Patterns and Progress of Peninsular Malaysia's Amphibian Research in the 21st Century (2000–2020)

Kin Onn Chan^{1,*} and Norhayati Ahmad^{2,3}

¹ *Lee Kong Chian Natural History Museum, National University of Singapore, 2 Conservatory Drive, 117377 Singapore*

² *School of Environment and Natural Resource Sciences, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia*

³ *Langkawi Research Centre, Institute for Environment and Development (LESTARI), Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia*

**Corresponding Author's Email: cko@nus.edu.sg*

Abstract

In this study, we review the status, patterns, and progress of Peninsular Malaysia's amphibian research in the 21st century with the main goal of identifying areas for improvement that can help focus and prioritize future research initiatives. Between 2000–2020 we found 130 publications that can be broadly categorized into four groups: 1) checklists and biodiversity; 2) new species and taxonomy; 3) ecology and natural history; and 4) evolution and phylogenetics. An average of 6.5 papers was published per year and although the number of papers fluctuated, there was a significant upward trend in the number of papers published. Almost half (49%) of all papers published comprised checklists and biodiversity-related papers. This was followed by new species and taxonomy (25%, 33 papers), evolution and phylogenetics (14%, 18 papers), and ecology and natural history (12%, 16 papers). Amphibian research was conducted most frequently in the states of Kedah, Pahang, and Perak, and most infrequently in the states of Malacca, Negeri Sembilan, Selangor/Kuala Lumpur, Perlis, and Kelantan. Despite being a megadiverse country and a biodiversity hotspot, not a single conservation-centric paper has ever been published on Peninsular

Malaysian amphibians, highlighting the urgent need for future research to focus on conservation.

Keywords: Biodiversity, Conservation, Systematics, Taxonomy, Evolution, Natural History, Phylogenetics, Ecology.

Introduction

Amphibian research in Peninsular Malaysia began in earnest towards the late 19th and early 20th century with notable contributions from early explorers (e.g. Ferdinand Stoliczka), herpetologists (e.g. Malcolm Arthur Smith and Norman Smedley), and workers at the British Museum (e.g. George Albert Boulenger). Understandably, early collections were centered around port and administrative cities in the states of Penang (Stoliczka 1870), Malacca (Boulenger 1887), and Perak (Boulenger 1900; Smith 1935), as well as important Hill Stations such as Cameron Highlands (Smedley 1931). Additionally, several expeditions to high elevation mountains were carried out (Boulenger 1908; Dring 1979; Grandison 1972). These early collections resulted in a thrive of new species and laid the groundwork for a better understanding of Peninsular Malaysia's amphibian fauna in the 21st century.

At the turn of the 21st century, important contributions continue to be made, largely led and inspired by the prominent Malaysian zoologist Dr. Lim Boo Liat (Das *et al.* 2004; Grismer *et al.* 2001, 2004; Kiew *et al.* 1995; Leong & Lim 2004; Lim *et al.* 2002; Norhayati *et al.* 2005). Alongside surveys, inventories, and new species discoveries that continue to be forthcoming, the breadth of research topics also expanded to include research in the field of molecular systematics and evolution (Chan *et al.* 2017, 2018b, 2020c, b; a; Chan & Brown 2017, 2020; Chan & Grismer 2019; Davis *et al.* 2016; Hurzaid *et al.* 2014; Matsui *et al.* 2017; Stuart *et al.* 2006). As research continues to develop with changing times and technologies, we review the status, patterns, and progress of Peninsular Malaysia's amphibian research in the 21st century with the main goal of identifying areas for improvement that can help focus and prioritize future research initiatives.

Material and Methods

We performed a comprehensive literature review of amphibian research publications in Peninsular Malaysia from the year 2000–2020. Only peer-reviewed primary literature was included and studies that did not directly involve material from Peninsular Malaysia were not considered. In total, 130 publications were found and categorized into the following groups:

- 1) Checklists and biodiversity: surveys, inventories, checklists, distribution, and measures of diversity.
- 2) New species and taxonomy: new species descriptions, taxonomic notes, and revisions.
- 3) Ecology and natural history: natural history notes, behavior, disease, and environmental correlates.
- 4) Evolution and phylogenetics: evolutionary history and phylogenetic relationships.

To characterize research trends and patterns, we analyzed the dataset according to the year of publication, number of papers, category, and geography. For geography, we classified papers according to states. Studies that were not focused on a particular state were excluded. All analyses were performed in R (R Core Team 2014). The categorized bibliography of all papers used in this study is presented in the Appendix.

Results

Despite fluctuations from year to year, the 20-year trend showed a significant increase in the number of papers published (Fig. 1). On average, 6.5 papers were published per year, with a median of 5.5. The lowest number of papers published was one (years 2001 and 2005), while the highest number was 17 (year 2020).

Fig. 1. Scatter plot showing the number of amphibian research papers published by year. The blue line represents the regression line obtained using a local polynomial regression fitting method.

Almost half (49%) of all amphibian research published between 2000–2020 was represented by checklists and biodiversity-related papers (Fig. 2). This was followed by new species and taxonomy (25%, 33 papers), evolution and phylogenetics (14%, 18 papers), and ecology and natural history (12%, 16 papers). Checklists and biodiversity-related papers also dominated the research literature across all years (Fig. 3). New species and taxonomic papers ranked second highest from the years 2000–2015. Between 2016–2020, the number of ecology, natural history, evolution, and phylogenetic papers increased more than two-fold and outnumbered papers on new species and taxonomy (Fig. 3).

Fig. 2. Percentage and number of papers published (in parenthesis) by category between 2000–2020.

Fig. 3. Bar plots grouped by category and binned into 5-year periods. Numbers above bars represent the total number of papers published in each category.

Amphibian research was conducted most frequently in the states of Kedah, Pahang, and Perak, and most infrequently in the states of Malacca, Negeri Sembilan, Selangor/Kuala Lumpur, Perlis, and Kelantan (Fig. 4).

Fig. 4. Number of papers published by state. Only studies that were explicitly conducted within a particular state were included.

Discussion

The increasing number of papers published per year shows that amphibian research in Peninsular Malaysia is on an upward trend and the dominance of checklists, biodiversity, new species, and taxonomy-related papers indicate that the biodiversity of amphibians in Peninsular Malaysia is still far from being fully realized. The number of papers published by state (Fig. 4) shows that some regions are still poorly studied. This most notably includes the states of Perlis, Negeri Sembilan, Malacca, Kelantan, Selangor/Kuala Lumpur, and Terengganu. Research in some of these areas has resulted in numerous important discoveries (Chan *et al.* 2011, 2014b, 2018a), indicating that these areas are still poorly studied and should be prioritized for future research. However, states that have received more research attention such as Perak, Pahang, and Kedah continue to produce new discoveries (Chan *et al.*

2014a; Davis *et al.* 2016; Quah *et al.* 2011) and thus, research intensity in these states should continue and not be reduced.

Over the years, the number of papers on ecology, natural history, evolution, and phylogenetics has increased, particularly in the last five years (Fig. 3). In comparison, not a single paper on evolution and phylogenetics was published between 2000–2005. This could be due to the lack of expertise and the high cost of genetic sequencing during that period. Advances in sequencing technology coupled with a concomitant reduction in sequencing cost and collaborations with international partners saw a rise in genetic research between 2005–2020. These, including more recent studies involving genome-scale data (Chan *et al.* 2020a, c; b) indicate that amphibian research in Peninsular Malaysia is progressing and is on par with other research programmes around the world.

