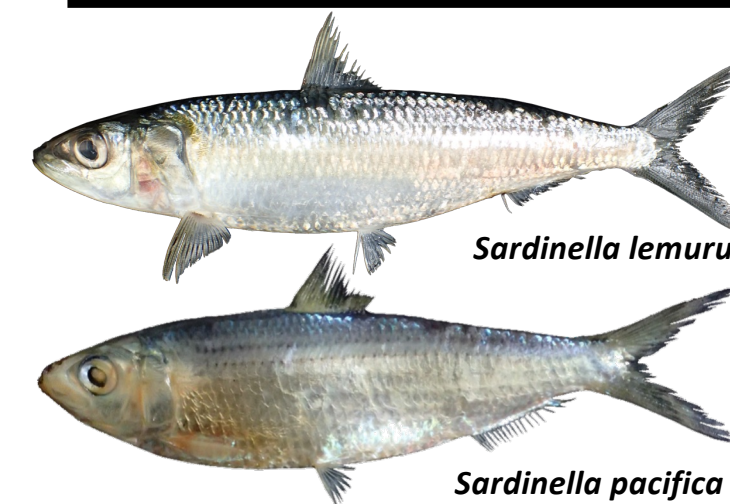
# Monitoring catch and effort and linking fleet movement of sardine fishery in Fisheries Management Area (FMA) 7, Philippines



Kim P. Nuñez<sup>1</sup>, Wilfredo L. Campos<sup>1</sup>, Alexanra Bagarinao-Regalado<sup>1</sup>, Antonio Mendoza<sup>2</sup>, Plutomeo Nieves<sup>2</sup> and Jesus T. Racuyal<sup>3</sup>

<sup>1</sup>OceanBio Lab, Division of Biological Sciences, College of Arts and Sciences, UP Visayas, Miag-ao, Iloilo <sup>2</sup>Bicol University Tabaco Campus, Tabaco City, Albay <sup>3</sup>Samar State University, Catbalogan City, Samar  
corresponding author's email: kpnunez@up.edu.ph

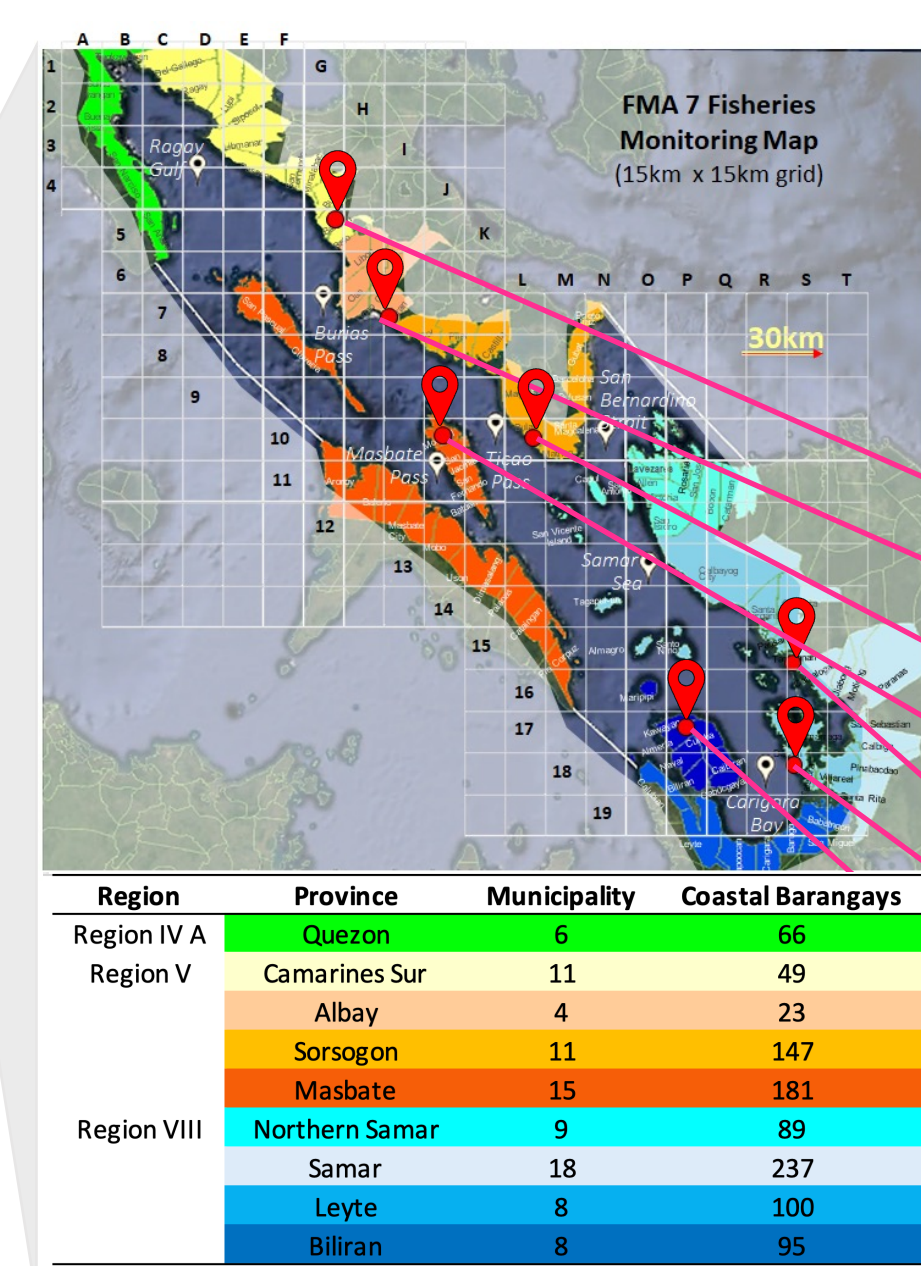
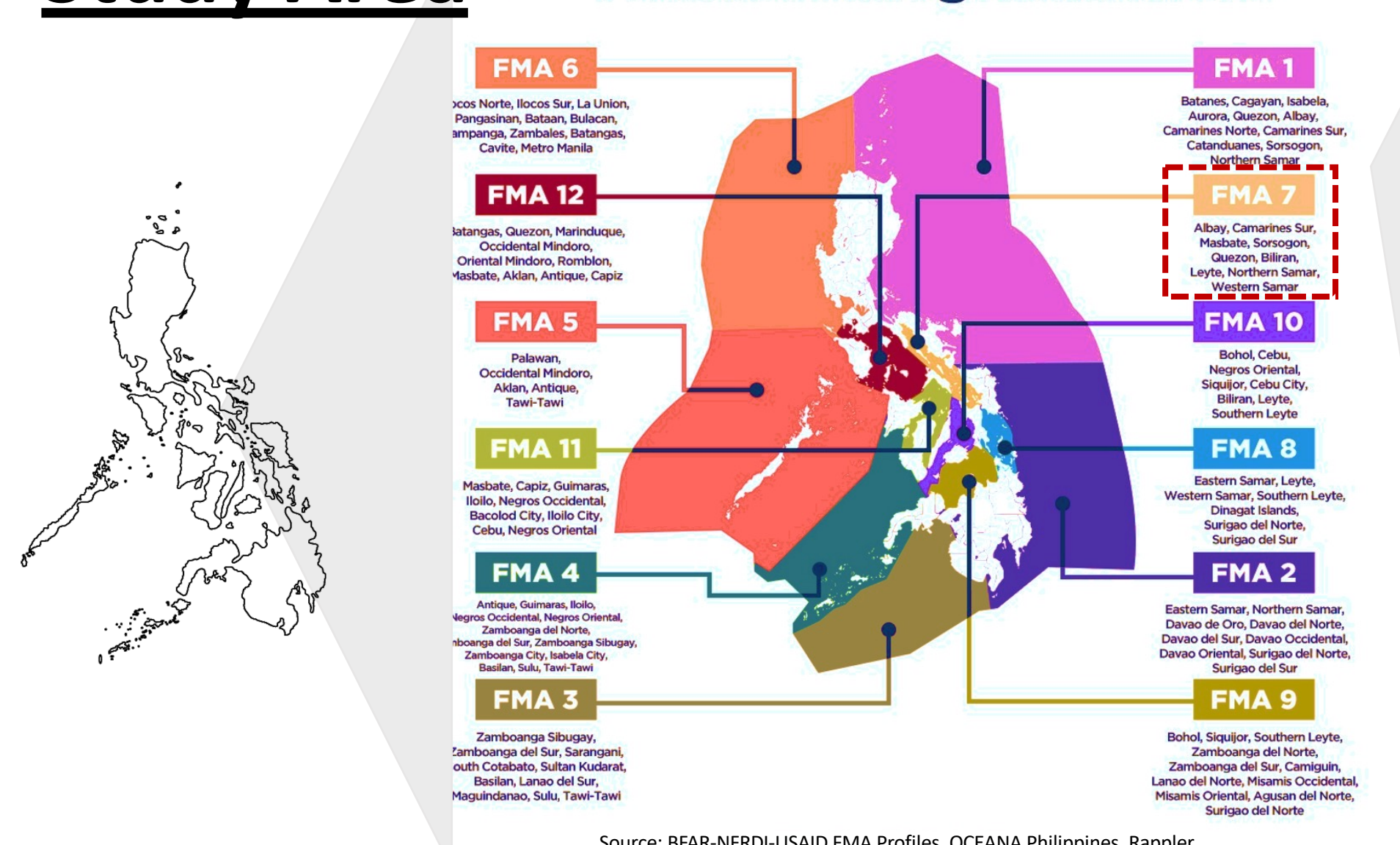
## Introduction



