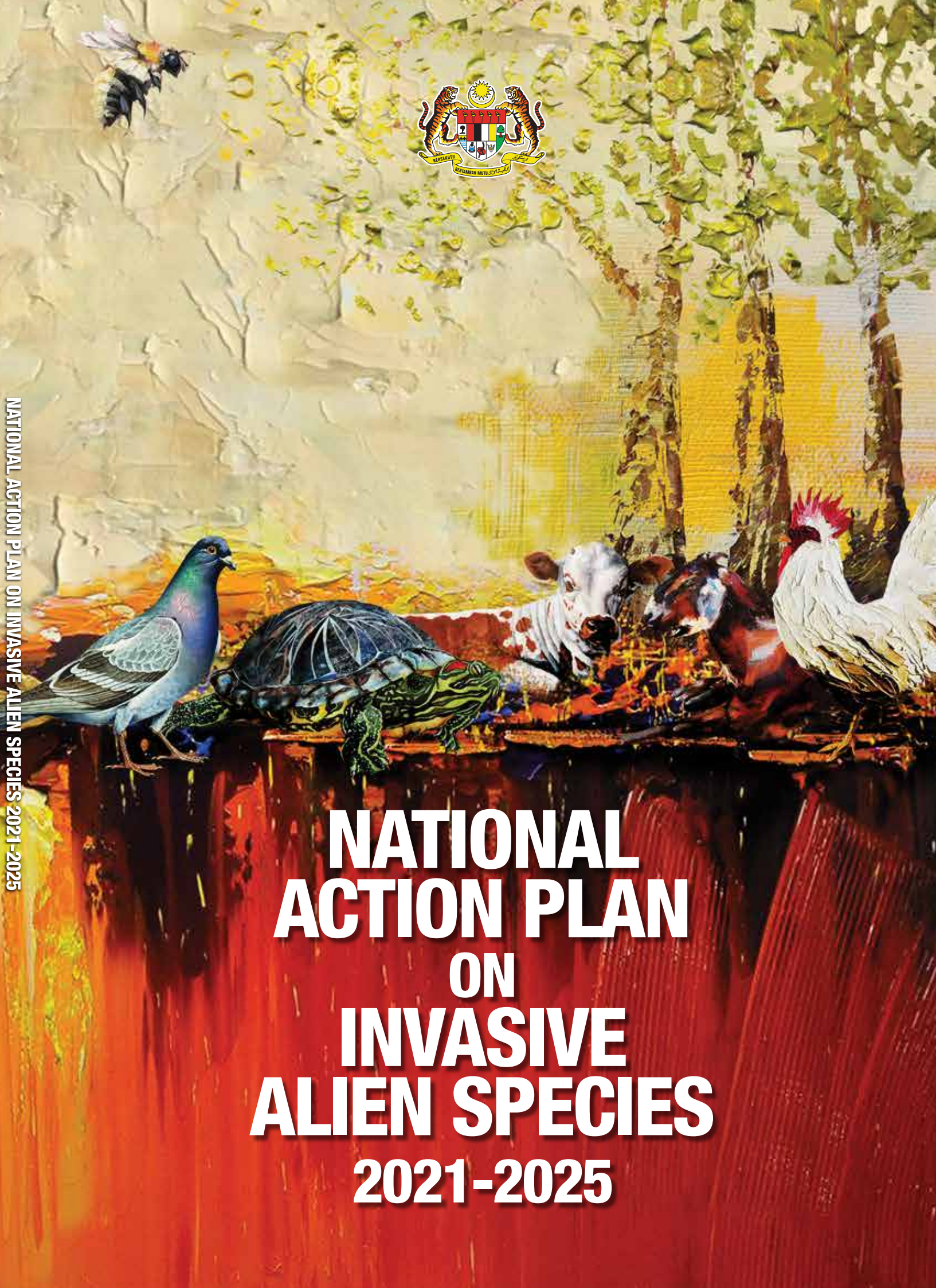

NATIONAL ACTION PLAN ON INVASIVE ALIEN SPECIES 2021-2025

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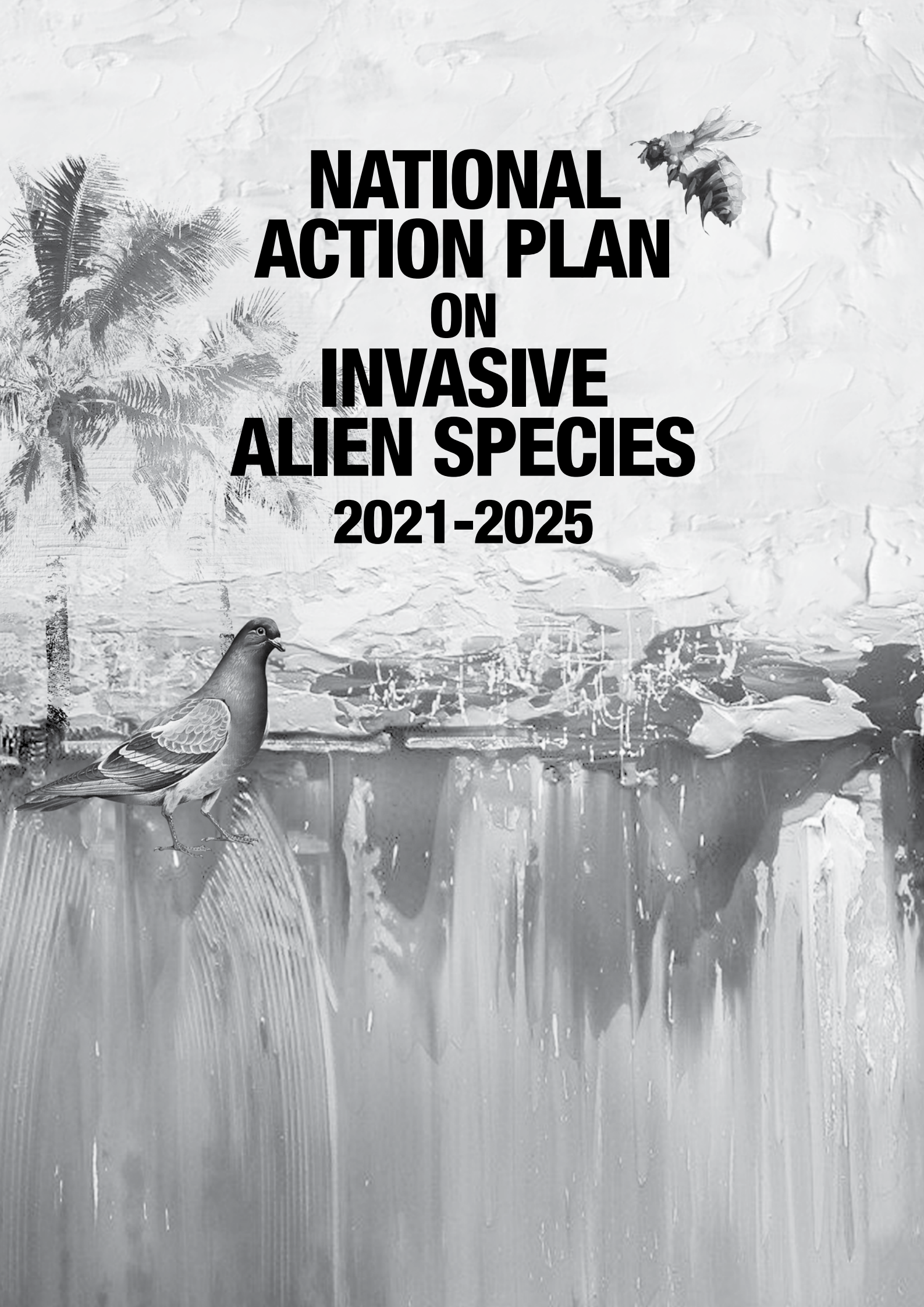

NATIONAL ACTION PLAN ON INVASIVE ALIEN SPECIES 2021-2025

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The three main goals of the NAP IAS establishment are to improve the understanding and public awareness of IAS; conduct a risk assessment on all introduced exotic species before their release into the environment, and strengthen quarantine inspection and enforcement at entry points and international borders.