One notable research gap is the lack of conservation-based research. Despite being a megadiverse country and a biodiversity hotspot, not a single conservation-centric paper has ever been published on Peninsular Malaysian amphibians. Research in this field is urgently needed as Malaysia is one of the countries with the highest rate of deforestation (Hansen *et al.* 2013) with almost 30% of its amphibian species threatened (MyBis 2021).

Literature Cited

- Boulenger, G.A. (1887) On new batrachians from Malacca. *Annals and Magazine of Natural History, Series 5* 19, 345–348.
- Boulenger, G.A. (1900) Descriptions of new batrachians and reptiles from the Larut Hills, Perak. *Annals and Magazine of Natural History, Series 7* 6, 186–193.
- Boulenger, G.A. (1908) Report on the Gunong Tahan expedition, May–Sept. 1905. III. Fishes, batrachians and reptiles. *Journal of the Federated Malay States Museums* 3, 61–69.
- Chan, K.O., Abraham, R.K., Grismer, J.L. & Grismer, L.L. (2018a) Elevational size variation and two new species of torrent frogs from Peninsular Malaysia (Anura: Ranidae: *Amolops* Cope). *Zootaxa* 4434, 250–264.
<https://doi.org/http://dx.doi.org/10.11646/zootaxa.4434.2.2>
- Chan, K.O., Alexander, A.M., Grismer, L.L., Su, Y.-C., Grismer, J.L., Quah, E.S.H. &

- Brown, R.M. (2017) Species delimitation with gene flow: a methodological comparison and population genomics approach to elucidate cryptic species boundaries in Malaysian Torrent Frogs. *Molecular Ecology* 26, 5435–5450. <https://doi.org/10.1111/mec.14296>
- Chan, K.O. & Brown, R.M. (2017) Did true frogs “dispersify”? *Biology Letters* 13, 20170299. <https://doi.org/10.1098/rsbl.2017.0299>
- Chan, K.O. & Brown, R.M. (2020) Elucidating the drivers of genetic differentiation in Malaysian torrent frogs (Anura: Ranidae: Amolops): a landscape genomics approach. *Zoological Journal of the Linnean Society* 190, 65–78. <https://doi.org/10.1093/zoolinnean/zlz151>
- Chan, K.O. & Grismer, L.L. (2019) To split or not to split? Multilocus phylogeny and molecular species delimitation of southeast Asian toads (family: Bufonidae). *BMC Evolutionary Biology* 19, 95. <https://doi.org/10.1186/s12862-019-1422-3>
- Chan, K.O., Grismer, L.L., Anuar, S., Quah, E.S.H., Grismer, J.L., Wood, P.L., Muin, M.A. & Ahmad, N. (2011) A new species of *Chiromantis* Peters 1854 (Anura: rhacophoridae) from Perlis state park in extreme northern Peninsular Malaysia with additional herpetofaunal records for the park. *Russian Journal of Herpetology* *Journal of Herpetology* 18, 253–259.
- Chan, K.O., Grismer, L.L. & Brown, R.M. (2014a) Reappraisal of the Javanese Bullfrog complex, *Kaloula baleata* (Müller, 1836) (Amphibia: Anura: Microhylidae), reveals a new species from Peninsular Malaysia. *Zootaxa* 3900, 569–580. <https://doi.org/10.11646/zootaxa.3900.4.7>
- Chan, K.O., Grismer, L.L. & Brown, R.M. (2018b) Comprehensive multi-locus phylogeny of Old World tree frogs (Anura: Rhacophoridae) reveals taxonomic uncertainties and potential cases of over- and underestimation of species diversity. *Molecular Phylogenetics and Evolution* 127, 1010–1019.
- Chan, K.O., Hutter, C.R., Wood, P.L., Grismer, L.L. & Brown, R.M. (2020a) Larger, unfiltered datasets are more effective at resolving phylogenetic conflict: Introns, exons, and UCEs resolve ambiguities in Golden-backed frogs (Anura: Ranidae; genus *Hylarana*). *Molecular Phylogenetics and Evolution* 151, 106899. <https://doi.org/10.1016/j.ympev.2020.106899>

- Chan, K.O., Hutter, C.R., Wood, P.L., Grismer, L.L., Das, I. & Brown, R.M. (2020b) Gene flow creates a mirage of cryptic species in a Southeast Asian spotted stream frog complex. *Molecular Ecology* 29, 3970–3987. <https://doi.org/10.1111/mec.15603>
- Chan, K.O., Hutter, C.R., Wood, P.L.J., Grismer, L.L. & Brown, R.M. (2020c) Target-capture phylogenomics provide insights on gene and species tree discordances in Old World Treefrogs (Anura: Rhacophoridae). *Proceedings of the Royal Society B* 287, 20202102. <https://doi.org/10.1098/rspb.2020.2102>
- Chan, K.O., Wood, P.L.J., Anuar, S., Muin, M.A., Quah, E.S.H., Sumarli, A.X.Y. & Grismer, L.L. (2014b) A new species of upland Stream Toad of the genus *Ansonia* Stoliczka, 1870 (Anura: Bufonidae) from northeastern Peninsular Malaysia. *Zootaxa* 3764, 427–440. <https://doi.org/http://dx.doi.org/10.11646/zootaxa.3764.4.3>
- Das, I., Yaakob, N. & Lim, B.L. (2004) A new species of *Calluella* Stoliczka, 1872 (Anura: Microhylidae) from Taman Negara, Pahang State, Peninsular Malaysia. *Raffles Bulletin of Zoology* 52, 257–260.
- Davis, H.R., Grismer, L.L., Klabacka, R.L., Muin, M.A., Quah, E.S.H., Anuar, S., Wood, P.L.J. & Sites, J.W. (2016) The phylogenetic relationships of a new Stream Toad of the genus *Ansonia* Stoliczka, 1870 (Anura: Bufonidae) from a montane region in Peninsular Malaysia. *Zootaxa* 4103, 137–153. <https://doi.org/http://dx.doi.org/10.11646/zootaxa.4103.2.4>
- Dring, J.C.M. (1979) Amphibians and reptiles from northern Trengganu, Malaysia, with descriptions of two new geckos: *Cnemaspis* and *Cyrtodactylus*. *Bulletin of the British Museum of Natural History (Zoology)* 34, 181–241.
- Grandison, A.G.C. (1972) The Gunong Benom Expedition 1967. 5. Reptiles and amphibians of Gunong Benom with a description of a new species of *Macrocalamus*. *Bulletin of the British Museum of Natural History (Zoology)* 23, 45–101.
- Grismer, J.L., Grismer, L.L., Das, I., Yaakob, N.S., Lim, B.L., Leong, T.M., Youmans, T.M. & Kaiser, H.F. (2004) Species diversity and checklist of the herpetofauna of Pulau Tioman, Peninsular Malaysia, with a preliminary overview of habitat utilization. *Asiatic Herpetological Research* 10, 247–279.
- Grismer, L.L., Yaakob, N.S., Lim, B.L., Leong, T.M., Das, I., Sosa, R.A., Grismer, J.L.,

