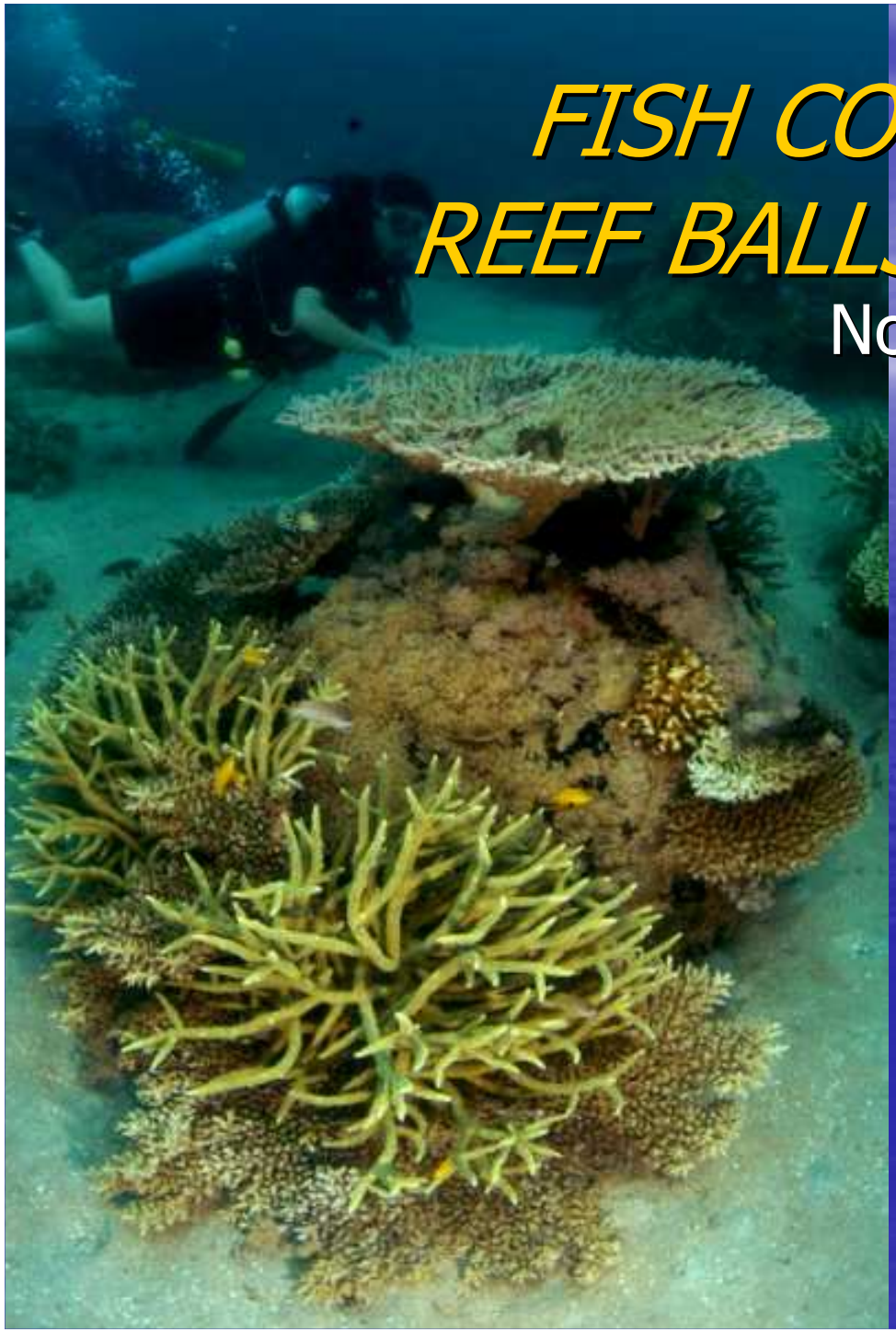


FISH COLONISATION OF REEF BALLS OVER 8 YEARS

North Sulawesi, Indonesia

Presented at: 9th CARAH, Brazil

8-13 November, 2009

David Lennon[1], Jerry Kojansow[2], David Sompie[2] & Djonlie Emor[2]

