

Building evidence for conservation globally

Journal of Threatened TAXA

10.11609/jott.2023.15.6.23283-23462

www.threatenedtaxa.org

26 June 2023 (Online & Print)

15(6): 23283-23462

ISSN 0974-7907 (Online)

ISSN 0974-7893 (Print)



Open Access



43/2 Varadarajulu Nagar, 5th Street West, Ganapathy, Coimbatore, Tamil Nadu 641006, India
Registered Office: 3A2 Varadarajulu Nagar, FCI Road, Ganapathy, Coimbatore, Tamil Nadu 641006, India
Ph: +91 9385339863 | www.threatenedtaxa.org
Email: sanjay@threatenedtaxa.org

EDITORS**Founder & Chief Editor****Dr. Sanjay Molur**Wildlife Information Liaison Development (WILD) Society & Zoo Outreach Organization (ZOO),
43/2 Varadarajulu Nagar, 5th Street West, Ganapathy, Coimbatore, Tamil Nadu 641006, India**Deputy Chief Editor****Dr. Neelesh Dahanukar**

Noida, Uttar Pradesh, India

Managing Editor**Mr. B. Ravichandran**, WILD/ZOO, Coimbatore, Tamil Nadu 641006, India**Associate Editors****Dr. Mandar Paingankar**, Government Science College Gadchiroli, Maharashtra 442605, India**Dr. Ulrike Streicher**, Wildlife Veterinarian, Eugene, Oregon, USA**Ms. Priyanka Iyer**, ZOO/WILD, Coimbatore, Tamil Nadu 641006, India**Dr. B.A. Daniel**, ZOO/WILD, Coimbatore, Tamil Nadu 641006, India**Editorial Board****Dr. Russel Mittermeier**

Executive Vice Chair, Conservation International, Arlington, Virginia 22202, USA

Prof. Mewa Singh Ph.D., FASc, FNA, FNAsc, FNAPsy

Ramanna Fellow and Life-Long Distinguished Professor, Biopsychology Laboratory, and Institute of Excellence, University of Mysore, Mysuru, Karnataka 570006, India; Honorary Professor, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore; and Adjunct Professor, National Institute of Advanced Studies, Bangalore

Stephen D. Nash

Scientific Illustrator, Conservation International, Dept. of Anatomical Sciences, Health Sciences Center, T-8, Room 045, Stony Brook University, Stony Brook, NY 11794-8081, USA

Dr. Fred Pluthero

Toronto, Canada

Dr. Priya Davidar

Sigur Nature Trust, Chadapatti, Mavinahalli PO, Nilgiris, Tamil Nadu 643223, India

Dr. Martin Fisher

Senior Associate Professor, Battcock Centre for Experimental Astrophysics, Cavendish Laboratory, JJ Thomson Avenue, Cambridge CB3 0HE, UK

Dr. John Fellowes

Honorary Assistant Professor, The Kadoorie Institute, 8/F, T.T. Tsui Building, The University of Hong Kong, Pokfulam Road, Hong Kong

Prof. Dr. Mirco Solé

Universidade Estadual de Santa Cruz, Departamento de Ciências Biológicas, Vice-coordenador do Programa de Pós-Graduação em Zoologia, Rodovia Ilhéus/Itabuna, Km 16 (45662-000) Salobrinho, Ilhéus - Bahia - Brasil

Dr. Rajeev Raghavan

Professor of Taxonomy, Kerala University of Fisheries & Ocean Studies, Kochi, Kerala, India

English Editors**Mrs. Mira Bhojwani**, Pune, India**Dr. Fred Pluthero**, Toronto, Canada**Mr. P. Ilangovan**, Chennai, India**Ms. Sindhura Stothra Bhashyam**, Hyderabad, India**Web Development****Mrs. Latha G. Ravikumar**, ZOO/WILD, Coimbatore, India**Typesetting****Mrs. Radhika**, ZOO, Coimbatore, India**Mrs. Geetha**, ZOO, Coimbatore India**Fundraising/Communications****Mrs. Payal B. Molur**, Coimbatore, India**Subject Editors 2020–2022****Fungi****Dr. B. Shivaraju**, Bengaluru, Karnataka, India**Dr. R.K. Verma**, Tropical Forest Research Institute, Jabalpur, India**Dr. Vatsavaya S. Raju**, Kakatiya University, Warangal, Andhra Pradesh, India**Dr. M. Krishnappa**, Jnana Sahyadri, Kuvenpu University, Shimoga, Karnataka, India**Dr. K.R. Sridhar**, Mangalore University, Mangalagangotri, Mangalore, Karnataka, India**Dr. Gunjan Biswas**, Vidyasagar University, Midnapore, West Bengal, India**Plants****Dr. G.P. Sinha**, Botanical Survey of India, Allahabad, India**Dr. N.P. Balakrishnan**, Ret. Joint Director, BSI, Coimbatore, India**Dr. Shonil Bhagwat**, Open University and University of Oxford, UK**Prof. D.J. Bhat**, Retd. Professor, Goa University, Goa, India**Dr. Ferdinando Boero**, Università del Salento, Lecce, Italy**Dr. Dale R. Calder**, Royal Ontario Museum, Toronto, Ontario, Canada**Dr. Cleofas Cervancia**, Univ. of Philippines Los Baños College Laguna, Philippines**Dr. F.B. Vincent Florens**, University of Mauritius, Mauritius**Dr. Merlin Franco**, Curtin University, Malaysia**Dr. V. Irudayaraj**, St. Xavier's College, Palayamkottai, Tamil Nadu, India**Dr. B.S. Kholia**, Botanical Survey of India, Gangtok, Sikkim, India**Dr. Pankaj Kumar**, Department of Plant and Soil Science, Texas Tech University, Lubbock, Texas, USA**Dr. V. Sampath Kumar**, Botanical Survey of India, Howrah, West Bengal, India**Dr. A.J. Solomon Raju**, Andhra University, Visakhapatnam, India**Dr. Vijayasankar Raman**, University of Mississippi, USA**Dr. B. Ravi Prasad Rao**, Sri Krishnadevaraya University, Anantpur, India**Dr. K. Ravikumar**, FRLHT, Bengaluru, Karnataka, India**Dr. Aparna Watve**, Pune, Maharashtra, India**Dr. Qiang Liu**, Xishuangbanna Tropical Botanical Garden, Yunnan, China**Dr. Noor Azhar Mohamed Shazili**, Universiti Malaysia Terengganu, Kuala Terengganu, Malaysia**Dr. M.K. Vasudeva Rao**, Shiv Ranjani Housing Society, Pune, Maharashtra, India**Prof. A.J. Solomon Raju**, Andhra University, Visakhapatnam, India**Dr. Manda Datar**, Agharkar Research Institute, Pune, Maharashtra, India**Dr. M.K. Janarthanam**, Goa University, Goa, India**Dr. K. Karthigeyan**, Botanical Survey of India, India**Dr. Errol Vela**, University of Montpellier, Montpellier, France**Dr. P. Lakshminarasimhan**, Botanical Survey of India, Howrah, India**Dr. Larry R. Nobile**, Montgomery Botanical Center, Miami, USA**Dr. K. Haridasan**, Pallavur, Palakkad District, Kerala, India**Dr. Analinda Manila-Fajard**, University of the Philippines Los Baños, Laguna, Philippines**Dr. P.A. Sinu**, Central University of Kerala, Kasaragod, Kerala, India**Dr. Afroz Alam**, Banasthali Vidyapith (accredited A grade by NAAC), Rajasthan, India**Dr. K.P. Rajesh**, Zamorin's Guruvayurappan College, GA College PO, Kozhikode, Kerala, India**Dr. David E. Boufford**, Harvard University Herbaria, Cambridge, MA 02138-2020, USA**Dr. Ritesh Kumar Choudhary**, Agharkar Research Institute, Pune, Maharashtra, India**Dr. A.G. Pandurangan**, Thiruvananthapuram, Kerala, India**Dr. Navendu Page**, Wildlife Institute of India, Chandrabani, Dehradun, Uttarakhand, India**Dr. Kannan C.S. Warrier**, Institute of Forest Genetics and Tree Breeding, Tamil Nadu, India**Invertebrates****Dr. R.K. Avasthi**, Rohtak University, Haryana, India**Dr. D.B. Bastawade**, Maharashtra, India**Dr. Partha Pratim Bhattacharjee**, Tripura University, Suryamaninagar, India**Dr. Kailash Chandra**, Zoological Survey of India, Jabalpur, Madhya Pradesh, India**Dr. Ansie Dippenaar-Schoeman**, University of Pretoria, Queenswood, South Africa**Dr. Rory Dow**, National Museum of natural History Naturalis, The Netherlands**Dr. Brian Fisher**, California Academy of Sciences, USA**Dr. Richard Gallon**, Ilandudno, North Wales, LL30 1UP**Dr. Hemant V. Ghate**, Modern College, Pune, India**Dr. M. Monwar Hossain**, Jahangirnagar University, Dhaka, Bangladesh**Mr. Jatishwar Singh Irungbam**, Biology Centre CAS, Branišovská, Czech Republic.For Focus, Scope, Aims, and Policies, visit https://threatenedtaxa.org/index.php/JoTT/aims_scopeFor Article Submission Guidelines, visit <https://threatenedtaxa.org/index.php/JoTT/about/submissions>For Policies against Scientific Misconduct, visit https://threatenedtaxa.org/index.php/JoTT/policies_various