- Crane, K.M., Diaz, R.E. & Figueroa, S. V (2001) Report on the herpetofauna of Pulau Tulai, West Malaysia. *Hamadryad* 26, 369–371.
- Hansen, M.C.C., Potapov, P. V, Moore, R., Hancher, M., Turubanova, S.A. a, Tyukavina, A., Thau, D., Stehman, S.V. V, Goetz, S.J.J., Loveland, T.R.R., Kommareddy, A., Egorov, A., Chini, L., Justice, C.O.O., Townshend, J.R.G.R.G., Patapov, P.V., Moore, R., Hancher, M., Turubanova, S.A. a, Tyukavina, A., Thau, D., Stehman, S.V. V, Goetz, S.J.J., Loveland, T.R.R., Kommareddy, A., Egorov, A., Chini, L., Justice, C.O.O. & Townshend, J.R.G.R.G. (2013) High-Resolution Global Maps of 21st-Century Forest Cover Change. *Science* 342, 850–854. <https://doi.org/10.1126/science.1244693>
- Hurzaid, A., Jaafar, I., Awang, Z. & Nor, S.A.M. (2014) Genetic structure of the Asian Grass Frog, *Fejervarya limnocharis* (Amphibia: Anura: Dicroglossidae) of Peninsular Malaysia: a preliminary report. *Zoological Studies* 53, 1–7. <https://doi.org/10.1186/s40555-014-0077-4>
- Kiew, B.H., Diong, C.H. & Lim, B.L. (1995) An annotated checklist of the amphibians fauna in the Temenggor Forest Reserve, Hulu Perak, Malaysia. *Malayan Nature Journal* 48: 3–4.
- Leong, T.M. & Lim, B.L. (2004) *Rana siberu* Dring, McCarthy & Written, 1990 - A first record for Peninsular Malaysia (Amphibia: Anura: Ranidae). *Raffles Bulletin of Zoology* 52, 261–263.
- Lim, K.K.P., Leong, T.M. & Lim, B.L. (2002) Herpetofaunal records from Cameron Highlands, Peninsular Malaysia. *Journal of Wildlife and Parks* 20, 49–57.
- Matsui, M., Eto, K., Nishikawa, K., Hamidy, A., Belabut, D., Norhayati AHMAD, S.P., Khonsue, W. & Grismer, L.L. (2017) Mitochondrial Phylogeny of Leptolalax From Malay Peninsula and Leptobrachella (Anura, Megophryidae). *Current Herpetology* 36.
- MyBis (2021) Malaysia Biodiversity Information System. Available from: <https://www.mybis.gov.my/one/> (May 7, 2021)
- Norhayati, A., Senawi, J. & Lim, B.L. (2005) *Amphibians of Ulu Muda Forest Reserve, Kedah*. Forestry Department of Peninsular Malaysia, Kuala Lumpur.
- Quah, E.S.H., Grismer, L.L., Muin, M.A. & Anuar, S. (2011) Re-discovery and re-description of *Ansonia penangensis* Stoliczka, 1870 (Anura: Bufonidae) from Penang

Island, Malaysia. *Zootaxa* 64, 57–64.

R Core Team (2014) A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.

Smedley, M.A. (1931) Amphibians and reptiles from the Cameron Highlands, Malay Peninsula. *Bulletin of the Raffles Museum* 6, 105–124.

Smith, M.A. (1935) On a collection of reptiles and amphibians from Perak, Malay Peninsula. *Bulletin of the Raffles Museum* 10.

Stoliczka, F. (1870) Observations on some Indian and Malayan Amphibia and Reptilia. *Journal of the Asiatic Society of Bengal* 39, 134–157.

Stuart, B.L., Inger, R.F. & Voris, H.K. (2006) High level of cryptic species diversity revealed by sympatric lineages of Southeast Asian forest frogs. *Biology Letters* 2, 470–474.
<https://doi.org/10.1098/rsbl.2006.0505>

Appendix

Categorized bibliography of all papers used in this study:

Checklists and Biodiversity

Chan, K.O., Muin, M.A., Badli-Sham, B.H., Fatihah-Syafiq, M., Abraham, R.K., Ahmad, A. & Zakaria, R. (2020) Identification and species delimitation of the enigmatic Marsh Frog *Pulchrana rawa* (Matsui, Mumpuni, and Hamidy, 2012): Second confirmed specimen and first country record for Malaysia. *Journal of Herpetology* 54, 282–288.
<https://doi.org/10.1670/19-132>

Dasi, O. & Shahriza, S. (2020) A checklist of amphibians at Lubuk Semilang recreational park, Langkawi island, Kedah, Peninsular Malaysia. *Arxius de Miscellania Zoologica* 18, 9–26. <https://doi.org/10.32800/amz.2020.18.0009>

Fatihah-Syafiq, M., Badli-Sham, B.H., Fahmi-Ahmad, M., Aqmal-Naser, M., Rizal, S.A., Azmi, M.S.A., Grismer, L.L. & Ahmad, A.B. (2020) Checklist of herpetofauna in the severely degraded ecosystem of Bidong Island, Peninsular Malaysia, South China Sea. *ZooKeys* 985, 143–162. <https://doi.org/10.3897/zookeys.985.54737>

Hui, N.Y., Ngadi, E., Md-Zain, B.M., Md-Zairi, Z. & Abdul-Latiff, M.A.B. (2020) Short communication: A note on the new record of the amphibian fauna in Pulau Tinggi, Malaysia. *Biodiversitas* 21, 2425–2429. <https://doi.org/10.13057/biodiv/d210613>

