INTERNATIONAL SYMPOSIUM
DRIVERS OF DYNAMICS
OF SMALL PELAGIC FISH RESOURCES

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Catch dynamics of small pelagic fishes at Bali Strait & South Java Sea in relation to the climatic regime shift: case study on *Sardinella lemuru*

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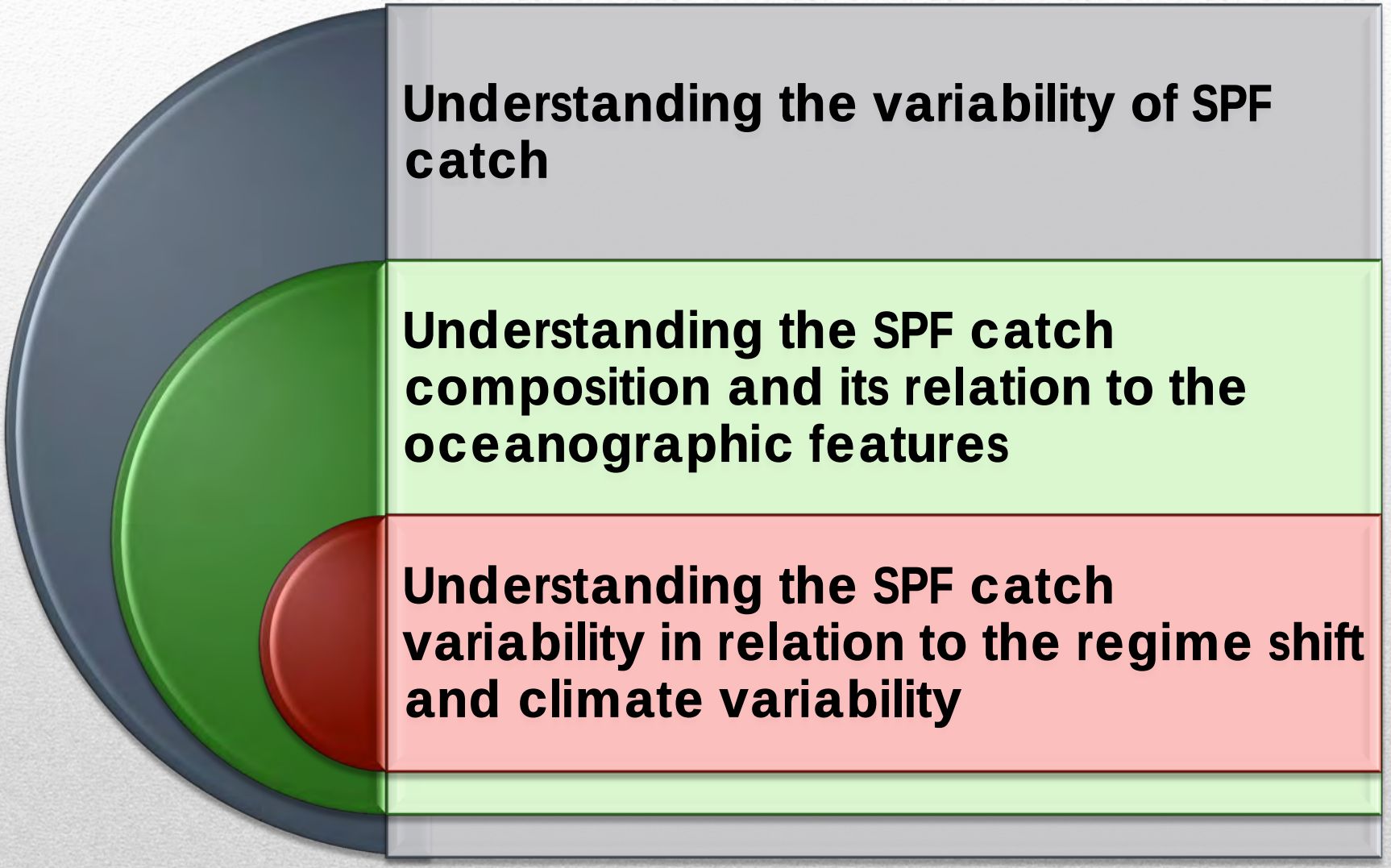
Outline:

- Introduction
- Objective
- Data and Methods
- Result and Discussion
- Small Pelagic Fish CPUE Trend
- Seasonal Variation
- Inter-annual Variation
- Regime Shift
- Summary

Background

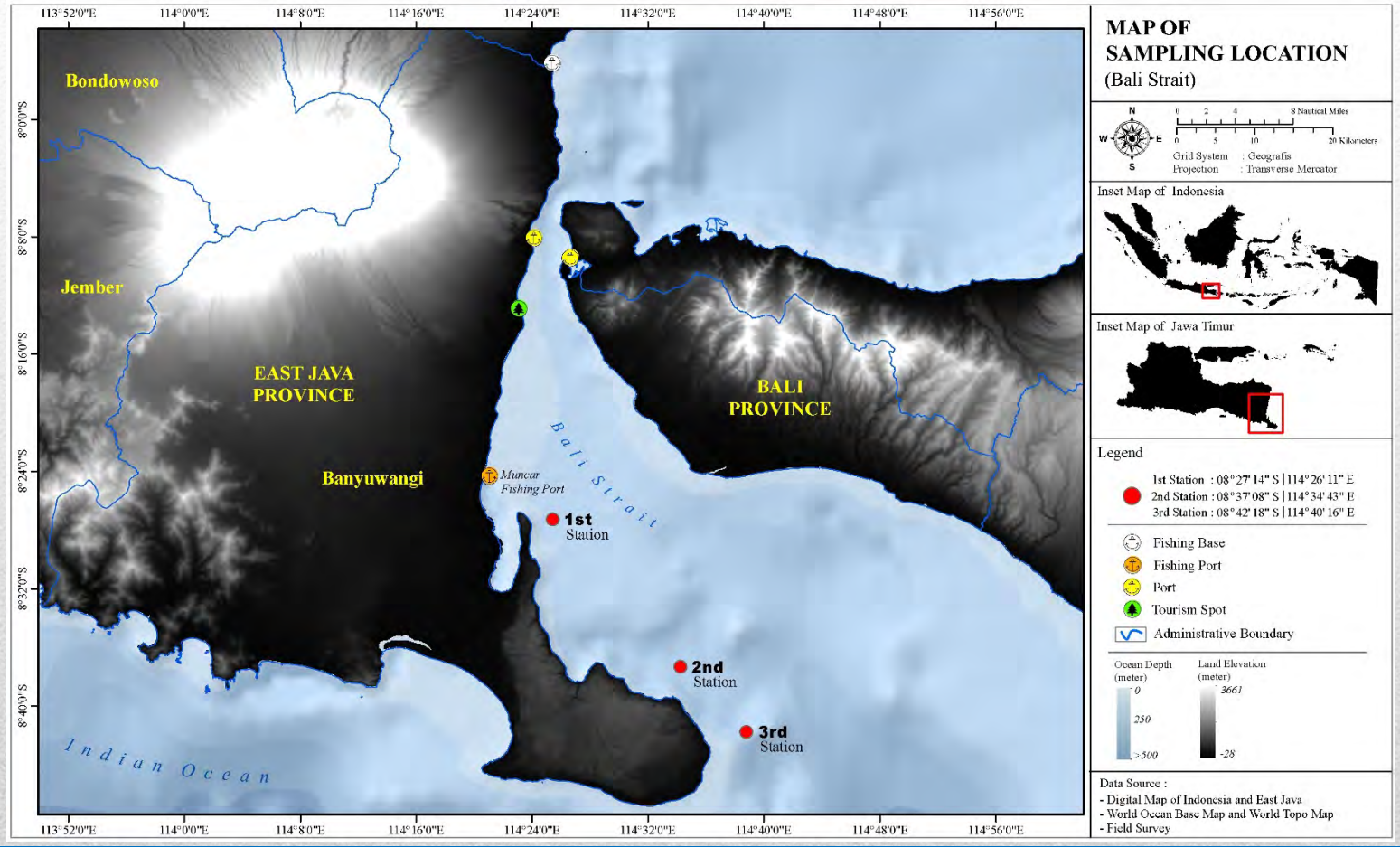
- ***S. Lemuru (SPF)*** → **main species target of Bali Strait (80-90%), followed by *Decapterus spp.* and *Euthynus spp. (Merta et al., 1995; Hendiarti et al, 2005)***
- ***S. Lemuru*** → **supporting public health (>25% of total sardine oil were contained omega-3 fatty acid) (Sartimbul et al., 2015)**
- **It was disappeared in 2010 to 2012→ it gave impact on economics loss mainly for coastal community**
- **Limited study related to the SPF dynamics and its relation to the climate change and regime shift in Indonesia…….**

