# Relationship Between Species Composition of Butterflyfishes and Coral Cover (Case Study: Taka Bonerate National Park)

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***Abstract***

*Coral reef environment has a strong influence on associated organisms such as fishes, mollusks, and others. Wherein, the butterflyfishes are marine fishes which closely associated with the tropic group as dietary specialization i.e. obligate coral feeder, facultative, and generalist. The obligate may respond only to change in preferred corals and not indicate others. However, generally show in different response in habitat deteriorates and may allow switching feeding to a less preferred one. Many questions remain about food specific at the species level which may potentially as bio-indicator for coral conditions. Here, this studied the species composition among coral coverage. We explore the environmental degradation in Taka Bonerate National Park impact on food resources and fishes especially for butterflyfishes community. This study focused on family Chaetodontidae with Underwater Visual Census (UVC) method and Underwater Photo Transect (UPT) method for coral cover. This study was carried out at Taka Bonerate National Park, South Sulawesi between May and June 2019. There were 342 individuals observed and dominated by Chaetodon kleinii, Hemitaurichthys polylepis, Heniochus chrysostomus, C. lunulatus, C. melannotus, C punctatofasciatus, and Forcipiger flavissimus. However, we found a site with diversity index and coral cover has across conditions. Whilst, these benthic communities mostly dominated by Acropora, which may be preferred by specific species. Butterflyfishes have several types of foraging tasks and may impact in utilizing the coral reef and other social habitats used. The species composition and abundance of butterflyfishes had relations not only by coral coverage but also benthic compositions. However, factors that regulate its specific species distribution and species compositions are still under study.*

***Keywords:*** *species compositions, benthic compositions, foraging task, coral cover, obligate*

## Introduction

Taka Bonerate is a Marine Nasional Park located in South Sulawesi with the Flores Sea geographical characteristic. Taka Bonerate consists of the atoll islands which expanse as the largest atoll in Indonesia with a major hotspot for biodiversity. The lagoon filled with massive reefs and various types of high-value fishes, mollusks, and other organisms (Aspan, 2015). These considered having a large influence on the structural systems such provide habitat, food, and shelter for associated organisms. Habitat consists of numerous types such as hard coral, soft coral, coral rubble, and macroalgae. However, hard coral plays the key to associated fishes. The anthropogenic influence such as destructive fishing, pollution, and climate change are seriously threatening the biodiversity of coral reef (Titaheluw *et al*., 2015). The stressful environmental condition affected the corals by less nutrition and respond to coral feeding behaviors. Those should be directly correlated with the distribution and abundance of butterflyfishes. However, the territory size, feeding rate, and other related behaviors is a simple way to asses the general health of the coral reef (Khalaf and Crosby, 2005).

Butterflyfishes is an indicator of coral reef change conditions, those fish belong to family Chaetodontidae which mostly feeds on coral (Allen, 2000). However, they have foraging categories and feeding types as an obligate, facultative, generalist and planktivorous (Allen and Erdmann, 2012), and also have several types of coral tissue preference for their food (Hourigan *et al.*, 1988). Study of stomach

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ijms.undip.ac.id
DOI: 10.14710/ik.ijms.25.3.121-126
Received : 29-05-2020
Accepted : 03-08-2020

contents showed that some butterflyfishes feed dominance on hard corals, feed on both soft and hard coral, feed on small invertebrates, feed on zooplankton, and the other feed on a wide range of above food categories (Allen and Erdmann, 2012). Coral feeding behavior intimately linked to dietary specialization. Most organisms have a range of dietary specialized adjusted as a response to food available resource fluctuation (Berumen and Pratchett, 2008). Coral feeding specialists expected to emigrate and respond differently than species with generalized diet to changes in coral conditions. The specialist may respond only to change in preferred corals and not indicate others. However, generalist show in different response in habitat deteriorates and may allow switching feeding to a less preferred one. The coral feeders for a non-territorial response to decreased food abundance may involve more rapid than those of territorial species (Hourigan *et al.*, 1988).