- Munisamy, B., Kamaruddin, K.N., Kulaimi, A.M., Mohamed, K.A., Ithnin, H., Rovie-ryan, J.J., Topani, R. & Manickam, S. (2020) A revised and updated checklist of herpetofauna of Tasek Bera RAMSAR site, Pahang, Malaysia. *Journal of Wildlife and Parks* 35, 93–103.
- Ngadi, E., Hambali, K., Mohamed, M.S., Abdul Wahab, M.A.I. & Nor, S.M. (2020) Amphibians and Reptiles Survey at Tasik Pergau, Jeli, Kelantan and Its Updated Checklist. *IOP Conference Series: Earth and Environmental Science* 549, 012046. <https://doi.org/10.1088/1755-1315/549/1/012046>
- S, N., T, M.M., R, N., M, Na.S.F., A, F.A., K, R.M. & A, A.M. (2020) The Diversity of Anuran Species in Urban Forest in Selangor. *IOP Conf. Series: Earth and Environmental Science* 494, 012009. <https://doi.org/10.1088/1755-1315/494/1/012009>
- Talib, A., Hambali, K., Ngadi, E., Haiqal, M.S., Amir, A. & Sow, A.Y. (2020) A preliminary survey of herpetofauna at Delta Tumpat mangrove forest, Kelantan, Malaysia. *Journal of Wildlife and Parks* 35, 27–37.
- Badli-Sham, B.H., Ayob, M., Faiz, M., Halim, A., Mustafa, S.K., Ismail, N.F., Andam, J., Belabut, D.M. & Ahmad, A.B. (2019) Herpetofauna in southern part of Pulau Tioman, Pahang, Peninsular Malaysia. *Journal of Wildlife and Parks* 34, 23–38.
- Chan, K.O., Muin, M.A., Anuar, S., Andam, J., Razak, N. & Aziz, M.A. (2019) First checklist on the amphibians and reptiles of Mount Korbu, the second highest peak in Peninsular Malaysia. *Check List* 15, 1055–1069. <https://doi.org/10.15560/15.6.1055>
- Marina, M.T. & Wong, C.C.T. (2019) An update on Anuran diversity via opportunistic survey on Pulau Banding, Perak, Malaysia. *Malayan Nature Journal* 71, 47–53.
- Norhayati, A., Ehwan, N., Nurul Nadiah, R., Nur Izzah Syahirah, M., Nur Johana, J., Baizul Hafsyam, B.S., Amirah Azizah, Z. & Amirrudin, A. (2019) Species richness and diversity of amphibians and reptilians in Pulau Pangkor, Perak, peninsular Malaysia. *The Malaysian Forester* 82, 283–296.
- Davis, H.R., Grismer, L.L., Cobos, A.J., Murdoch, M.L., Sumarli, A.X., Anuar, S., Muin, M.A., Wood, P. L. Jr. & Quah, E.S.H. (2018) Checklist of the herpetofauna of Hutan Lipur Gunung Senyum, Pahang, Peninsular Malaysia. *Russian Journal of Herpetology* 25, 207–220. <https://doi.org/10.30906/1026-2296-2018-25-3-207-220>
- Quah, E.S.H. & Shahrul, A. (2018) Herpetofauna of the northern corridor: A review of recent herpetological discoveries around the Malaysian-Thai border regions. *Journal of Wildlife and Parks* 33, 15–29.
- Amalina, M.I., Azhari, M., Norshaqinah, A., Azrin, N.A., Shukor, M.N., Aisah, M.S., Amirrudin, A., Grismer, L.L. & Norhayati, A. (2017) Species composition of amphibians and reptiles in Tembat Forest Reserve, Hulu Terengganu, Terengganu, Peninsular Malaysia. *Malaysian Applied Biology* 46, 119–129.

- Shahriza, S. & Ibrahim, J. (2017) A survey of the amphibian species of Sungai Bubu, Anak Kurau, Perak, Peninsular Malaysia. *Russian Journal of Herpetology* 24, 54–62. <https://doi.org/10.30906/1026-2296-2019-24-1-54-62>
- Ehwan, N., Shukor, M.N., Salmah, Y., Grismer, L.L. & Norhayati, A. (2016) Herpetofauna diversity at Gunung Raya, Pulau Langkawi, Kedah, Peninsular Malaysia. *AIP Conference Proceedings* 1784, 060008. <https://doi.org/10.1063/1.4966846>
- Izam, N.A.M., Ahmad, A., Grismer, L.L., Saidin, A.N., Nor, S.M. & Ahmad, N. (2016) Species composition and richness of amphibians in logged forests at Hulu Terengganu, Peninsular Malaysia. *AIP Conference Proceedings* 1784. <https://doi.org/10.1063/1.4966872>
- Nur Johana, J., Muzzneena, A.M., Grismer, L.L. & Norhayati, A. (2016) Species composition, diversity and relative abundance of amphibians in forests and non-forest habitats on Langkawi Island, Peninsular Malaysia. *AIP Conference Proceedings* 1784. <https://doi.org/10.1063/1.4966873>
- Nur Johana, J., Muzzneena, A.M., Grismer, L.L. & Norhayati, A. (2016) Species composition, diversity and relative abundance of amphibians in forests and non-forest habitats on Langkawi Island, Peninsular Malaysia. *AIP Conference Proceedings* 1784. <https://doi.org/10.1063/1.4966873>
- Nurulhuda, Z., Daicus, B., Shukor, M.N., Fakhrul Hatta, M. & Norhayati, A. (2015) Spatial and temporal variation of amphibian assemblage at Kuala Gandah, Krau Wildlife Reserve, Pahang, Peninsular Malaysia. *Malaysian Applied Biology* 44, 107–117.
- Sumarli, A.X., Grismer, L.L., Anuar, S., Muin, M.A. & Quah, E.S.H. (2015) First report on the amphibians and reptiles of a remote mountain, Gunung Tebu in northeastern Peninsular Malaysia. *Checklist* 11, 1–32. <https://doi.org/10.15560/11.4.1679>
- Hui, Y.C., Awang, Z., Hurzaid, A., Belabut, D. & Jaafar, I. (2014) Diversity and density of amphibians at Sungai Kampi, Teluk Kampi, Penang National Park, Malaysia. *Journal of Wildlife and Parks* 27, 97–101.
- Jaafar, I., Chee Hui, Y., Hurzaid, A. & Abu Bakar, A. (2014) Amphibian Density and Diversity in a Disturbed Habitat in Belum. *Journal of Wildlife and Parks* 28, 141–143.
- Nurulhuda, Z., Senawi, J., Musa, F.H., Belabut, D., Chan, K.O., Md. Nor, S. & Ahmad, N. (2014) Species composition of amphibians and reptiles in Krau Wildlife Reserve, Pahang, Peninsular Malaysia. *Check List* 10, 335–343. <https://doi.org/10.15560/10.2.335>
- Shahriza, S. & Ibrahim, J. (2014) A Preliminary Checklist of Amphibians of Ulu Paip Recreational Forest, Kedah, Malaysia. *CheckList* 10, 253–259.
- Shahrudin, S. & Ibrahim, J. (2014) Reptiles of Lata Bukit Hijau, Kedah, Malaysia. *Songklanakarin Journal of Science and Technology* 36, 37–44.
- Shahrudin, S. & Jaafar, I. (2014) The amphibian checklist of Bukit Larut, Perak, Malaysia. *Pertanika Journal of Tropical Agricultural Science* 37, 87–99.