Objectives

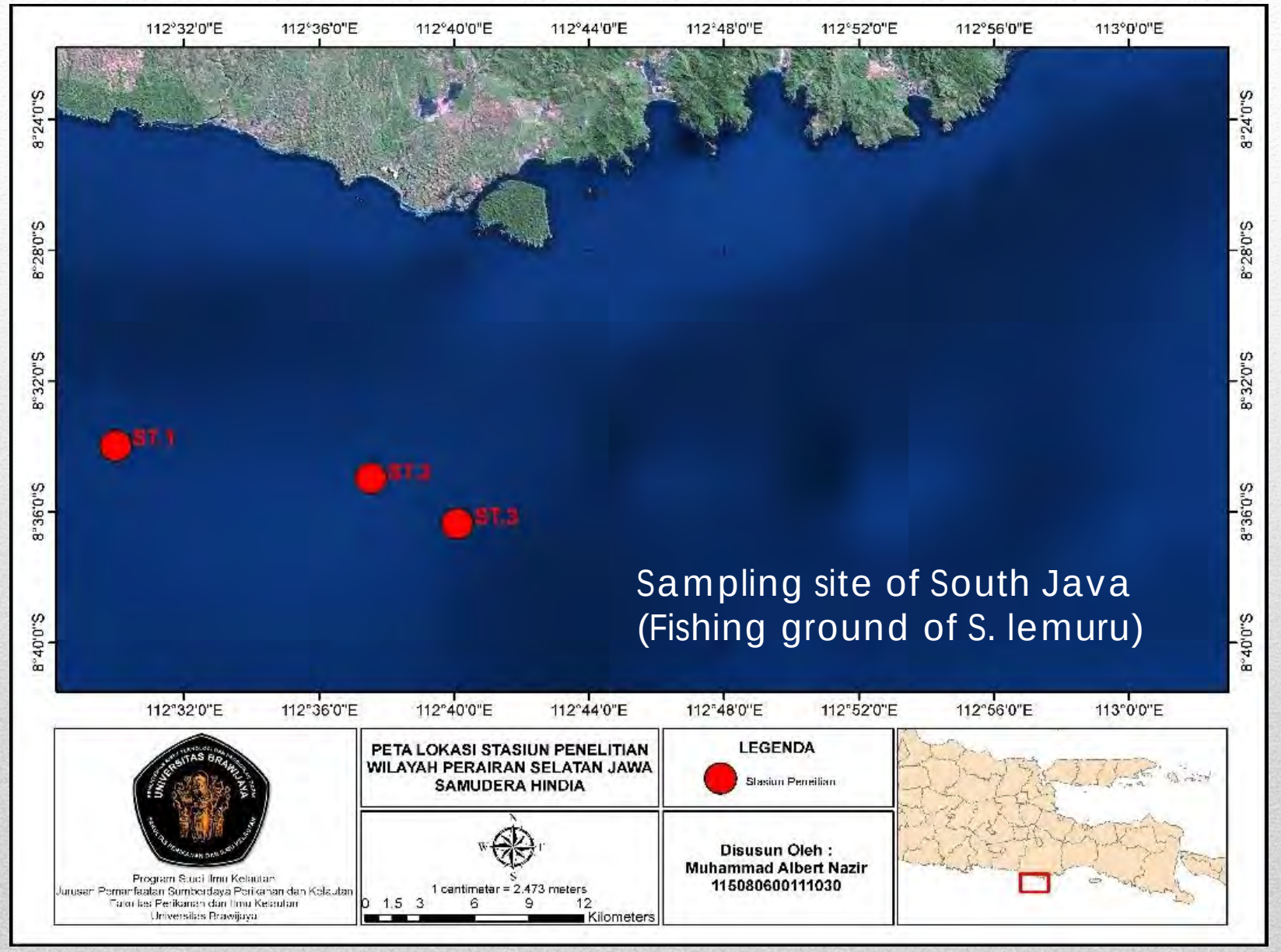

Understanding the variability of SPF catch
Understanding the SPF catch composition and its relation to the oceanographic features
Understanding the SPF catch variability in relation to the regime shift and climate variability

Study Area

1st Station : 114^0 26’ 11” BT 08 27’ 14” LS
2nd Station : 114^0 34’ 43” BT 08 37’ 08” LS
3rd Station : 114^0 40’16 BT 08 42’ 18” LS
(Fishing Ground at Bali Strait



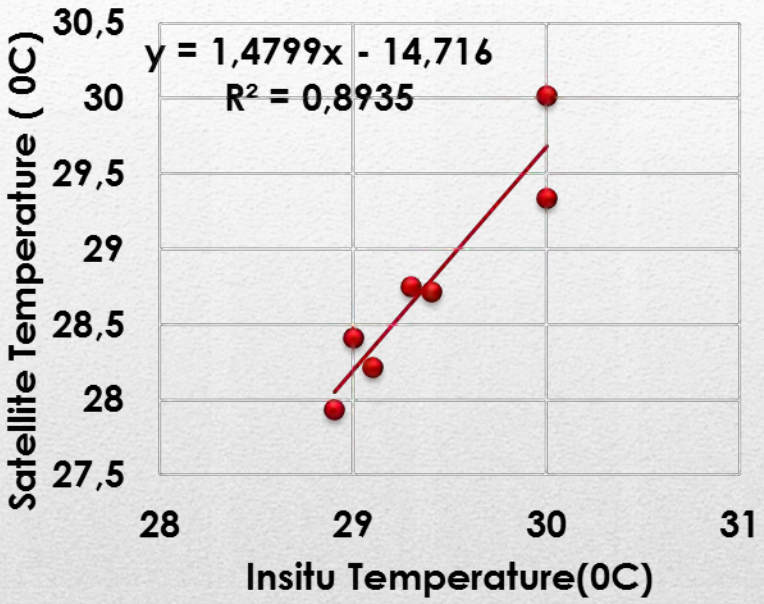
Temperature and Clorophyl-a Insitu Data : June – December 2013
Temperature and Clorophyl-a Satellite Data : February 2002 - April 2015


112°32'0"E
112°36'0"E
112°40'0"E
112°44'0"E
112°48'0"E
112°52'0"E
112°56'0"E
113°0'0"E
8°24'0"S
8°28'0"S
8°32'0"S
8°36'0"S
8°40'0"S
ST.1
ST.2
ST.3
Sampling site of South Java
(Fishing ground of S. lemuru)
UNIVERSITAS BRAWIJAYA
Program Studi Ilmu Kelautan
Jurusan Pemanfaatan Sumberdaya Perikanan dan Kelautan
Fakultas Perikanan dan Ilmu Kelautan
Universitas Brawijaya
PETA LOKASI STASIUN PENELITIAN
WILAYAH PERAIRAN SELATAN JAWA
SAMUDERA HINDIA
LEGENDA
Stasiun Penelitian
N
W
E
S
1 centimeter = 2.473 meters
0 1.5 3 6 9 12
Kilometers
Disusun Oleh :
Muhammad Albert Nazir
115080600111030

Data and Methods

- 14-year monthly Catch per Unit Effort (CpUE) of SPF catch data provided by Muncar Fishing Port (Bali Strait) and South Java
- 14-year monthly satellite Aqua MODIS data of SST & Chl-a (2002-2015) (www.modis.gsfc.nasa.gov).
- Monthly temp. and Chl-a Insitu Data were collected using **AAQ Alec Japan (Jun – Dec 2013)**
- Plankton data were sampled on June-Dec, 2013
- Anomalies, standardization, statistics, and Regime shift detection (Rodionov, 2005) methods were applied in this study
- Nino 3.4 and IOD were used as Climate index (NOAA, 2007)

Insitu and Satellite Temperature Data Verification

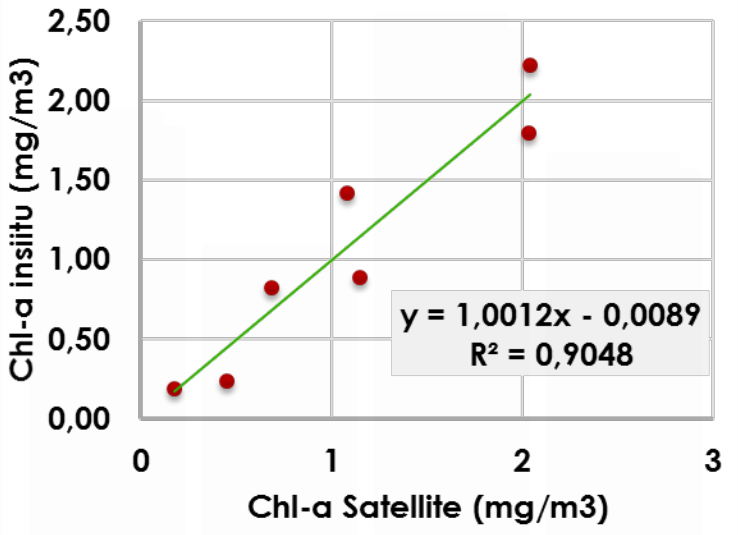


No.	Date of Data Retrieval	Insitu Data (⁰C)	Satellite Data (⁰C)	Temp. difference (⁰C)
1	June 15, 2013	30,00	29,34	0,66
2	July 20, 2013	29,40	28,72	0,68
3	August 20, 2013	29,10	28,22	0,88
4	September 21, 2013	28,90	27,94	0,96
5	October 16, 2013	29,00	28,41	0,59
6	November 12, 2013	29,30	28,75	0,55
7	December 11, 2013	30,00	30,02	-0,02
	Maximum Value			30,02
	Minimum Value			27,94

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,945[a]	,894	,872	,25324

RESULT & DISCUSSION

Clorophyl-a Data Verification



No.	Date of Retrieval Data	Insitu Data (mg/m³)	Satellite Data (mg/m³)	Chl-a difference (mg/m³)
1	Jun 15, 2013	0,17	0,18	-0,01
2	Jul 20, 2013	1,38	1,41	-0,04
3	Aug 20, 2013	2,04	2,22	-0,18
4	Sep 21, 2013	2,13	1,98	0,14*
5	Nov 16, 2013	1,14	1,26	-0,12
6	Nov 12, 2013	0,70	1,05	-0,36
7	Dec 11, 2013	0,64	0,38	0,26*
	Maximum Value			2,13
	Minimum Value			0,17

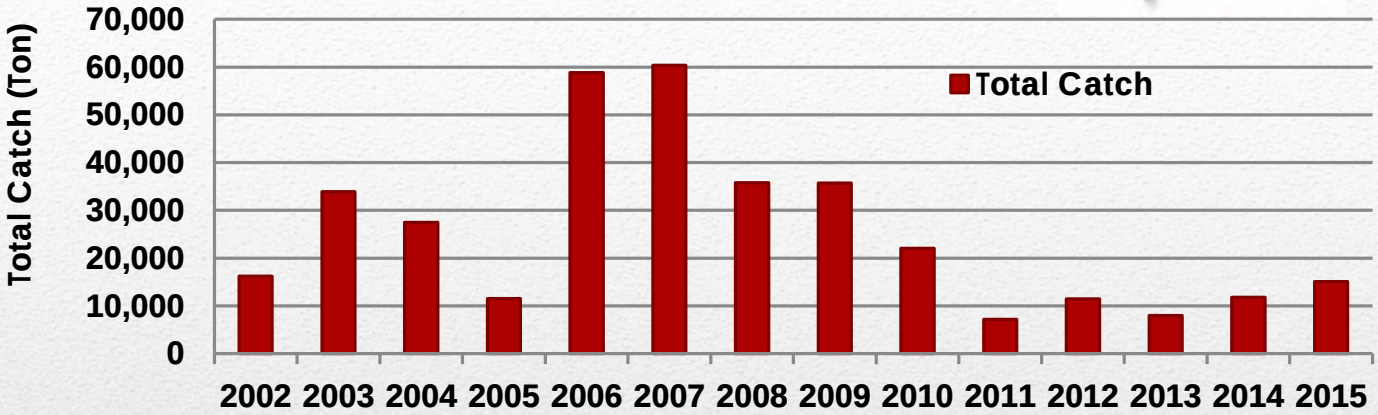
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,951[a]	,904	,885	,24738