Small pelagic fisheries make up over half of total marine capture fisheries production of the country. Sardines comprise a major fishery resource in the Philippines, making up 1 of every 6 kg of marine catches. The inner interisland waters of east central Philippines (FMA 7) is the second most productive sardine fishing ground where *Sardinella lemuru* dominates the catches. Reports of decreasing catches in the past decade make management of the fisheries urgent but estimates of annual catch are still lacking. This study was conducted from February 2020 to April 2021 to provide such an estimate and to characterize the distribution of the stock.

## Study Area

### Fisheries Management Areas

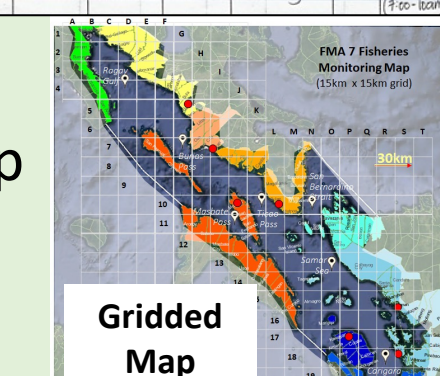
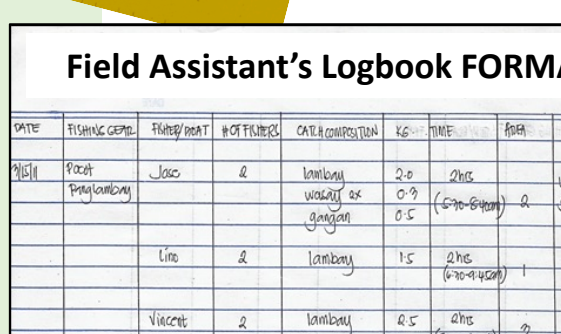


## Methods

- ✓ **7 monitoring sites** (based on initial fisheries profiling)
  - Each site: **1 trained field assistant**
    - Monitored 10 tagged fisher/ fisher groups
    - Records daily catches:

Sites	Province	Fishing Gears
Balatan	Camarines Sur	Drift Gill Net
Pio Duran	Albay	Drift Gill Net
Bulan	Sorsogon	Drift Gill Net
Monreal	Masbate	Drift Gill Net
Tarangnan	Samar	Scoop Net (blastF)
Daram	Samar	Ring Net
Kawayan	Biliran	Surface Gill Net