- Barnett, J.B., Benbow, R.L., Ismail, A. & Fellowes, M.D.E. (2013) Abundance and diversity of anurans in a regenerating former oil palm plantation in Selangor, Peninsular Malaysia. *Herpetological Bulletin* 125, 1–9.
- Jaafar, I., Hurzaid, A., Shahrudin, S., Ibrahim, N.H., Awang, Z., Majid, N.A. & Zaaba, N.H.C. (2013) Updated checklist of amphibians of Pulau Jerejak, Penang, Peninsular Malaysia. *Procedia - Social and Behavioral Sciences* 91, 36–40.
<https://doi.org/10.1016/j.sbspro.2013.08.398>
- Jaafar, I., Hurzaid, A., Shahrudin, S., Ibrahim, N., Awang, Z., Hui, Y.C., Majid, N.A. & Zaaba, N.H.C. (2013) Additions to the herpetofauna of Jerejak Island, Penang, Peninsular Malaysia. *Malayan Nature Journal* 64, 213–232.
- Quah, E.S.H., Sah, S.A.M., Mohd Abdul Muin, M.A., Rahman, N.A.A., Mustafa, F.S. & Grismer, L.L. (2013) Species diversity of herpetofauna of Bukit Panchor State Park, Penang, Peninsular Malaysia. *Malayan Nature Journal* 64, 193–211.
- Shahriza, S., Ibrahim, J. & Shahrul Anuar, M.S. (2013) Amphibian of Tupah Recreational Forest, Merbok, Kedah, Malaysia. *Malaysian Applied Biology* 42, 71–75.
- Jaafar, I., Awang, Z., Shahrudin, S., Sah, S.A.M., Ibrahim, N.H., Hurzaid, A., Rahim, N.D.A., Min, M.A. & Ismail, A. (2012) Checklist of the herpetofauna of Bukit Perangin forest reserve, Kedah, Malaysia. *Sains Malaysiana* 41, 691–696.
- Shahriza, S., Ibrahim, J., Shahrul Anuar, M.S. & Abdul Muin, M.A. (2012) Herpetofauna of Peta area of Endau-Rompin National Park, Johor, Malaysia. *Pertanika Journal of Tropical Agricultural Science* 35, 553–567.
- Shahrudin, S. & Jaafar, I. (2012) The amphibian diversity of Bukit Jana, Taiping, Perak. *Tropical Life Sciences Research* 23, 49–57.
- Ahmad, N., Farah, A.D., Chan, K.O., Belabut, D. & Muin, M.A. (2011) An update of herpetofaunal records from Bukit Fraser, Pahang, Peninsular Malaysia. *Malaysian Applied Biology* 40, 9–17.
- Fazlin, M. & Hadijah, S. (2011) Amphibian assemblage of Bubu Permanent Forest Reserve, Perak, Peninsular Malaysia. *Malaysian Applied Biology* 40, 1–6.
- Grismer, L.L., Grismer, J.L., Wood, P.L., Ngo, V.T., Neang, T. & Chan, K.O. (2011) Herpetology on the fringes of the Sunda shelf: a discussion of discovery, taxonomy, and biogeography. *Bonner Zoologische Monographien* 57, 57–97.
- Quah, E.S.H., Anuar, S.M.S., Grismer, L.L., Muin, M.A., Chan, K.O. & Grismer, J.L. (2011) Preliminary checklist of the herpetofauna of Jerejak Island, Penang, Malaysia. *Malayan Nature Journal* 63, 595–600.
- Shahriza, S., Ibrahim, J. & Anuar, M.S.S. (2011) The Amphibian Fauna of Lata Bukit Hijau, Kedah, Malaysia. *Russian Journal of Herpetology* 18, 221–227.

- Shahrudin, S., Jaafar, I.H., Rahim, N.D.A. & Mohd Akil, M.A.M. (2011) An annotated checklist of the herpetofauna of Beris Valley, kedah, malaysia. *Tropical Life Sciences Research* 22, 13–24.
- van Rooijen, J., Chan, K.O., Grismer, L.L. & Ahmad, N. (2011) Estimating the herpetofaunal species richness of Pangkor Island, Peninsular Malaysia. *Bonn zoological Bulletin* 60, 3–8.
- Chan, K.O., Grismer, L.L., Matsui, M., Nishikawa, K., Wood, P.L., Grismer, J.L., Belabut, D. & Ahmad, N. (2010) Herpetofauna of Gunung Panti Forest Reserve, Johor, Peninsular Malaysia. *Tropical Life Sciences Research* 21, 71–82.
- Chan, K.O., Belabut, D. & Ahmad, N. (2010) A revised checklist of the amphibians of Peninsular Malaysia. *Russian Journal of Herpetology* 17, 202–206.
- Chan, K.O., van Rooijen, J., Grismer, L.L., Belabut, D., Muin, M.A., Jamaludin, H., Gregory, R. & Norhayati, A. (2010) First report on the herpetofauna of Pulau Pangkor, Perak, Malaysia. *Russian Journal of Herpetology* 17, 139–146.
- Grismer, L.L., Chan, K.O., Grismer, J.L., Wood, P.L., Norhayati, A. & Ahmad, N. (2010) A checklist of the herpetofauna of the Banjaran Bintang, Peninsular Malaysia. *Russian Journal of Herpetology* 17, 147–160.
- Lim, B.L., Wira, N.A., Chan, K.O., Daicus, B. & Norhayati, A. (2010) An updated checklist of the herpetofauna of Pulau Singa Besar, Langkawi , Peninsular Malaysia. *Malaysian Applied Biology* 39, 13–23.
- Chan, K.O., Azman, M.S., Azlin, N. & Pan, K.A. (2009) Additions to the herpetofauna of Pasoh forest reserve, Negeri Sembilan, Peninsular Malaysia. *Tropical Life Sciences Research* 20, 71–80.
- Chan, K.O. & Ahmad, N. (2009) Distribution and natural history notes on some poorly known frogs and snakes from Peninsular Malaysia. *Herpetological Review* 40, 294–301.
- Chan, K.O., Grismer, L.L., Sharma, D.S., Daicus, B. & Norhayati, A. (2009) New herpetofaunal records for Perlis state park and adjacent areas. *Malayan Nature Journal* 61, 277–284.
- Chan, K.O., Grismer, L.L., Wood, P.L., Grismer, J.L. & Ahmad, N. (2009) Preliminary checklist of the herpetofauna of Pulau Besar, Melaka, Malaysia. *Tropical Life Sciences Research* 20, 81–87.
- Jaafar, I., Chai, T.C., Sah, S.A.M. & Akil, M.A.M.M. (2009) Checklist and simple identification key for frogs and toads from District IV of the MADA scheme, Kedah, Malaysia. *Tropical Life Sciences Research* 20, 49–57.
- Lim, B.L., Khan, M.K.M., Chai, K.S. & Lim, C.C. (2008) Pre-logging survey of herpetological and mammal fauna at Lakum Forest Reserve, Raub, Pahang, Malaysia. *Journal of Science & Technology in the Tropics* 4, 99–116.

- Norhayati, A., Abdul Rahman, M.R., Juliana, S., Daicus, B. & Chan, K.O. (2008) A checklist of amphibians at Taman Negara Kelantan National Park, Kuala Koh, Peninsular Malaysia. *Journal of Wildlife and Parks* 25, 1–7.
- Wood, P.L.J., Grismer, L.L., Youmans, T.M., Nasir, N., Ahmad, N. & Senawi, J. (2008) Additions to the herpetofauna of Endau-Rompin, Johor, West Malaysia. *Herpetological Review* 39, 112–121.
- Grismer, L.L., Youmans, T.M., Wood, P.L., Ponce, A., Wright, S.B., Jones, B.S., Johnson, R., Sanders, K.L., Gower, D.J., Yaakob, N.S. & Lim, K.K.P. (2006) Checklist of the herpetofauna of Pulau Langkawi, Malaysia, with comments on taxonomy. *Hamadryad* 30, 61–74.
- Grismer, L.L., Yoiunans, T.M., Wood, P.L. & Grismer, J.L. (2006) Checklist of the herpetofauna of the Seribu Archipelago, West Malaysia with comments on biogeography, natural history, and adaptive types. *Raffles Bulletin of Zoology* 54, 157–180.
- Belabut, D.M., Hasim, R., Ramli, R. & Sofian-Azirun, M. (2005) Herpetofauna of Two Habitats in Northeast Pulau Langkawi, Kedah, Peninsular Malaysia. *Malaysian Journal of Science* 24.
- Belabut, D. & Hashim, R. (2004) Herpetofauna of the western region of Endau-Rompin, Johore, Peninsular Malaysia. *Malaysian Journal of Science* 23, 65–72.
- Risner, J.E.L.G., Risner, L.L.E.E.G., As, I.N.D., Aakob, N.O.S.Y., Iat, L.I.M.B.O.O.L., Eong, T.Z.I.M.I.N.G.L., Oumans, T.I.M.Y. & Aiser, H.I.K. (2004) Species Diversity and Checklist of the Herpetofauna of Pulau Tioman, Peninsular Malaysia, With a Preliminary Overview of Habitat Utilization. *Asiatic Herpetological Research* 10, 247–279.
- Grismer, L.L., McGuire, J.A., Sosa, R.A. & Kaiser, H. (2002) Revised checklist and comments on the terrestrial herpetofauna of Pulau Tioman, Peninsular Malaysia. *Herpetological Review* 33, 26–29.
- Sukumaran, J. (2002) The amphibian fauna of a forested area in Temengor, Perak, Malaysia, with the first record of *Philautus parvulus* (Boulenger, 1893) in the Malay Peninsula. *Hamadryad* 27, 1–10.