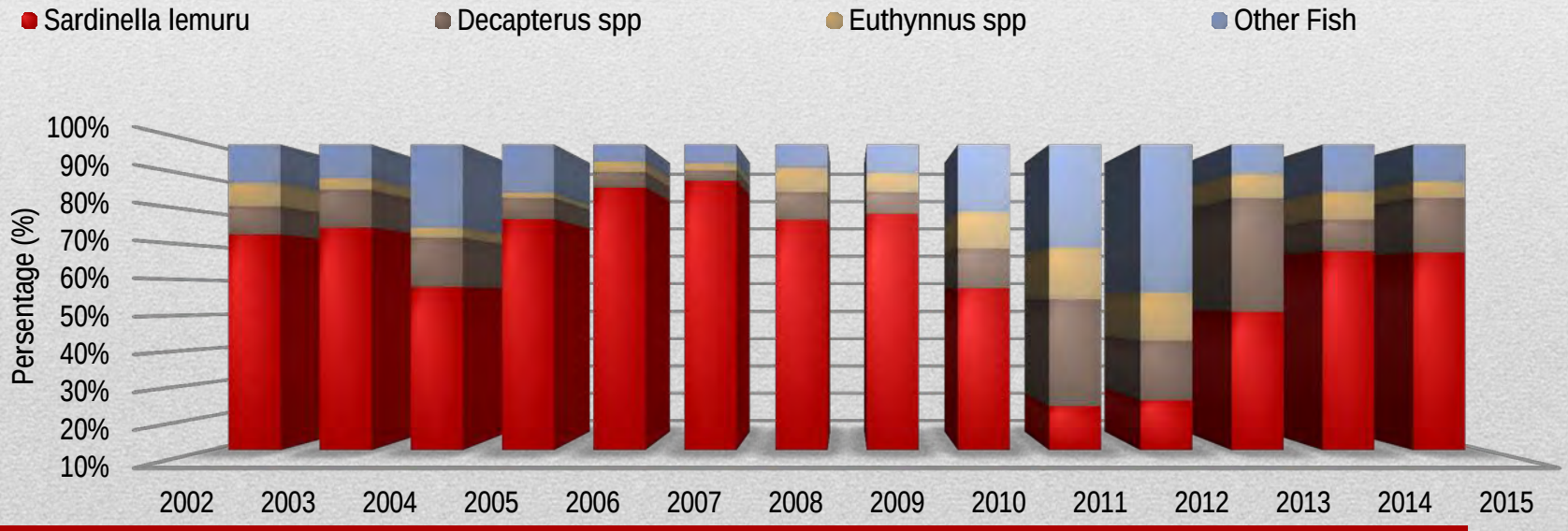
a. Predictors: (Constant), suhusatelitMODIS

Fish Catch landed in Bali Strait

- **Total Fish Catch in Bali Strait**

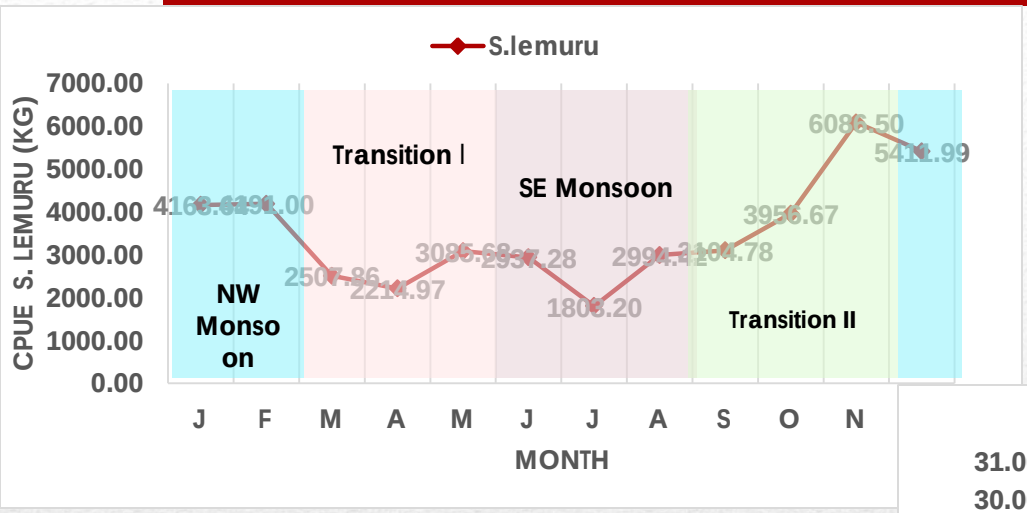




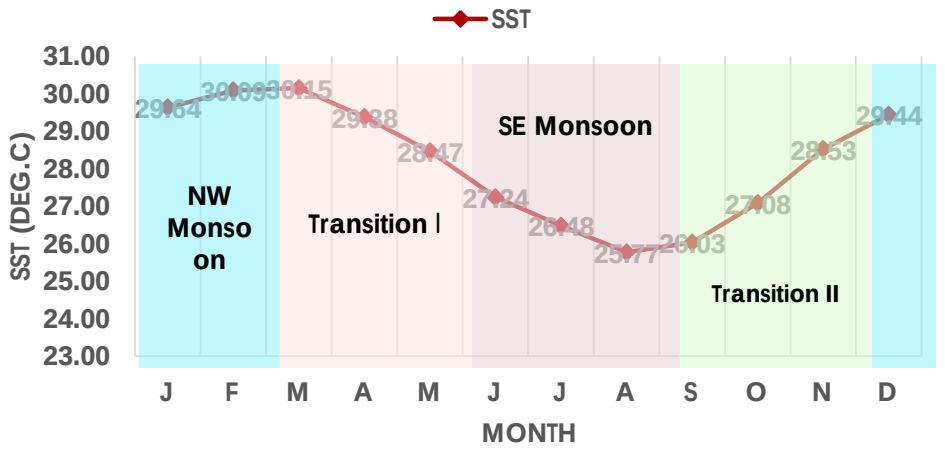


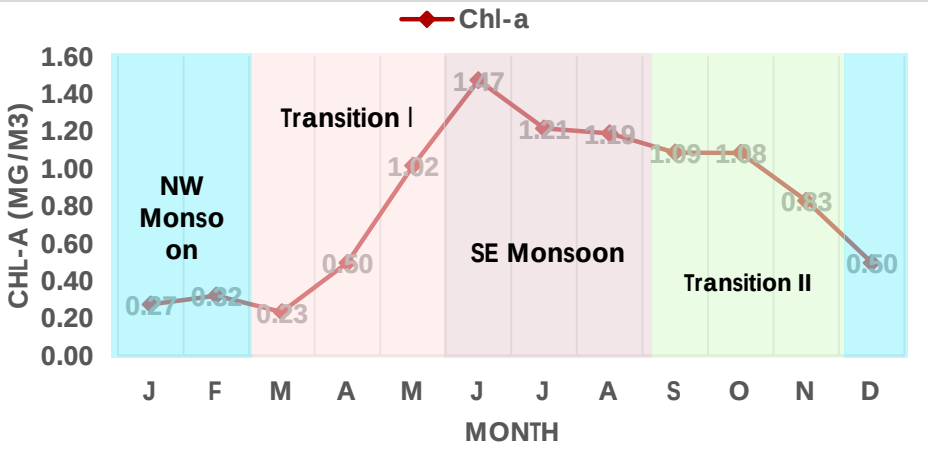
- **Percentage Fish Dominant Landed in Bali Strait**