- Date of fishing trip
- Name of fisher/vessel
- Duration of actual fishing operation
- Number of fishers in operation
- Specific location of fishing operation on gridded map (15 km x 15 km)
- Catch (kg) by category/group or individual species
- Recorded non-fishing occasions



## Vessel Tracking

### 1. Solar-powered vessel tracking devices

(Zunibal Vessel Tracer Solar iVMS) for small commercial vessels (> 3GT)

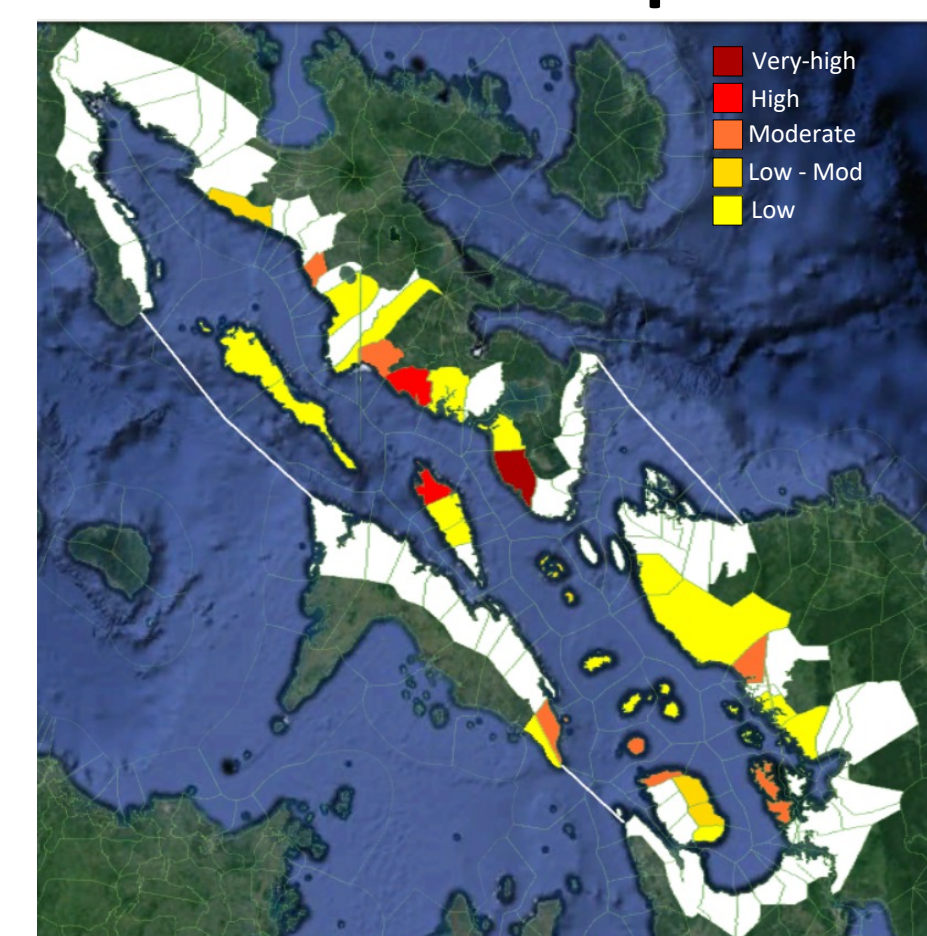


### 2. Battery-powered data loggers for smaller vessels (< 3GT)



## Estimated Annual Catch

### Identified municipalities in FMA 7 with local sardine landings.



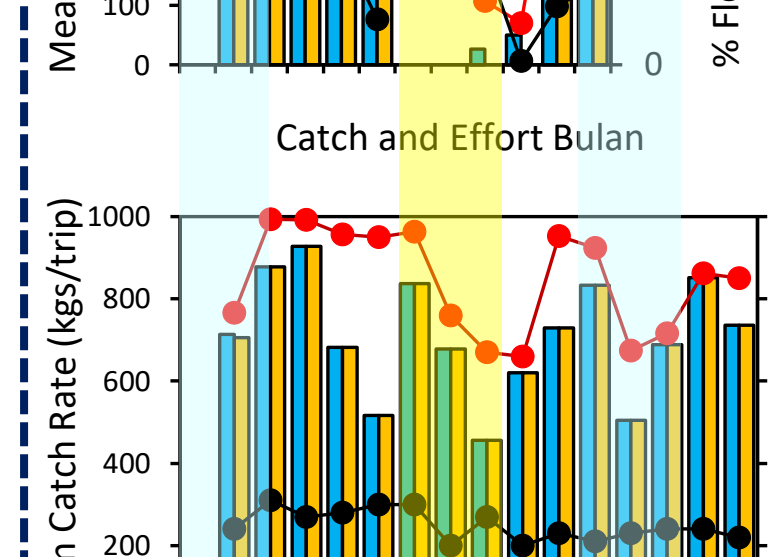
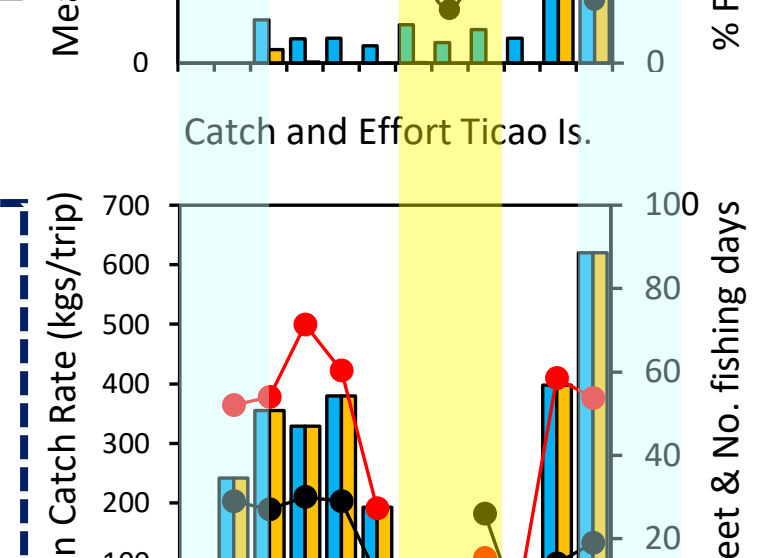
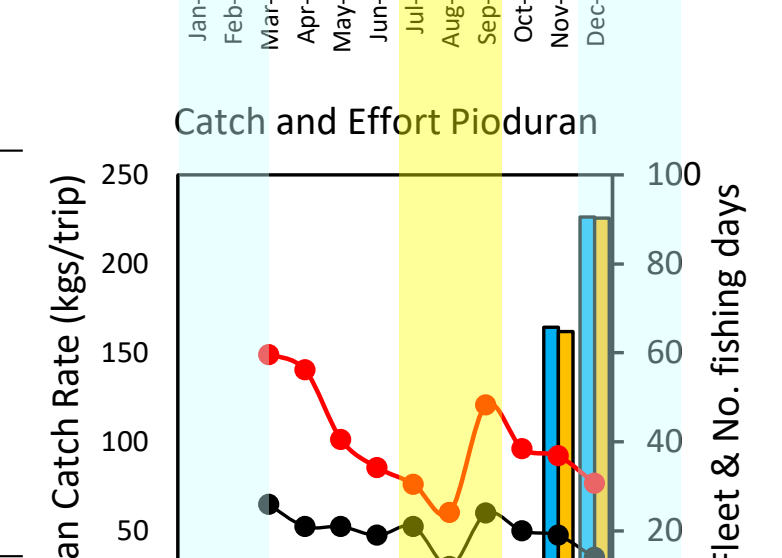
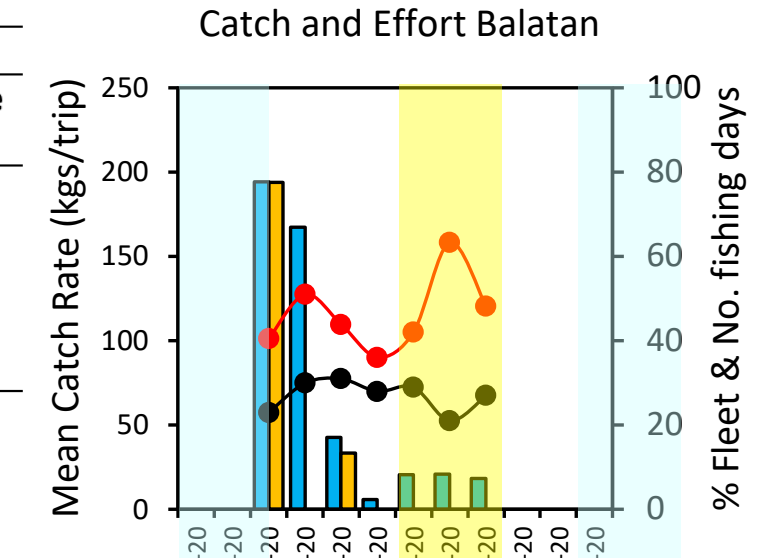
Municipality Monitored	North FMA 7		South FMA 7		
	Ann Prod Category	Est Ann Sardine Prod (mt)	Municipality	Est Ann Sardine Prod (mt)	
Bulan	V High	45,021.4	Daram	Mod	681.4
Balatan	High	608.5	Kawayan	Mod	490.9
Pioduran	Mod	837.6	Tarangnan	Low	100.3