Butterflyfishes are not normally target fishing and also highly sensitive to change in coral conditions. The biological indicator organisms have a close relationship to the resources, while coral condition drives the abundance and species composition of butterflyfishes. Butterflyfishes heve foraging areas based on their preferred coral cover. The coral cover influenced evidently differences in fish abundance in different areas. According to Hourigan *et al*. (1988), they found a correlation between coral cover and the number of coral feeding, but a negative correlation between preferred coral cover and feeding territory. Here, this research explore the environmental degradation in Taka Bonerate National Park impact on food resources and fishes community. Specifically, this study aims to determine the coral coverage affects the abundance and species compositions of butterflyfishes, and investigate how certain more closely their relationship.

## Materials and Methods

This study was carried out at Taka Bonerate National Park, South Sulawesi (6°51'9.89" S, 120°47'32.48" E) between May and June 2019. There were twelve sites in present study and distributed on several areas. Figure 1. All sites were characterized by steep drop-offs with 45° greater walls, the area occurred in shallow waters between 7-10 m depth.

Research focused on butterflyfishes that contribute to association with spatial variation of coral covers percentage (Pratchett and Berumen, 2008).

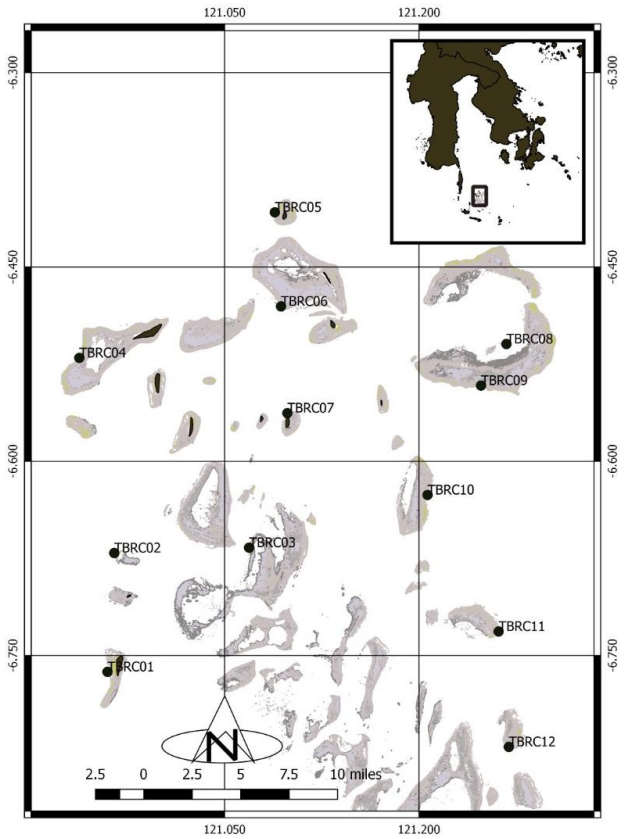


**Figure 1.** Map of the study and sampling sites

Butterflyfishes was characterized based on their diet information and feeding behavior, obtained from Extensive published data (Berumen and Pratchett, 2008; Berumen *et al*., 2011). This study focused on genera of Chaetodontidae which may dominant, thus each plays different and complementary roles in the coral reef: obligate, generalist, planktivore, and others. However, seem amongst environmental variables condition correlate with the feeding activity patterns. Method to observe butterflyfishes used was UVC (Underwater Visual Census), as anon-destructive methods and superior to collect data for diversity (Putra *et al.*, 2018). A total of 70 m long with 5 m on either side of transect were conducted per sampling sites, which is an area for assessment of fish diversity (number of species) and abundance (number of individuals). This study was used SCUBA diving equipment for collecting the data.

### *Coral reef coverage*

The benthic coverage was assessed using the UPT (Underwater Photo Transect) method. The photograph was taken in 90° angles perpendicular to quadrat transect with dimension of 58x44 $cm^2$. The distance of 60 cm between the camera and substrate, and the quadrat transect has a distance of 1 m of each Underwater digital camera Canon G15 was used to taken 50 photos per site. The estimate of benthic coverage was carried out using the software CPCe 4.1 (Coral Point Count with excel extension). The benthic substrates based on following types: hard coral (HC), dead coral (DC), dead coral with algae (DCA), soft coral (SC), sponge (SP), fleshy seaweed (FS), other fauna (OT), rubble (R), sand (S), silt (Si), and rock (Rk) (Giyanto, 2012).

