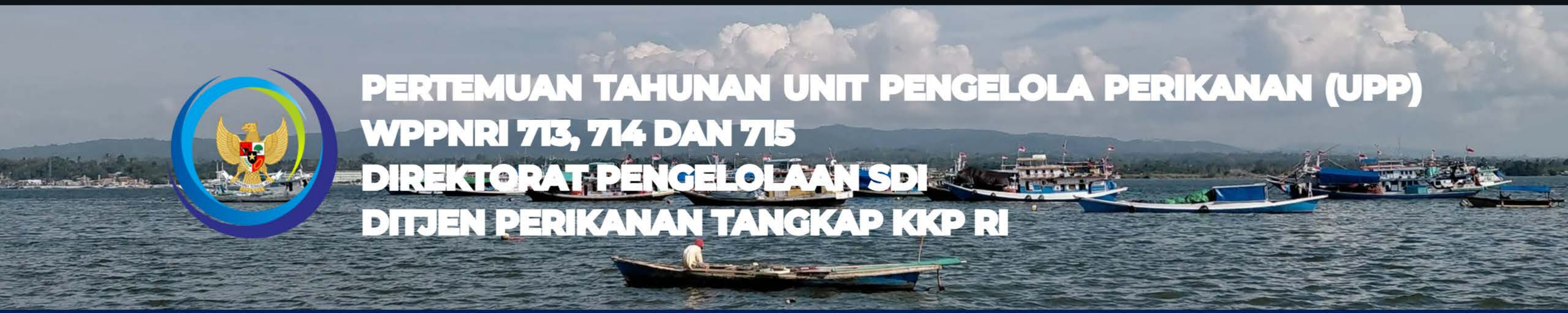


KONDISI SUMBER DAYA TUNA DAN PENERAPAN KEBIJAKAN HARVEST STRATEGY SERTA KUOTA DI WPPNRI 714

condition of tuna ressources and implementation of the harvest strategy in WPPNRI 714

Dr. Ir. Andi Irwan Nur, M.Env.St.
Koordinator Panel Ilmiah WPPN-RI 714

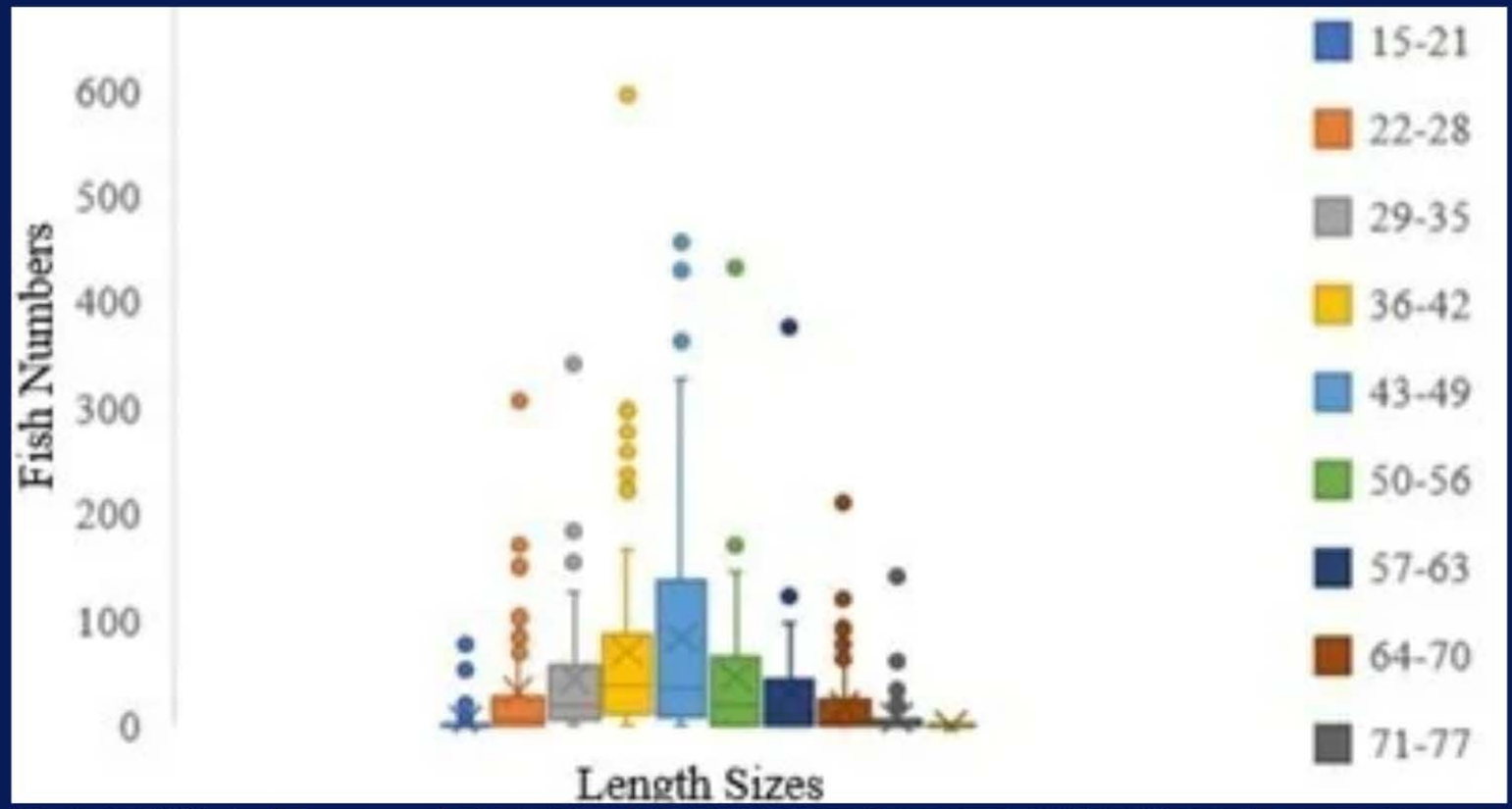
Universitas Hasanuddin, 16-18 Juli 2025

ccondition of ressources
2019-2024

A. KONDISI SUMBERDAYA 2019-2024

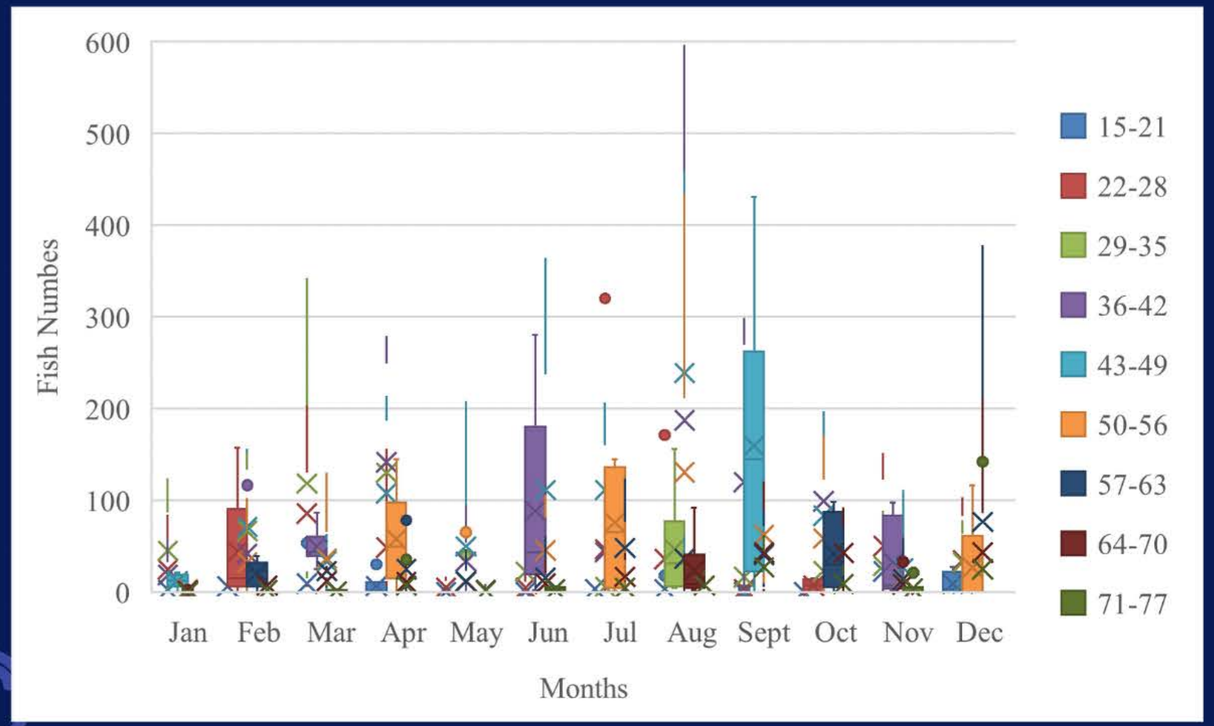
Distribusi Ukuran dan Penangkapan Ikan yang Belum Dewasa

Kisaran ukuran dominan cakalang di WPP 714, dari 36–49 cm (N=24.618 ekor FL). Peningkatan tekanan terhadap juvenil, yang berdampak pada menurunnya proporsi individu dewasa dalam populasi.