Monreal	High	2,055.0			
<b>Profiled (FGD)</b>					
Donsol	High	2,009.9	San Vicente*	Low-mod	223.2
Magallanes	Low	163.5	Catbalogan City*	Low	176.0
Pio V Corpuz	Mod	413.4	Rama/ Catbalogan*	Low	108.1
Pasacao	Low-mod	250.9	Calbayog*	Low	120.1
Claveria	Low	70.7	San Isidro*	Low	111.6
San Jacinto	Low	114.6			
<b>Approximated from est ann catches</b>					
San Fernando	Low	120.6	Sta Margarita	Mod	606.4
Ligao	Low	120.6	Marapipi	Mod	606.4
Pilar	Low	120.6	Calbiran	Low-mod	237.1
San Pascual	Low	120.6	Culaba	Low-mod	237.1
Esperanza	Low	120.6	Sto Nino	Low	120.6
			Almagro	Low	120.6
			Tagapul-an	Low	120.6
			Cabucuyan	Low	120.6
<b>Sub-total</b>		<b>52,269.6</b>			<b>4,181.0</b>
<b>Total</b>					<b>56,450.6</b>

\*Estimates for these municipalities were based on limited interviews with MAO staff and fishing vessel operators in the final months of the study

Category	n	min	max	mean
Very High	1		45,021.4	
High	2	2,009.9	2,055.0	2,055.0
Moderate	5	413.4	837.6	837.6
Low-moderate	2	223.2	250.9	250.9
Low	8	70.7	176.0	176.0