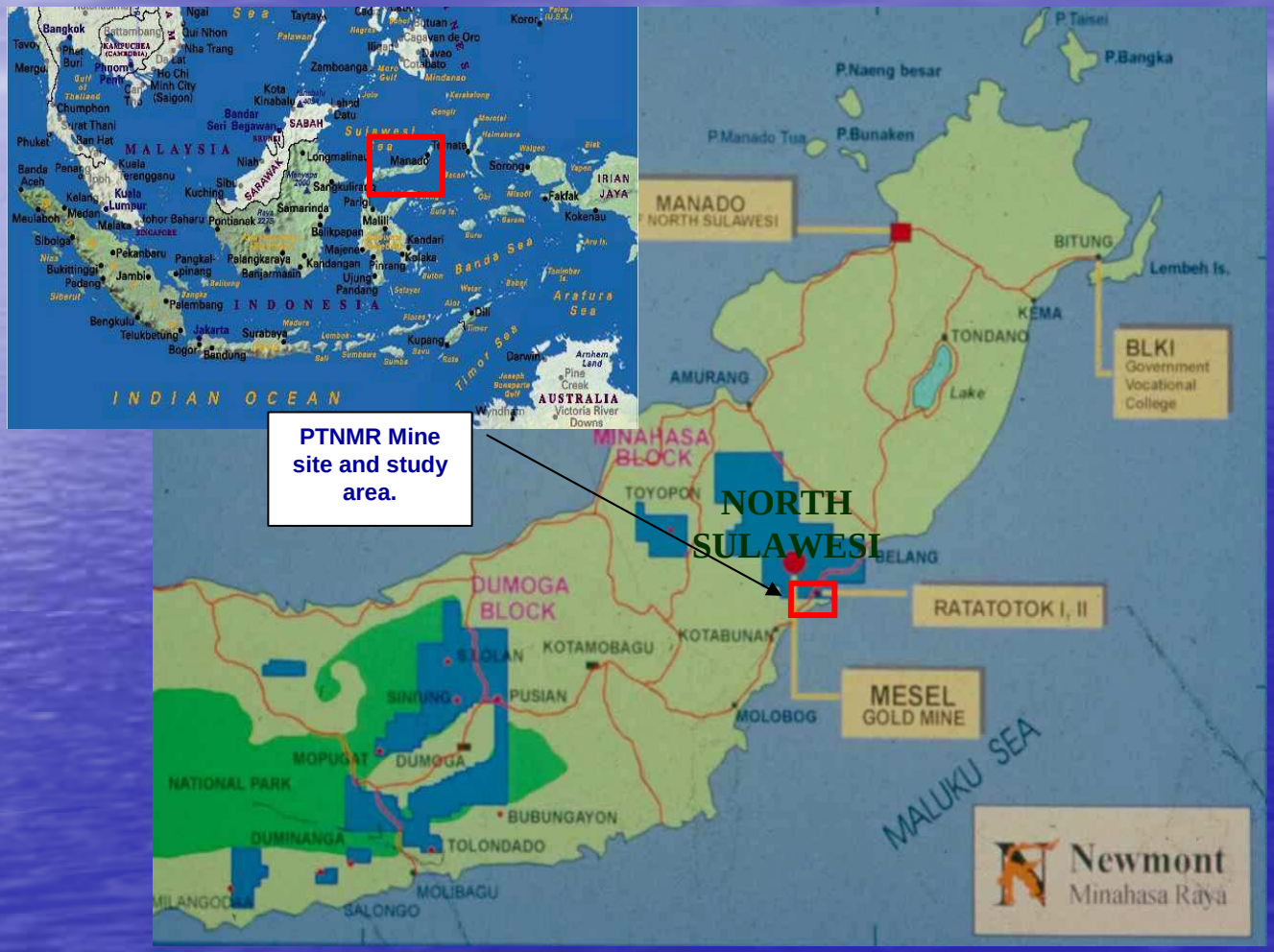
[1]Reef Ball Australia
[2]PT Newmont Minahasa Raya