continued on the back inside cover

Cover: Marine invertebrates - made with acrylic paint. © P. Kritika.



Survey of Black Band Disease-affected scleractinian corals via drone-based observations in Okinawa, Japan

Rocktim Ramen Das^{1†} , Parviz Tavakoli-Kolour^{2†} , Sanaz Hazraty-Kari³  & James Davis Reimer⁴ 

^{1,4} Molecular Invertebrate Systematics and Ecology (MISE) Lab, University of the Ryukyus, Nishihara, Okinawa 903-0213, Japan.

^{1,2} Graduate School of Engineering and Science, University of the Ryukyus, Nishihara, Okinawa 903-0213, Japan.

³ Sesoko Station, Tropical Biosphere Research Center (TBRC), University of the Ryukyus, Motobu, Okinawa 905-0227, Japan.

⁴ Department of Biology, Chemistry and Marine Science, Faculty of Science, University of the Ryukyus, Nishihara, Okinawa 903-0213, Japan.

⁴ TBRC, University of the Ryukyus, Nishihara, Okinawa 903-0213, Japan.

¹ asomorlora@gmail.com (corresponding author), ² p.tavakoli@hotmail.com, ³ s.hazrati@hotmail.com,

⁴ jreimer@sci.u-ryukyu.ac.jp (corresponding author)

†Equal contribution

Abstract: Diseases are a growing global threat to scleractinian corals. This study used a relatively inexpensive commercial drone flown simultaneously along with reef walking/snorkeling to confirm the presence of cyanobacterial Black Band Disease (BBD) on a reef in subtropical Okinawa, Japan. At the surveyed reef, the scleractinian corals included encrusting forms ($12.57\% \pm 5.72$ coverage), followed by massive/submassive ($6.09\% \pm 4.05$) and tabular corals ($2.66\% \pm 1.19$). Our survey is unique in that drone research has not been previously applied to BBD surveys, followed by ground truthing. Thus, this study can be regarded as an example of using drones during coral disease assessments.

Keywords: coral disease, subtropical, coral reef, *Montipora*.

Japanese abstract: イシサンゴ類の病気は世界的な脅威となっている。本研究では、亜熱帯域である沖縄島のサンゴ礁リーフにおいて、歩行およびシュノーケリングによって目視で観察すると同時に、比較的安価な市販のドローンを飛行させ、シアノバクテリアのブラックバンド病（BBD）の感染率を算出した。本調査地で観察されたイシサンゴ類のうち、BBDが確認された面積の割合は、被覆状サンゴが（ $12.57\pm5.72\%$ ）と最も高く、次いで塊状サンゴ（ $6.09\pm4.05\%$ ）、テーブル状サンゴ（ $2.66\pm1.19\%$ ）であった。これまでの研究ではドローンを用いた観察手法が野外でBBDの識別に用いられたことはなく、本研究で適用可能なことが初めて示唆された。本研究の結果は、ドローンと目視観察を組み合わせてBBDの感染率を評価した研究の一例として位置づけられる。

Editor: M. Nithyanandan, Kuwait Institute for Scientific Research (KISR), Salmiya, Kuwait.

Date of publication: 26 June 2023 (online & print)

Citation: Das, R.R., P. Tavakoli-Kolour, S. Hazraty-Kari & J.D. Reimer (2023). Survey of Black Band Disease-affected scleractinian corals via drone-based observations in Okinawa, Japan. *Journal of Threatened Taxa* 15(6): 23397–23402. <https://doi.org/10.11609/jott.8215.15.6.23397-23402>

Copyright: © Das et al. 2023. Creative Commons Attribution 4.0 International License. JoTT allows unrestricted use, reproduction, and distribution of this article in any medium by providing adequate credit to the author(s) and the source of publication.

Funding: The APC was funded by an internal University of the Ryukyus project grant to J.D.R.

Competing interests: The authors declare no competing interests.

Author details: ROCKTIM RAMEN DAS is currently a PhD candidate at the MISE lab, University of the Ryukyus (UR). His main research interests lies in understanding the Indo-Pacific coral health and diseases. PARVIZ TAVAKOLI-KOLOUR is a PhD candidate at UR (based at the Sesoko Station). His research mainly focuses on mesophotic coral ecosystems especially related to acclimatization and plasticity potential of corals across depths. SANAZ HAZRATY-KARI is a post-doc at the Sesoko Station (UR), where she primarily studies the effects of global warming on various stages of coral life. JAMES DAVIS REIMER is a professor at UR. His primary research interests are in understanding understudied invertebrate groups using field based and molecular techniques.

Author contributions: RRD—conceptualization, writing - original draft, reviewing and editing, investigation, visualization, data curation, formal analysis, validation, funding acquisition, software. PTK—conceptualization, writing - review and editing, investigation, methodology, visualization, software. SHK—writing - review and editing, resources. JDR—writing - review and editing, funding acquisition, supervision.

Acknowledgements: The authors are grateful to the staff of Sesoko Station (University of the Ryukyus) for providing the necessary facilities. The drone used in this study is registered at the Drone/UAS Information Platform System ID: JU3226D60F69 with the Ministry of Land Infrastructure, Transport and Tourism of Japan. No specimens were collected during this study. The authors are grateful to prof. Andrew H. Baird (James Cook University) for help with coral identification and Dr. Taiga Kunishima (Wakayama Prefectural Museum of Natural History) for help with the Japanese abstract. Constructive comments and suggestions by three reviewers and the section editor is appreciated.



INTRODUCTION

Coral diseases are one of the major factors implicated in the decline of shallow water coral reef ecosystems worldwide (Sutherland et al. 2004; Hazraty-Kari et al. 2021). Among the diseases recognized to date, cyanobacterial Black Band Disease (BBD) is one of most well-studied diseases, affecting at least 24 scleractinian, one hydrozoan, and six gorgonian species in the Atlantic and Indo-Pacific oceans/seas (Antonious 1973; Bruckner 2015; Roff 2016). Within the Japanese archipelago, BBD has been reported from both mesophotic and shallow reefs affecting six coral genera: *Montipora*, *Acropora*, *Echinopora*, *Pachyseris*, *Goniastrea* and *Gardineroseris* (Wada et al. 2017; Kubomura et al. 2018; Das et al. 2022a) and among these, the encrusting form of genus *Montipora* can be considered one of the primary hosts in the region (Wada et al. 2018; Das et al. 2022a).