## Catch and Effort

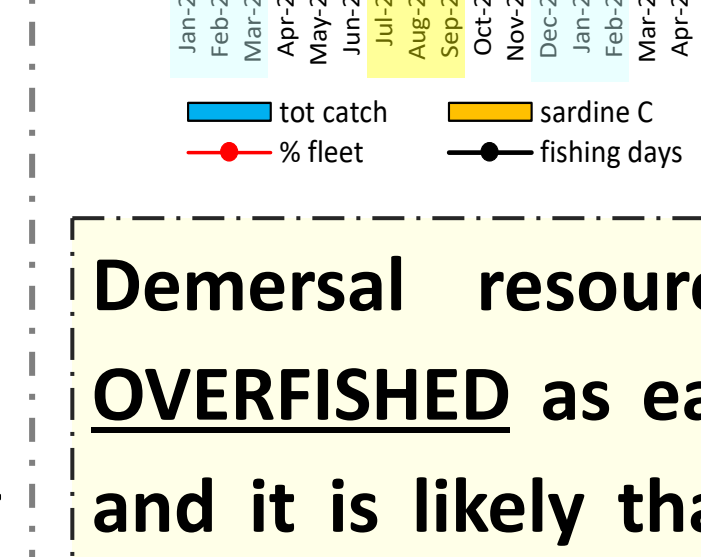
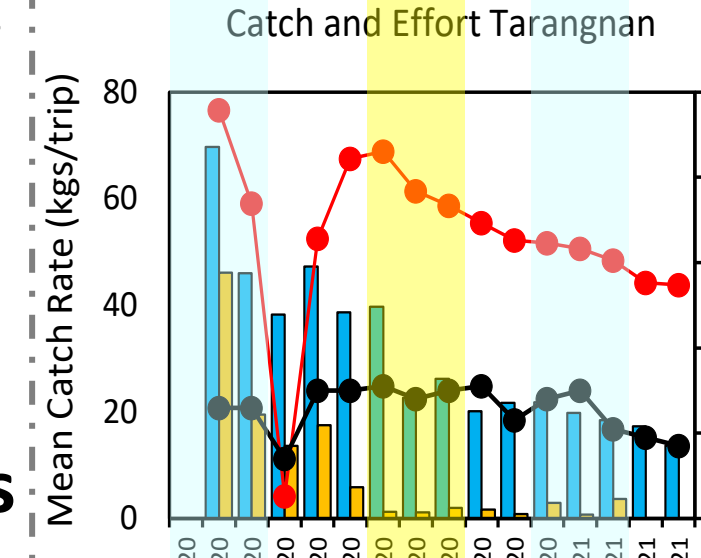
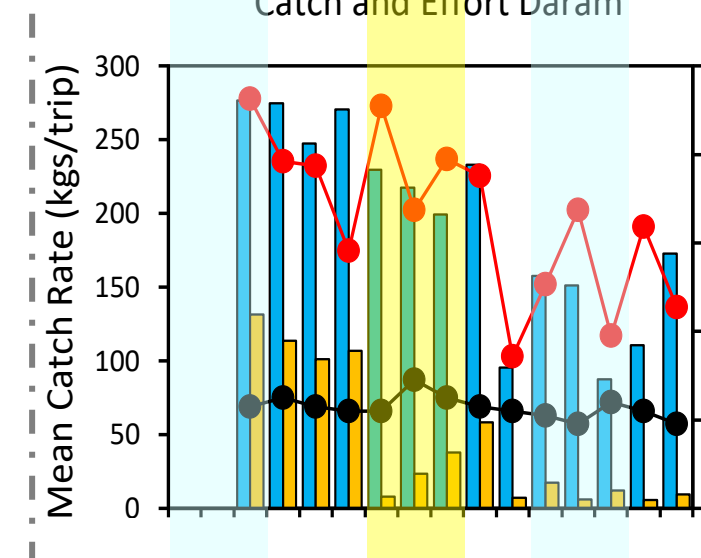
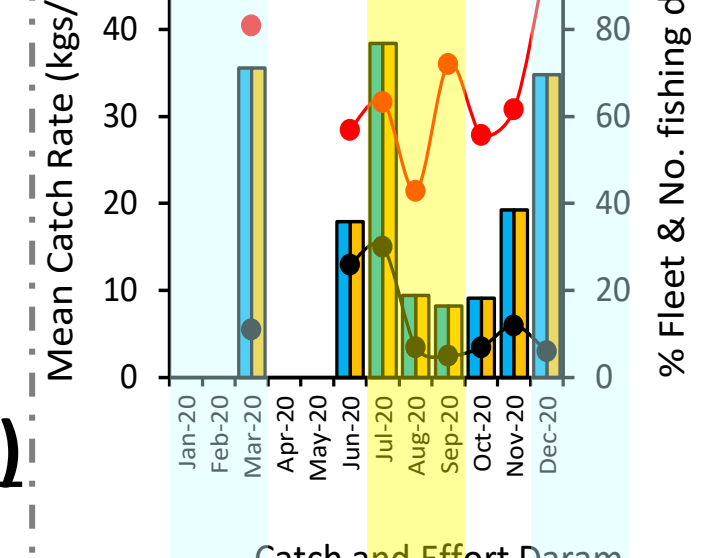
### North FMA 7



- Catch rates for sardines (yellow bars) were lowest during the SW monsoon months (Jun/Jul to Oct) in all sites, **except in Bulan, Sorsogon (moderate to high)**
- Overall, catch rates **increased in Nov/Dec in all sites and remained high from Mar to Apr in both years**
- Fishing effort- low in Pio Duran and Monreal, Ticao Is. (During SW monsoon months)
- Reduction/absence of catches during the SW monsoon due to southwards dispersal of stock
- **Bulan fleet catch rates and fishing effort moderate to high during SW monsoon**
  - fleet of larger vessels
  - capable of fishing further south towards San Vicente and Tagapul-an islands