This presentation covers…

- Program location and sponsor
- Artificial reef objectives, design and construction
- Survey methodology
- Results
- Conclusions

- Questions?
- Contacts for further information

Program Location



Program Sponsor

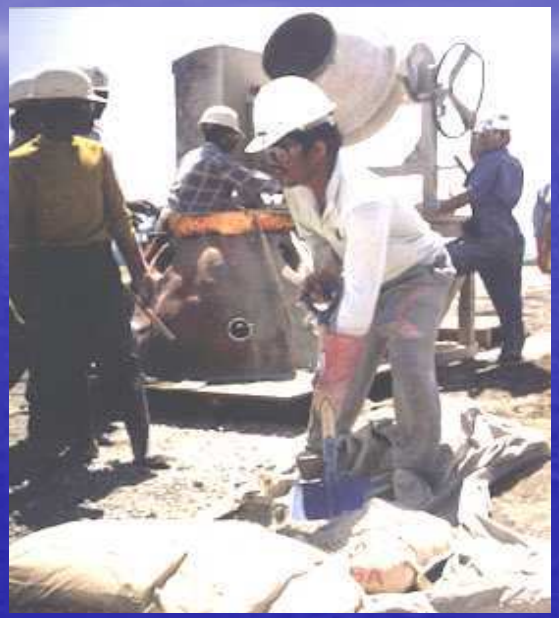
- PT Newmont Minahasa Raya (PTNMR)
  - Joint venture company between Newmont Gold Company (USA) and PT Tanjung Serapung (Indonesia).
  - Operated an open pit gold mine from 1996 until 2001. Mine closure activities completed in 2004.
  - As part of PTNMR's commitment to the environment and local community, PTNMR funded the construction and monitoring of the