### *Data analysis*

Data of butterflyfishes were analyzed using Shannon diversity index (*H'*), evenness index (E), and dominance index (D). The calculation of each indices used was the PAST analysis. Diversity index was categorized into 3 criteria which is H'<1= low, 1<H' ≤ 3=middle and H'≥3=high diversity. However, the evenness categories described as E<0.4=low, 0.4 <E<0.6= middle and E>0.6= high (Wilhm and Doris, 1986).

## Result and Discussion

A total of 342 individuals of butterflyfishes were found across all 12 sites. Wherein, 22 species recorded which belong to genera *Chaetodon*, *Coradion, Forcipiger*, *Hemitaurichthys* and *Heniochus*. According to the index of diversity (Figure 2), all sites showed in the middle diversity category, except at TBRC08 (H' = 0.8) in the lowest diversity conditions. The benthic community at TBRC08 showed that the site has a hard coral coverage at 26.53% (Table 1). Thus has across conditions with TBRC02, 06, 09, and 12 as a middle condition for diversity index in the lowest percentage of hard coral cover. Whilst, the benthic communities in TBRC08 were mostly dominated by *Acropora*, which may be preferred by specific species. It has a low range of foods for other species which have different foraging tasks. Wherein only founded 13 individuals in 3 genera which *Chaetodon kleinii* was founded in large aggregations (69.2%). This species formed in small groups and found in various habitats (Kuiter and Tonozuka, 2001). Moreover, the index of dominances in TBR08 was showed at D=0.5, the value approached 1 indicated there is found species dominated (Sirait *et al.,* 2018). The other entities of the evenness index showed a high category for all sites. However, 3 sites were found in the middle category *i.e.* TBRC01, 03, and 09 (E=0.6). The evenness index presents how species in individuals or biomass are spread among other species in the same habitat.

Here, the benthic substrate was focused on the hard coral percentage as a rigid habitat and feeding grounds, especially for butterflyfishes. The total of individuals, species and coral coverage by different sites were presented in Figure 3. Corresponding to the graphic showed repeatable relationships, those were represented the correlation of all sites on a total individual and species with percent cover of hard corals. Coral coverage either as food resources, habitat for nursery, spawning, or others shows that live coral cover influences the number of individuals and the diversity of species. Hard coral is an important not only provide food resources but topographic complexity which provides the key of biological processes (Pratchett and Berumen, 2008). A previous study between an abundance of butterflyfishes and the live coral cover have a positive relationship (Adrim and Hutomo, 1989; Pratchett and Berumen, 2008). However, factors that regulate its specific species distribution and species compositions are still under study.

Species compositions may show the different rules and this study showed that fishes observed during sampling expected have a relation with benthic substrate composition. Butterflyfishes which commonly found (>5% presence) during samplings were *Chaetodon kleinii, Hemitaurichthys polylepis, Heniochus chrysostomus, C. lunulatus, C. melannotus, C punctatofasciatus,* and *Forcipiger flavissimus* (Figure 4.). *Chaetodon kleinii* almost reported in all sites (109 ind, 11 sites). This fish is categorized as omnivorous which encountered feeds on soft coral and able changed to planktivore. This

species usually found on rocky reefs and rich coral areas of the lagoon. However, it is also found in sandy coral reef areas (Adrim and Hutomo, 1989; Allen and Erdmann, 2012). *Hemitaurichthys polylepis* (72 ind, 5 sites) was the second largest number of butterflyfishes but no more often founded during sampling. Thus it was observed in a group and large aggregation in the water column above coral reefs. This fish has feeding behavior as planktivory (Allen and Erdmann, 2012). *Heniochus chrysostomus* (30 ind, 9 sites), were observed in pairs. *Chaetodon lunulatus* (30 ind, 8 sites) also usually was found in