Length distribution and catch of immature fish

dominant size of SKJ in WPP714 between 36-49cm (N= 24,618, FL). Icreased pressure on juveniles impacts the proportion of adult individuals in the population

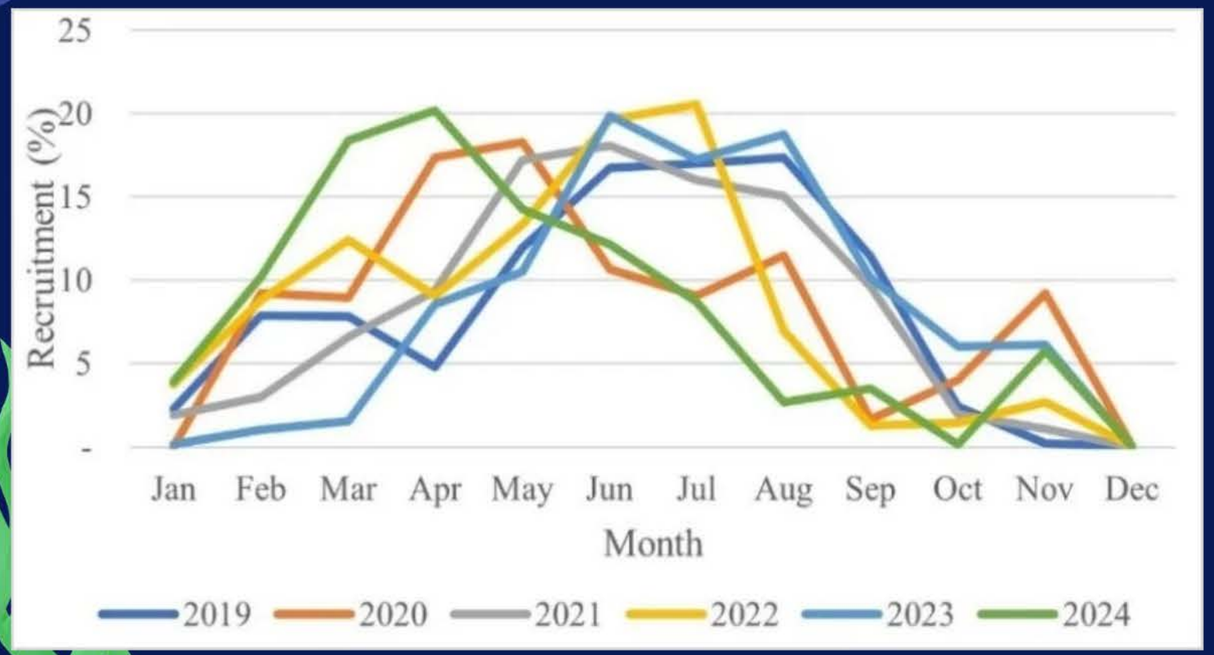


Variasi Musiman

Puncak penangkapan Juni-Agustus.

Seasonal varition

Peak catch in June to August



Pola Rekrutmen

Rekrutmen memuncak pada Juni–Agustus dan menurun pada November–Desember

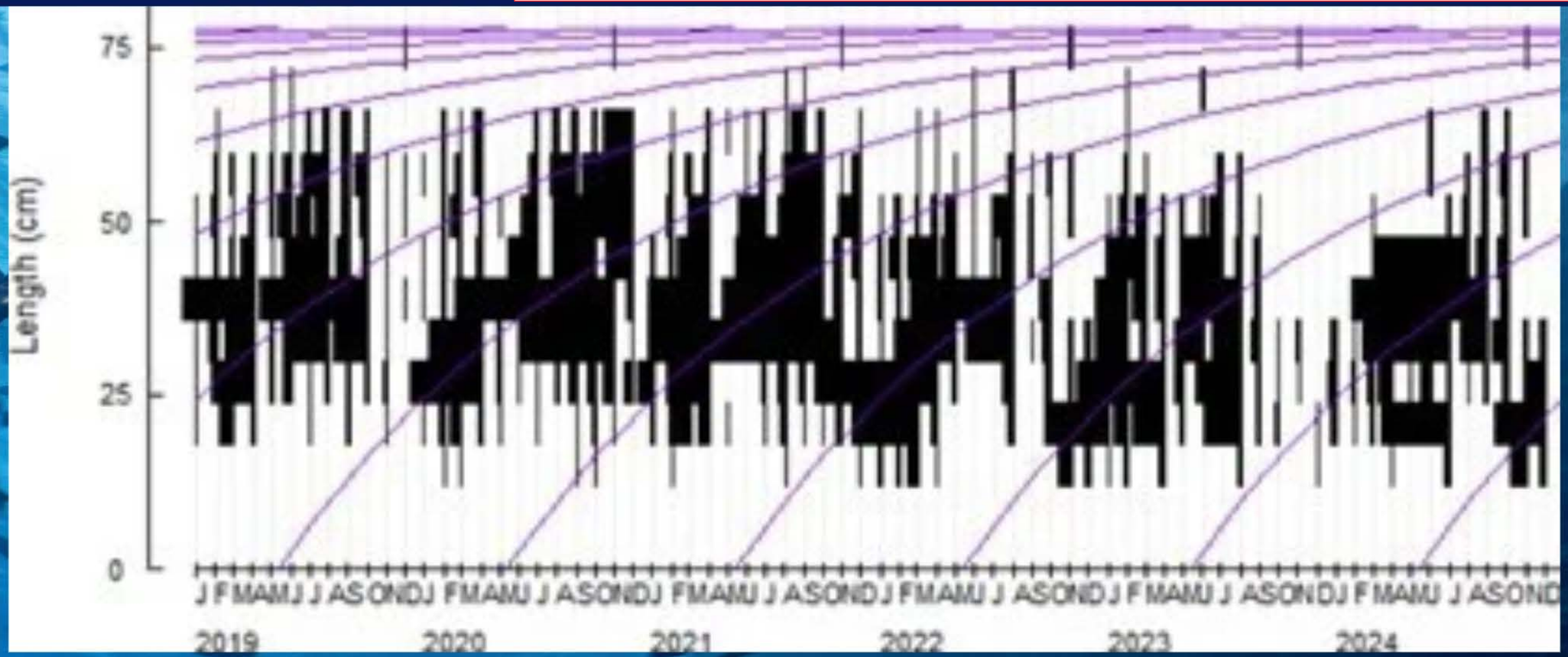
Rexruitment pattern

Rexrutment peaks in June to August and falls in November-December

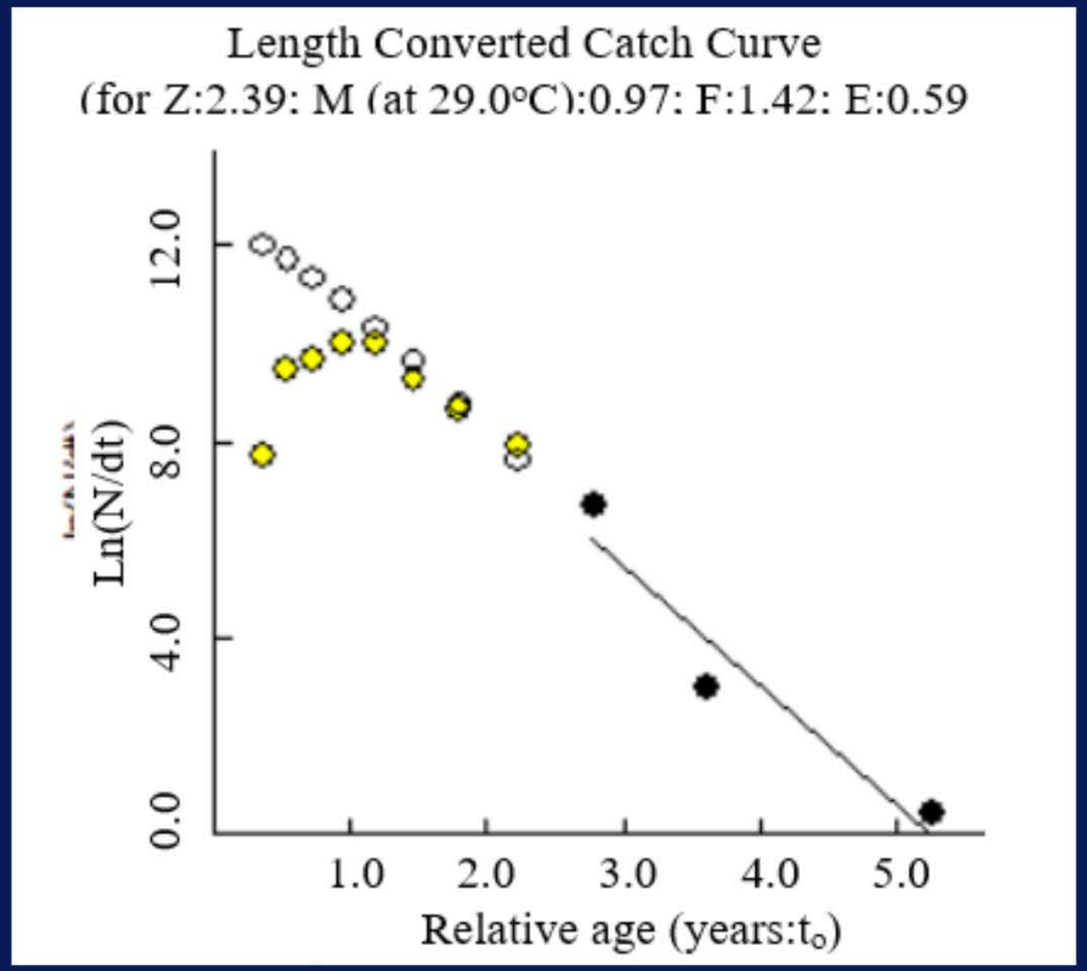
Parameter Pertumbuhan

Panjang maksimum 76,75 cm dan laju pertumbuhan moderat (K = 0,58 tahun^{-1})dengan ukuran dominan <50cm, mengindikasikan potensi dampak eksploitasi terhadap karakteristik biologis populasi

Growth parametersMaximum length 76.75cm dan moderate growth rate (K=0.58 a-1) with dominant size <50cm indicates a potential impact of exploitation on population biology characteristics



MortalityHi exploitation (E= 0.59) with fishing mortality (F= 1.42a-1) excedes natural mortality (M=0.97 a-1). This indicates an excessive fishing pressure and risk to stock sustainability



Tingkat Kematian

Eksploitasi tinggi (E = 0,59), dengan kematian akibat penangkapan (F = 1,42 tahun^{-1}) melebihi kematian alami (M = 0,97 tahun^{-1}). Hal ini menunjukkan tekanan penangkapan yang berlebihan dan risiko terhadap keberlanjutan stok.