largest Reef Ball artifical reef program conducted by a private company, with over 3,000 Reef Balls deployed. An asset that will continue providing for many years.

Objectives

1. Enhance fish stocks;
2. Mitigate loss of reef due to blast fishing, cyanide fishing or other unsustainable practices; and
3. Increase skills within the local community, provide additional source of income.

Artificial Reef Construction

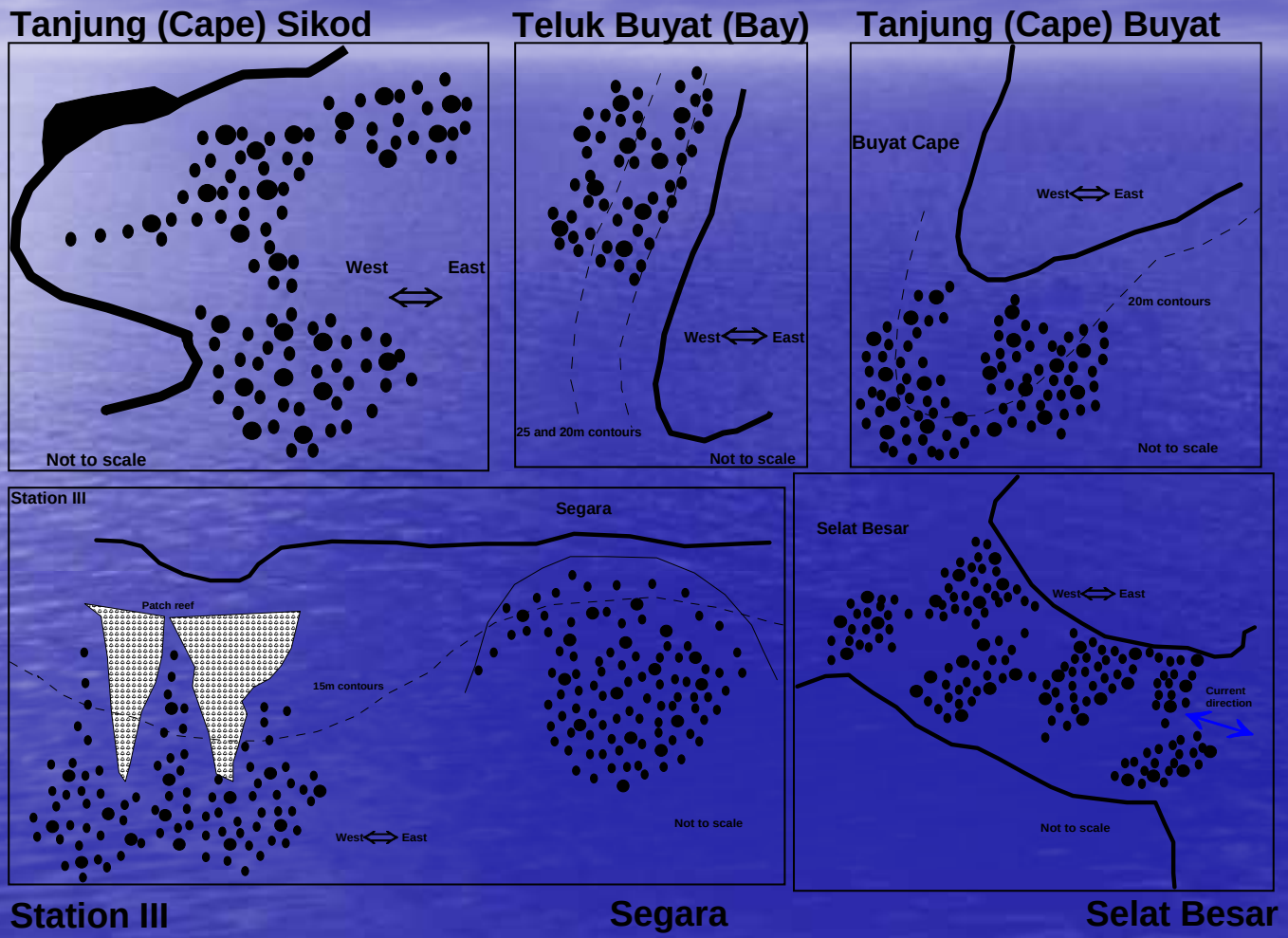
- Pallet Ball (~650kg, 0.9m H) and Bay Ball (~280kg, 0.6m H)
- Construction of units by 25 local villagers, over 4yrs, full time.
- Deployment by barge
- Commenced in 1999, finished 2002.