**Tabel 1.** Percentage of benthic substrat (%)

| Site | Hard Coral | Soft Coral | Sponge | Others |
|---|---|---|---|---|
| TBRC01 | 31.73 | 6.73 | 1.00 | 60.53 |
| TBRC02 | 15.93 | 2.33 | 1.67 | 80.07 |
| TBRC03 | 26.53 | 0.53 | 1.87 | 71.07 |
| TBRC04 | 22.53 | 9.07 | 4.60 | 63.80 |
| TBRC05 | 24.93 | 11.07 | 13.07 | 50.93 |
| TBRC06 | 17.13 | 6.67 | 8.60 | 67.60 |
| TBRC07 | 35.93 | 0.20 | 1.40 | 62.47 |
| TBRC08 | 26.53 | 0.93 | 2.67 | 69.87 |
| TBRC09 | 14.87 | 22.67 | 3.87 | 58.60 |
| TBRC10 | 24.80 | 5.33 | 1.07 | 68.80 |
| TBRC11 | 37.07 | 13.07 | 2.07 | 47.80 |
| TBRC12 | 17.40 | 3.67 | 3.00 | 75.93 |

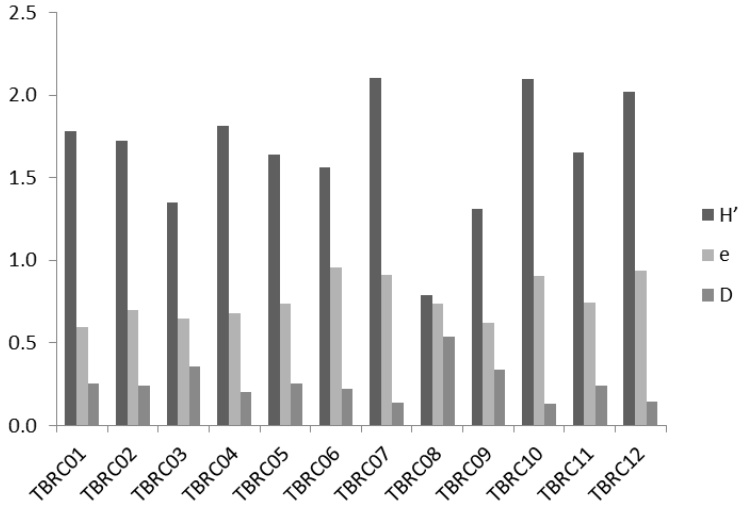


**Figure 2.** Index of diversity, evenness and dominant
Note: H'=diversity index; E=evenness index; D=dominant index

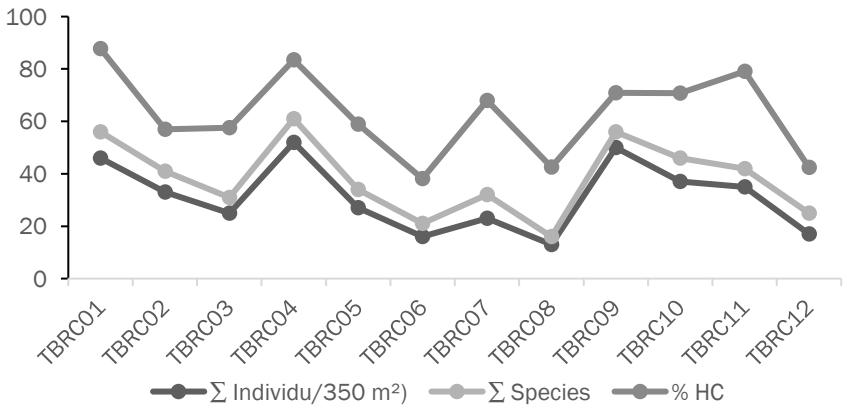


**Figure 3.** Total of individu.350m-2, species and coral cover percentage

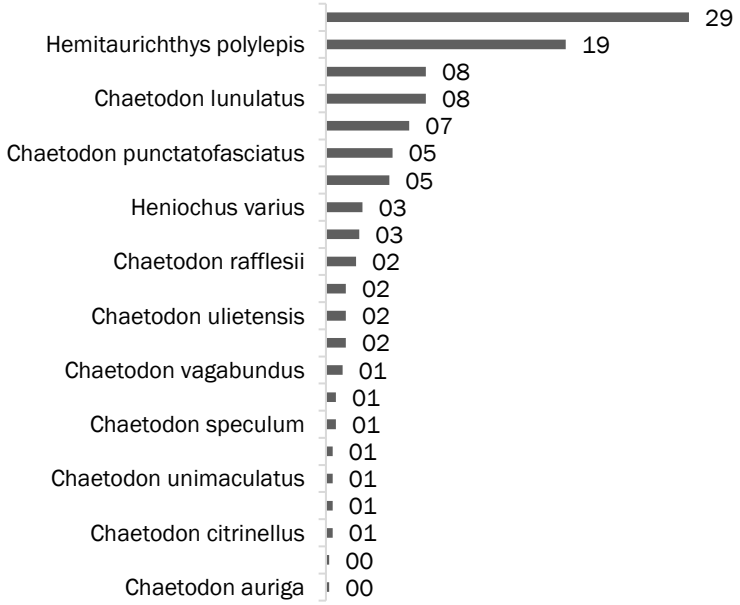


**Figure 4.** Species composition of butterflyfishes

pairs, closely associated with rich coral reef and exclusively feeds on live hard coral polyps (Allen and Erdmann, 2012). *Chaetodon melannotus* (25 ind, 6 sites) was encountered in 2-3 individuals aggregate. This fish primarily feeds on soft coral and some hard corals (Allen and Erdmann, 2012). *Chaetodon punctatofasciatus* (20 ind, 8 sites) was founded in pairs, as well as *Forcipiger flavissimus* (19 ind, 6 sites). This fish reported feeds on invertebrates, especially Polychaeta and small crustaceans (Allen and Erdmann, 2012).

This revealed marked differences in abundance and community structure of butterflyfishes among all sites at Taka Bonerate National Park. The zonation pattern of butterflyfish has also considerable potential to move among different reef zone territories. However, the competition may also influence abundance for some species. Some species may well strict and others not depends on the foraging tasks itself. Species compositions of butterflyfish mostly linked to benthic coral reef composition as supported for food resources and territories. According to the reference for grouping species with foraging tasks as coral obligate found were *C. baronessa, C. lunulatus, C. ornatissimus, C. trifascialis,* and *Heniochus chrysostomus*. Among tropic groups, specialist includes species *C. baronessa* and *C. lunulatus* with foraging tasks on live coral polyps were found in several sites. The dietary specialization exhibited the variation in abundance and also a pattern of zonation (Berumen and Pratchett, 2008). *Chaetodon baronessa* (10 ind, 4 sites) encounters in pairs form, has closely associated with rich corals especially in *Acropora* and traveling in the territory, whereas engaged in foraging tasks on hard corals (Allen and Erdmann, 2012).