Biological trend 1969 - 2024

B. TREND BIOLOGI 1969-2024

Distribusi Ukuran

Penurunan ukuran dominan dari 35–56 cm (1969–1990) menjadi 20–40 cm (2001–2010), mencerminkan meningkatnya penangkapan ikan juvenil. Namun, periode 2011–2024 menunjukkan tren pemulihan, dengan ukuran dominan meningkat menjadi 36–49 cm, serta mulai munculnya kembali ikan >60 cm..

Size distribution
Decrease in dominant size from 35-56cm (1969-1990) to 20-40cm (2001-2010) mirrors the increase in juvenile catch. However, in ther period 2011-2024 there is a tred to recovery, with dominant sizes increasing to 36-49cm and the re-occurance of fish >60cm

Table 2. Length Size Distribution Trends of Skipjack Tuna by Periods in FMA 714.

Period	Dominant Size Range (FL)	Larger Individuals (>60 cm FL)	Trend Description
1969–1990	35–56 cm	Common	Healthier stocks, larger fish present
1991–2000	25–45 cm	Rare	Shift toward smaller individuals
2001–2010	20–40 cm	Rarely observed	Continued skew toward smaller fish
2011–2018	25–45 cm	Slight recovery	Partial improvement in size range
2019–2024	36–49 cm*	More common (>60 cm FL)	Stabilization, but juveniles dominant

**: estimation from recent data analysis*

Penangkapan Ikan yang Belum Dewasa

Proporsi ikan belum dewasa dalam tangkapan mengalami penurunan dari sangat tinggi menjadi lebih stabil, yaitu 60–70% (2011–2018) dan 69,9% (2019–2024). Meskipun membaik, angkanya tetap menunjukkan dominasi juvenil, menandakan perlunya penguatan.

Catch of immature fish
The proportion of immature fish in the catch decreased from very high to a more stable rate, i.e. 60-70% (2011-2018) and 69.9% (2019-2024). Even though improving, this number still shows the dominance of juvenils, indicating the need for imrpovement.

Table 3. Immature Catch Trends of Skipjack Tuna by Periods in FMA 714.

Time Period	Immature (≤49 cm FL)	Mature (>49 cm FL)	Trend Description
1969–1990	40–50%	50–60%	Balanced composition; low fishing pressure and healthier stocks.
1991–2000	60–70%	30–40%	Significant skew toward immature individuals; overfishing of larger, mature fish.
2001–2010	70–80%	20–30%	Highly imbalanced composition; severe overfishing of mature fish; dominance of smaller size classes.
2011–2018	60–70%	30–40%	Improved composition; reduced fishing pressure on mature fish due to management interventions.
2019–2024	69.9%*	30.1%*	Majority of catch remains immature; focus on juveniles threatens stock recovery.

**: estimation from recent data analysis*

Seasonal and recruitment variations
Recruitment underwent a phase of significant change since 1969. Initially stable and together with the rainy season, strting in 1991 the recruitment period started shiifting. By 2019-2024, the peak recruitmnt had shifted drastically to June-September. This shift indicates serios population stress and requires immediate management measures to prevent stock collapse.

Variasi Musiman dan Rekrutmen

Rekrutmen mengalami fase perubahan signifikan sejak 1969. Awalnya stabil dan selaras dengan musim hujan, namun sejak 1991 terjadi pergeseran waktu rekrutmen . Pada 2019–2024, puncak rekrutmen bergeser drastis ke Juni–September. Pergeseran ini menandakan stres populasi yang serius dan perlunya tindakan manajemen segera untuk mencegah keruntuhan stok.

Table 4. Seasonal Variation and Recruitment Trends of Skipjack by Periods in FMA 714.

Time Period	Seasonal Variation	Recruitment Peaks	Trend Description
1969–1990	Strong peaks during wet season (November–April); favorable ocean conditions.	December–February.	Low fishing pressure; stable recruitment and balanced age structure.
1991–2000	Pronounced seasonal variation; peaks shifted slightly earlier.	November–January.	Increasing fishing pressure led to earlier recruitment peaks.
2001–2010	Persistent seasonal variation; peaks shifted further earlier.	October–December.	Further Increasing fishing pressure, recruitment peaks to shift even earlier
2011–2018	Consistent seasonal variation; peaks stabilized.	November–January.	Temporary stabilization because reductions in fishing effort
2019–2024	Peaks shifted progressively to August..	June–September.*	Extreme six-month phenological shift, adaptation to persistent fishing pressure

**: estimation from recent data analysis*

Growth parameters
Growth K experienced a gradual decrease since 1991 due to fishing pressure, while Loo remained relativelt stable. By 2019-2024, K stabilized (0.5-0.8 a-1) and Loo was 76.75cm. This change mirrors the cumulative effects of fishing and the potential evolutionary respoonse of the population

Parameter Pertumbuhan

Pertumbuhan mengalami penurunan K secara bertahap sejak 1991 akibat tekanan penangkapan, sementara L∞ relatif stabil. Pada 2019–2024, K mulai stabil (0,5–0,8 tahun^{-1}) dan L∞ tercatat 76,75 cm. Perubahan ini mencerminkan dampak kumulatif penangkapan dan potensi respons evolusioner populasi.

Table 5. Growth Parameters Trends of Skipjack Tuna by Periods in FMA 714.

Time Period	L∞ (cm FL)	K (year^{-1})	Trend Description
1969–1990	75-81 cm	0.7–1.2	Stable growth parameters; rapid growth indicative of minimal exploitation
1991–2000	70–75 cm	0.6–1.0	L∞ stable; K declined slightly due to increased fishing pressure affecting younger cohorts.
2001–2010	70–75 cm	0.5–0.9	Growth stabilized but slowed; regional variations in K.
2011–2018	70–75 cm	0.4–0.8	Continued decline in K; slower growth rates reflect fishing pressure.
2019–2024	70–75 cm 76.75 cm*	0.5–0.8 0.56*	Growth parameters stabilized; adaptation to current fishing pressures.

**: estimation from recent data analysis*

Table 6. Mortality Rates of Skipjack Tuna Trends by Periods in FMA 714.

Time Period	Natural Mortality (M)	Fishing Mortality (F)	Total Mortality (Z)	Trend Description
1969–1990	0.6–0.8 year^{-1}	0.2–0.4 year^{-1}	0.8–1.2 year^{-1}	M dominates, shows resilience under minimal exploitation.
1991–2000	0.6–0.8 year^{-1}	0.5–0.8 year^{-1}	1.1–1.6 year^{-1}	F rises significantly, higher Z, early signs of overfishing emerge.
2001–2010	0.6–0.8 year^{-1}	0.8–1.2 year^{-1}	1.4–2.0 year^{-1}	F reaches its highest, unsustainable levels.
2011–2018	0.6–0.8 year^{-1}	0.6–1.1 year^{-1}	1.2–1.8 year^{-1}	A slight reduction in F, Z decreases, initial recovery efforts
2019–2024	0.6–0.97 year^{-1}*	0.6–1.42 year^{-1} *	1.6 -2.39 year^{-1}*	F and Z remain high, posing a threat of overfishing.

**: estimation from recent data analysis*

Mortalitas

Mortalitas meningkat sejak 1991 akibat tekanan penangkapan yang intensif. F terbaru (1,42 tahun^{-1}) melebihi batas keberlanjutan, dengan 69,9% tangkapan berasal dari ikan belum dewasa. Penurunan biomassa sebesar 32% di Laut Banda dan menurunnya CPUE memperkuat indikasi overfishing. Indonesia perlu segera menetapkan batas tangkapan berbasis sains dan memperkuat pengelolaan untuk mencegah keruntuhan stok.

MortalityMortality increased since 1991 due to intese fishing pressure. The latest F (1.42 a-1) excedes the sustainability threshold, with 69.9% of catch consisting of immature fish. The decrease in biomass by 32% in the Banda Sea and the decreased CPUE strengthen the indication of overfishing. Indonesia need to immediately set science based fishing quotas and improve management to prevent stock collapse.