Coral diseases have been widely studied by field-based in situ observations, which obviously provide several benefits such as ease of observation and the need for few pieces of equipment. However, such observer-based data are also prone to bias and inconsistency, as well as often only being able to cover only limited areas. An alternate method of observation to cover large areas is remote sensing-based disease assessments (Kabiri et al. 2013; Maynard et al. 2015), although such methods have their own limitations such as interference via clouds and dust (Purkis 2018). Recently, consumer-grade drones have been increasingly used to monitor coral reef ecosystems (Casella et al. 2017; Kabiri et al. 2020), and this relatively low-cost equipment can clearly increase the ease of monitoring coral reefs (Murfitt et al. 2017). While the commercialization of cheap drones is recent, the concept existed earlier with suggestions of utilizing high-resolution cameras along with multiple spectrum/hyper-spectral sensors on hexacopters, and the usage of hydrogen balloons (Rützler 1978; Kabiri et al. 2014). Here, we utilized such drone technology to detect and identify cyanobacterial BBD infecting individual coral colonies on a nearshore intertidal habitat in Okinawa, Japan.

MATERIALS AND METHODS

On a clear day on the 09th of September 2021, we flew a commercial drone (Mini2, DJI Technology Co. Ltd.) equipped with a 1/2.3" inch CMOS sensor camera (12 MP) over the shallow nearshore reefs of Sesoko Island (off central western Okinawajima Island), near Sesoko Station, University of the Ryukyus (26.6340°N,

127.8641°E) (Das & Yamashiro 2018; Das et al. 2022a). The reef in this area is comprised of various morphotypes and species of the genus *Montipora*, such as *Montipora* cf. *aequituberculata*, *Montipora* cf. *digitata*, and encrusting *Montipora* cf. *informis*, *Montipora* cf. *efflorescens*, and other *Montipora* spp. (Yamashiro et al. 2000; Baird et al. 2018; Das et al. 2022a). *Montipora* spp. in Okinawa have been recently reported to be easily infected by BBD (Das et al. 2022a). The time and the day of our survey were chosen based on low wind and tidal conditions. We identified BBD-infected encrusting *Montipora* colonies from drone imagery. Simultaneously, reef walking and snorkeling was conducted to locate and confirm BBD-infected colonies initially identified by the drone imagery.

In this study, a total number of 148 images (4000 x 2250 pixels) and four videos (1920 x 1080 p; obtained between 9000 h to 1600 h) were taken from different heights between 30 to <100 m.

Aerial photographs were converted from initial .jpg to .tiff format. Three photographs were specifically chosen based on clarity and low sea surface reflection (sun glint), and in each of them a 5x5m quadrat was delineated. Additionally, wherever possible, in-situ images of the infected colonies were taken during reef walking/snorkeling (Olympus TG-5 camera/PT-058 housing). The drone images were then uploaded into open-sourced Coral-Net software (Beijbom et al. 2012) for benthic analyses. The benthic components were classified as tabular, encrusting, foliose, massive/submassive hard corals, dead coral, hard substrate/sand, and others. A total of 175 randomly generated points were created in each of the three 5x5 quadrats and were categorized accordingly. The categories were then identified visually based on the above-mentioned classification. Automatic annotation was not applicable since a minimum of twenty images are required to train the AI-based classification algorithm in Coral Net to provide satisfactory results (Chen et al. 2021).

RESULTS AND DISCUSSION

Benthic analyses revealed encrusting hard corals had the highest percentage cover within quadrats (12.57% ± 5.72 SD), followed by massive/submassive (6.09% ± 4.05 SD) and tabular corals (2.66% ± 1.19 SD) (Supplementary Table 1). Soft corals along with other benthos accounted for 23.05% ± 4.01 SD, while dead corals accounted for 2.48% ± 2.16 SD. A total of six encrusting *Montipora* colonies with BBD were identified through these drone images and videos. The dead white bare skeleton along

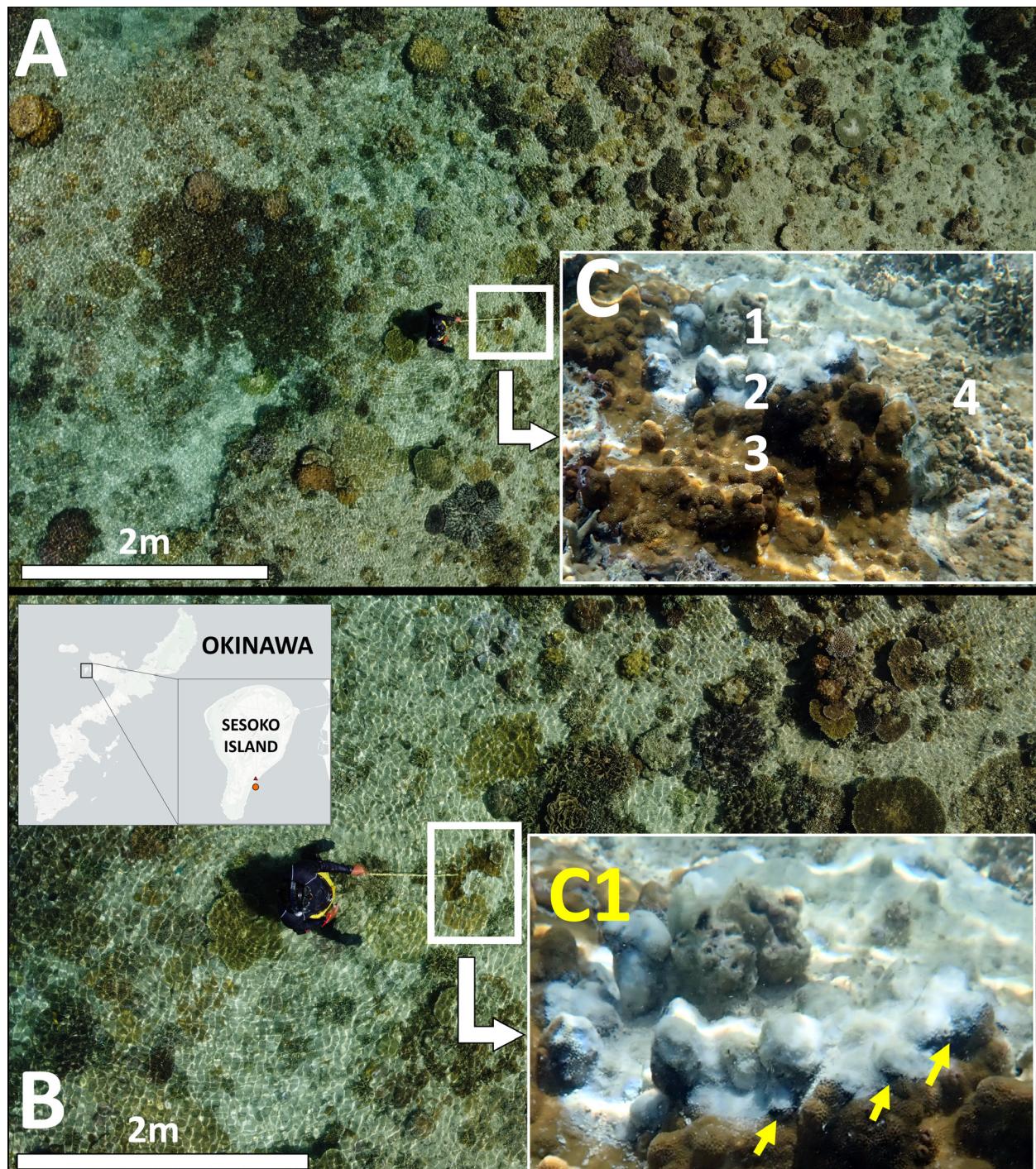


Image 1. A—Aerial view of the study area with a BBD-infected encrusting *Montipora* colony (white arrow) | B—Close-up image with BBD colony (White box) | C—In situ image of BBD infected colony (1—Recently dead coral skeleton | 2—Progressing BBD | 3—Healthy coral | 4—Healthy *Montipora* colony competing for space) | C1—Close-up image, yellow arrows indicating progressing black band. The black band is not as thick and wide probably due to low tide and direct exposure to sunlight. © Image A and B: PT-K; Image C and C1: RRD.

with neighboring healthy tissue was clearly visible through the high-resolution images (Image 1A–C, C1; 2A, B, B1). To our knowledge, this is the first study where cyanobacterial BBD affected areas were surveyed through drones.