Another foraging tasks as *C. melannotus* while feeds on soft coral and some hard coral belongs to generalist. This species has alternate food resources during moderate or selective disturbances (Pratchett *et al.*, 2004). Dietary specialization has a preference for food resources, it may not outperform when consumed the food preferences compare with generalist species. The specialist distributions were more restricted (Berumen and Pratchett, 2006), however, there is predicted that ecological variation are basic rules to understanding the patterns and trend of biodiversity species specialization (Berumen and Pratchett, 2008). The specialization targeting one single coral species and generalist most in location thus enhances understanding the foraging behaviors and dietary preference of butterflyfishes (Berumen *et al*., 2011). The existence of specialist which closely to the relationship between live coral coverage and food preferences such as *C. octofasciatus* as a potential bio-indicators for the coral, in particular to the ongoing degradation of *Acropora* (Madduppa *et al.*, 2014).

## Conclusion

Butterflyfishes have a close relation with coral reefs. The diversity index in Taka Bonerate National Park has a middle categories of species compositions. Butterflyfishes have several types of foraging tasks and may impact in utilizing the coral reef and other social habitats used. In general, based

on abundance and species compositions showed the relations between butterflyfishes and coral reefs are mostly affected by benthic compositions. However, the live hard coral cover especially affect the species composition of obligate feeders.

## Acknowledgment

This research was supported by COREMAP for Reef Health Monitoring Programs in Taka Bonerate National Park. We thank to Taka Bonerate National Park staff for technical assistance and information during sampling.

## References

Adrim, M. & Hutomo, M. 1989. Species composition, distribution and abundance of Chaetodontidae along reef transects in the Flores Sea. *Neth. J. Sea Res*. 23(2): 85-93. doi: 10.1016/0077-7579(89)90003-3

Allen, G. 2000. Marine Fishes of South East Asia, a Field Guide for Anglers and Divers. Periplus Editions (HK) Ltd., Australia.