Seasonal variation

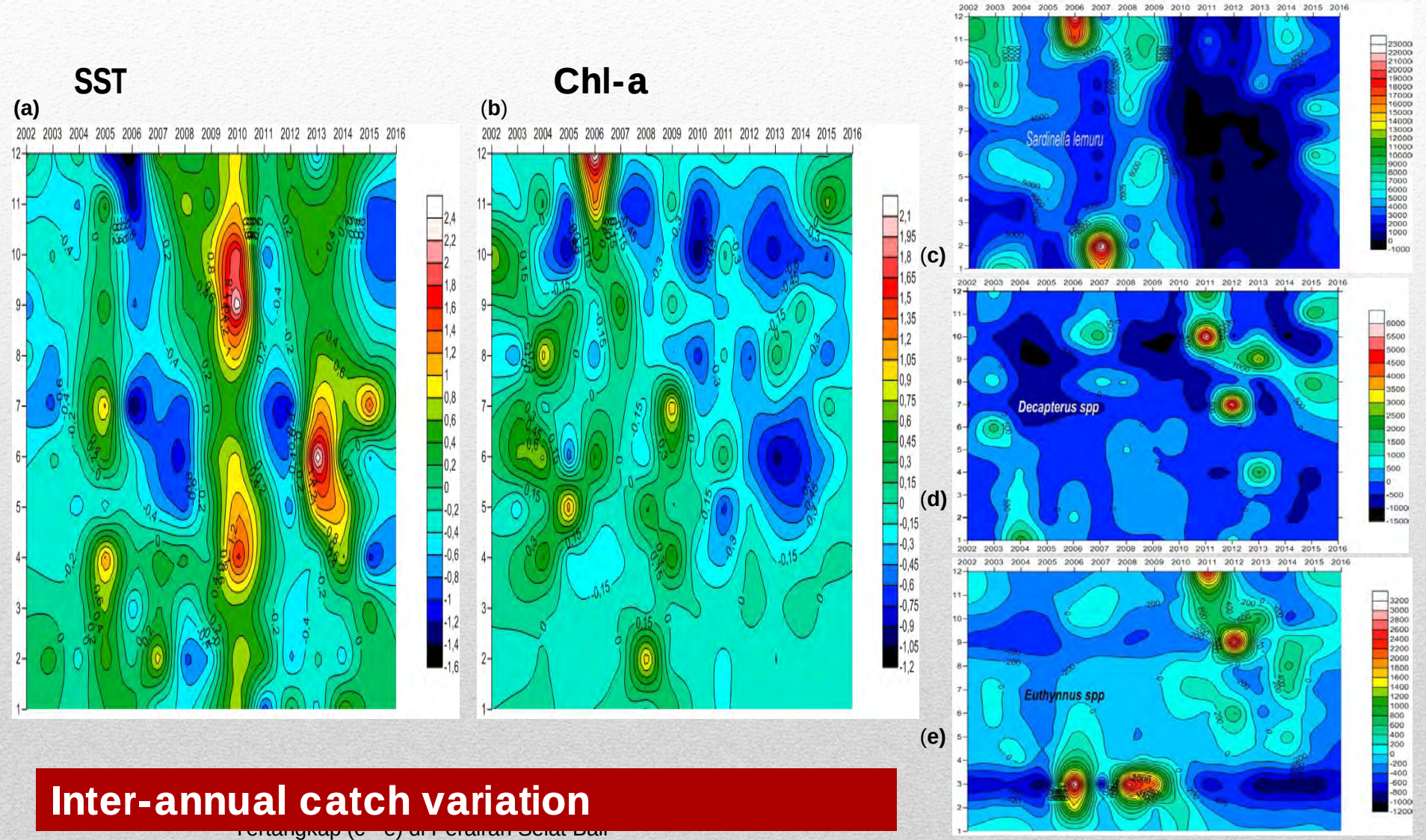


- **Max. catches of *S. lemuru* occurs in Trans-1 Monsoon**
- **It is 3-month after upwelling event during SE monsoon (Sartimbul et al., 2010)**
- **Intensive upwelling → the primarily production increases (Chl-a)**

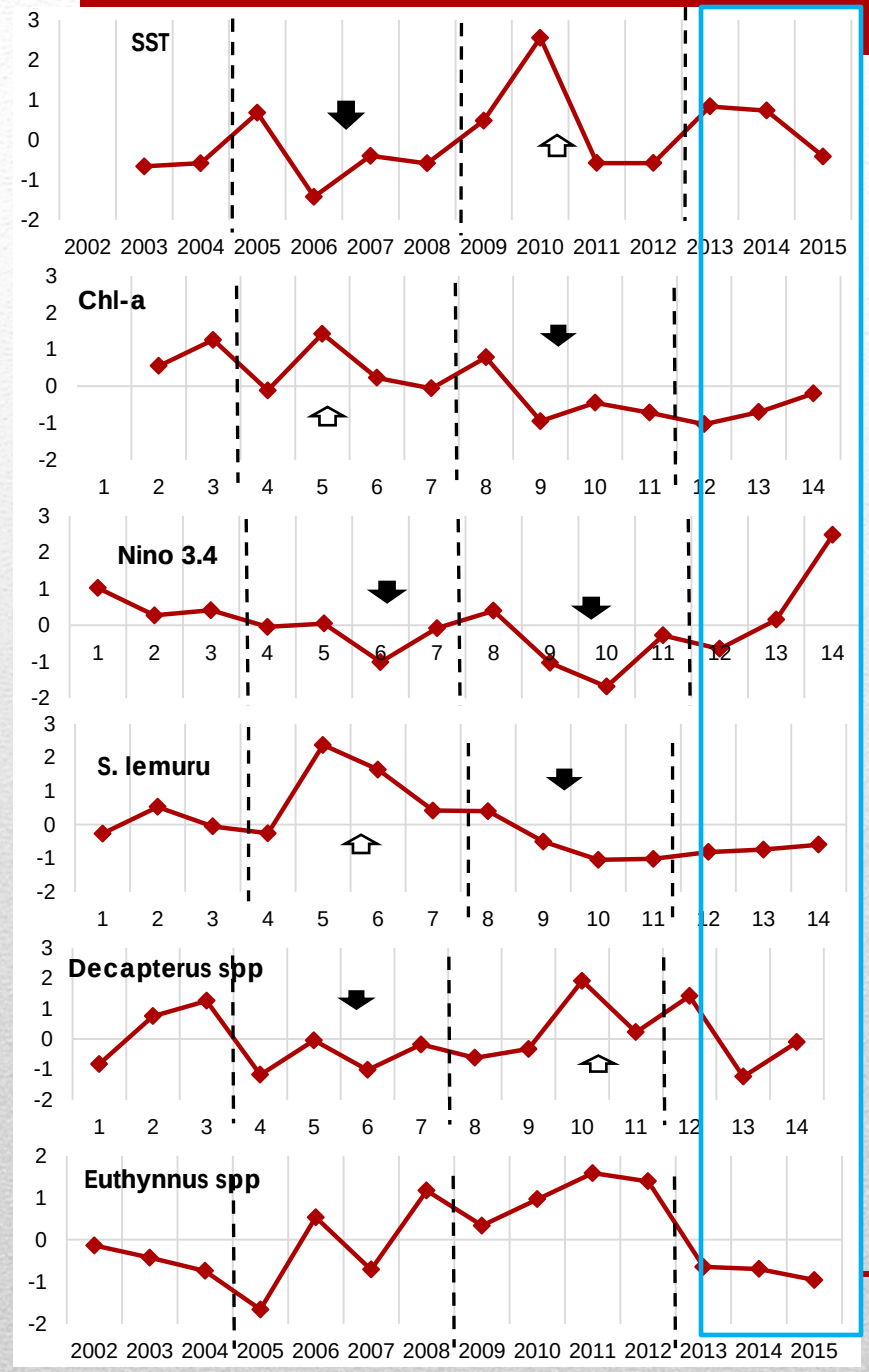




Inter-annual SPF Catch Composition and Oceanographic variation



Inter-annual catch variation



Standardization parameters

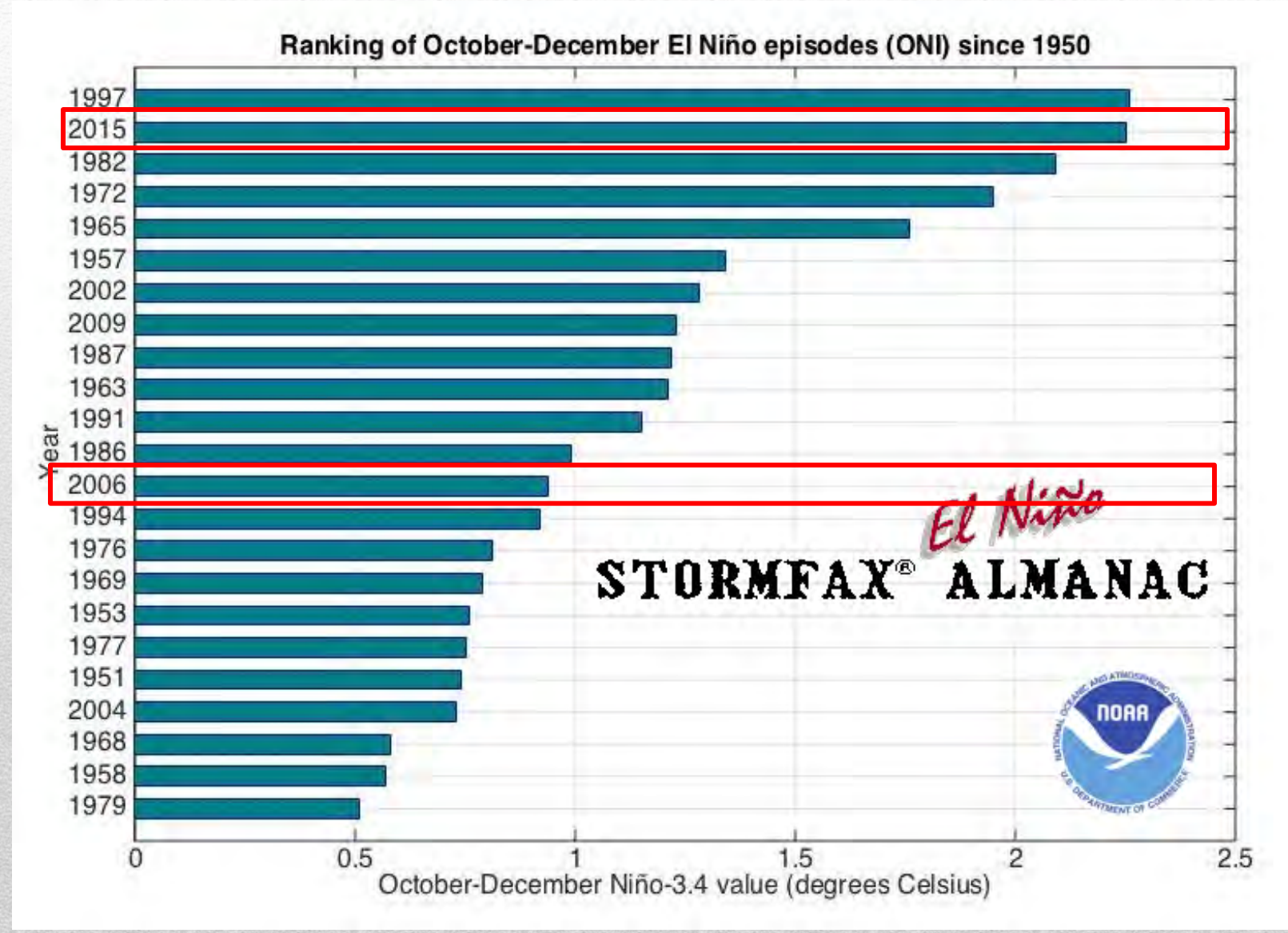
Cooling year (El Nino 2006) → peak fish catch of S. lemuru in Bali Strait