Globally, coral reef health has been successfully monitored through the usage of commercial drones. Within the Persian Gulf, commercial drones have been used to map coral reefs, revealing coral mortality and bleaching (Kabiri et al. 2020). In a similar study at

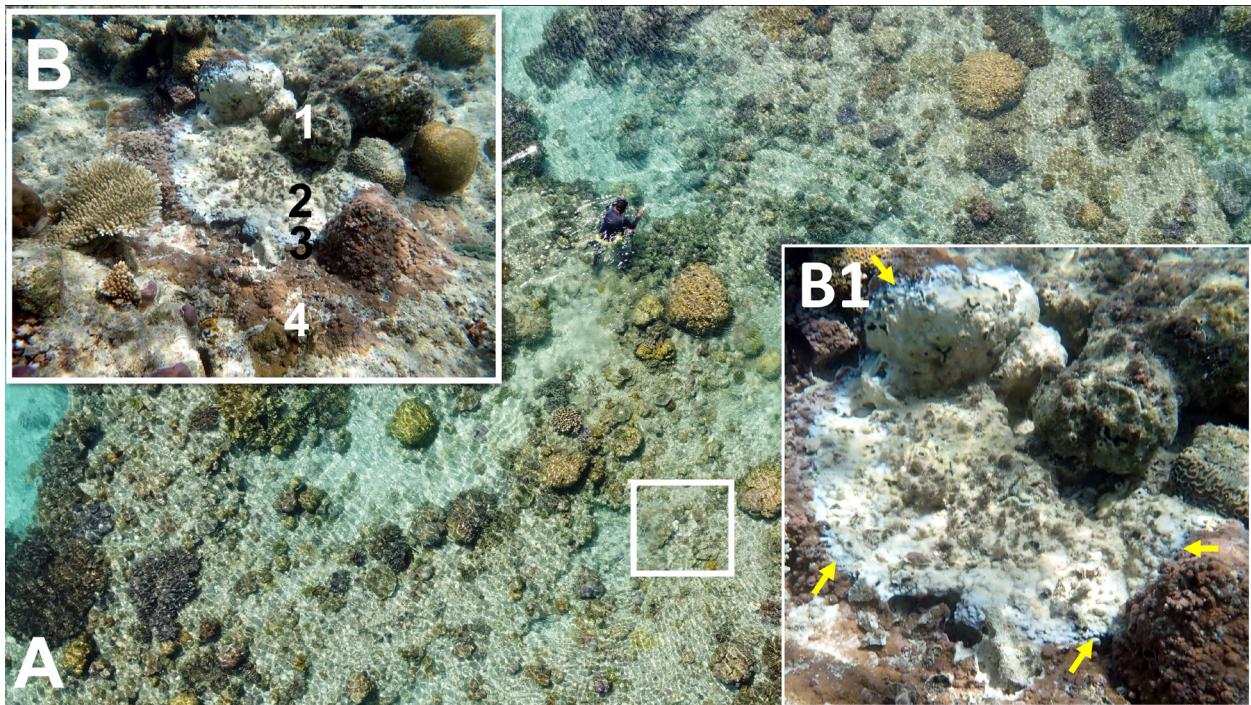


Image 2. A—Aerial view of the study area with BBD colony | B—Close up of the same colony (white box) via Olympus TG5 camera (1—Dead coral skeleton overgrown by turf algae | 2—Recently dead coral skeleton | 3—Progressing BBD | 4—Healthy coral) | B1—Further zoomed image of (B), arrows indicating the progressing black band. © Image A: PT-K; Image B and B1: RRD.

Kaneohe Bay, Hawaii, coral bleaching was observed using drones (Levy et al. 2018). In the current study, we specifically focused on a readily observable disease (BBD) within a specific study area, combined with simultaneous *in situ* verification.

A fully developed BBD has a thick microbial consortium, generally black/dark in color, the dark coloration from the dominant cyanobacterium *Roseofilum reptotaenium* (Hutabarat et al. 2018). Wada et al. (2017), in research at Akajima, Okinawa (~40 km from Sesoko Is.), further showed four different types of BBD patterns; black bands; grey bands; mottled black bands, and an absence of bands, all affecting encrusting *Montipora*. At greater depths of >30m, BBD appears purple-black due to the lack of sulfide oxidizing (SO) bacteria *Beggiatoa* sp. (Kubomura et al. 2018). These SO bacteria form a major population within shallow water BBD bacterial mats and are thought to be responsible for the whitish coloration of BBD during the night (Richardson 1996).

In future studies, there remains a necessity to focus on more diverse coral genera which are affected by numerous other diseases and pathogens. Thus, this work demonstrates the potential of incorporating drones while concurrently doing field observations under appropriate conditions (low wind, low surface sunlight reflection, etc.). Additionally, drone usage will be very

effective if diseases have reached epizootic levels within a given reef. Further, recurrent observations of the same reef could also provide time-series datasets. Additionally, we were able to cover a large reef area in much shorter time than when compared to snorkeling/free swimming methods. The drone was flown over an area of 7,000 m² with approximately 75 m² (n = 3 of 5 X 5 m quadrats) was considered for analyses of coral percent coverage. It can be argued that drone-based observations are only limited to shallow reef ecosystems, but reefs in such shallow waters are often diverse and are among the most threatened by anthropogenic factors (Richards et al. 2015). We suggest the use of similar methodology to understand other forms of coral diseases, such as the coral-killing sponge *Terpios hoshinota* ("Black Disease"), which threatens intertidal reefs in many areas of southern Japan (e.g., Reimer et al. 2010, 2011) and elsewhere in the Indo-Pacific (e.g., Montano et al. 2015; Das et al. 2020).

Finally, we provide a few considerations and suggestions for utilizing drones to monitor coral reefs. Drone flight is feasible only under optimal environmental conditions, with successful flights and good-quality image acquisition hampered by strong winds, rain, or even too much sunshine. Additionally, even if drones can cover large areas, it is possible to overlook colonies

that have just begun to exhibit early signs of infection. For instance, BBD initially develops as a cyanobacterial patch (Sato et al. 2009), and because these early phases may not have considerable tissue loss, such colonies can be easily overlooked. Similar issues may exist in the case of other diseases and should be considered before research planning. Another issue is that drones can only clearly view very shallow or intertidal reefs, and to reach deeper reefs, submersible drones would be necessary (Das et al. 2022b). Finally, if there is a large population of marine birds in the survey region, drone flights should be carefully monitored or should be flown at a suitable height.

Therefore, based on these limitations and recommendations, we conclude that drones can be regarded as tools to be included when or if the weather conditions are suitable. Such technologies can significantly improve the efficiency of surveys of coral diseases and aid in creating effective management strategies for the preservation of the coral reef ecosystems.

REFERENCES

Antonious A. (1973). 10th Meeting of the Association of Island Marine Laboratories of the Caribbean, University of Puerto Rico (Mayaguez).