Ecology and Natural History

- Ayob, N., Mustapha, M.A., Senawi, J. & Ahmad, N. (2020) Herpetofauna roadkills on Langkawi Island, Peninsular Malaysia: The influence of landscape and season on mortality distribution. *Sains Malaysiana* 49, 2373–2382. <https://doi.org/10.17576/jsm-2020-4910-04>

- Leblanc, J., Faruk, A., Dort, E., Govindarajulu, P., Quah, E., Abdul Muin, M. & Hintz, W. (2014) Multi-year surveillance for batrachochytrium dendrobatidis in amphibians of peninsular Malaysia. *Herpetological Review* 45, 603–608.
- Leong, T.M. (2002) Status of larval identities among the Peninsular Malaysian Anura. *Herpetological Review* 33, 171–174.
- Leong, T.M. & Lim, C.F. (2003) The tadpole of *Rana miopus* Boulenger, 1918 from Peninsular Malaysia. *Hamadryad* 27, 175–178.
- Norhayati, A., Ehwan, N. & Okuda, T. (2014) Assessment of riparian ecosystem on amphibians along a green corridor in oil palm plantation, pasoh, negeri sembilan, peninsular malaysia. *Sains Malaysiana* 43, 655–666.
- Savage, A.E., Grismer, L.L., Anuar, S., Chan, K.O., Grismer, J.L., Quah, E., Muin, M.A., Ahmad, N., Lenker, M. & Zamudio, K.R. (2011) First record of *Batrachochytrium dendrobatidis* infecting four frog families from Peninsular Malaysia. *EcoHealth* 8, 121–128. <https://doi.org/10.1007/s10393-011-0685-y>
- Shahriza, S.H., Ibrahim, H.J. & Shahrul Anuar, M.S. (2010) The Correlation between Total Rainfall and Breeding Parameters of White-Lipped Frog, *Rana labialis* (Anura: Ranidae) in Kedah, Malaysia. *Tropical Natural History* 10, 131–139.
- Shahriza, S., Ibrahim, J. & Anuar, M.S.S. (2016) Reproductive parameters of *Chalcorana labialis* (Anura: Ranidae) from Peninsular Malaysia. *Sains Malaysiana* 45, 535–539.
- Shahriza, S., Ibrahim, J. & Shahrul Anuar, M.S. (2012) Breeding activities of *Ingerophrynus parvus* (Anura: Bufonidae) in Kedah, Malaysia. *Sains Malaysiana* 41, 1431–1435.
- Shahriza, S. (2020) Death-feigning behavior in *Microhyla berdmorei*, *M. butleri*, and *M. heymonsi* (Anura: Microhylidae) from Peninsular Malaysia. *Phyllomedusa* 19, 125–129. <https://doi.org/10.11606/issn.2316-9079.v19i1p125-129>
- Shahriza, S. (2018) Antipredator mechanisms of *Ingerophrynus parvus* (Boulenger, 1887) (Anura, Bufonidae) and *Philautus vermiculatus* (Boulenger, 1900) (Anura, Rhacophoridae) from northern Peninsular Malaysia. *Alytes* 35, 48–56.
- Shahrudin, S. (2019) Heterospecific Amplexus Between a Male Four-lined Treefrog, *Polypedates leucomystax* (Gravenhorst 1829) and a Female Dark-eared Treefrog, *Polypedates macrotis* (Boulenger 1891) (Anura: Rhacophoridae) from Peninsular Malaysia. *IRCF Reptiles & Amphibians* 26, 68–69.
- Shahrudin, S. (2017) Breeding biology of *Microhyla heymonsi* Vogt, 1911 (Anura, Microhylidae) form Kedah, Peninsular Malaysia. *The Herpetological Bulletin* 140, 31–32. <https://doi.org/10.2307/4082641>
- Shahrudin, S. (2016) Antipredator behaviour of *Leptobrachium hendricksoni* Taylor, 1962 (Anura: Megophryidae) from Peninsular Malaysia. *Alytes* 33, 12–15.

- Shahrudin, S. (2016) Defensive strategies of *Polypedates leucomystax* (Gravenhorst, 1829) (Anura: Rhacophoridae) from Peninsular Malaysia. *Herpetology Notes* 9, 163–165.
- Shahrudin, S. (2016) Interspecific amplexus between male *Rhacophorus prominans* and female *Polypedates leucomystax* from Peninsular Malaysia. *Herpetological Bulletin*, 30–31.
- Shahrudin, S. (2014) Defensive behaviour of *Microhyla berdmorei* (Blyth, 1856) (Anura: Microhylidae) from Peninsular Malaysia. *Herpetology Notes* 7, 787–789.
- Shahrudin, S., Ismail, M.N., Kwan, S.H. & Najimudin, N. (2017) Ecology and protein composition of *Polypedates leucomystax* (Gravenhorst, 1829) (Anura: Rhacophoridae) foam nests from Peninsular Malaysia. *Annual Research and Review in Biology* 14, 1–10. <https://doi.org/10.9734/ARRB/2017/34211>

New Species and Taxonomy

- Chan, K.O. & Grismer, L.L. (2010) Re-assessment of the Reinwardt's gliding frog, *Rhacophorus reinwardtii* (Schlegel 1840) (Anura: Rhacophoridae) in southern Thailand and Peninsular Malaysia and its re-description as a new species. *Zootaxa* 2505, 40–50.
- Chan, K.O., Brown, R.M., Lim, K.K.P., Ahmad, N. & Grismer, L.L. (2014) A new species of frog (Amphibia: Anura: Ranidae) of the *Hylarana signata* Complex from Peninsular Malaysia. *Herpetologica* 70, 228–240. <https://doi.org/10.1655/HERPETOLOGICA-D-13-00057>
- Chan, K.O., Abraham, R.K. & Badli-sham, B.H. (2020) A revision of the Asian tree toad complex *Rentapia hosii* (Anura: Bufonidae) with the description of a new species from Peninsular Malaysia. *Raffles Bulletin of Zoology* 68, 595–607. <https://doi.org/10.26107/RBZ-2020-0075>
- Chan, K.O., Abraham, R.K., Grismer, L.L. & Brown, R.M. (2020) A systematic review of the *Pulchrana picturata* complex, with the description of a new species from Peninsular Malaysia, Sumatra, and southern Thailand. *Raffles Bulletin of Zoology* 68, 880–890. <https://doi.org/10.26107/RBZ-2020-0096>
- Chan, K.O., Abraham, R.K., Sanguila, M.B. & Brown, R.M. (2020) Over-splitting destabilizes the taxonomy of hylaranine frogs: A response to Chandramouli et al. (2020). *Zootaxa* 4877, 598–600. <https://doi.org/10.11646/zootaxa.4877.3.11>
- Chan, K.O., Abraham, R.K., Grismer, J.L. & Grismer, L.L. (2018) Elevational size variation and two new species of torrent frogs from Peninsular Malaysia (Anura: Ranidae: *Amolops* Cope). *Zootaxa* 4434, 250–264. <https://doi.org/http://dx.doi.org/10.11646/zootaxa.4434.2.2>
- Chan, K.O., Grismer, L.L., Anuar, S., Quah, E.S.H., Grismer, J.L., Wood, P.L., Muin, M.A. & Ahmad, N. (2011) A new species of *Chiromantis* Peters 1854 (Anura: rhacophoridae) from Perlis state park in extreme northern Peninsular Malaysia with additional