Warming year (La Nina 2010)→ lowest fish catch in Bali Strait

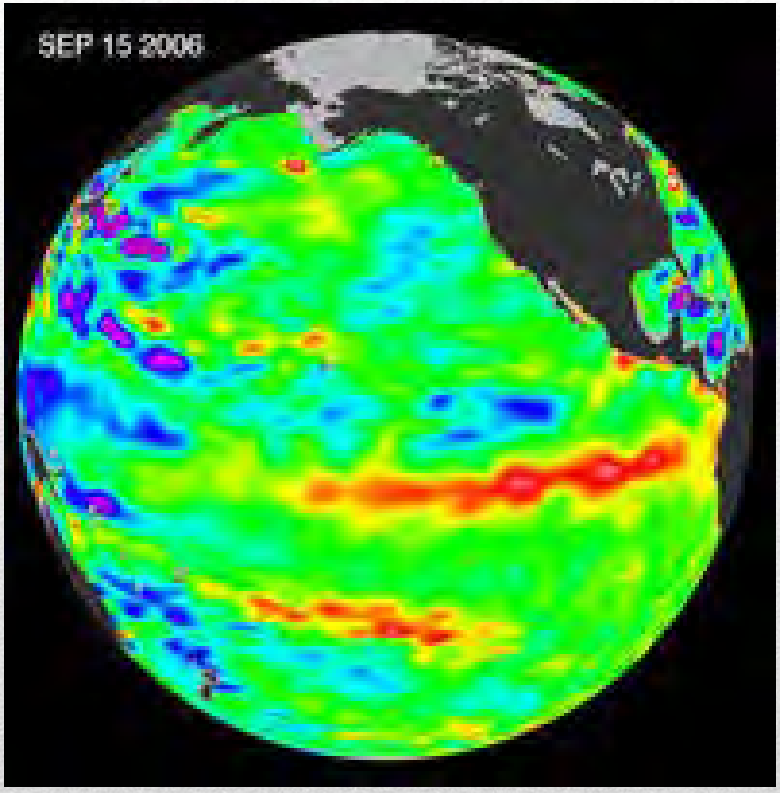
El Nino 2015→ No consistency ???

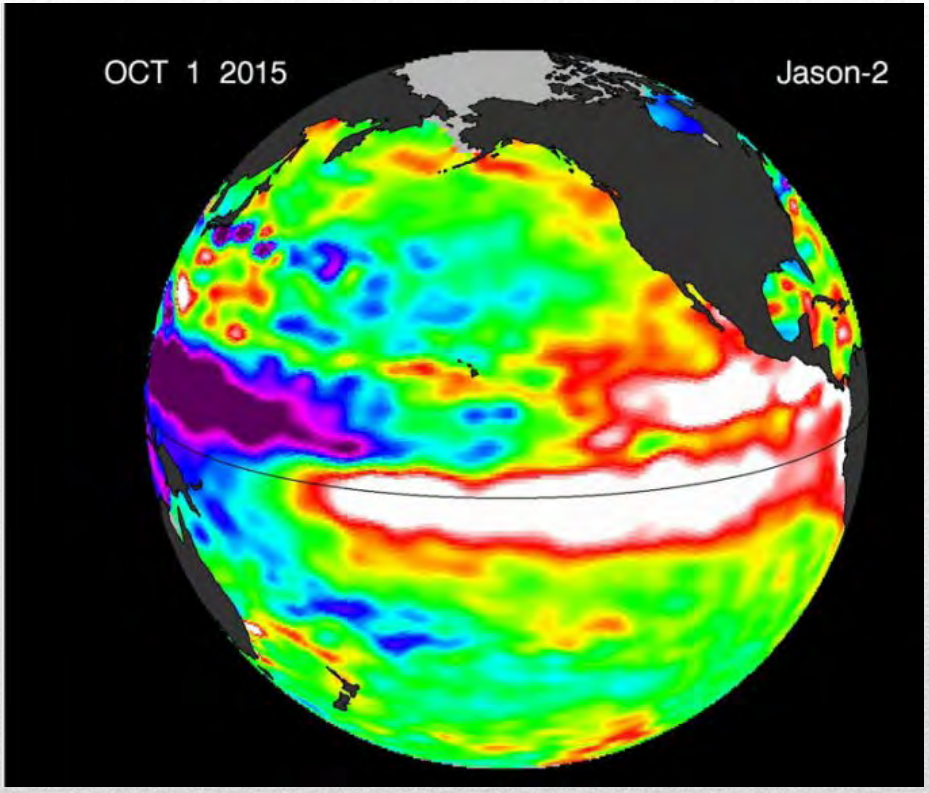
Why???

But…..

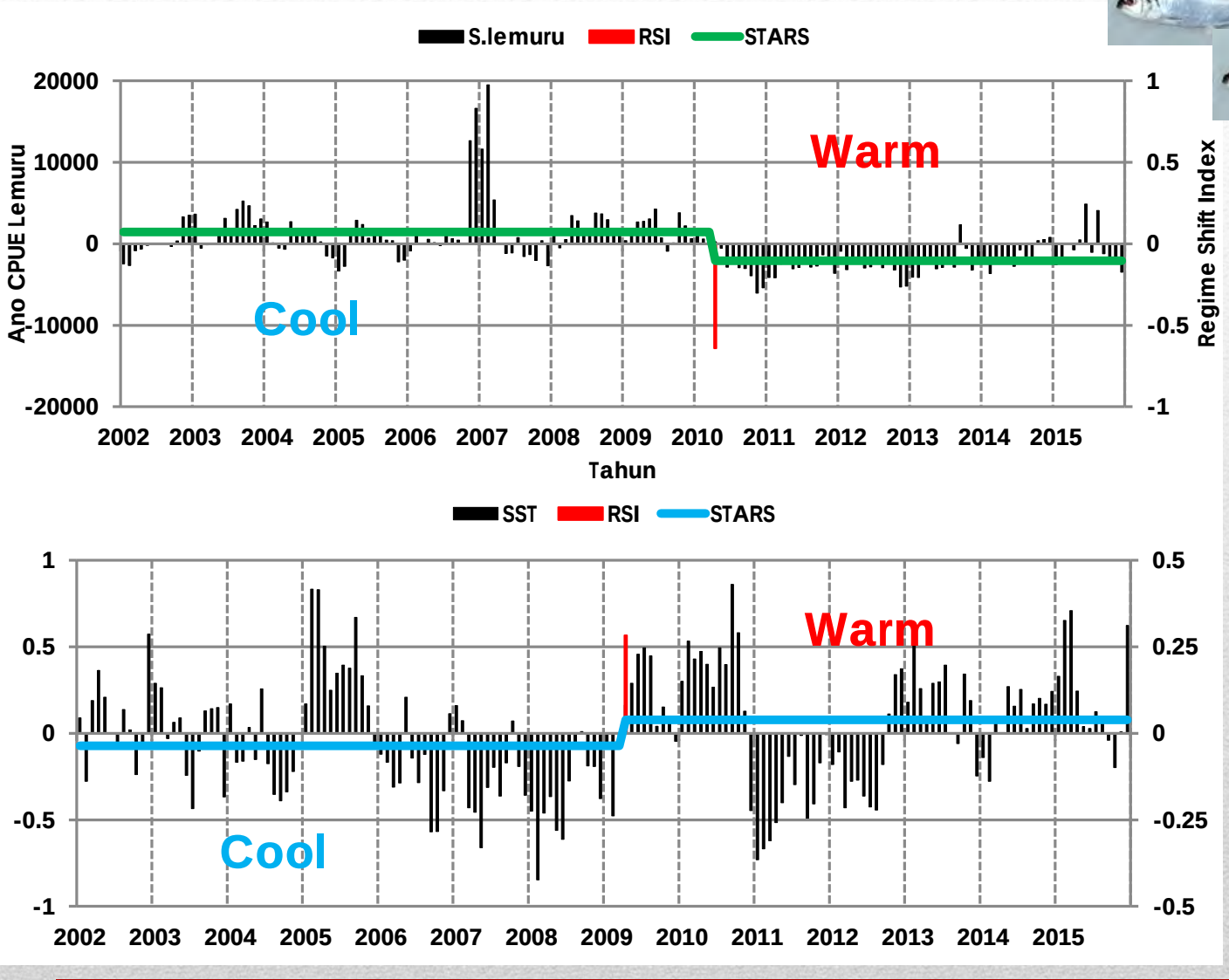

Ranking of October-December El Niño episodes (ONI) since 1950
Year
1997
2015
1982
1972
1965
1957
2002
2009
1987
1963
1991
1986
2006
1994
1976
1969
1953
1977
1951
2004
1968
1958
1979
0
0.5
1
1.5
2
2.5
October-December Niño-3.4 value (degrees Celsius)
El Niño
STORMFAX® ALMANAC
NOAA

EL Nino 2006 DAN 2015 (Nasa, 2016)