DATUK MOHD NASIR BIN WARRIS

Director General
Department of Agriculture
(Chairman of the National Committee on Invasive Alien Species)

PREFACE

The adoption of the National Action Plan on Invasive Alien Species (NAP IAS) in 2014-2018 and its subsequent renewal in 2020 for adoption in 2021-2025 are significant milestones for the IAS management in Malaysia. This action plan with its comprehensive goals and targets map out activities that provide a valuable framework for policymakers, government agencies, and related private institutions involved in IAS management nationwide. This NAP IAS will also play a critical role in mobilising available resources including experts in various fields to work cohesively to address the IAS issues in Malaysia.

This NAP IAS has been prepared under Target 11 in the National Policy on Biological Diversity (NPBD) 2016-2025 which reads "By 2025, Invasive Alien Species and pathways are identified, priority species controlled, and measures are in place to prevent their introduction and establishment". Target 11 of the NPBD aims to control the establishment and spread of IAS through an integrated approach of research, education, and awareness, as well as to strengthen inspection and control at entry points and international borders. The three main goals of the NAP IAS establishment are to improve the understanding and public awareness of IAS; conduct a risk assessment on all introduced exotic species before their release into the environment, and strengthen quarantine inspection and enforcement at entry points and international borders.

A book on a key of Invasive Alien Species in Malaysia has been published in 2018. Some of the important IAS that have been established in Malaysia are Peacock Bass (*Cichla spp.*), Red Claw Crayfish (*Cherax quadricarinatus*), Red-eared Slider (*Trachemys scripta elegans*), Diamondback Moth (*Plutella xylostella*), Cocoa Pod Borer (*Conopomorpha cramerella*), Apple Snail (*Pomacea spp.*), Parthenium Weed (*Parthenium hysterophorus),* Kariba Weed (*Salvinia molesta*), Red Palm Weevil (*Rhynchophorus ferrugineus*), Snowflake Coral (*Carijoa riisei*), and Highly Pathogenic Avian Influenza (HPAI). The identified IAS have caused significant damages to the agriculture sectors affecting crop production, livestock, fisheries, and ultimately human health as well as biodiversity.

A series of workshops have been organised between year 2017 and 2020 by the National IAS Committee for the IAS experts from 26 different organisations to meet, discuss and prepare this NAP IAS. This document includes a five-year IAS Management Plan for prevention, eradication, containment, and control of IAS in Malaysia.

I wish to congratulate the National IAS Working Group for bringing their expertise and experience around the table and engaging in such fruitful, constructive and open exchanges throughout the discussion in preparing this NAP IAS document.

I hope that with the support from all stakeholders, this NAP IAS will be effectively implemented to ensure our beloved country is safeguarded from any IAS invasion for the well-being of our present and future generations.

CONTENTS

EXECUTIVE SUMMARY

Invasive Alien Species (IAS) are species that are introduced accidentally or intentionally outside of their natural geographical range. IAS have devastating impacts, causing the decline or extinction of native species, alter and degrade the environment as well as degrading the ecosystems. IAS are introduced as a result of globalisation of economies through the movement of people and goods via shipment of consignment carrying insects and diseases or transportation of agriculture based-products to new areas. To combat the threat of Invasive Alien Species, Malaysia needs to have a legislative framework to manage and mitigate the impacts; and improve public awareness of IAS.

To address the IAS impacts on the economy and biodiversity, and formulate national strategies in combating IAS the government of Malaysia had set up a National Working Group comprising of representatives of various government ministries, departments, agencies, universities and non-government organisations. The involvement of different organisations and agencies helps in the legislation implementation, enforcement, monitoring and research related to IAS.

Previous National Action Plan for Invasive Alien Species 2014-2018 was focused on strengthening the legal framework in prevention, detection, eradication, containment and control related to IAS issues, intensify the capacity building for implementation of action plan and enhance research and development of IAS among agencies in Malaysia. Efforts and strategies to conserve and to manage the biodiversity from IAS threats escalate through **Malaysia National Action Plan on Invasive Alien Species 2021-2025** (**NAP IAS 2021-2025)**.