C. MANAGEMENT MEASURE:
PURSE SEINE KECIL

Management measure: Small Purse Seine

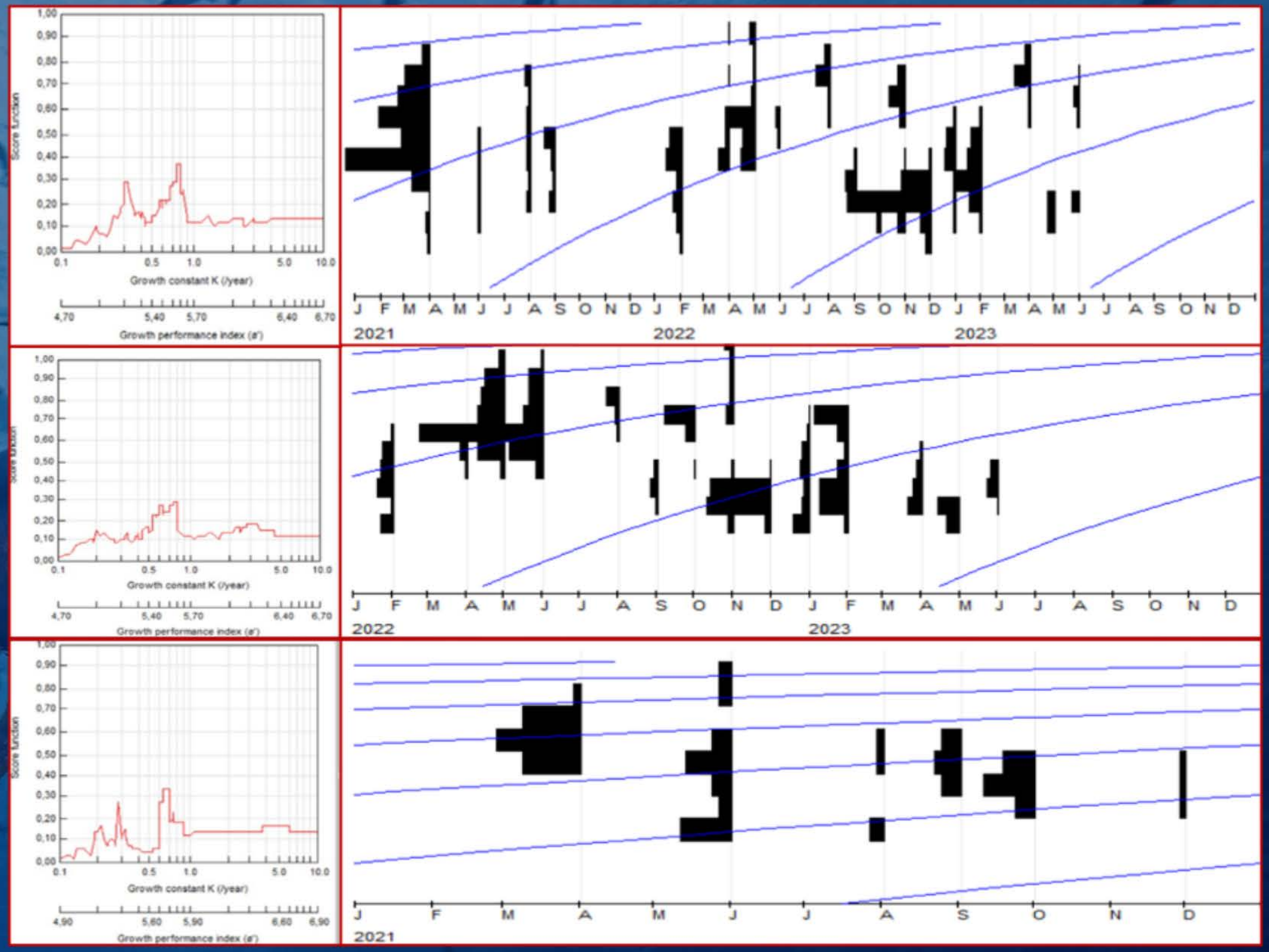
Growth

Pertumbuhan

Skipjack (1663, range 170-700 mm)
L∞ : 760 mm
K : 0,78 year-1

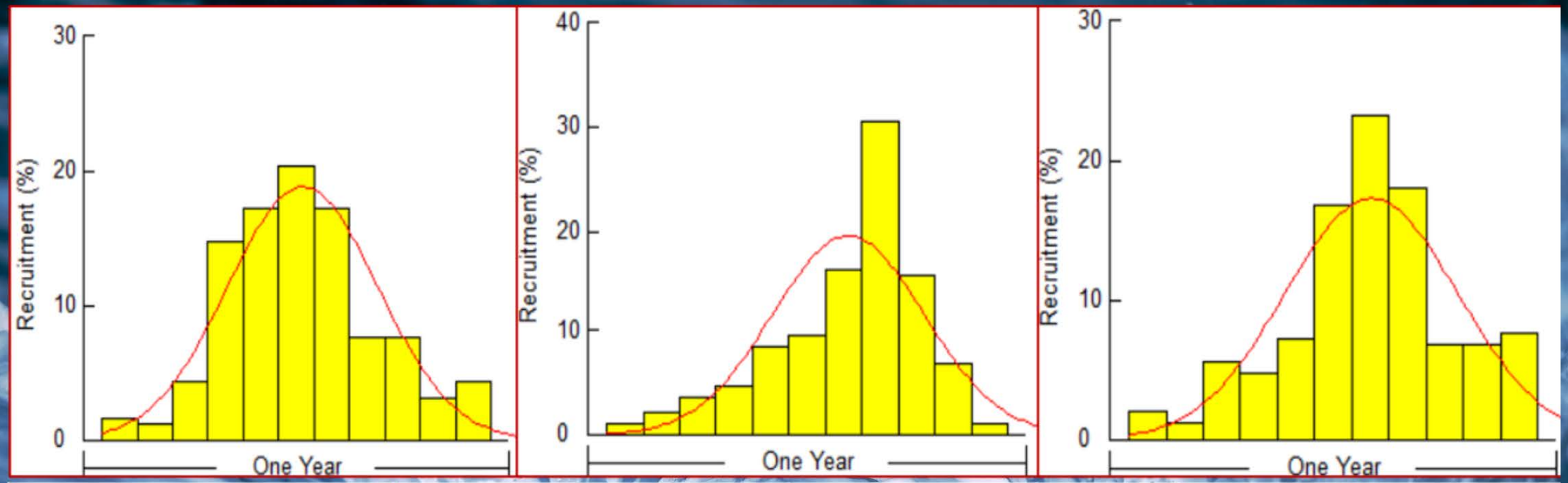
Yellowfin Tuna (907, range 110-590 mm)
L∞ : 790 mm
K : 0,76 year-1

Bigeye Tuna (489, range 154-630 mm
L∞ : 910 mm
K : 0,66 year-1



recruitment

Rekruitmen

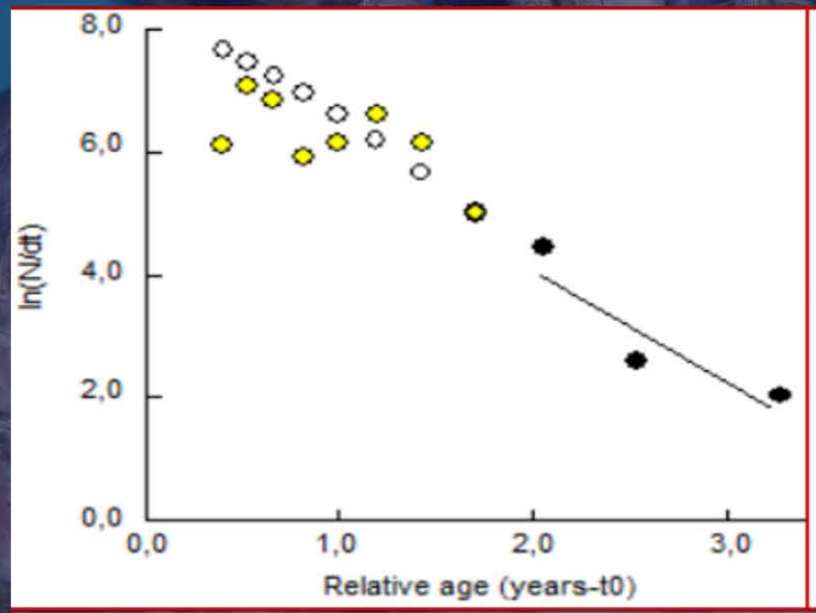


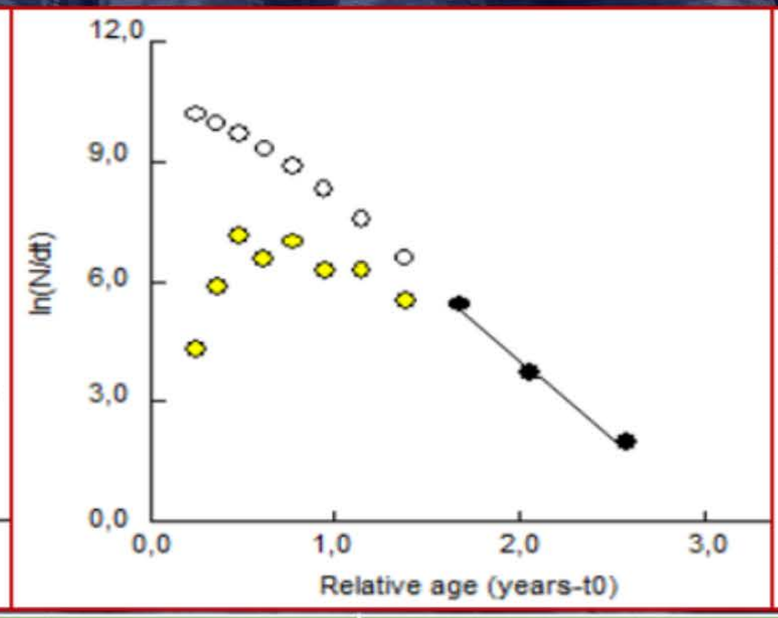
Rekruitmen	Skipjack (SKJ)	Yellowfin Tuna (YFT)	Bigeye Tuna (BET)
Pola	Multiple spawning	Multiple spawning	Multiple spawning
Puncak	Mei-Juli	Agustus-Oktober	Agustus-Oktober