## South FMA 7

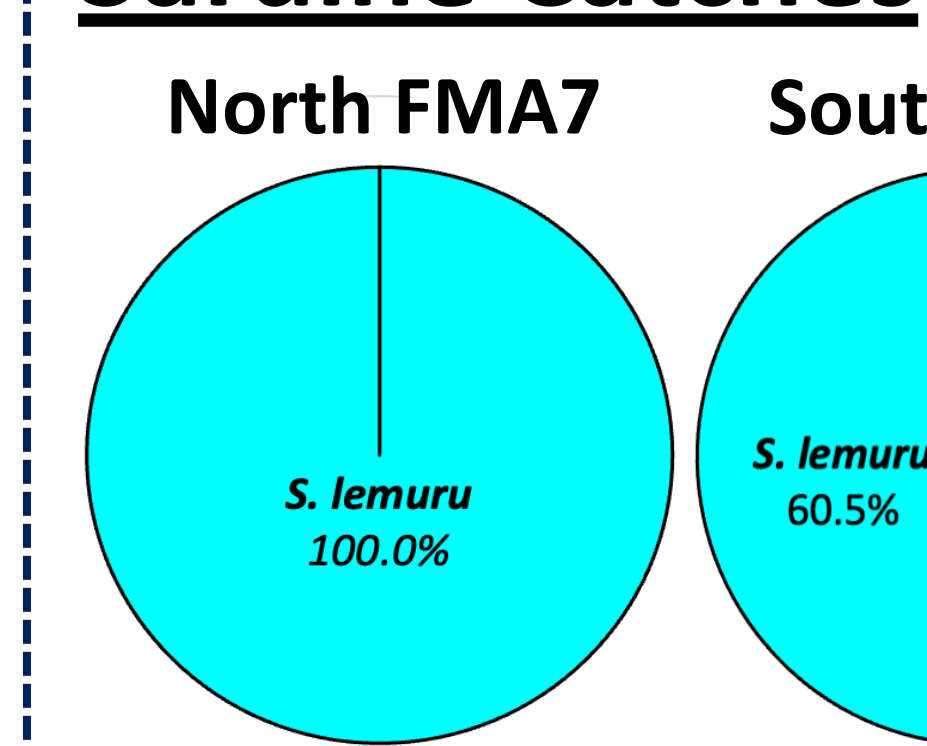
### Catch and Effort Kawayan



- Sardine catch rates **high at tail end of NE monsoon (Feb/Mar) towards the Summer** and **decreased to lower levels in Daram and Tarangnan well within Samar Sea**
- Catch rates in Kawayan (mouth of Samar Sea) high in Mar and Jul and increased in **Nov to Dec 2020**
- Fishing effort decreased from August-October and increase again towards the end of the year.
- Fishing effort in Daram and Tarangnan showed continuous decrease with fleet operations in Feb/Mar at 80-90% decreasing to 50-60% fleet operations a year later (Mar/Apr 2021)
- Decreasing trend reflects **yr-to-yr differences in sardine abundance** rather than true decline in sardine production from the previous year

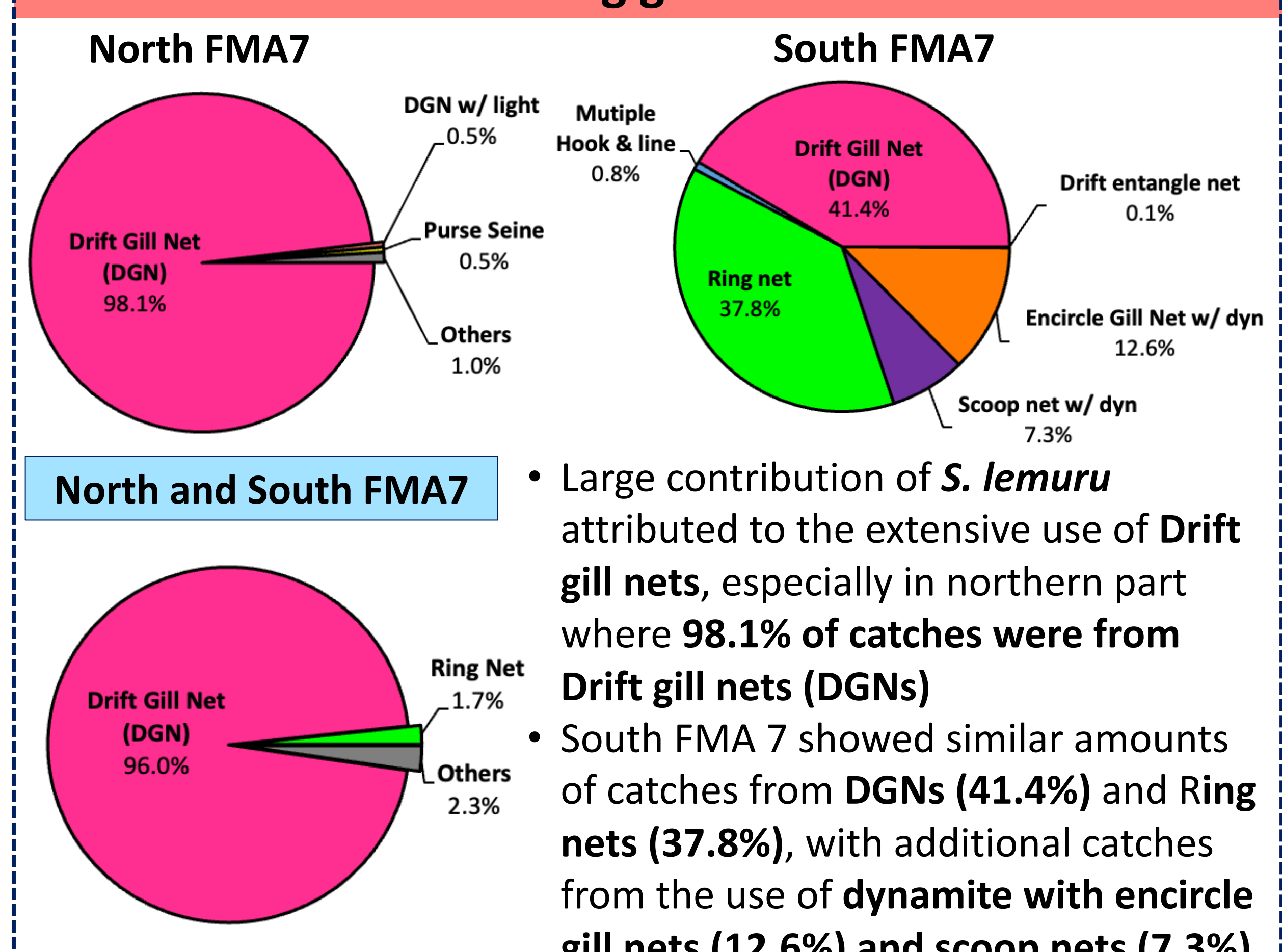
Demersal resources in Samar Sea- documented as **OVERFISHED** as early as the 1980s (Silvestre et al., 1986) and it is likely that the status of small pelagic resources followed the same trend not long after. The observed decrease in catch rates from 2020-21 is likely just a blip in the long-term historical trend.