The **NAP IAS 2021-2025** is aligned with Target 11 of National Policy on Biological Diversity (NPBD) 2016-2025 and Target 9 of the Aichi Biodiversity Targets Convention on Biological Diversity (CBD), which focuses on identification, prioritisation, and prevention of the introduction and establishment of IAS.

This **NAP IAS 2021-2025** will be implemented by various target groups and responsible agencies. It contains 11 targets, 27 activities and 69 sub-activities under 3 goals as follows:

Goal 1: Improve the understanding and public awareness of IAS; intensifying capacity building for the implementation of the action plan; as well enhancing research and development of IAS.

Goal 2: Establish a formal and transparent mechanism for risk assessment of alien species and initiate response plans and the capacity to contain and eradicate potential IAS before their release into Malaysia.

Goal 3: Strengthen quarantine enforcement and inspection at Malaysia's entry points and international borders in controlling and preventing the entry and spread of IAS into Malaysia.

COUNTRY OVERVIEW

Malaysia is located in Southeast Asia between 0º51'N and 7º33'N, and 98º01'E and 119º30'E. Malaysia is divided into two major geographical regions; Peninsular Malaysia and East Malaysia, consisting of thirteen (13) states and three (3) Federal Territories. There are eleven (11) states and two (2) Federal Territories situated in Peninsular Malaysia while the other two (2) states and one (1) Federal Territory are in East Malaysia.

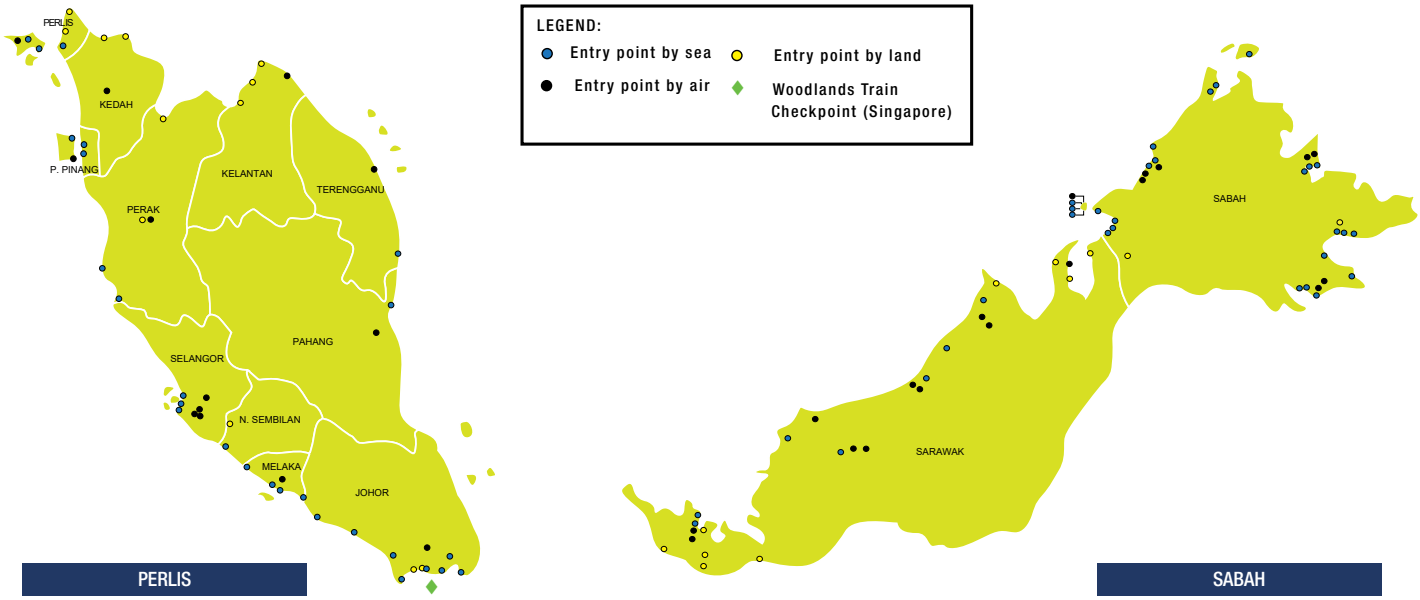
The total land area of Malaysia covers approximately 330,345 km^2 (33.0345 million ha). Peninsular Malaysia makes up nearly 40% of the country's land area, while Sabah and Sarawak in East Malaysia cover the remaining 60% of land areas. There are several mountain ranges in Malaysia. With an average height of 1,800 m, the highest mountain in Malaysia is Mount Kinabalu at 4,095 m while in Peninsular Malaysia, Titiwangsa Range divides the landscape into the Eastern and Western strips. The highest point of the range is Mount Tahan at 2,187 m. Mountain ranges are also the source of Malaysia's 150 major rivers and an estimated 1,800 minor rivers and tributaries. The extensive river systems, associated riparian, floodplain and catchment forests support an immense diversity of aquatic and terrestrial biodiversity.