Baird, A.H., S.A. Keith, E. Woolsey, R. Yoshida & T. Naruse (2018). Rapid coral mortality following unusually calm and hot conditions on Iriomote, Japan. *F1000 Research* 6: 1728. <https://doi.org/10.12688/f1000research.12660.2>

Beijbom, O., P.J. Edmunds, D.I. Kline, B.G. Mitchell, D. Kriegman (2012). Automated annotation of coral reef survey images. In Proceedings of the 2012 IEEE Conference on Computer Vision and Pattern Recognition (IEEE), Providence, RI, USA, 16–21 June 2012; pp. 1170–1177. <https://doi.org/10.1109/CVPR.2012.6247798>

Bruckner A.W. (2015). History of coral disease research, pp. 52–84. In: Woodley, C.M., C.A. Downs, A.W. Bruckner, J.W. Porter & S.B. Galloway (eds.), *Disease of Coral*. Wiley, Hoboken.

Casella, E., A. Collin, D. Harris, S. Ferse, S. Bejarano, V. Parravicini, J.L. Hench & A. Rovere (2017). Mapping coral reefs using consumer-grade drones and structure from motion photogrammetry techniques. *Coral Reefs* 36: 269–275. <https://doi.org/10.1007/s00338-016-1522-0>

Chen, Q., O. Beijbom, S. Chan, J. Bouwmeester & D. Kriegman (2021). A new deep learning engine for Coral-Net, pp. 3693–3702. In Proceedings of the IEEE/CVF International Conference on Computer Vision. <https://doi.org/10.1109/ICCV48922.2021>

Das, R.R. & H. Yamashiro (2018). Corals dominate monofilament lines in Sesoko Island, Japan. *Current Science* 114: 730–731.

Das, R.R., C.R. Sreeraj, G. Mohan, K.R. Abhilash, V.K.D. Samuel, P. Ramachandran & R. Ramachandran (2020). Incursion of the killer sponge *Terpios hoshinota* Rützler & Muzik, 1993 on the coral reefs of the Lakshadweep Archipelago, Arabian Sea. *Journal of Threatened Taxa* 12: 17009–17013. <https://doi.org/10.11609/jott.5790.12.14.17009-17013>

Das, R.R., H. Wada, G.D. Masucci, T. Singh, P. Tavakoli-Kolour, N. Wada, S-L. Tang, H. Yamashiro & J.D. Reimer (2022a). Four-year field survey of black band disease and skeletal growth anomalies in encrusting *Montipora* spp. corals around Sesoko island, Okinawa. *Diversity* 14: 32. <https://doi.org/10.3390/d14010032>

Das, R.R., T. Immanuel, R.K. Lakra, K. Baath & G. Thiruchitrambalam (2022b). First report of marine sponge *Chelonaplysilla delicata* (Demospongiae: Darwinellidae) from the Andaman Sea/Indian Ocean with baseline information of epifauna on a mesophotic shipwreck. *Journal of Threatened Taxa* 14(10): 21961–21967. <https://doi.org/10.11609/jott.7495.14.10.21961-21967>

Hazraty-Kari, S., P. Tavakoli-Kolour, R.R. Das, M. Farhadi, A. Barkhordari-Ahmadi, M. Yahyavi & H. Rezai (2021). Baseline assessment of coral diseases in an environmentally extreme environment of the northern Persian Gulf. *Marine Pollution Bulletin* 171: 112707. <https://doi.org/10.1016/j.marpolbul.2021.112707>

Hutabarat, P.U.B., X.H. Nguyen & S. Suda (2018). Black Band disease-related (BBD) cyanobacterium from Okinawan corals. *Journal of Applied Phycology* 30: 3197–3203. <https://doi.org/10.1007/s10811-018-1507-1>

Kabiri, K., B. Pradhan, K. Samimi-Namin & M. Moradi (2013). Detecting coral bleaching, using QuickBird multi-temporal data: a feasibility study at Kish Island, the Persian Gulf. *Estuarine, Coastal and Shelf Science* 117: 273–281. <https://doi.org/10.1016/j.ecss.2012.12.006>

Kabiri, K., H. Rezai, M. Moradi & F. Pourjomeh (2014). Coral reefs mapping using parasailing aerial photography-feasibility study: Kish Island, Persian Gulf. *Journal of Coastal Conservation* 18: 691–699. <https://doi.org/10.1007/s11852-014-0345-9>

Kabiri, K., H. Rezai & M. Moradi (2020). A drone-based method for mapping the coral reefs in the shallow coastal waters – case study: Kish Island, Persian Gulf. *Earth Science Informatics* 13: 1265–1274. <https://doi.org/10.1007/s12145-020-00507-z>

Kubomura, T., H. Yamashiro & J.D. Reimer (2018). Appearance of an anomalous black band disease at upper mesophotic depths after coral bleaching. *Diseases of Aquatic Organisms* 131: 245–249. <https://doi.org/10.3354/dao03292>

Levy, J., C. Hunter, T. Lukaczyk & E.C. Franklin (2018). Assessing the spatial distribution of coral bleaching using small unmanned aerial systems. *Coral Reefs* 37: 373–387. <https://doi.org/10.1007/s00338-018-1662-5>

Maynard, J., R.V. Hooidonk, C.M. Eakin, M. Puotinen, M. Garren, G. Williams, S.F. Heron, J. Lamb, E. Weil, B. Willis & C.D. Harvell (2015). Projections of climate conditions that increase coral disease susceptibility and pathogen abundance and virulence. *Nature Climate Change* 5: 688–695. <https://doi.org/10.1038/NCLIMATE.2625>

Montano, S., W-H. Chou, C.A. Chen, P. Galli & J.D. Reimer (2015). First record of the coral-killing sponge *Terpios hoshinota* in the Maldives and Indian Ocean. *Bulletin of Marine Science* 91(1): 000–000. <http://dx.doi.org/10.5343/bms.2014.1054>

Murfitt, S.L., B.M. Allan, A. Bellgrove, A. Rattray, M.A. Young & D. Ierodiaconou (2017). Applications of unmanned aerial vehicles in intertidal reef monitoring. *Scientific Reports* 7: 10259. <https://doi.org/10.1038/s41598-017-10818-9>

Purkis, S.J. (2018). Remote sensing tropical coral reefs: The view from above. *Annual Review of Marine Science* 10: 4.1–4.20. <https://doi.org/10.1146/annurev-marine-121916-063249>

Reimer, J.D., Y. Nozawa & E. Hirose (2010). Domination and disappearance of the black sponge: A quarter century after the initial *Terpios* outbreak in Southern Japan. *Zoological Studies* 50: 394.

Reimer, J.D., M. Mizuyama, M. Nakano, T. Fujii & E. Hirose (2011). Current status of the distribution of the coral-encrusting cyanobacteriosponge *Terpios hoshinota* in southern Japan. *Galaxea, Journal of Coral Reef Studies* 13: 35–44.

Richardson, L.L. (1996). Horizontal and vertical migration patterns of *Phormidium coralliticum* and *Beggiatoa* spp. associated with Black-Band Disease of corals. *Microbial Ecology* 32: 323–335.