Six sites...


RATATOTOK
Teluk Totok
Hard, strong current
474
Depth: 8-12m
Sandy rubble
227
Depth: 10-25m
Selat Besar
Pulau Dako
Sungai
BUYAT
Steep slope
59
Depth: 20-30m
Dermaga Lakban
Ratatotok
Segara
Station III
Tanjung
Teluk Buyat
Teluk Buyat
G.Babakan
Tanjung Buyat
Hard, sandy rubble
153
Depth: 15-25m
Hard, sandy rubble
203
Depth: 10-30m
Tanjung Sikod
Sandy mud
358
Depth: 12-14m
MALUKU SEA
Tanjung Sikod

Configuation of the AR's



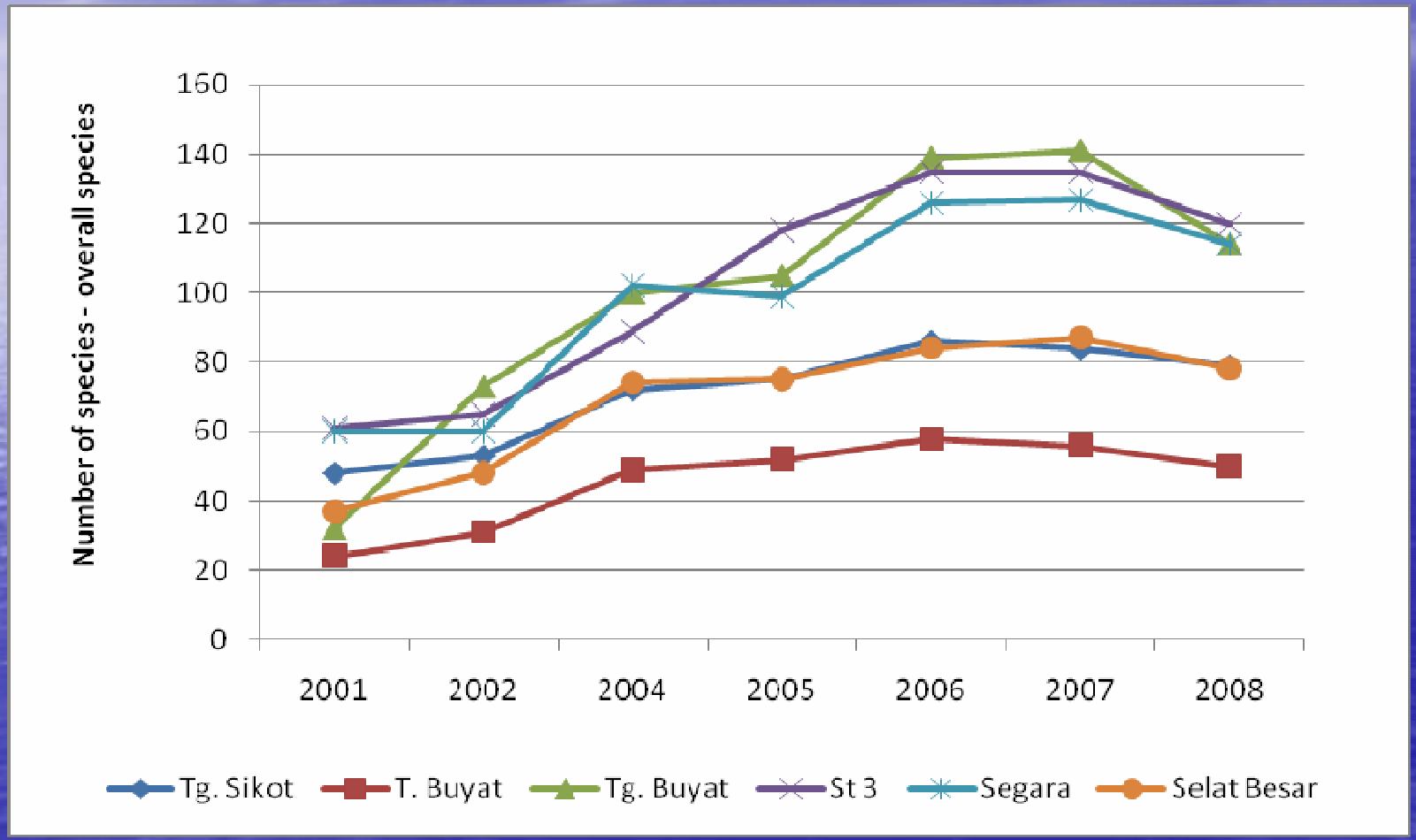
Survey Methodology

- Annually, August or September
- 2001 to 2008
- Visual census, 30-40 mins
- One sampling event per site
- Same observer
- Same Reef Balls each time, however # varies between sites
- Depths: 5-30m