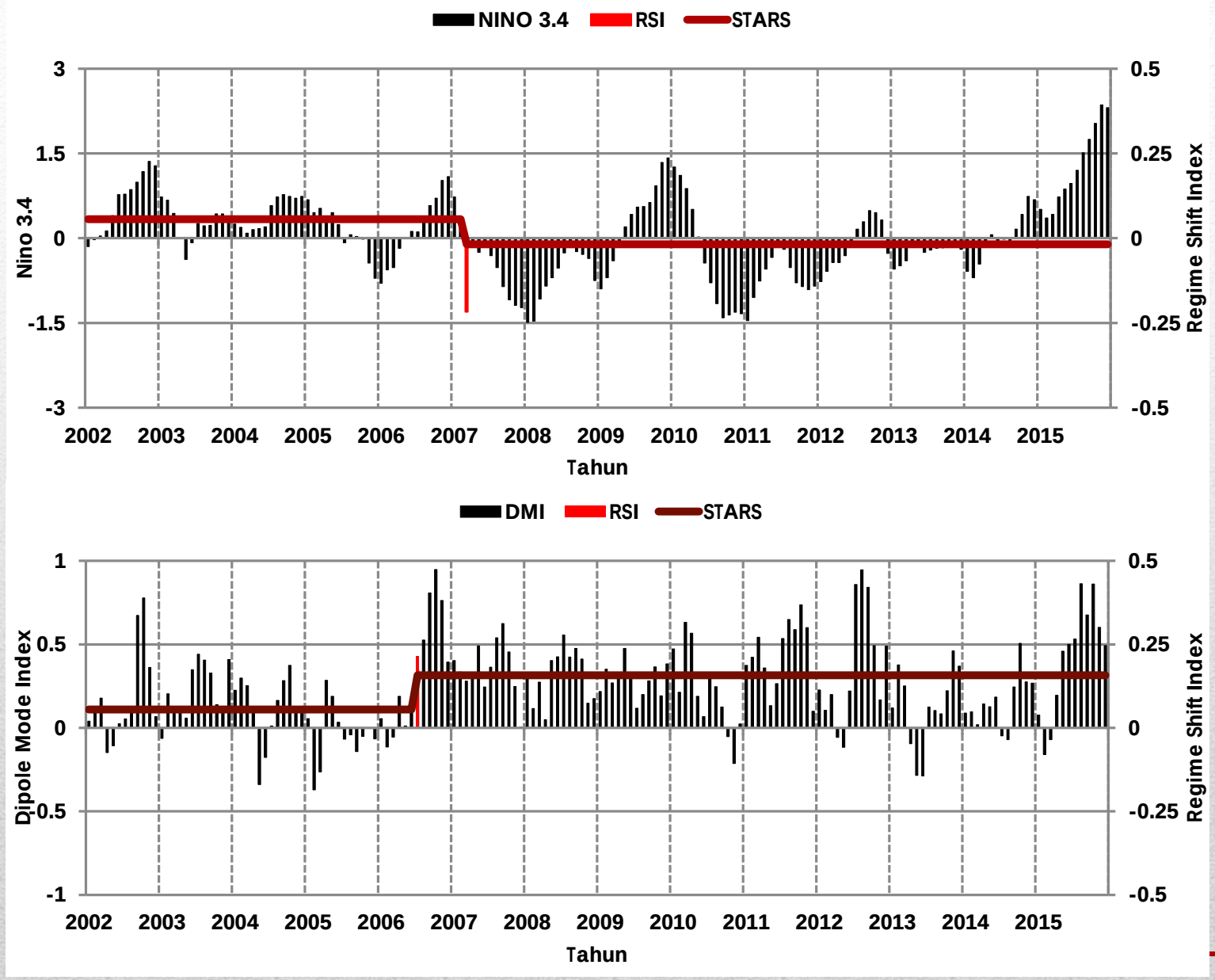


Regime Shift on *S.lemuru*



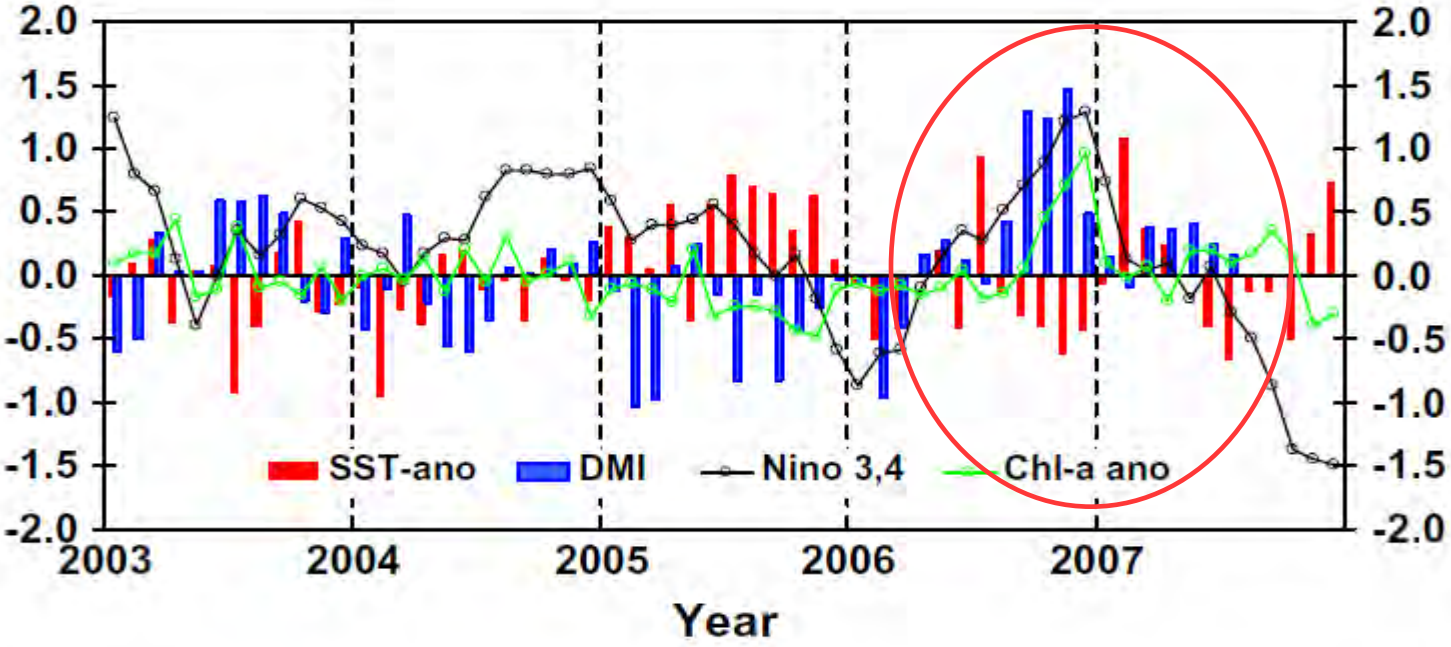
1 RS

RS detection (Rodinov, 2005):
based on sequential T-test for RS (Sequential T-test Analysis of RS/ STAR)


NINO 3.4
RSI
STARS
Nino 3.4
Regime Shift Index
Tahun
DMI
RSI
STARS
Dipole Mode Index
Regime Shift Index
Tahun

1 RS

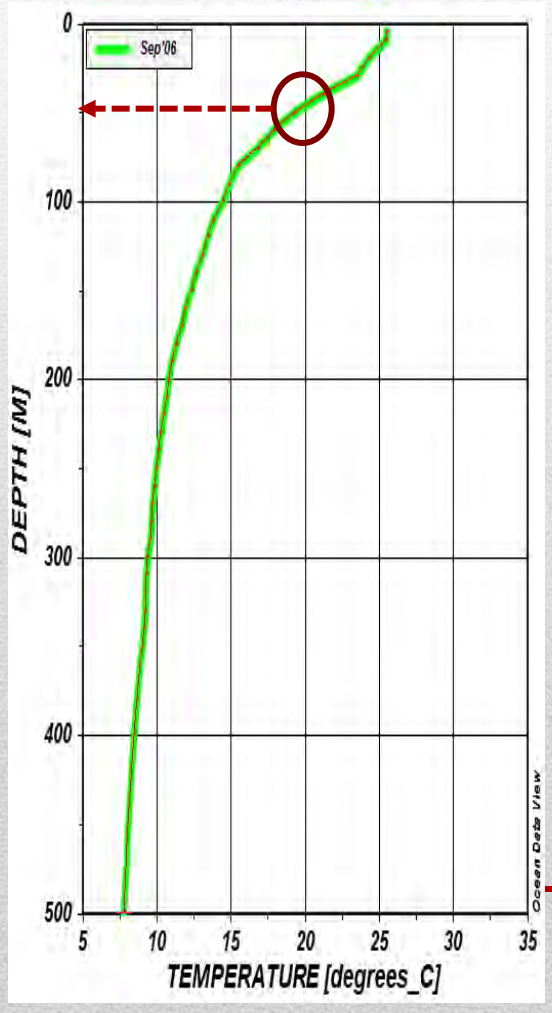
Sartimbul et al., 2010: Cool year and peak season of S.lemuru after 3-month moving average

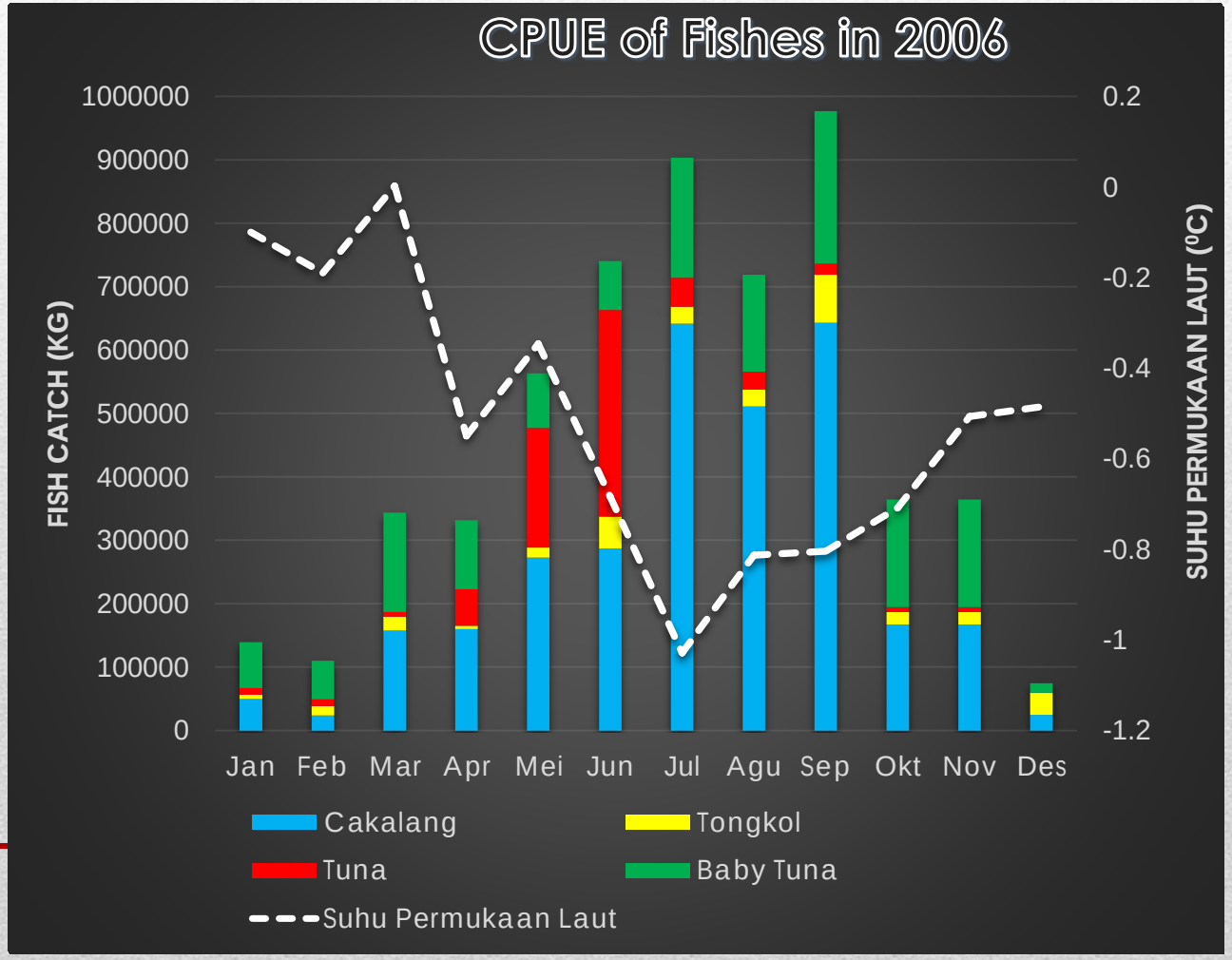


Components	Comp. 1	Comp. 2	Comp. 3	Comp. 4
IOD	0.56	−0.63	0.51	−0.09
Niño 3.4	0.42	0.78	0.45	0.03
Chl-a	0.89	−0.11	−0.21	0.36
CPUE	0.86	0.14	−0.34	−0.33