Richards, Z.T., R.A. Garcia, C.C. Wallace, N.L. Rosser & P.R. Muir (2015). A diverse assemblage of reef corals thriving in a dynamic intertidal reef setting (Bonaparte Archipelago, Kimberley, Australia). *Plos One* 10(2): e0117791. <https://doi.org/10.1371/journal.pone.0117791>

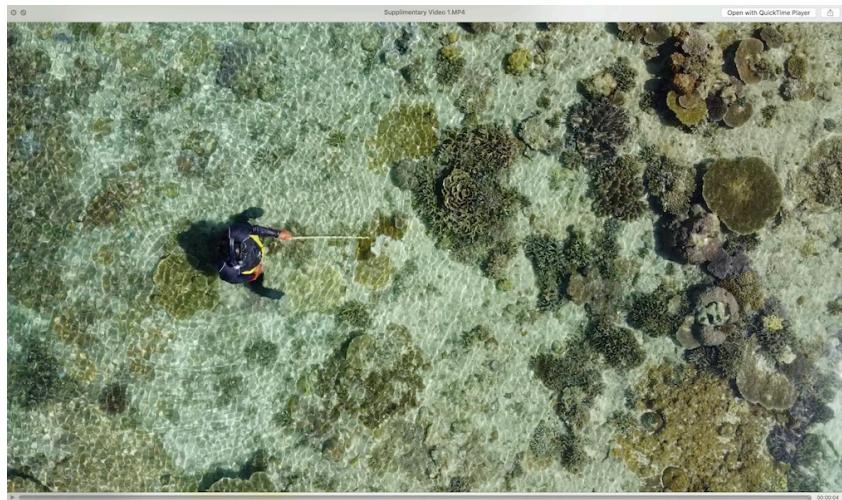
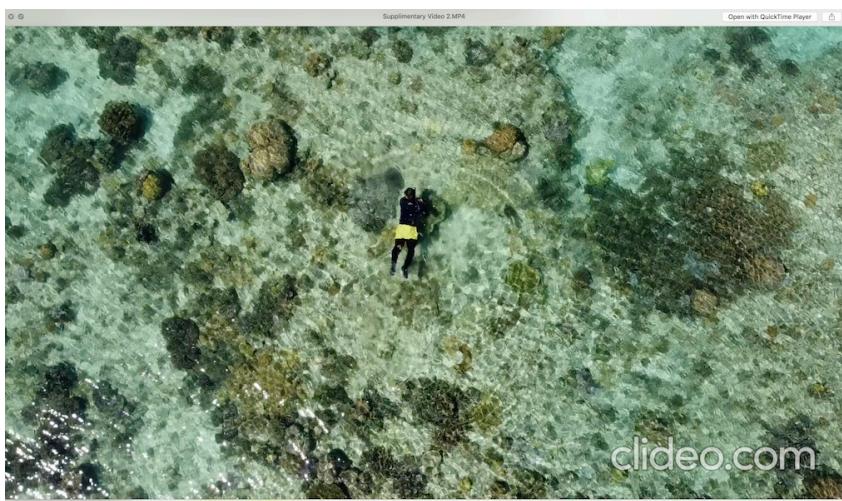
Roff, G. (2016). Earliest record of a coral disease from the Indo-Pacific? *Coral Reefs* 35: 457. <https://doi.org/10.1007/s00338-016-1416-1>

Rützler, K. (1978). Photogrammetry of reef environments by helium balloon. *Coral Reefs: Research Methods*. UNESCO, Paris.

Sato, Y., B.L. Willis & D.G. Bourne (2009). Successional changes

Supplementary Table 1. Percent coverage of benthic categories obtained from CoralNet.

Image ID	Image name	Annotation status	Points	51_tabular_hard_coral	Hard Coral (encrusting)	Hard Coral (foliose)	Hard Coral (massive/submassive)	Dead coral	Hard Substrate/Sand	Other
2293735	Drone-Q1-RRD-Sesoko-5x5-DII_0385.JPG	Confirmed	175	4	18.286	1.143	1.714	4	47.429	23.429
2293736	Drone-Q2-RRD-Sesoko-5x5-DII_0346.JPG	Confirmed	175	2.286	12.571	0	6.857	0	59.429	18.857
2295906	Drone-Q3-RRD-Sesoko-5x5-DII_0451.JPG	Confirmed	175	1.714	6.857	0	9.714	3.429	51.429	26.857
	Average			2.666666667	12.57133333	0.381	6.095	2.47623333	52.76233333	23.048
	SD			1.189592087	5.714500007	0.659911358	4.0540693	2.163488	6.110100927	4.0136

Supplementary Video 1. In situ observation of BBD-infected encrusting *Montipora* colony.Supplementary Video 2. In situ observation of BBD-infected encrusting *Montipora* colony.

in bacterial communities during the development of black band diseases on the reef coral, *Montipora hispida*. *The ISME Journal* 4: 203–214. <https://doi.org/10.1038/ismej.2009.103>

Sutherland, K.P., J.W. Porter & C. Torres (2004). Disease and immunity in Caribbean and Indo-Pacific zooxanthellate corals. *Marine Ecology Progress Series* 266: 273–302.

Wada, N., N. Mano, Y. Yanagisawa & T. Mori (2017). Occurrence of coral diseases at Akajima, Okinawa, Japan in 2010 and 2011. *Galaxea, Journal of Coral Reef Studies* 19: 35–44.

Wada, N., Ohdera A & Mano N., 2018. Coral disease in Japan, pp. 41–62. In: Iguchi, A. & C. Hongo, (ed.). *Coral Reef Studies in Japan*. Springer, Singapore, 179 pp.

Yamashiro, H., M. Yamamoto & R.V. Woesik (2000). Tumor formation on the coral *Montipora informis*. *Diseases of Aquatic Organisms* 41: 211–217.



Dr. Ian J. Kitching, Natural History Museum, Cromwell Road, UK
Dr. George Mathew, Kerala Forest Research Institute, Peechi, India
Dr. John Noyes, Natural History Museum, London, UK
Dr. Albert G. Orr, Griffith University, Nathan, Australia
Dr. Sameer Padhye, Katholieke Universiteit Leuven, Belgium
Dr. Nancy van der Poorten, Toronto, Canada
Dr. Karen Schnabel, NIWA, Wellington, New Zealand
Dr. R.M. Sharma, (Retd.) Scientist, Zoological Survey of India, Pune, India
Dr. Manju Siliwal, WILD, Coimbatore, Tamil Nadu, India
Dr. G.P. Sinha, Botanical Survey of India, Allahabad, India
Dr. K.A. Subramanian, Zoological Survey of India, New Alipore, Kolkata, India
Dr. P.M. Sureshan, Zoological Survey of India, Kozhikode, Kerala, India
Dr. R. Varatharajan, Manipur University, Imphal, Manipur, India
Dr. Eduard Vives, Museu de Ciències Naturals de Barcelona, Terrassa, Spain
Dr. James Young, Hong Kong Lepidopterists' Society, Hong Kong
Dr. R. Sundararaj, Institute of Wood Science & Technology, Bengaluru, India
Dr. M. Nithyanandan, Environmental Department, La Ala Al Kuwait Real Estate. Co. K.S.C., Kuwait
Dr. Himender Bharti, Punjabi University, Punjab, India
Mr. Purnendu Roy, London, UK
Dr. Saito Motoki, The Butterfly Society of Japan, Tokyo, Japan
Dr. Sanjay Sondhi, TITLI TRUST, Kalpavriksh, Dehradun, India
Dr. Nguyen Thi Phuong Lien, Vietnam Academy of Science and Technology, Hanoi, Vietnam
Dr. Nitin Kulkarni, Tropical Research Institute, Jabalpur, India
Dr. Robin Wen Jiang Ngiam, National Parks Board, Singapore
Dr. Lionel Monod, Natural History Museum of Geneva, Genève, Switzerland.
Dr. Asheesh Shivam, Nehru Gram Bharti University, Allahabad, India
Dr. Rosana Moreira da Rocha, Universidade Federal do Paraná, Curitiba, Brasil
Dr. Kurt R. Arnold, North Dakota State University, Saxony, Germany
Dr. James M. Carpenter, American Museum of Natural History, New York, USA
Dr. David M. Claborn, Missouri State University, Springfield, USA
Dr. Karen Schnabel, Marine Biologist, Wellington, New Zealand
Dr. Amazonas Chagas Júnior, Universidade Federal de Mato Grosso, Cuiabá, Brasil
Mr. Monsoon Jyoti Gogoi, Assam University, Silchar, Assam, India
Dr. Heo Chong Chin, Universiti Teknologi MARA (UiTM), Selangor, Malaysia
Dr. R.J. Shiel, University of Adelaide, SA 5005, Australia
Dr. Siddharth Kulkarni, The George Washington University, Washington, USA
Dr. Priyadarshan Dharma Rajan, ATREE, Bengaluru, India
Dr. Phil Alderslade, CSIRO Marine And Atmospheric Research, Hobart, Australia
Dr. John E.N. Veron, Coral Reef Research, Townsville, Australia
Dr. Daniel Whitmore, State Museum of Natural History Stuttgart, Rosenstein, Germany.
Dr. Yu-Feng Hsu, National Taiwan Normal University, Taipei City, Taiwan
Dr. Keith V. Antioch, California, USA
Dr. Siddharth Kulkarni, The Hormiga Lab, The George Washington University, Washington, D.C., USA
Dr. Tomas Ditrich, Faculty of Education, University of South Bohemia in Ceske Budejovice, Czech Republic
Dr. Mihaly Foldvari, Natural History Museum, University of Oslo, Norway
Dr. V.P. Uniyal, Wildlife Institute of India, Dehradun, Uttarakhand 248001, India
Dr. John T.D. Caleb, Zoological Survey of India, Kolkata, West Bengal, India
Dr. Priyadarshan Dharma Rajan, Ashoka Trust for Research in Ecology and the Environment (ATREE), Royal Enclave, Bangalore, Karnataka, India