Allen, G. R. & Erdmann, M. V. 2012. Reef Fishes of the East Indies, Volumes I-III. Tropical Reef Research, Perth, Australia.

Aspan, Z. 2015. Perlindungan hukum terhadap terumbu karang di Taman Nasional Taka Bonerate (TNT). *J. Hukum Ling*., 2(2): 73-94. doi: 10.38011/jhli.v2i2.26

Berumen, M.L. & Pratchett, M.S. 2006. Recovery without resilience: Persistent disturbance and long-term shifts in the structure of fish and coral communities at Tiahura Reef, Moorea. *Coral Reefs*, 25:647-653. doi: 10.1007/s00 338-006-0145-2

Berumen, M.L. & Pratchett, M.S. 2008. Trade-offs associated with dietary specialization in corallivorous butterflyfishes (Chaetodontidae: Chaetodon). *Behav. Ecol. Sociobiol*., 62(6):989-994. doi: 10.1007/s00265-007-0526-8

Berumen, M.L., Pratchett, M.S. & Goodman, B.A. 2011. Relative gut lengths of coral reef butterflyfishes (Pisces: Chaetodontidae. *Coral Reefs*, 30(4):1005-1010. doi: 10.1007/ s00338-011-0791-x

Giyanto. 2012. Penilaian kondisi terumbu karang dengan metode transek foto bawah air. *Oseanol. Limnol. Indo*., 38(3):377-390.

Hourigan, T.F., Timothy, C.T. & Reese, E.S. 1988. Coral reef fishes as indicators of environmental stress in coral reefs. *Marine organisms as indicators*, pp. 107-135. doi: 10.1007/978-1-4612-3752-5

Khalaf, M. & Crosby, M. P. 2005. Middle East Regional Science Symposium and Workshop : Butterflyfish (Family Chaetodontidae) research and monitoring. *Aquat. Conserv*., 15(S1):S3-S11. doi: 10.1002/aqc.720.

Kuiter, R.H. & Tonozuka, T. 2001. Pictorial Guide to Indonesian Reef Fishes. Zoonetics, Seaford, Australia.

Madduppa, H., Zamani, N.P., Subhan, B., Aktani, U. & Ferse, S.C., 2014. Feeding behavior and diet of the eight-banded butterflyfish *Chaetodon octofasciatus* in the Thousand Islands, Indonesia. *Environ. Biol. Fish.*, 97:1353-1365. doi: 10.1007/s10641-014-0225-z.

Pratchett, M.S., Wilson, S.K., Berumen, M.L. & McCormick, M.I. 2004. Sublethal effects of coral bleaching on an obligate coral feeding butterflyfish. *Coral Reefs*, 23:352-356. doi: 10.1007/s00338-004-0394-x.

Pratchett, M.S. & Berumen, M.L. 2008. Interspecific variation in distributions and diets of coral reef butterflyfishes (Teleostei: Chaetodontidae). *J. Fish Biol.*, 73:1730-1747. doi: 10.1111/j.1095-8649.2008.02062.x.

Putra, R.D., Suryanti, A., Kurniawan, D., Pratomo, A., Irawan, H., Raja'i, T. S., Kurniawan, R., Pratama, G. & Jumsurizal. 2018. Responses of herbivorous fishes on coral reef cover in outer island Indonesia (Study Case: Natuna island). *E3S Web Conferen*., 47:04009. doi: 10.1051/e3sconf/20184704009.

Sirait, M., Rahmatia, F. & Pattulloh. 2018. Comparison of diversity index and dominant index of phytoplankton at Ciliwung river Jakarta. *J. Kelautan*, 11(1):75-79. doi: 10.21107/jk.v 11i1.3338

Titaheluw, S.S., Kamal, M.M. & Ernawati, Y. 2015. Hubungan antara ikan Chaetodontidae dengan bentuk pertumbuhan karang. *J. Ilmiah Agribis. Perikan*., 8(1):77-86. doi: 10.29239/j.agrikan. 8.1.77-86

Wilhm, J.L. & Doris, T.C. 1986. Biologycal parameter for water quality criteria. *Bio Science*, 8:477-481. doi: 10.2307/1294272