herpetofaunal records for the park. *Russian Journal of Herpetology* *Journal of Herpetology* 18, 253–259.

- Chan, K.O., Grismer, L.L. & Brown, R.M. (2014) Reappraisal of the Javanese Bullfrog complex, *Kaloula baleata* (Müller, 1836) (Amphibia: Anura: Microhylidae), reveals a new species from Peninsular Malaysia. *Zootaxa* 3900, 569–580.
<https://doi.org/10.11646/zootaxa.3900.4.7>
- Chan, K.O., Grismer, L.L. & Grismer, J.L. (2011) A new insular, endemic frog of the genus *Kalophrynus* Tschudi, 1838 (Anura: Microhylidae) from Tioman Island, Pahang, Peninsular Malaysia. *Zootaxa* 68, 60–68.
- Chan, K.O., Grismer, L.L., Ahmad, N. & Belabut, D. (2009) A new species of *Gastrophrynoides* (Anura: microhylidae): an addition to a previously monotypic genus and a new genus for Peninsular Malaysia. *Zootaxa* 68, 63–68.
- Chan, K.O., Wood, P.L.J., Anuar, S., Muin, M.A., Quah, E.S.H., Sumarli, A.X.Y. & Grismer, L.L. (2014) A new species of upland Stream Toad of the genus *Ansonia* Stoliczka, 1870 (Anura: Bufonidae) from northeastern Peninsular Malaysia. *Zootaxa* 3764, 427–440.
<https://doi.org/http://dx.doi.org/10.11646/zootaxa.3764.4.3>
- Das, I. (2010) *Rana ulukalensis* Nakatani, 1969, A Junior Synonym of *Rana tweediei* Smith, 1935 (Amphibia: Anura: Dicroglossidae). *Current Herpetology* 29, 33–35.
<https://doi.org/10.3105/018.029.0104>
- Das, I. & Lim, K.K.P. (2001) A new *Bufo* (Anura: Bufonidae) from the peat swamps of Selangor, West Malaysia. *Raffles Bulletin of Zoology* 49, 1–6.
- Das, I., Yaakob, N. & Lim, B.L. (2004) A new species of *Calluella* Stoliczka, 1872 (Anura: Microhylidae) from Taman Negara, Pahang State, Peninsular Malaysia. *Raffles Bulletin of Zoology* 52, 257–260.
- Das, I., Yaakob, N. & Sukumaran, J. (2007) A new species of *Microhyla* (Anura: Microhylidae) from the Malay Peninsula. *Hamadryad* 31, 304–314.
- Dehling, J.M. (2012) Redescription of *Leptolalax gracilis* (Günther, 1872) from Borneo and taxonomic status of two populations of *Leptolalax* (Anura: Megophryidae) from Peninsular Malaysia. *Zootaxa* 3328, 20–34.
- Dehling, J.M. (2014) Eine neue Fangzahnfroschart der Gattung *Limnonectes* (Anura: Dicroglossidae) vom Gunung Lawit, Malaiische Halbinsel. *Sauria* 36, 17–30.
- Grismer, L.L. (2006) A new species of *Ansonia* Stoliczka 1872 (Anura: Bufonidae) from central Peninsular Malaysia and a revised taxonomy for *Ansonia* from the Malay Peninsula. *Zootaxa* 21, 1–21.
- Grismer, L.L. (2006) A new species of *Ansonia* Stoliczka, 1870 (Anura: Bufonidae) from a lowland rainforest in southern Peninsular Malaysia. *Herpetologica* 62, 466–475.

- Grismer, L.L., Grismer, J.L. & Youmans, T.M. (2004) A new species of *Leptolalax* (Anura: Megophryidae) from Pulau Tioman, West Malaysia. *Asiatic Herpetological Research* 10, 8–11.
- Lee Grismer, L. (2007) A new species of *Ingerophrynus* (Anura: Bufonidae) from a lowland rain forest in southern Peninsular Malaysia. *Journal of Herpetology* 41, 225–230. [https://doi.org/10.1670/0022-1511\(2007\)41\[225:ANSOIA\]2.0.CO;2](https://doi.org/10.1670/0022-1511(2007)41[225:ANSOIA]2.0.CO;2)
- Leong, T.M., Matsui, M., Yong, H. Sen & Hamid, A.A. (2003) Revalidation of *Rana laterimaculata* Barbour et Noble, 1916 from the Synonymy of *Rana baramica* Boettger, 1901. *Current Herpetology* 22, 17–27. <https://doi.org/10.5358/hsj.22.17>
- Matsui, M. (2019) A new species of *Pelophryne* from Malay Peninsula (Anura, Bufonidae). *Current Herpetology* 38, 128–139. <https://doi.org/10.5358/hsj.38.128>
- Matsui, M. (2009) A new species of *Kalophrynus* with a unique male humeral spine from Peninsular Malaysia (Amphibia, Anura, Microhylidae). *Zoological Science* 26, 579–585. <https://doi.org/10.2108/zsj.26.579>
- Matsui, M., Belabut, D.M. & Ahmad, N. (2014) Two new species of fanged frogs from Peninsular Malaysia (Anura: Dicroglossidae). *Zootaxa* 3881, 75–93. <https://doi.org/10.11646/zootaxa.3881.1.6>
- Matsui, M., Belabut, D.M., Ahmad, N. & Yong, H.-S. (2009) A new species of *Leptolalax* (Amphibia, Anura, Megophryidae) from Peninsular Malaysia. *Zoological Science* 26, 243–247. <https://doi.org/10.2108/zsj.26.243>
- Matsui, M., Eto, K., Belabut, D.M. & Nishikawa, K. (2017) A New *Kalophrynus* (Amphibia, Anura, Microhylidae) from Peninsular Malaysia. *Current Herpetology* 36, 75–86. <https://doi.org/10.5358/hsj.36.75>
- Matsui, M. & Jaafar, I. (2006) A new cascade frog of the subgenus *Odorrana* from Peninsular Malaysia. *Zoological science* 23, 647–651. <https://doi.org/10.2108/zsj.23.647>
- Matsui, M., Nishikawa, K., Daicus, B., Norhayati, A. & Yong, H. Sen (2012) A new species of *Kalophrynus* (Amphibia, Anura, Microhylidae) from southern Peninsular Malaysia. *Zootaxa* 3155, 38–46.
- McLeod, D.S. & Ahmad, N. (2007) A New Species of *Theloderma* (Anura: Rhacophoridae) from southern Thailand and Peninsular Malaysia. *Russian Journal of Herpetology* 14, 65–72.
- Quah, E.S.H., Grismer, L.L., Muin, M.A. & Anuar, S. (2011) Re-discovery and re-description of *Ansonia penangensis* Stoliczka, 1870 (Anura: Bufonidae) from Penang Island, Malaysia. *Zootaxa* 64, 57–64.
- Quah, E.S.H., Anuar, S., Grismer, L.L., Wood, P.L., Siti Azizah, M.N.S. & Muin, M.A. (2017) A new species of frog of the genus *Abavorana* Oliver, Prendini, Kraus & Raxworthy 2015 (Anura: Ranidae) from Gunung Jerai, Kedah, northwestern Peninsular Malaysia. *Zootaxa* 4320, 272–288. <https://doi.org/10.11646/zootaxa.4320.2.4>