## Sardine Catches



- North FMA 7: catches were almost 100% *S. lemuru*
- South FMA 7: 60.5% *S. lemuru* and 39.5% *S. pacifica* (previously referred to as *S. fimbriata* but corrected by Hata & Motomura, 2019)
- *S. lemuru* dominated both the northern and southern parts of FMA 7

## Contribution of fishing gears to sardine catches



- Large contribution of *S. lemuru* attributed to the extensive use of **Drift gill nets**, especially in northern part where **98.1% of catches were from Drift gill nets (DGNs)**
- South FMA 7 showed similar amounts of catches from **DGNs (41.4%) and Ring nets (37.8%)**, with additional catches from the use of **dynamite with encircle gill nets (12.6%) and scoop nets (7.3%)**

## Literature cited:

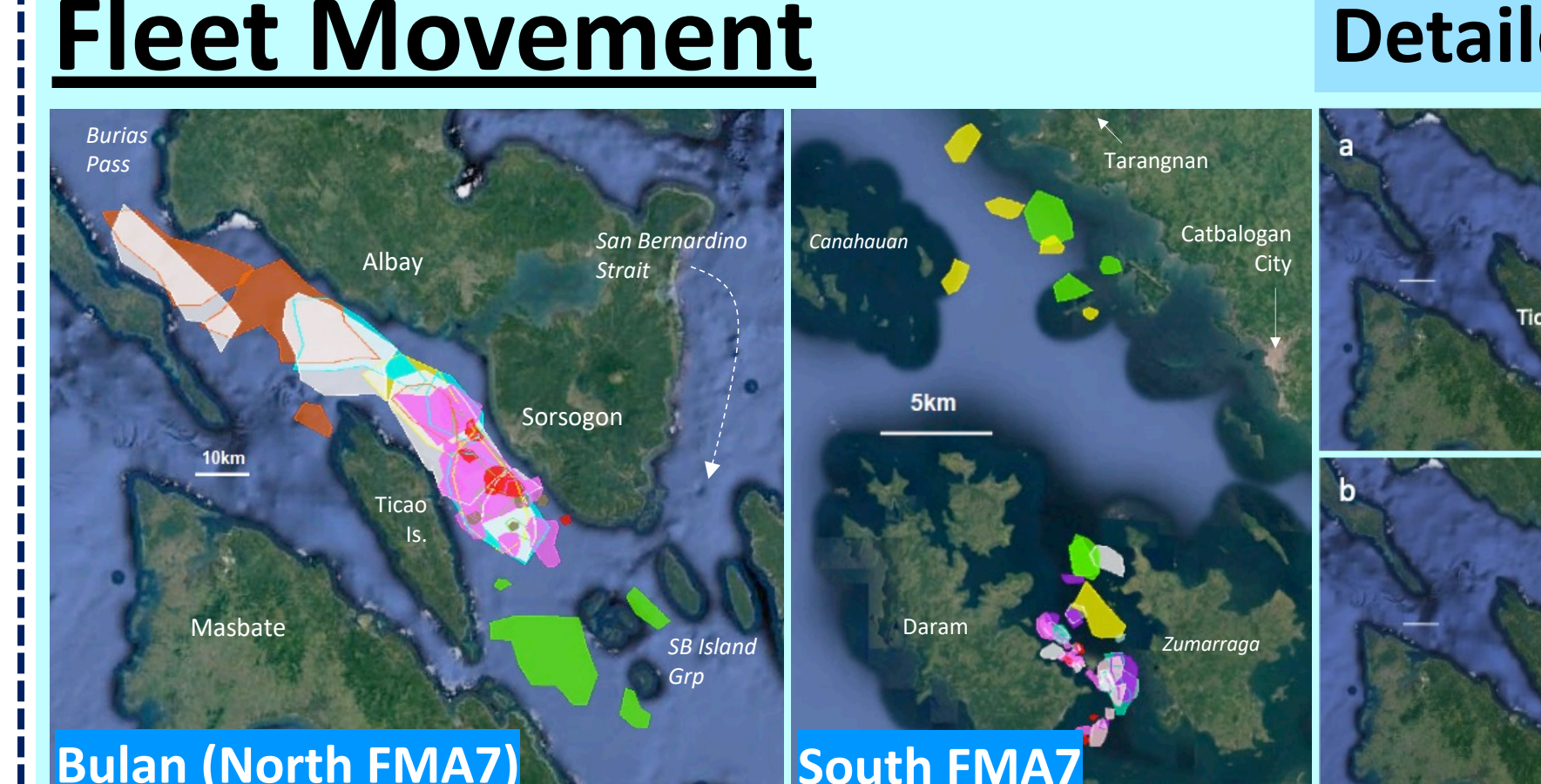
Hata H, Motomura H (2019) A new species of sardine, *Sardinella pacifica* from the Philippines (Teleostei, Clupeiformes, Clupeidae). ZooKeys 829: 75–83  
Silvestre, G. and D. Pauly. 1986. Estimate of yield and economic rent from Philippine demersal stocks 1946-1984. Paper presented at the IOC/WESTPAC Symposium on Marine Science in the Western Pacific: The Indo-Pacific Convergence, 1-6 December 1986, Townsville, Australia

## Acknowledgments:

The *Developing the Sardine Management Plan for FMA 7* Project was funded by OCEANA Philippines, and was a collaboration between the OceanBio Lab of the University of the Philippines Visayas, Bicol University Tabaco Campus and Samar State University