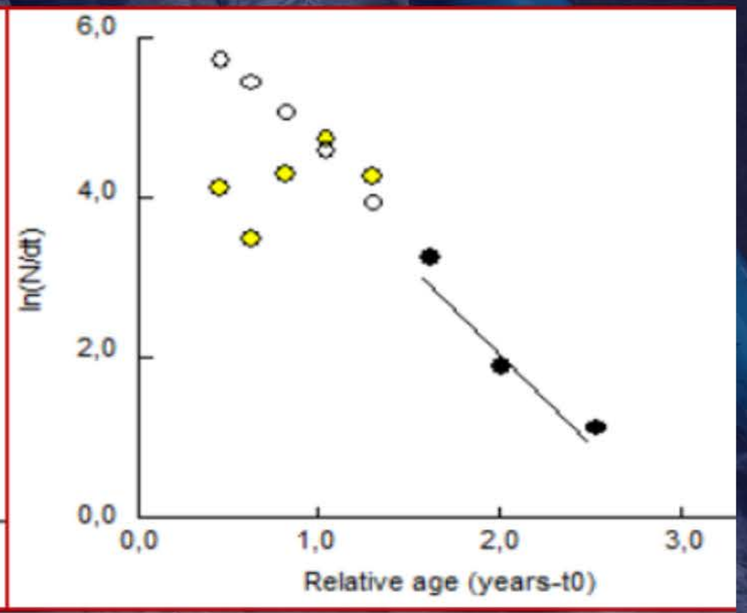
pattern

peak

Mortalitas







Mortality	Skipjack (SKJ)	Yellowfin Tuna (YFT)	Bigeye Tuna (BET)
Total (Z)	1,87	3,77	2,26
Alami (M)	0,59	0,61	0,53
Penangkapan (F)	1,28	3,16	1,73
Laju penangkapan (E)	0,68	0,84	0,74

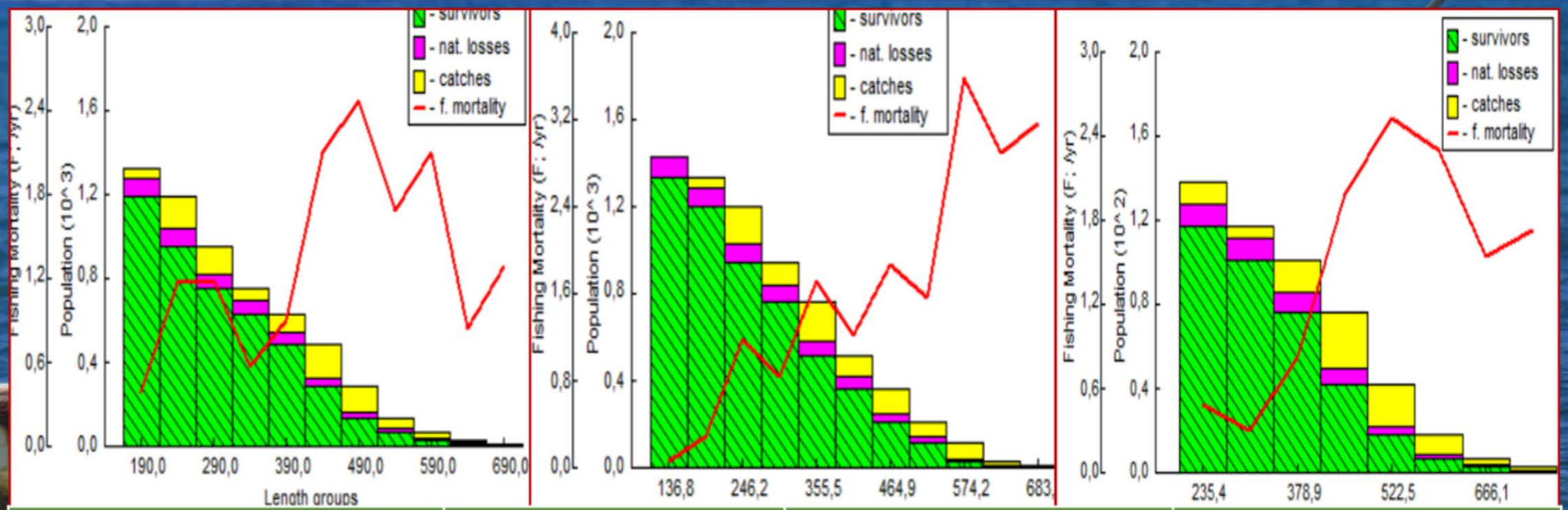
natural

fishing

fishing rate

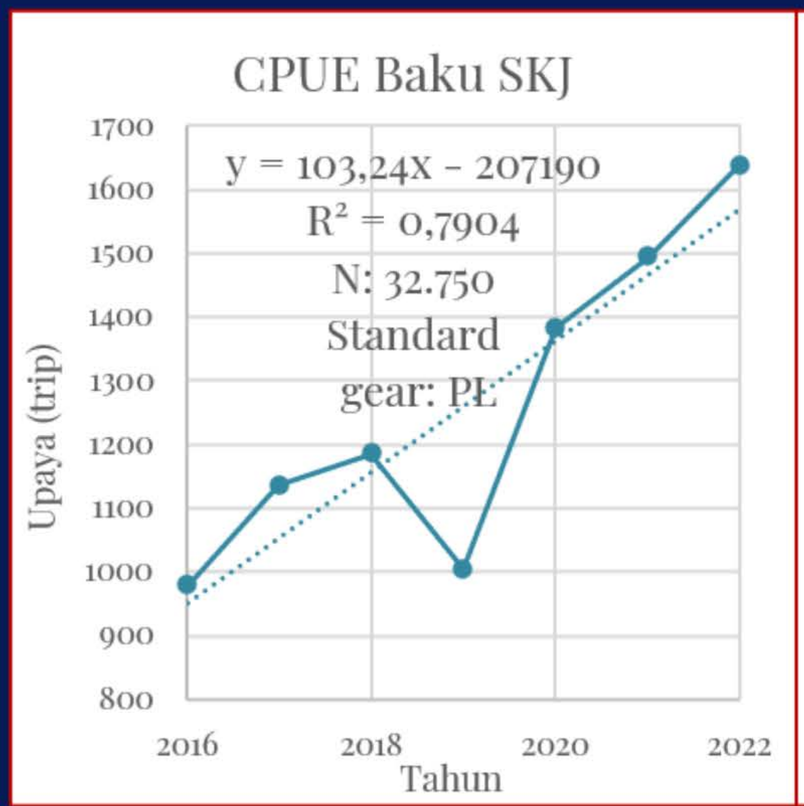
comparison biomass and exploitation rate

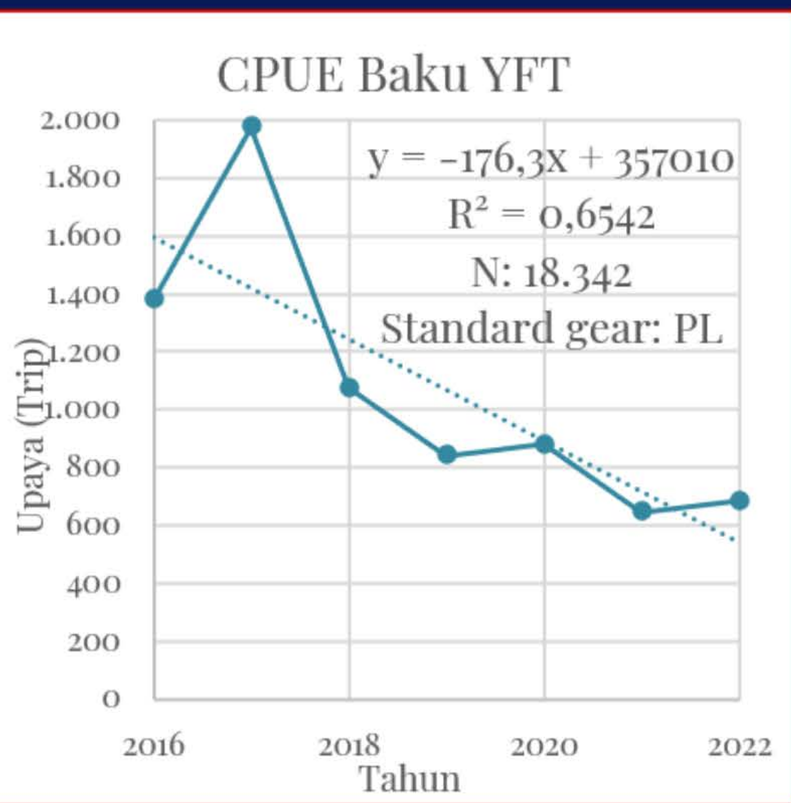
Perbandingan Biomassa dan Tingkat Eksploitasi