Malaysia is one of the 12 mega-biodiverse countries in the world with an estimated 15,000 species of vascular plants, 307 species of mammals, 785 species of birds, 242 species of amphibians, 567 species of reptiles, over 449 species of freshwater fish, over 1,619 species of marine fish and more than 150,000 species of invertebrates.

Malaysia's climate could be characterised by three main components namely wind pattern, rainfall and temperature. Malaysia experiences humid weather throughout the year. The average daily temperature across Malaysia is between 21 °C and 32 °C. Typically, the Malaysian climate is influenced by the winds blowing from the Indian Ocean (Southwest Monsoon - May to September) and the South China Sea (Northeast Monsoon - November to March). Its annual rainfall is between 2,000 mm to 2,500 mm. In addition, the presence of El-Nino Southern Oscillation (ENSO), Indian Ocean Dipole (IOD) periodic cycle and Madden Julian Oscillation (MJO) affect the nation's rainfall distribution.

Since its formation in 1963, Malaysia has successfully diversified its economy from agriculture and commodity-based to manufacturing and service industries. With RM64.86 billion in value, exports of agriculture goods ranked third and accounted for 6.6% of Malaysia's total exports in 2019, behind electrical and electronic appliances, parts and components (37.8%), and mining goods (8.1%).

The soaring international trade activities and tourism industry has escalated the risks of IAS introduction through the importation of goods and people movement into Malaysia. Every state in Malaysia has multiple international entry points either by sea, air or land. These entry points are manned by personnel from various government agencies to screen inbound visitors and imported goods. In total, Malaysia has 112 entry points as shown in Map 1.



PERLIS

1	Padang Besar	○
2	Kuala Perlis	●
3	Wang Kelian	○

KEDAH

1	Bukit Kayu Hitam	○
2	Sultan Abdul Halim Airport, Alor Setar	●
3	Kuah Jetty	●
4	Langkawi International Airport	●
5	Tg. Lembung Port	●
6	Durian Burung	○

PULAU PINANG

1	NBCT	●
2	Dermaga Ayer Dalam	●
3	Penang International Airport	●
4	Port Weld Quay	●

PERAK

1	Sultan Azlan Shah Airport, Ipoh	●
2	Pengkalan Hulu	○
3	Lumut Port	●
4	Ipoh Cargo Terminal	○
5	Hutan Melintang	●

SELANGOR

1	Klang Northport	●
2	Klang Westport	●
3	Klang Southport	●
4	Sultan Abdul Aziz Shah Airport, Subang	●
5	KLIA	●
6	KLIA 2	●
7	KLIA Cargo	●