Food and Agriculture Organization (FAO) and University of the Philippines Office of International Linkages (UP-OIL) for support in attending the Conference on Small Pelagic Fishes

## Fleet Movement

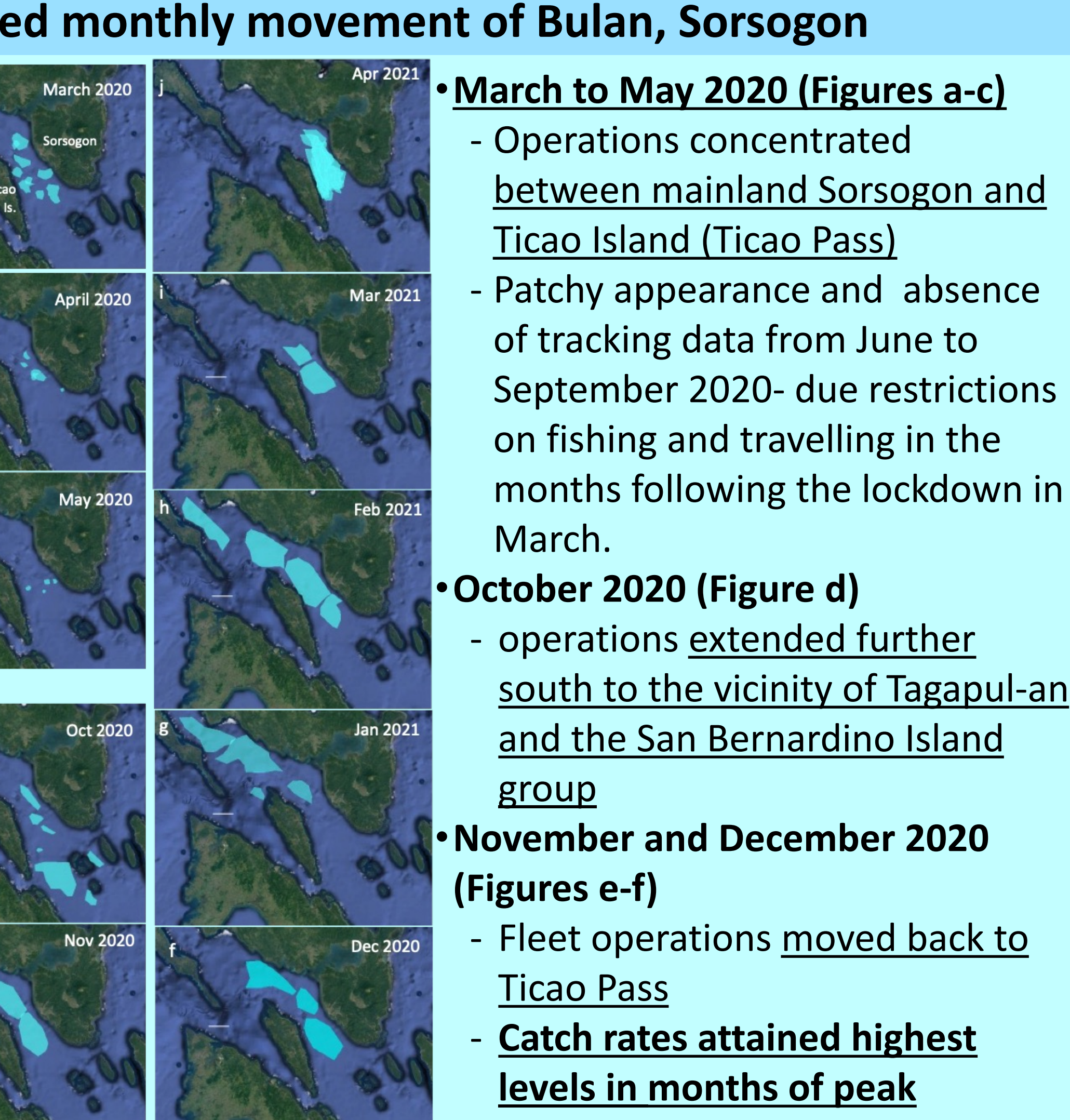


- Trackers initially deployed in all 7 sites, but focus shifted to **Bulan (North)** and **Daram & Tarangan (South)** due to lockdown and COVID-19 restrictions
- Colored polygons refer to locations of operations in different months
- **Bulan w/ larger vessels that can fish further from their base**
- South FMA 7, both monitoring sites in the inner portion of Samar Sea where operations were **confined to areas very close to the coast and within a few kilometers from vessel bases**

- ✓ The tracking of limited number of vessels showed the **same spatial & temporal patterns as the more comprehensive georeferencing using the gridded maps**
- ✓ Vessels from Bulan seemed to follow the movement of *S. lemuru* year-round

- ★ In addition to insights on **stock movement patterns**, the results of this study also showed that **tracking of fishing vessels** (small-scale or commercial) **need not be expensive, risky or carbon-footprint heavy**.
- ★ It also **illustrates the feasibility of designing a monitoring system** to efficiently generate **information on fishing grounds, fishing intensity, and monitoring of compliance with regulations**.

## Detailed monthly movement of Bulan, Sorsogon



- **March to May 2020 (Figures a-c)**
  - Operations concentrated **between mainland Sorsogon and Ticao Island (Ticao Pass)**
  - Patchy appearance and absence of tracking data from June to September 2020- due restrictions on fishing and travelling in the months following the lockdown in March.
- **October 2020 (Figure d)**
  - operations **extended further south** to the vicinity of Tagapul-an and the San Bernardino Island group
- **November and December 2020 (Figures e-f)**
  - Fleet operations **moved back to Ticao Pass**
  - **Catch rates attained highest levels in months of peak spawning**
- **Beginning of December 2020- April 2021 (Figures f-j)**
  - a **gradual movement northwards**, extending into Burias Pass in January, then back to the Ticao Pass in late February, where drift gill net vessels continued to operate until April and perhaps up to May