Fishes

Dr. Neelesh Dahanukar, IISER, Pune, Maharashtra, India
Dr. Topiltzin Contreras MacBeath, Universidad Autónoma del estado de Morelos, México
Dr. Heok Hee Ng, National University of Singapore, Science Drive, Singapore
Dr. Rajeev Raghavan, St. Albert's College, Kochi, Kerala, India
Dr. Robert D. Sluka, Chiltern Gateway Project, A Rocha UK, Southall, Middlesex, UK
Dr. E. Vivekanandan, Central Marine Fisheries Research Institute, Chennai, India
Dr. Davor Zanella, University of Zagreb, Zagreb, Croatia
Dr. A. Biju Kumar, University of Kerala, Thiruvananthapuram, Kerala, India
Dr. Akhilesh K.V., ICAR-Central Marine Fisheries Research Institute, Mumbai Research Centre, Mumbai, Maharashtra, India
Dr. J.A. Johnson, Wildlife Institute of India, Dehradun, Uttarakhand, India
Dr. R. Ravinesh, Gujarat Institute of Desert Ecology, Gujarat, India

Amphibians

Dr. Sushil K. Dutta, Indian Institute of Science, Bengaluru, Karnataka, India
Dr. Annemarie Ohler, Muséum national d'Histoire naturelle, Paris, France

Reptiles

Dr. Gernot Vogel, Heidelberg, Germany
Dr. Raju Vyas, Vadodara, Gujarat, India
Dr. Pritpal S. Soorae, Environment Agency, Abu Dhabi, UAE.
Prof. Dr. Wayne J. Fuller, Near East University, Mersin, Turkey
Prof. Chandrashekher U. Rixonker, Goa University, Taleigao Plateau, Goa, India
Dr. S.R. Ganesh, Chennai Snake Park, Chennai, Tamil Nadu, India
Dr. Himansu Sekhar Das, Terrestrial & Marine Biodiversity, Abu Dhabi, UAE

Journal of Threatened Taxa is indexed/abstracted in Bibliography of Systematic Mycology, Biological Abstracts, BIOSIS Previews, CAB Abstracts, EBSCO, Google Scholar, Index Copernicus, Index Fungorum, JournalSeek, National Academy of Agricultural Sciences, NewJour, OCLC WorldCat, SCOPUS, Stanford University Libraries, Virtual Library of Biology, Zoological Records.

NAAS rating (India) 5.64

Birds

Dr. Hem Sagar Baral, Charles Sturt University, NSW Australia
Mr. H. Biju, Coimbatore, Tamil Nadu, India
Dr. Chris Bowden, Royal Society for the Protection of Birds, Sandy, UK
Dr. Priya Davidar, Pondicherry University, Kalapet, Puducherry, India
Dr. J.W. Duckworth, IUCN SSC, Bath, UK
Dr. Rajah Jayopal, SACON, Coimbatore, Tamil Nadu, India
Dr. Rajiv S. Kalsi, M.L.N. College, Yamuna Nagar, Haryana, India
Dr. V. Santharam, Rishi Valley Education Centre, Chittoor Dt., Andhra Pradesh, India
Dr. S. Balachandran, Bombay Natural History Society, Mumbai, India
Mr. J. Praveen, Bengaluru, India
Dr. C. Srinivasulu, Osmania University, Hyderabad, India
Dr. K.S. Gopi Sundar, International Crane Foundation, Baraboo, USA
Dr. Gombobaatar Sundev, Professor of Ornithology, Ulaanbaatar, Mongolia
Prof. Reuven Yosef, International Birding & Research Centre, Eilat, Israel
Dr. Taej Mundkur, Wetlands International, Wageningen, The Netherlands
Dr. Carol Inskip, Bishop Auckland Co., Durham, UK
Dr. Tim Inskip, Bishop Auckland Co., Durham, UK
Dr. V. Gokula, National College, Tiruchirappalli, Tamil Nadu, India
Dr. Arkady Lelej, Russian Academy of Sciences, Vladivostok, Russia
Dr. Simon Dowell, Science Director, Chester Zoo, UK
Dr. Mário Gabriel Santiago dos Santos, Universidade de Trás-os-Montes e Alto Douro, Quinta de Prados, Vila Real, Portugal
Dr. Grant Connette, Smithsonian Institution, Royal, VA, USA
Dr. P.A. Azeem, Coimbatore, Tamil Nadu, India

Mammals

Dr. Giovanni Amori, CNR - Institute of Ecosystem Studies, Rome, Italy
Dr. Anwaruddin Chowdhury, Guwahati, India
Dr. David Mallon, Zoological Society of London, UK
Dr. Shomita Mukherjee, SACON, Coimbatore, Tamil Nadu, India
Dr. Angie Appel, Wild Cat Network, Germany
Dr. P.O. Nameer, Kerala Agricultural University, Thrissur, Kerala, India
Dr. Ian Redmond, UNEP Convention on Migratory Species, Lansdown, UK
Dr. Heidi S. Riddle, Riddle's Elephant and Wildlife Sanctuary, Arkansas, USA
Dr. Karin Schwartz, George Mason University, Fairfax, Virginia.
Dr. Lala A.K. Singh, Bhubaneswar, Orissa, India
Dr. Mewa Singh, Mysore University, Mysore, India
Dr. Paul Racey, University of Exeter, Devon, UK
Dr. Honnavalli N. Kumara, SACON, Anaikatty P.O., Coimbatore, Tamil Nadu, India
Dr. Nishith Dharaiya, HNG University, Patan, Gujarat, India
Dr. Spartaco Gippoliti, Socio Onorario Società Italiana per la Storia della Fauna "Giuseppe Altobello", Rome, Italy
Dr. Justus Joshua, Green Future Foundation, Tiruchirappalli, Tamil Nadu, India
Dr. H. Raghuram, The American College, Madurai, Tamil Nadu, India
Dr. Paul Bates, Harison Institute, Kent, UK
Dr. Jim Sanderson, Small Wild Cat Conservation Foundation, Hartford, USA
Dr. Dan Challender, University of Kent, Canterbury, UK
Dr. David Mallon, Manchester Metropolitan University, Derbyshire, UK
Dr. Brian L. Cypher, California State University-Stanislaus, Bakersfield, CA
Dr. S.S. Talmale, Zoological Survey of India, Pune, Maharashtra, India
Prof. Karan Bahadur Shah, Budhanilkantha Municipality, Kathmandu, Nepal
Dr. Susan Cheyne, Borneo Nature Foundation International, Palangkaraya, Indonesia
Dr. Hemanta Kafley, Wildlife Sciences, Tarleton State University, Texas, USA

Other Disciplines

Dr. Aniruddha Belsare, Columbia MO 65203, USA (Veterinary)
Dr. Mandar S. Paingankar, University of Pune, Pune, Maharashtra, India (Molecular)
Dr. Jack Tordoff, Critical Ecosystem Partnership Fund, Arlington, USA (Communities)
Dr. Ulrike Streicher, University of Oregon, Eugene, USA (Veterinary)
Dr. Hari Balasubramanian, EcoAdvisors, Nova Scotia, Canada (Communities)
Dr. Rayanna Helleni Santos Bezerra, Universidade Federal de Sergipe, São Cristóvão, Brazil
Dr. Jamie R. Wood, Landcare Research, Canterbury, New Zealand
Dr. Wendy Collinson-Jonker, Endangered Wildlife Trust, Gauteng, South Africa
Dr. Rajeshkumar G. Jani, Anand Agricultural University, Anand, Gujarat, India
Dr. O.N. Tiwari, Senior Scientist, ICAR-Indian Agricultural Research Institute (IARI), New Delhi, India
Dr. L.D. Singla, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, India
Dr. Rupika S. Rajakaruna, University of Peradeniya, Peradeniya, Sri Lanka
Dr. Bharat Baviskar, Wild-CER, Nagpur, Maharashtra 440013, India

Reviewers 2020–2022

Due to paucity of space, the list of reviewers for 2018–2020 is available online.