NEGERI SEMBILAN

1	Port Dickson	●
2	Nilai Inland Port	○

MELAKA

1	Kuala Linggi Port	●
2	Sungai Rambai Port	●
3	Melaka Airport	●
4	Tanjung Beruas Port	●
5	Melaka Port	●

KELANTAN

1	Bukit Bunga	○
2	Rantau Panjang	○
3	Pengkalan Kubor	○
4	Sultan Ismail Petra Airport	●

TERENGGANU

1	Sultan Mahmud Airport, Kuala Terengganu	●
2	Kemaman Port	●

PAHANG

1	Kuantan Port	●
2	Sultan Ahmad Shah Airport, Kuantan	●

JOHOR

1	Sultan Iskandar Building CIQ Complex, Johor Bahru	○
2	Muar Jetty	●
3	Batu Pahat Jetty	●
4	Senai International Airport	●
5	Sultan Abu Bakar CIQ Complex, Iskandar Puteri	○
6	Port of Tanjung Pelepas	●
7	Kukup Jetty	●
8	Stulang Laut Jetty	●
9	Pasir Gudang Port	●
10	Tanjung Belungkor Jetty	●
11	Tanjung Pengelih Jetty	●

F.T. LABUAN

1	Labuan Airport	●
2	Port of Labuan	●
3	Labuan Vehicle Ferry Terminal	●
4	Labuan Passanger Ferry Terminal	●

SARAWAK

1	ICQS Biawak	○
2	ICQS Tebedu	○
3	Tebedu Inland Port	○
4	ICQS Lubuk Antu	○
5	ICQS Sungai Tujoh	○
6	ICQS Tedungan	○
7	ICQS Pandaruan	○
8	ICQS Mengkalap	○
9	ICQS Merapok	○
10	Sim Kheng Hong Port	●
11	Senari Port	●
12	Rejang, Sibu Port	●
13	Tanjung Manis, Mukah	●
14	Bintulu Port	●
15	Samalaju Port	●
16	Miri Port	●
17	Kuching International Airport	●
18	Sibu Airport	●
19	Miri Airport	●
20	Bintulu Airport	●
21	Limbang Airport	●
22	Mukah Airport	●
23	Air Cargo Kuching	●
24	Air Cargo Sibu	●
25	Air Cargo Miri	●
26	Air Cargo Bintulu	●

SABAH

1	KKIA	●
2	KKIA Cargo	●
3	Kota Kinabalu Post Office	●
4	Kota Kinabalu Ferry Terminal	●
5	Kota Kinabalu Port	●
6	Sepanggar Bay Container Port	●
7	Menumbok - Labuan Ferry Terminal CIQS	●
8	Sipitang Jetty	●
9	SFI Jetty	●
10	Sipitang - Labuan Jetty	●
11	Sindumin - Merapok CIQS	○
12	Kudat Port	●
13	Kudat Ferry Terminal CIQS	●
14	Banggi Ferry Terminal CIQS	●
15	Sandakan International Airport	●
16	MAS Cargo Sandakan	●
17	Sandakan Port	●
18	Sandakan Ferry Terminal CIQS	●
19	Sandakan Barter Trade Jetty	●
20	Lahad Datu Port	●
21	POIC Port	●
22	FELDA Port	●
23	Lahad Datu Post Office	○
24	Kunak Private Jetty	●
25	Semporna Ferry Jetty	●
26	Tawau International Airport	●
27	MAS Cargo Tawau	●
28	Tawau Ferry Terminal CIQS	●
29	Tawau Port	●
30	Tawau Barter Trade Jetty	●

Map 1: Entry Points into Malaysia

NATIONAL COMMITTEE ON IAS

Just over a decade ago, there was no comprehensive and coordinated programme for monitoring and cataloging of IAS in Malaysia. There was not much research carried out on IAS, nor were there any cooperation between government and non-governmental organisations and universities to mitigate the problems caused by IAS. There are no official statistics available on the species and the total number of IAS in Malaysia.

Article 8(h) of the CBD states that '*Each contracting Party shall, as far as possible and as appropriate, prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species* '. The CBD Articles are legally binding thus Parties are expected to translate Article 8(h) into national legislation to prevent the introduction of, control or eradication of alien species, either directly or indirectly, depending on circumstances.