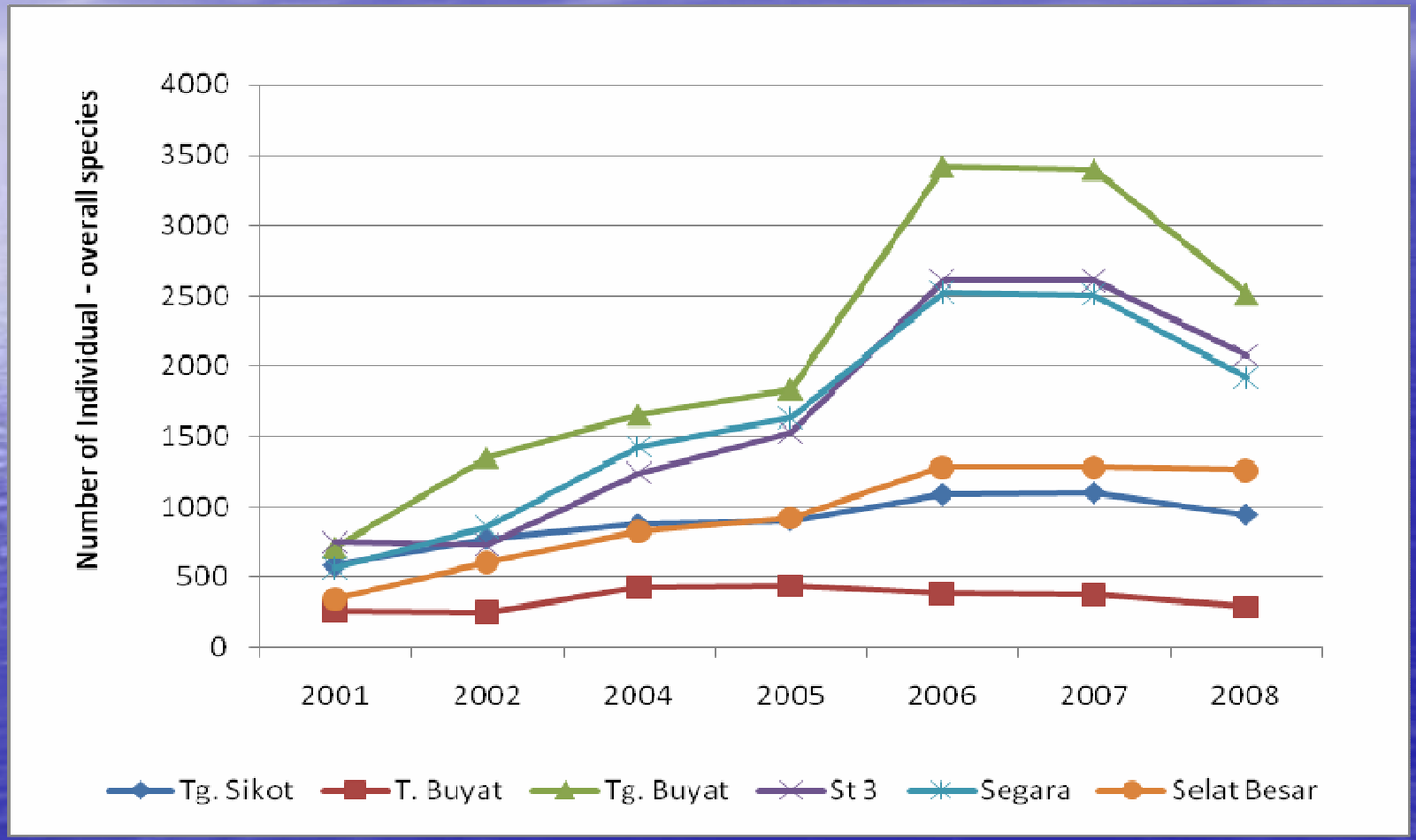
Results

- Key findings, for all reefs combined (2008)
  - 26 Families
  - 72 Genera
  - 150 species
  - 9,006 individuals
  - Steady increase up to 2006, then slowed, with decrease in mainly the commercial species and individuals in 2007 to 2008