Wood, P.L.J., Grismer, L.L., Ahmad, N. & Senawi, J. (2008) Two new species of torrent-dwelling toads *Ansonia* Stoliczka, 1870 (Anura: Bufonidae) from Peninsular Malaysia. *Herpetologica* 64, 321–340. <https://doi.org/10.1655/07-065.1>

Evolution and Phylogenetics

Chan, K.O., Grismer, L.L., Zachariah, A., Brown, R.M. & Abraham, R.K. (2016) Polyphyly of Asian tree toads, genus *Pedostibes* Günther, 1876 (Anura: Bufonidae), and the description of a new genus from Southeast Asia. *PLoS ONE* 11, e0145903. <https://doi.org/10.1371/journal.pone.0145903>

Chan, K.O., Alexander, A.M., Grismer, L.L., Su, Y.-C., Grismer, J.L., Quah, E.S.H. & Brown, R.M. (2017) Species delimitation with gene flow: a methodological comparison and population genomics approach to elucidate cryptic species boundaries in Malaysian Torrent Frogs. *Molecular Ecology* 26, 5435–5450. <https://doi.org/10.1111/mec.14296>

Chan, K.O. & Brown, R.M. (2017) Did true frogs “dispersify”? *Biology Letters* 13, 20170299. <https://doi.org/10.1098/rsbl.2017.0299>

Chan, K.O. & Brown, R.M. (2020) Elucidating the drivers of genetic differentiation in Malaysian torrent frogs (Anura: Ranidae: Amolops): a landscape genomics approach. *Zoological Journal of the Linnean Society* 190, 65–78. <https://doi.org/10.1093/zoolinnean/zlz151>

Chan, K.O. & Grismer, L.L. (2019) To split or not to split? Multilocus phylogeny and molecular species delimitation of southeast Asian toads (family: Bufonidae). *BMC Evolutionary Biology* 19, 95. <https://doi.org/10.1186/s12862-019-1422-3>

Chan, K.O., Grismer, L.L. & Brown, R.M. (2018) Comprehensive multi-locus phylogeny of Old World tree frogs (Anura: Rhacophoridae) reveals taxonomic uncertainties and potential cases of over- and underestimation of species diversity. *Molecular Phylogenetics and Evolution* 127, 1010–1019.

Chan, K.O., Hutter, C.R., Wood, P.L.J., Grismer, L.L. & Brown, R.M. (2020) Target-capture phylogenomics provide insights on gene and species tree discordances in Old World Treefrogs (Anura: Rhacophoridae). *Proceedings of the Royal Society B* 287, 20202102. <https://doi.org/10.1098/rspb.2020.2102>

Chan, K.O., Hutter, C.R., Wood, P.L., Grismer, L.L. & Brown, R.M. (2020) Larger, unfiltered datasets are more effective at resolving phylogenetic conflict: Introns, exons, and UCEs resolve ambiguities in Golden-backed frogs (Anura: Ranidae; genus *Hylarana*). *Molecular Phylogenetics and Evolution* 151, 106899. <https://doi.org/10.1016/j.ympev.2020.106899>

Chan, K.O., Hutter, C.R., Wood, P.L., Grismer, L.L., Das, I. & Brown, R.M. (2020) Gene flow creates a mirage of cryptic species in a Southeast Asian spotted stream frog complex. *Molecular Ecology* 29, 3970–3987. <https://doi.org/10.1111/mec.15603>

- Davis, H.R., Grismer, L.L., Klabacka, R.L., Muin, M.A., Quah, E.S.H., Anuar, S., Wood, P.L.J. & Sites, J.W. (2016) The phylogenetic relationships of a new Stream Toad of the genus *Ansonia* Stoliczka, 1870 (Anura: Bufonidae) from a montane region in Peninsular Malaysia. *Zootaxa* 4103, 137–153.
<https://doi.org/http://dx.doi.org/10.11646/zootaxa.4103.2.4>
- Hurzaid, A., Jaafar, I., Awang, Z. & Nor, S.A.M. (2014) Genetic structure of the Asian Grass Frog, *Fejervarya limnocharis* (Amphibia: Anura: Dicroglossidae) of Peninsular Malaysia: a preliminary report. *Zoological Studies* 53, 1–7.
<https://doi.org/10.1186/s40555-014-0077-4>
- Matsui, M., Eto, K., Nishikawa, K., Hamidy, A., Belabut, D., Norhayati AHMAD, S.P., Khonsue, W. & Grismer, L.L. (2017) Mitochondrial Phylogeny of Leptolalax From Malay Peninsula and Leptobrachella (Anura, Megophryidae). *Current Herpetology* 36.
- Matsui, M., Hamidy, A., Belabut, D.M., Ahmad, N., Panha, S., Sudin, A., Khonsue, W., Oh, H.S., Yong, H. Sen, Jiang, J.P. & Nishikawa, K. (2011) Systematic relationships of Oriental tiny frogs of the family Microhylidae (Amphibia, Anura) as revealed by mtDNA genealogy. *Molecular Phylogenetics and Evolution* 61, 167–176.
<https://doi.org/10.1016/j.ympev.2011.05.015>
- Matsui, M., Tominaga, A., Liu, W., Khonsue, W., Grismer, L.L., Diesmos, A.C., Das, I., Sudin, A., Yambun, P., Yong, H., Sukumaran, J. & Brown, R.M. (2010) Phylogenetic relationships of *Ansonia* from Southeast Asia inferred from mitochondrial DNA sequences: systematic and biogeographic implications (Anura: Bufonidae). *Molecular Phylogenetics and Evolution* 54, 561–570. <https://doi.org/10.1016/j.ympev.2009.08.003>
- McLeod, D.S. (2010) Of Least Concern? Systematics of a cryptic species complex: *Limnonectes kuhlii* (Amphibia: Anura: Dicroglossidae). *Molecular Phylogenetics and Evolution* 56, 991–1000. <https://doi.org/10.1016/j.ympev.2010.04.004>
- Stuart, B.L., Inger, R.F. & Voris, H.K. (2006) High level of cryptic species diversity revealed by sympatric lineages of Southeast Asian forest frogs. *Biology Letters* 2, 470–474.
<https://doi.org/10.1098/rsbl.2006.0505>