Paragraph 8 Decision VIII/27 adopted by The Conference of the Parties (COP) to the CBD at its eighth meeting in Curitiba, Brazil in 2006 encourages parties to ensure close inter-agency collaboration at the national and regional levels among the various sectors and interest-holders relevant to the introduction, control and management of IAS, for example through the establishment of national coordination committees.

As one of the signatories of the CBD, the **National Working Group (NWG) IAS** was formed in 2007 with 17 members from 11 government ministries and agencies. The main objective of the formation of this working group was to fulfill obligations of Article 8(h) and adhere to Decision VIII/27 during the 8th COP meeting. The name (NWG IAS) was later changed to **National Committee on IAS** in 2016 and as of 2020, the committee members comprised of representatives from 29 government ministries and agencies as well as universities and research institutions.

MEMBERSHIP

The **National Committee on IAS** membership involves various cross-functional agencies that are responsible to perform research, registration, enforcement, monitoring and instill public awareness on IAS. The committee normally meets twice a year but additional meeting(s) could be called upon if the need arises. The committee meeting is chaired by the Director - General of Department of Agriculture (DOA) Malaysia and the Plant Biosecurity Division of DOA serves as the Secretariat of this committee. Appendix II could be referred to for details of the committee members.

FUNCTIONS

The overall functions of the **National Committee on IAS** are:

1. To develop and review National Action Plan on IAS;
2. As a focal point for any issues related to IAS in COP or any Bilateral / Multilateral Agreements such as CBD, APEC, IPPC, OIE, IMO and others;
3. To coordinate all activities related to IAS such as enforcement, detection, prevention, monitoring, eradication, containment and effective control of any potential and established IAS in the country;
4. To prepare / assist in securing funding to finance IAS activities implemented by the government agencies and universities;
5. To provide guidance to various departments and agencies on early detection and rapid response to the incursion of IAS under their purview;
6. To serve as a central advisory body on any issues related to IAS;
7. To coordinate awareness and information dissemination programme (in appropriate languages) of policies, practices and procedures to stakeholders to empower them on detection, prevention, monitoring, eradication, containment and control of IAS;
8. To monitor control strategies and evaluate whether the measures are cost effective; and
9. To strengthen capacity building on enforcement, detection, prevention, monitoring, eradication, containment and control of IAS.

NATIONAL ACTION PLAN ON INVASIVE ALIEN SPECIES 2021-2025

GOAL 1

Improve understanding and public awareness about IAS

GOAL 2

Conduct risk assessment on all introduced exotic species before their release

GOAL 3

Strengthen quarantine inspection and enforcement at entry points and international borders

INTRODUCTION

Invasive alien species are plants, animals, pathogens, and other organisms that are non-native to an ecosystem, which may cause economic or environmental harm or adversely affect human health. In particular, they impact biodiversity adversely, including decline or elimination of native species - through competition, predation, or transmission of pathogens and the disruption of local ecosystems and ecosystem functions.

According to the Convention of Biological Diversity (CBD), alien species refers to a species, subspecies, or lower taxon, introduced outside its natural past or present distribution. Alien species include gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce. Invasive alien species means an alien species whose introduction and spread threaten biological diversity. They produce rapidly, out-compete native species for food, water, and space, and are among the leading causes of global biodiversity loss. Species are often introduced deliberately, through, for example, fish farming, pet trade, horticulture, biocontrol, or unintentionally, through such means as land and water transportation, travel, and scientific research.