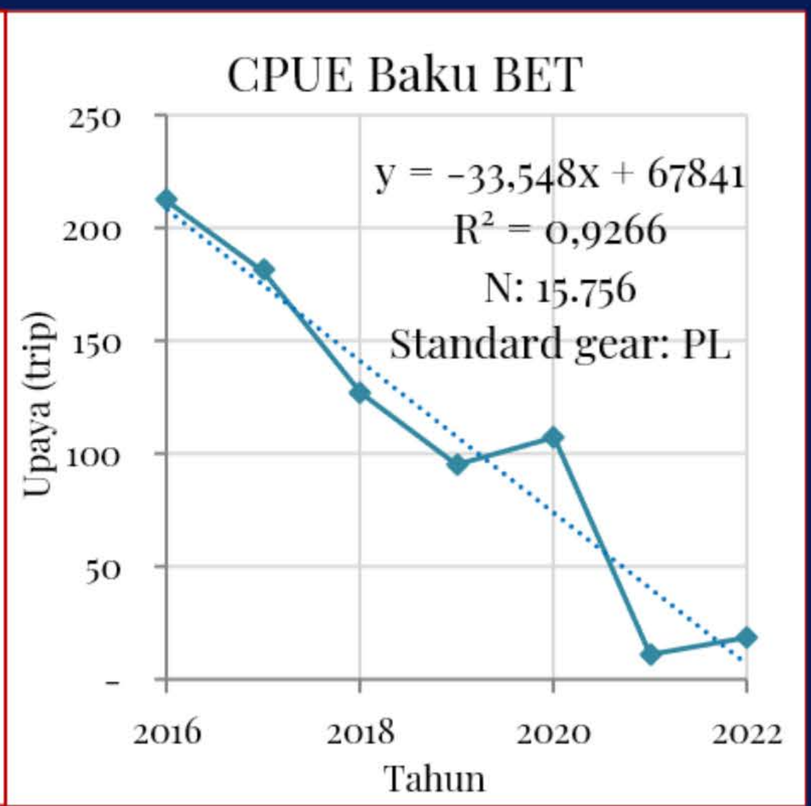


VPA (mm)	Skipjack (SKJ)	Yellowfin Tuna (YFT)	Bigeye Tuna (BET)
Titik kritis (critical point)	490	574,2	522,5
Ukuran Matang gonad (size at gonad maturity)	418	1060	1100

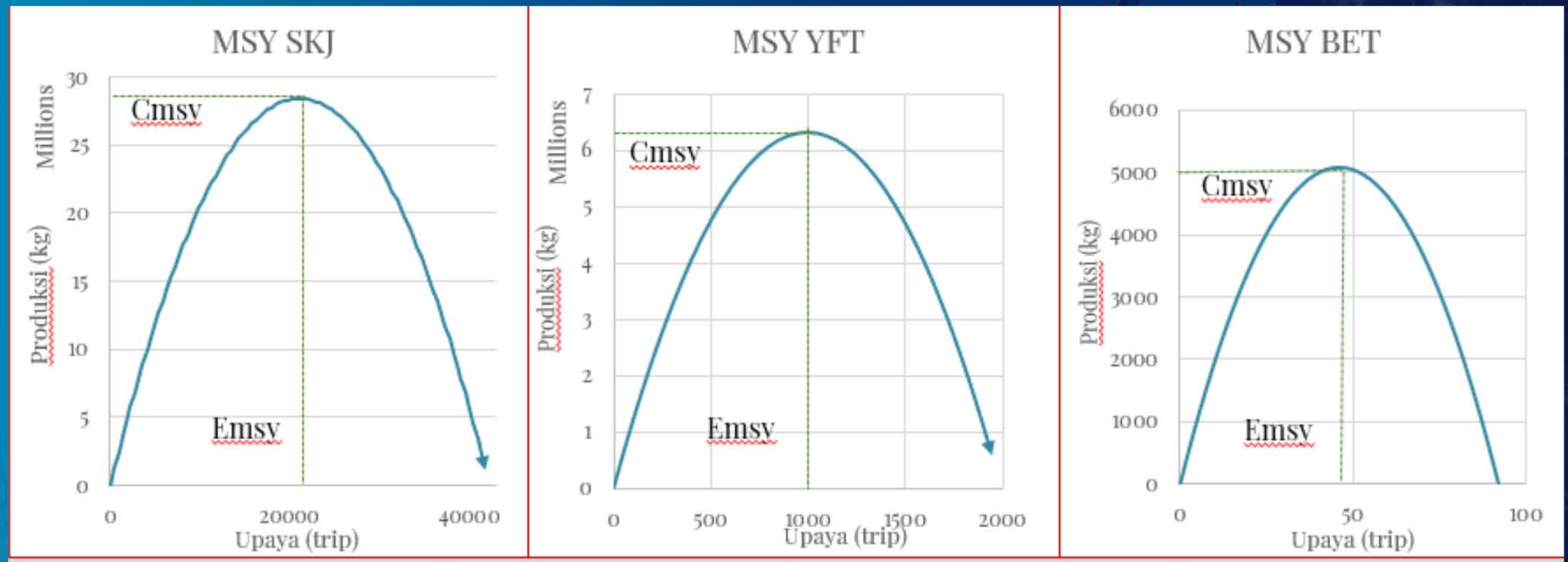
CPUE Baku 2016-2022





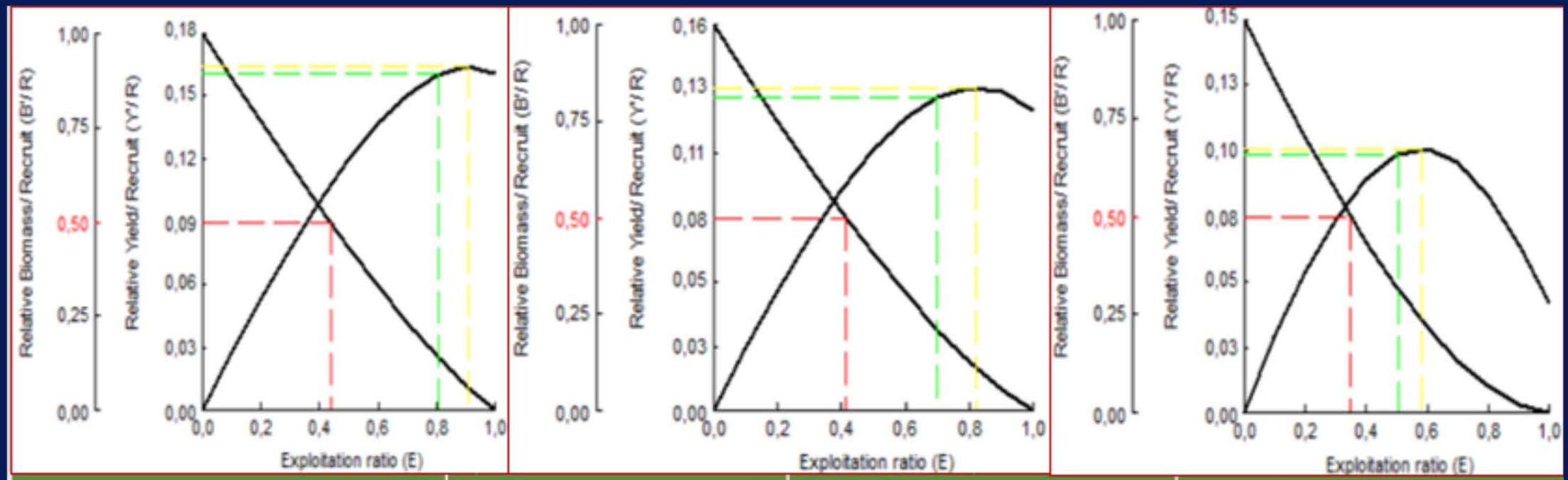


MSY tahun 2016-2022



MSY	Skipjack (SKJ)	Yellowfin Tuna (YFT)	Bigeye Tuna (BET)
EMSY (Trip)	2.400	1.089	48
CMSY (Kg)	27.288.73	6.276.876	4.999

MSY tahun 2016-2022



Relative Y &B/Rekruit	Skipjack (SKJ)	Yellowfin Tuna (YFT)	Bigeye Tuna (BET)
E10: *Y 10% /tahun*	0,805	0,701	0,506
E50: *Y 50% /tahun*	0,437	0,413	0,349
Emax: *Y 100%/tahun*	0,910	0,819	0,583
E: *Actual catch*	0,7 (76,9%)	0,8 (97,7%)	0,7 (120,1%)