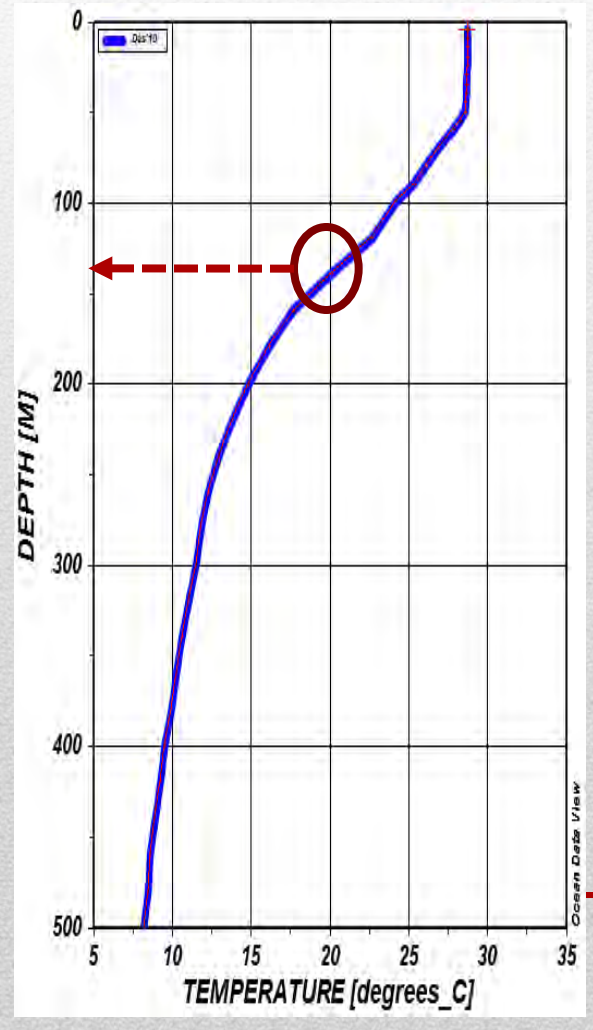
Case study BPF at South Java

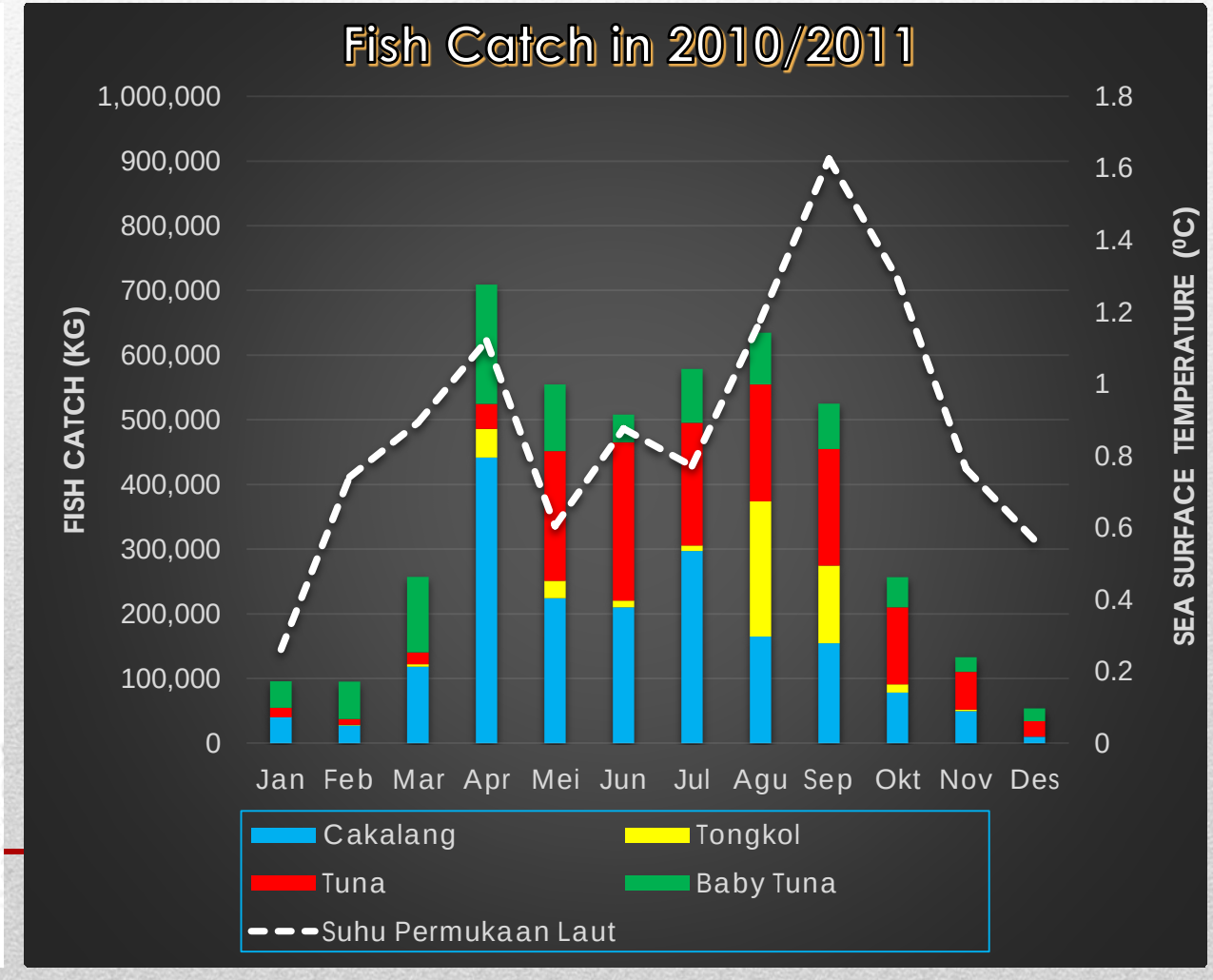
EL-NINO 2006-2007/ Cool year





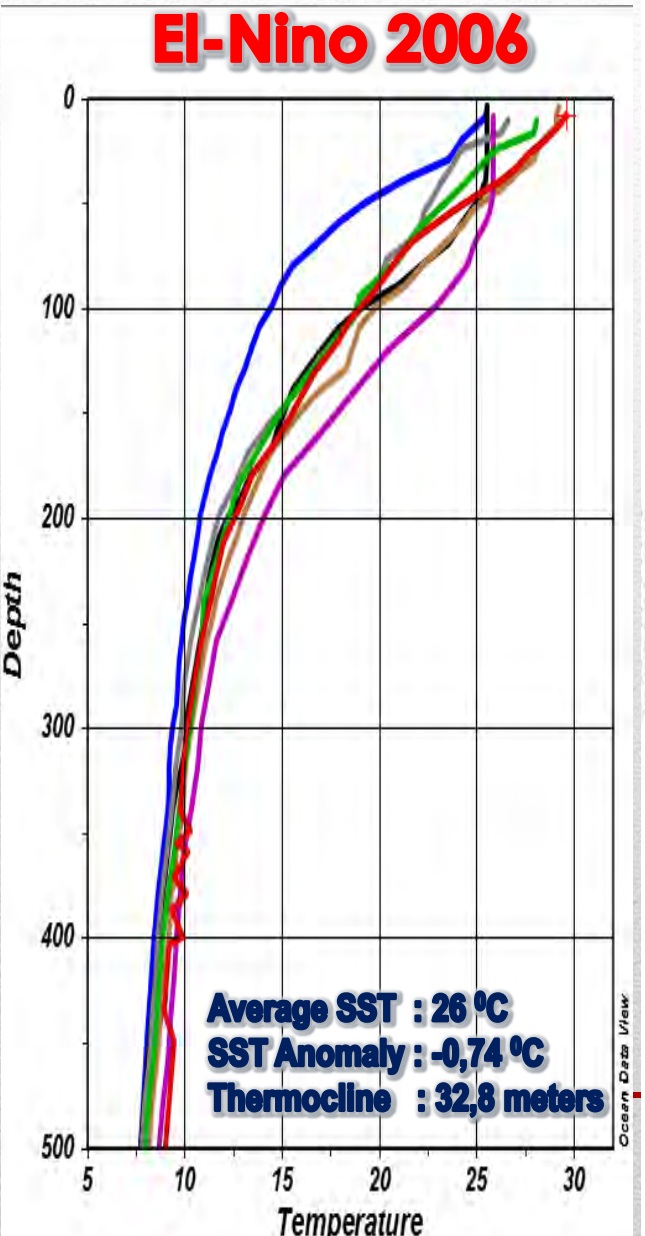
La-Nina 2010-2011/ Warm year



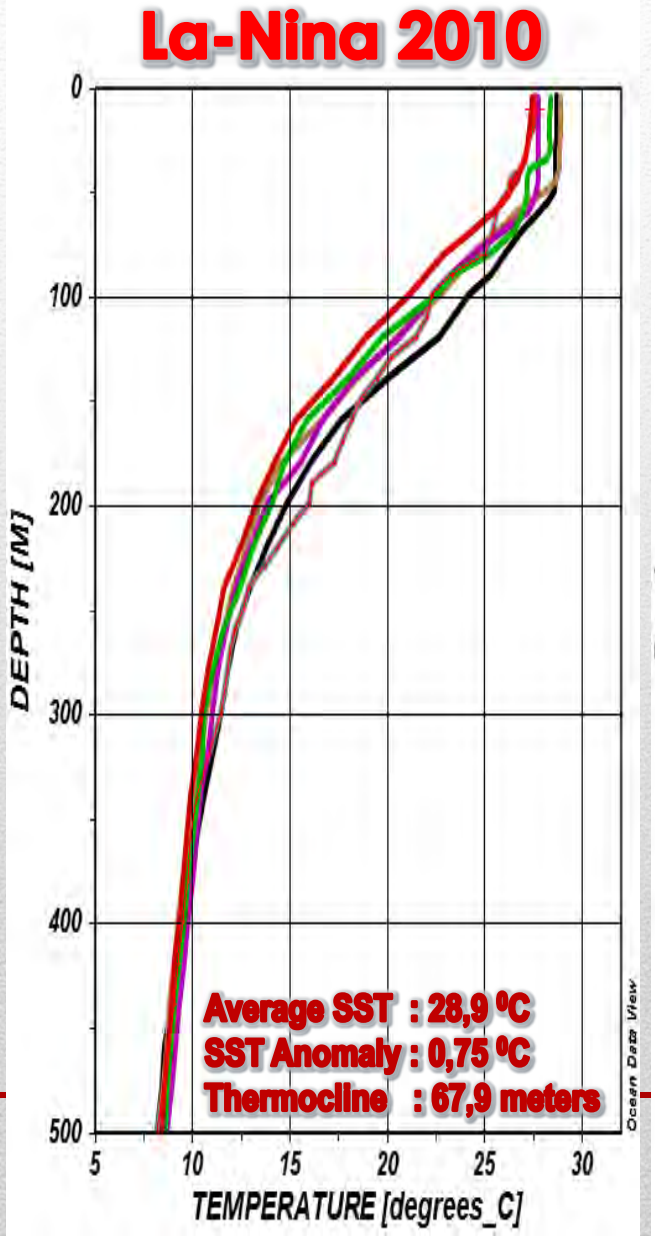


Thermocline Variation

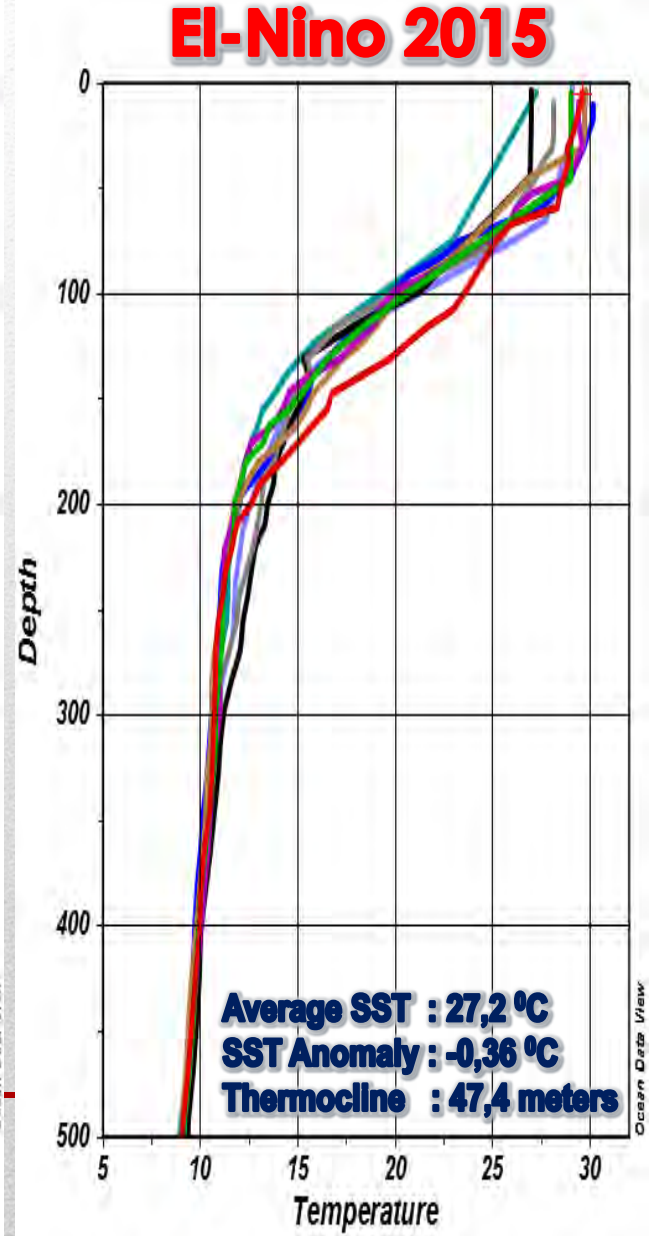
El-Nino 2006



La-Nina 2010

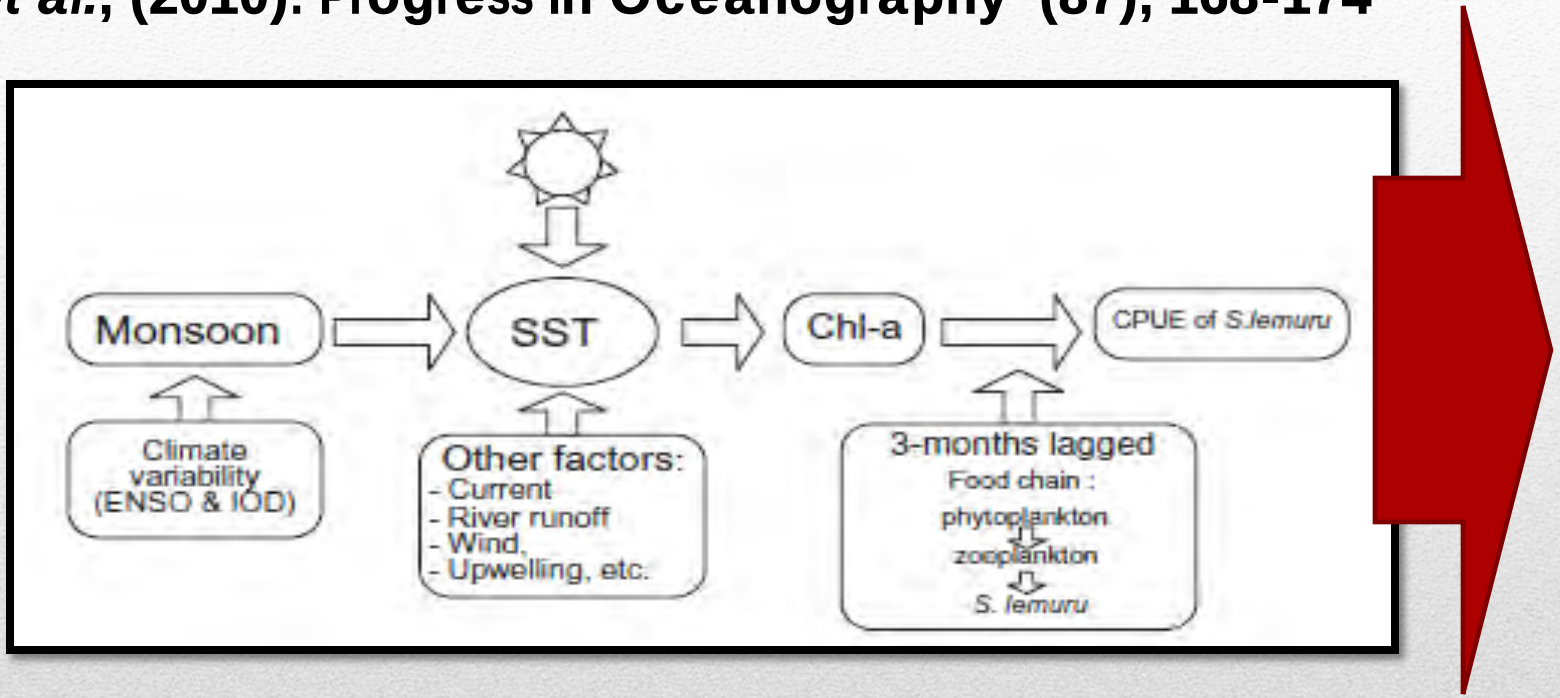


El-Nino 2015



Some possible reason of S.lemuru dynamics at Bali Strait and South Java Sea…..

1. Three-months time lagged for S.lemuru→ Modified from *Sartimbul et al.*, (2010): Progress in Oceanography (87), 168-174



2. **Regime shift of S.lemuru → cool and warm period**
3. **Horizontal movement → further north or south**
4. **Vertical migration → deeper/shallower thermocline (La Nina/ El Nino)**

Summary

1

- SPF composition were vary seasonally.
- *S.Lemuru* (Trans-2), Decapterus spp (NW Monsoon), and *Euthynnus spp* (always appear in all seasons)

2

- 14-year fishing trends→ regime shift from seasonal to inter-annual variation
- Change in fish composition from seasonal to inter-annual

3

- Cold year (ENSO and pIOD) in 2006-2007→ S.lemuru reached peak catch
- Warm year (La Nina) in 2010 – 2012, S.lemuru was lowest catch
- El Nino 2015 → low CPUE of S. lemuru may be caused by behavior of warmer El Nino

Future Task

1. • S.lemuru is important as key species of BPF→ lack of juvenile data

2. • Needed to develop new fishing ground map based on time lag and thermocline information

3. • Needed new climate index for Indonesia ocean system
   • Collaborations are welcome!

Thank you for your attention and contribution

ACKNOWLEDGEMENT

- Ministry of Research, Technology and Higher Education of Indonesia
- Brawijaya University
- PICES