The opinions expressed by the authors do not reflect the views of the Journal of Threatened Taxa, Wildlife Information Liaison Development Society, Zoo Outreach Organization, or any of the partners. The journal, the publisher, the host, and the partners are not responsible for the accuracy of the political boundaries shown in the maps by the authors.

Print copies of the Journal are available at cost. Write to:

The Managing Editor, JoTT,
c/o Wildlife Information Liaison Development Society,
43/2 Varadarajulu Nagar, 5th Street West, Ganapathy, Coimbatore,
Tamil Nadu 641006, India
ravi@threatenedtaxa.org

Communications

Presence of medium and large sized terrestrial mammals highlights the conservation potential of Patharia Hill Reserve in Bangladesh

– M. Aminur Rahman, Ai Suzuki, M. Sunam Uddin, M. Motalib, M. Rezaul Karim Chowdhury, Ameer Hamza & M. Abdul Aziz, Pp. 23283–23296

Diversity and abundance of aquatic birds in Koonthankulam village pond, Tamil Nadu, India

– Selvam Muralikrishnan, Esakkimuthu Shanmugam, Natarajan Arun Nagendran & Duraisamy Pandiaraja, Pp. 23297–23306

Plastral deossification zones in the Endangered Spiny Hill Turtle *Heosemys spinosa* (Testudines: Geoemydidae) on Borneo

– Siti Nor Baizurah & Indraneil Das, Pp. 23307–23314

Addition of four new records of pit vipers (Squamata: Crotalinae) to Manipur, India

– Premjit Singh Elangbam, Lal Biakzuala, Parag Shinde, Ht. Decemson, Mathipi Vabeiryureilai & Hmar Tlawmte Lalremsanga, Pp. 23315–23326

Addition to the Odonata fauna of Tripura, India

– Dhiman Datta, B.K. Agarwala & Joydeb Majumder, Pp. 23327–23337

Occurrence and distribution of two new libellulids (Odonata: Insecta) of the Kashmir Valley, India: *Orthetrum sabina* (Drury, 1770) and *Palpopleura sexmaculata* (Fabricius, 1787)

– Tahir Gazanfar & Mehreen Khaleel, Pp. 23338–23343

Rayed Thistle Fly *Tephritis cometa* Loew (Diptera: Tephritidae) a new record to India

– Rayees Ahmad, Tariq Ahmad & Barkat Hussain, Pp. 23344–23349

New state records of some Dermaptera De Geer, 1773 (Insecta) species in India

– Tanusri Das, Kochumackel George Emiliyamma & Subhankar Kumar Sarkar, Pp. 23350–23358

Moth diversity of Guindy, Chennai, India and DNA barcoding of selected erebid moths

– Seeramulu Bhavaragavan, Mani Meenakumari, Ramanathan Nivetha & Sundaram Janarthanan, Pp. 23359–23372

New record of the sphingid moth *Acherontia styx* Westwood, its parasitoid *Trichogramma achaearae* in *Jasmine Jasminum sambac* L., and its bioecology

– I. Merlin K. Davidson, Pp. 23373–23381

Identification and phylogenetic analysis of various termite species distributed across southern Haryana, India

– Bhanupriya, Shubhankar Mukherjee, Nidhi Kakkar & Sanjeev K. Gupta, Pp. 23382–23396

Survey of Black Band Disease-affected scleractinian corals via drone-based observations in Okinawa, Japan

– Rocktim Ramen Das, Parviz Tavakoli-Kolour, Sanaz Hazraty-Kari & James Davis Reimer, Pp. 23397–23402

Trace elements in *Penaeus* shrimp from two anthropized estuarine systems in Brazil

– Ana Paula Madeira Di Beneditto, Inácio Abreu Pestana & Cássia de Carvalho, Pp. 23403–23407

Aquatic Hemiptera inhabiting rice fields in Karaikal, Puducherry, India

– M. Kandibane & L. Gopianand, Pp. 23408–23415

Leaf defoliation and *Tabernaemontana rotensis* (Asterids: Gentianales: Apocynaceae) flower induction and fruit development

– Thomas E. Marler, Pp. 23416–23424

Short Communications

First record and DNA barcode of a scarab beetle, *Adoretus kanarensis* Arrow, 1917 (Coleoptera: Scarabaeidae: Rutelinae), from Maharashtra, India

– Pranil Jagdale, Sujata Magdum, Aparna Sureshchandra Kalawate, Swapnil Kajale & Yogesh Shouche, Pp. 23425–23430

New record of *Lucilia cuprina* (Wiedemann, 1830) (Diptera: Calliphoridae) from the Trans-Himalayan Region, cold arid desert of Kargil Ladakh, India

– Mohd Hussain, Altaf Hussain Mir, Hidayatullah Tak & Nassreen Fatima Kacho, Pp. 23431–23435

On the occurrence of *Nitella myriotricha* A.Braun ex Kützing, 1857 ssp. *acuminata* D.Subramanian, 1999 (Charophyceae: Charales: Characeae), from eastern India

– Kailash Mondal & Jai Prakash Keshri, Pp. 23436–23440

Notes

Dark Clouds Ahead? Anecdotal evidence for an illegal live trade in Sunda *Neofelis diardi* and Indochinese *N. nebulosa* Clouded Leopards (Mammalia: Carnivora: Felidae)

– Anthony J. Giordano, Leah M. Winstead, Muhammad Ali Imron, Rustam, Jephtha Sompud, Jayaraj Vijaya Kumaran & Kurtis Jai-Chyi Pei, Pp. 23441–23445

Further photographic record of Asiatic Brush-tailed Porcupine *Atherurus macrourus* Linnaeus, 1758 (Mammalia: Rodentia: Hystricidae) from Manas National Park, Assam, India

– Urjit Bhatt, Bilal Habib & Salvador Lyngdoh, Pp. 23446–23448

Predation of the Nicobar Shrew *Crocidura nicobarica* by a Cattle Egret *Bubulcus ibis*

– G. Gokulakrishnan, C.S. Vishnu & Manokaran Kamalakkannan, Pp. 23449–23451

War prompts distress symptoms in Israeli Blind Snake

– Shahar Dubiner, Shai Meiri & Eran Levin, Pp. 23452–23454

Further distribution records of *Varadia ambolensis* (Stylommatophora: Helicarionoidea) from the state of Goa

– Nitin Sawant, Shubham Rane, Sagar Naik, Seema Vishwakarma & Mayur Gawas, Pp. 23455–23457

Eleocharis acutangula ssp. *neotropica* D.J.Rosen (Cyperaceae): a new record for southern Western Ghats, India

– Kavya K. Nair & A.R. Viji, Pp. 23458–23460

Book Review

Putting wetland science to practice: a review

– Review by Tiasa Adhya & Partha Dey, Pp. 23461–23462

Publisher & Host