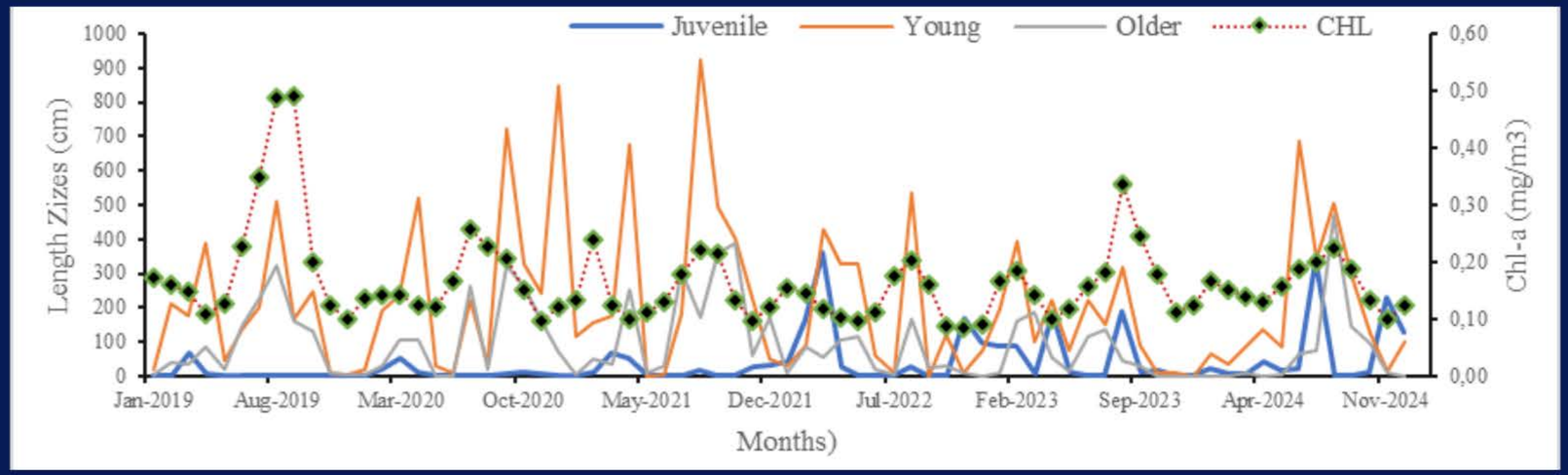
D. MANAGEMENT MEASURES :

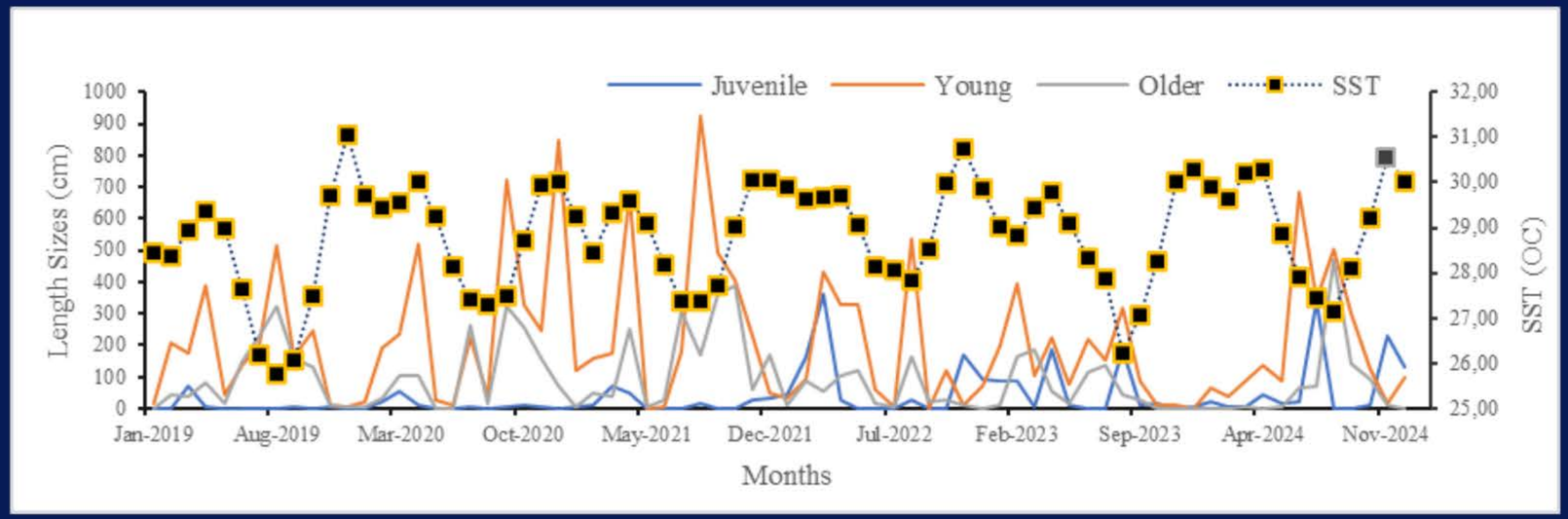
PERUBAHAN IKLIM

climate change

size segregation nased on ocanographic factors

Segregasi Ukuran Berdasarkan Faktor Oseanografi

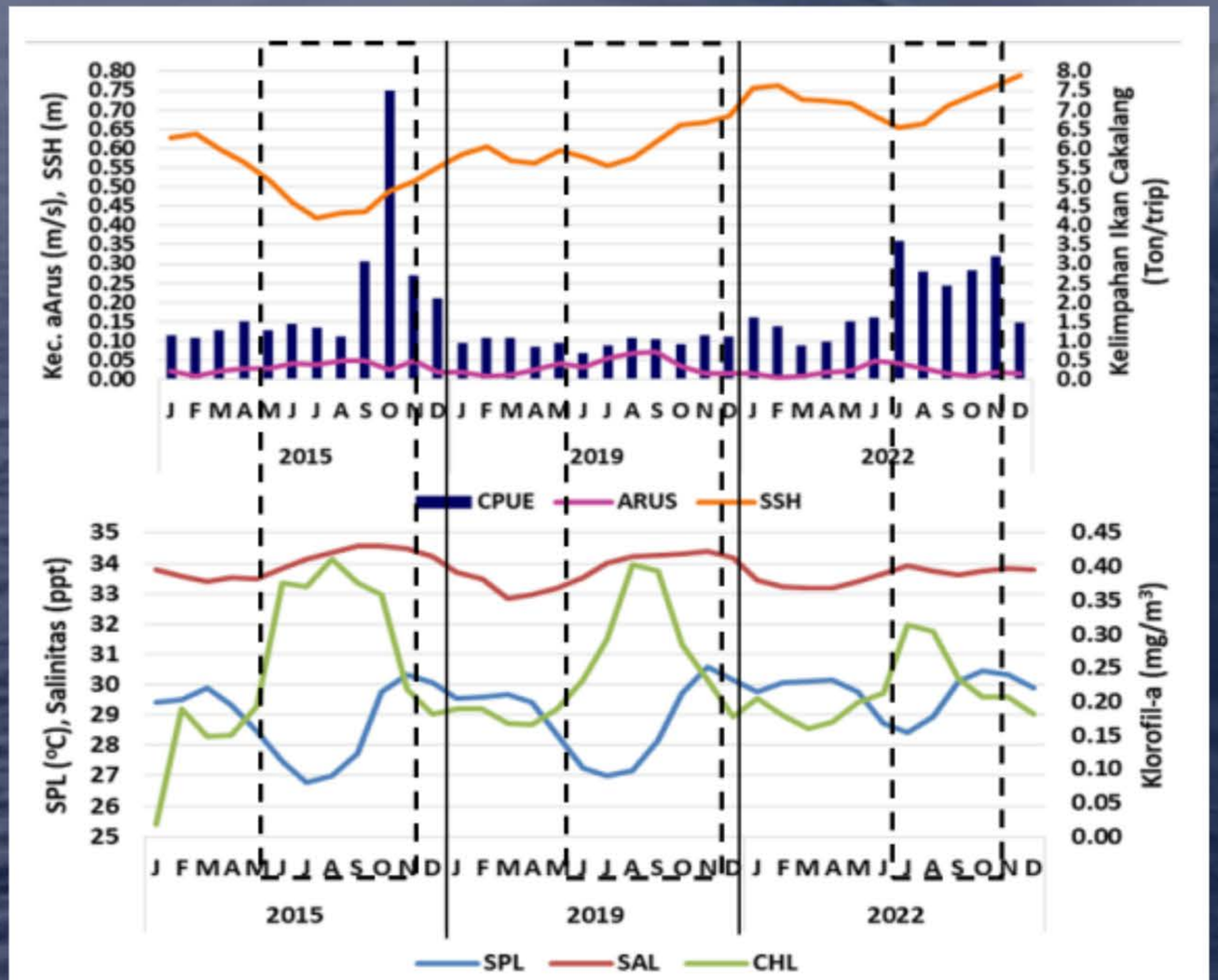




- oceanograhic factos have an impact on size segregation
- juveniles how segregation pattern based on fluctuations of SST and Chl-a. Segregation reduces for subadults, and is weak for adults
- juveniles are exposed to catch during certain months at the surface

- Faktor oseanografi berpengaruh pada segregasi ukuran
- Juvenil menunjukkan pola segregasi kuat berdasarkan fluktuasi SST dan Chl-a. Segregasi berkurang pada ikan remaja, dan lemah pada ikan dewasa
- Juvenil rawan tertangkap pada bulan tertentu di permukaan perairan