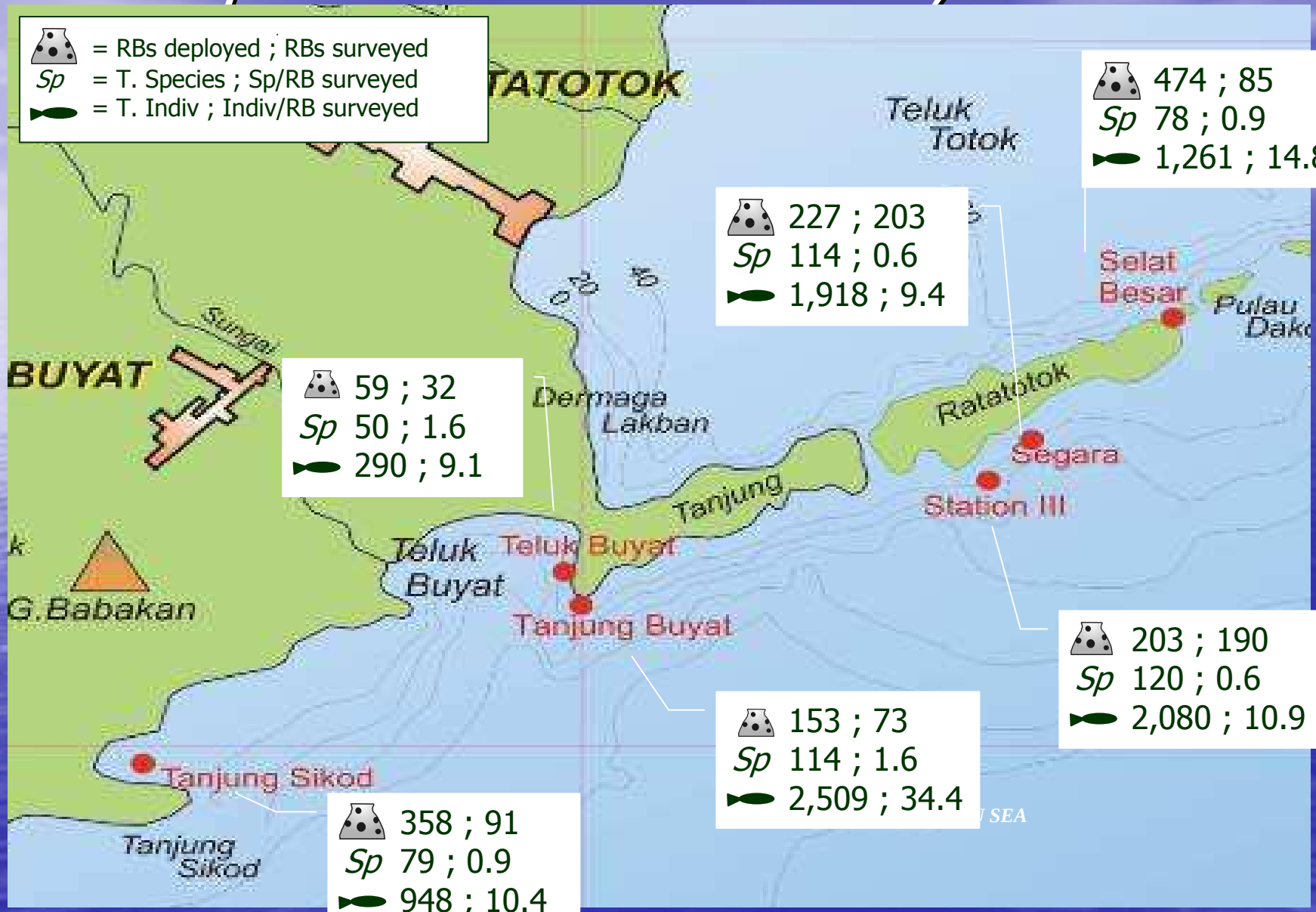
Total Species Recorded per Site

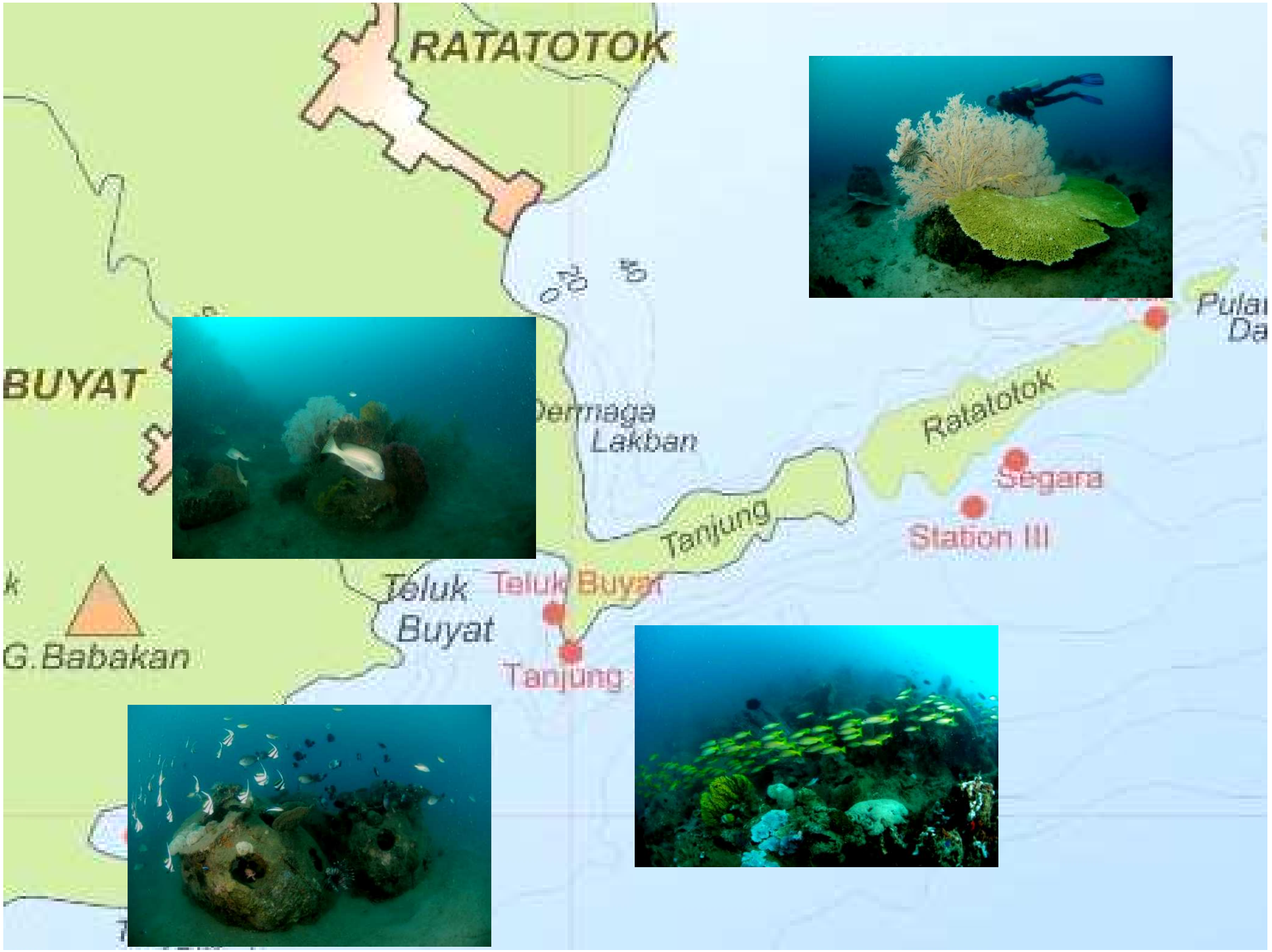


Total Individuals Recorded per Site



Total Species and Individuals, 2008




RATATOTOK
BUYAT
Lakban
Ratatotok
Segara
Station III
Tanjung
Teluk Buyat
Tanjung
G.Babakan

Top 5 species, all sites

- The top 5 most abundant species from all sites combined were:

1. Blue streak fusilier (*Pterocaesio tile*)
2. Yellow tail fusilier (*Caesio cuning*)
3. Blue stripe snapper (*Lutjanus kasmira*)
4. Two-tone tang (*Zebrasoma scopas*)
5. Moorish idol (*Zanclus cornutus)*

- Dominant Families: Acanthuridae, Lutjanidae, Mullidae, Siganidae, and Scaridae.

- Roughly an equal split between commercial and coral reef species overall.

Conclusions

- Likely factors influencing the variations between sites include:
  - Number of Reef Balls; more = ✓
  - Proximity to natural reef; <10m = ✓
  - Spacing of Reef Balls; min gaps = ✓
  - Bottom type: hard substrate = ✓ caution…
  - Water quality, nutrients, currents
  - Depth; 15-25m = ✓
- During the 8 yrs of study (2001-2008), colonization peaked at 6 to 7 yrs. NB: Reef Balls deployed between 1999-2000, therefore peak is actually year 7 to 8.
- Drop in numbers, 2007 to 2008 could be due to cessation of marine police patrolling the area from 2006 onwards.

Conclusions cont…

- Objective 2 – Mitigating impacts.
  - Considered successful based on this study and other studies showing coral growth in impacted areas, and increased awareness via local community development programs.
- Objective 3 – employment/income.
  - Reduced distance to fishing sites, increased number of fishers, employment during construction.


Thank You
Questions?

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