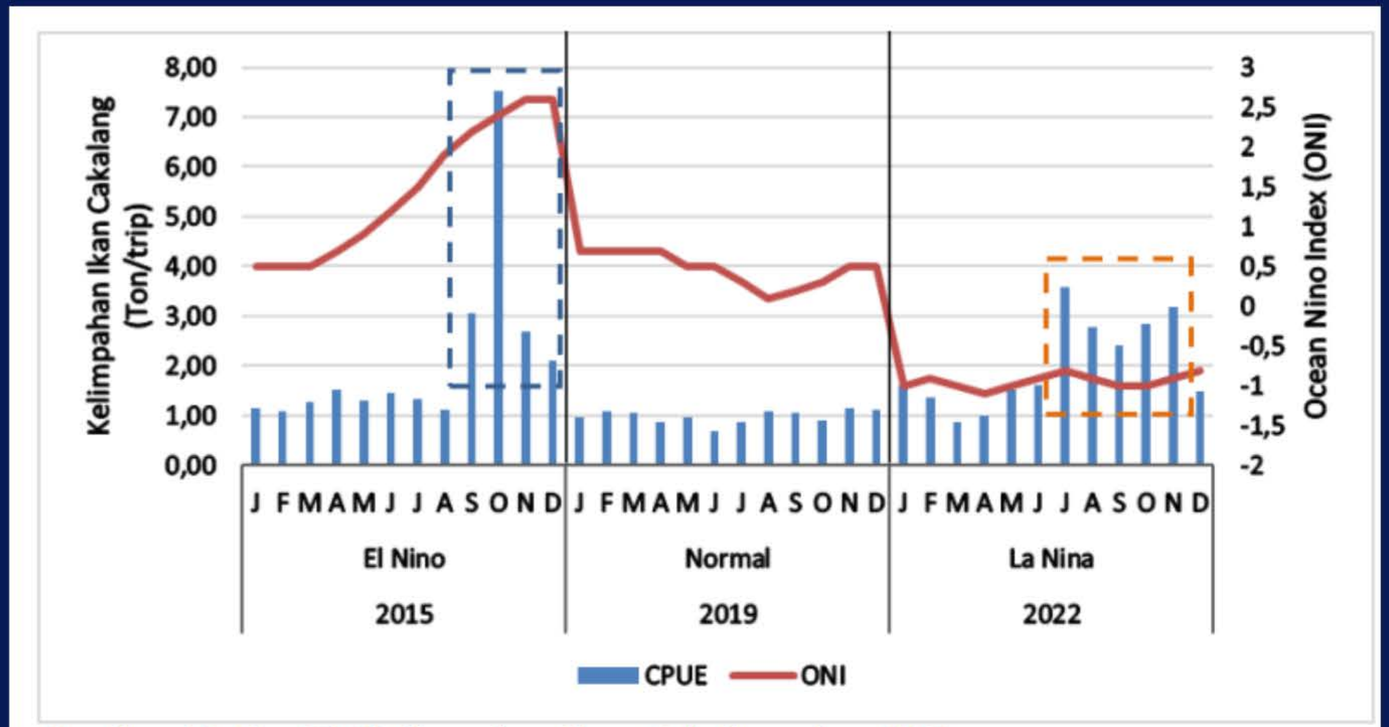
SKJ abundance based on ENSO phase
SKJ abundance during ENSO and normal conditions varies between 0.68 and 7.52 tons/trip. There is fluctuation for each phase, i.e., El Nino creates more productive water conditions and lasts longer than the La Nina phase



Gambar 6. Fluktuasi bulanan karakteristik oseanografi dan kelimpahan ikan cakalang pada Fase ENSO dan Normal di Laut Banda

Kelimpahan Cakalang Berdasarkan Fase ENSO

Kelimpahan ikan cakalang selama fase ENSO dan normal berkisar antara 0,68–7,52 ton/trip. Terdapat fluktuasi unik setiap fase yaitu El Niño menciptakan lingkungan perairan yang lebih produktif dan berdurasi lebih panjang dibanding fase La Niña.



Gambar 10. Grafik Kelimpahan Ikan Cakalang dan ONI

during the normal phase (ONI -0.5 to 0.5), oceanograihc conditions are stable and fish abundance is stable, too (0.68-1.14 tons/trip
- During El Nino (ONI >2.0), upwelling increases, pushing water productivity and fish abundance (2.1-7.52 tons/trip), predominantly durng Septermber - December
- during the La Nina phase (ONI -0.8 to -1.0) surface temperatures are still in the optimum range so that abundance increase (2.43-3.59 tons/trip) in June to November

- P
k
kelimpahan ikan juga stabil (0,68–1,14 ton/trip).

- Pada fase El Niño (ONI >2,0), upwelling meningkat, mendorong produktivitas perairan dan kelimpahan ikan (2,1–7,52 ton/trip), terutama pada September–Desember.

- Pada fase La Niña (ONI -0,8 s.d. -1,0), suhu permukaan laut masih dalam kisaran optimal, sehingga kelimpahan meningkat (2,43–3,59 ton/trip) pada Juni–November.

recommendations

E. REKOMENDASI

HS dan quota setting is done holistically and weighs biological aspect, oceanographic dynamics, climate change adaptation, and social economy. The expected output is to reduce the cathc of juveniles; increase of tuna stock,; reduced conflict between fishers, and increased income for small scale fishers

HS dan penetapan kuota dilakukan secara holistik mempertimbangkan aspek biologi, dinamika oseanografi, adaptasi perubahan iklim, teknologi penangkapan, dan sosial-ekonomi. Output yang diharapkan adalah Penurunan tangkapan juvenil; Peningkatan stok tuna; Pengurangan konflik nelayan, dan Peningkatan pendapatan nelayan kecil.

1: historical treds in fish resource health
- priority for protecting juveniles with size limits (SKJ >49cm, YFT >106cm, BET >110cm), closure during peak recruitment season (June - September), and lowering F under 0.6 a-1. 0%)
- Strengthen the implementation of seasonal closure during spawning and recruitment for stock recovery
- evaluation every 6 months using dynamic modeling for predicting impact of the quota on tuna stok, fisher income, and confrlict frequency
- need an evaluation of biological longitundinal trends for each tuna species as a baseline for setting quotas in WPPNRI 714

1. T

- Prioritas pada perlindungan juvenil melalui batas ukuran (Cakalang >49 cm, YFT >106 cm, BET >110 cm), penutupan musim saat puncak rekrutmen (Juni–September), dan penurunan F di bawah 0,6 tahun^{-1}. 0%).
- Penguatan implementasikan larangan melindungi musim pemijahan dan rekrutmen tuna untuk pemulihan stok.
- Evaluasi setiap 6 bulan menggunakan pemodelan dinamis untuk prediksi dampak kuota terhadap stok tuna, pendapatan nelayan, dan frekuensi konflik.
- Perlu kajian trend biologi longitudinal untuk setiap species tuna sebagai baseline penerapan kuota di WPPNRI 714

2. regulations for Purse Seine
complete the proposed adjustment for FAD limitation; there needs to be a regulation for FADs, i.e.:
- push for a complete migration of PS ke fishing area A and adjust stepwise the meshsize >2 inch (exlc. vessels <5 GT)
- limit the issuance of new licenses for small purse seine (mesh size <2 inch)
- prioritize licensing and quota for small fishers using env. frinedly gear (HL and PL)
- need to model pusrse seine vessel management and based on adjustment of zones, mesh size, and licensing based on biological and sociao-economic indicators, as well as integrating climate change

2. Pengaturan Purse Seine

Melengkapi usulan peyesuaian pembatasan rumpon, perlu dilakukan pengaturan alat tangkap purse seine, yaitu :

- Mendorong migrasi penuh purse seine ke jalur A dan penyesuaian bertahap ukuran meshsize >2 inch (tidak termasuk kapal ukuran < 5 GT)
- Pembetasan pemberian izin baru untuk purse seine kecil (meshsize <2 inchi)
- Mengutamakan pemberian izin dan kuota kepada nelayan klecil pengguna alat tangkap ramah lingkungan (HL dan PL)
- Perlu pemodelan pengelolaan kapal purse seine kecil dan besar berbasis penyesuaian zonasi, mesh size, dan perizinan berdasarkan indikator dampak biologi dan sosial-ekonomi, serta integrasi perubahan iklim

3. Integrasi Faktor Oseanografi dan PI

Perlu mempertimbangkan optimalisasi mu
konsentrasi Chl-a >0,3 mg/m³ dan SPL optir
tangkapan lebih besar, dan sebaliknya peng -a
rendah (<0,1 mg/m³) untuk menghindari tel

Adaptasi Terhadap Perubahan Iklim perlu diintegrasikan dengan:

- Pada fase Normal pertahankan penangkapan berbasis nilai kuota untuk keberlanjutan.
- Pada fase El Niño maksimalkan penangkapan pada September–Oktober.
- Pada fase La Niña tingkatkan penangkapan lebih tinggi dari fase normal pada Juni–November
- Penyesuaian periode larangan penangkapan bulan tertentu berdasarkan interaksi SPL+Chl-a dengan fase ENSO untuk memastikan perlindungan stok

3. Integrating oceanographic and climate change factors
Need to evaluate the optimalisation of fishing seasons based on Chl-A >0.3 mg/m3concentrations and optimal sea surface temperature (27-29C) because the potential for higher catch, and vice versa, reduce if surafce temperature >30C or Chl-A low ((<0.1 mg/m3) to avoid excess pressure on the stock.

Adaptations to climate change need to be integrated with:
- during normal fases, maintain catch based on a sustainable quota
- during El Nino phases, maxmize catch in September - October
- during La Nina phases, increase catch over normal phases in June - November
- adjust seasonal closure during certain months based on th interaction between sea surface temperature and Chl-a with the ENSO fase to ensure protection of the stock

LET'S DISCUSS!

0822-2004-8899

andirwannur@uho.ac.id