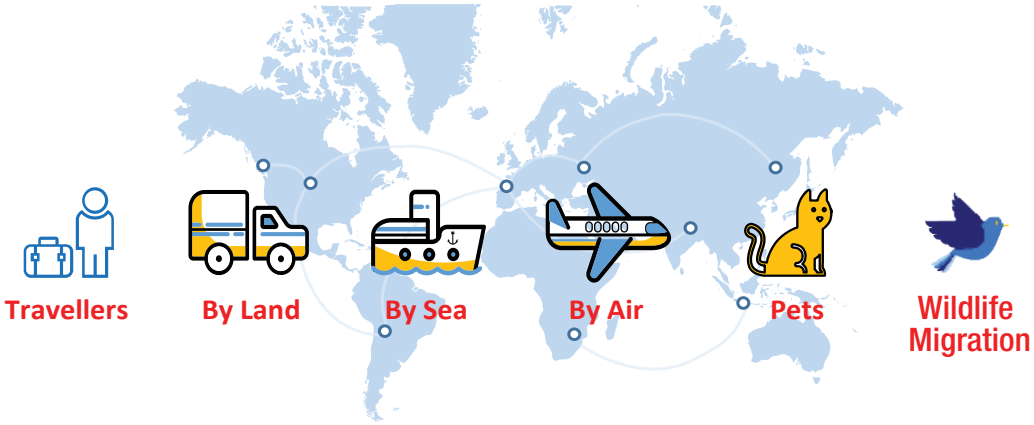
A globalised economy has resulted in increased transportation of goods, services and people which in turn facilitates the movement of live specimens over large distances, beyond national boundaries. While only a small percentage of transported organisms become invasive, those which do have a tremendous impact on the health of native biodiversity. IAS may also threaten human lives, affect local food security and ecosystem health. The presence of IAS have negatively impacted the economy of many countries anually, through loss in agricultural production and environmental remedial measures.

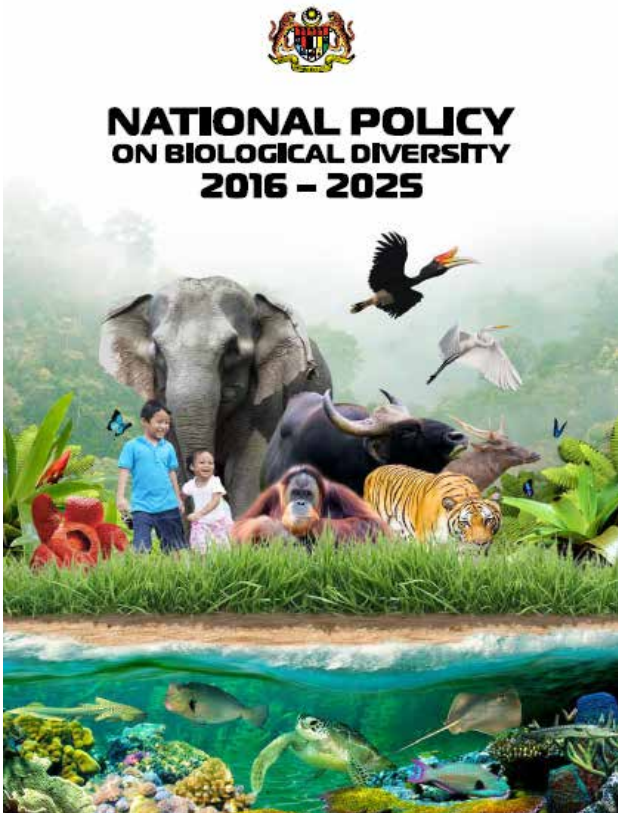
The adoption of the National Action Plan on Invasive Alien Species (NAP IAS) in 2014-2018 and its subsequent renewal in 2020 for adoption in 2021-2025 are significant milestones for the IAS management in Malaysia. This NAP is developed as a guideline for implementation and coordination in managing issues related to IAS. The NAP consists of three goals with comprehensive targets and strategies for prevention, eradication, containment, and IAS control.

The NAP IAS 2021-2025 framework is aligned with Target 11 of National Policy on Biological Diversity (NPBD) 2016 – 2025 and Target 9 of Aichi Biodiversity Targets; Convention on Biological Diversity (CBD) on identification, prioritization, and prevention of the introduction and establishment of IAS.

The NAP IAS lays out three main goals which are aligned with key indicator of Target 11 NPBD. Activities of the three goals in NAP IAS are formulated to address public awareness on IAS (Goal 1); risk assessment on IAS (Goal 2); and strengthen quarantine inspection and enforcement (Goal 3). Overall, this NAP IAS 2021-2025 contains 11 targets, 27 activities, and 69 sub-activities to be implemented by various target groups and responsible agencies.

Global trade and transportation activities are the main factors of introduction and spread of Invasive Alien Species.

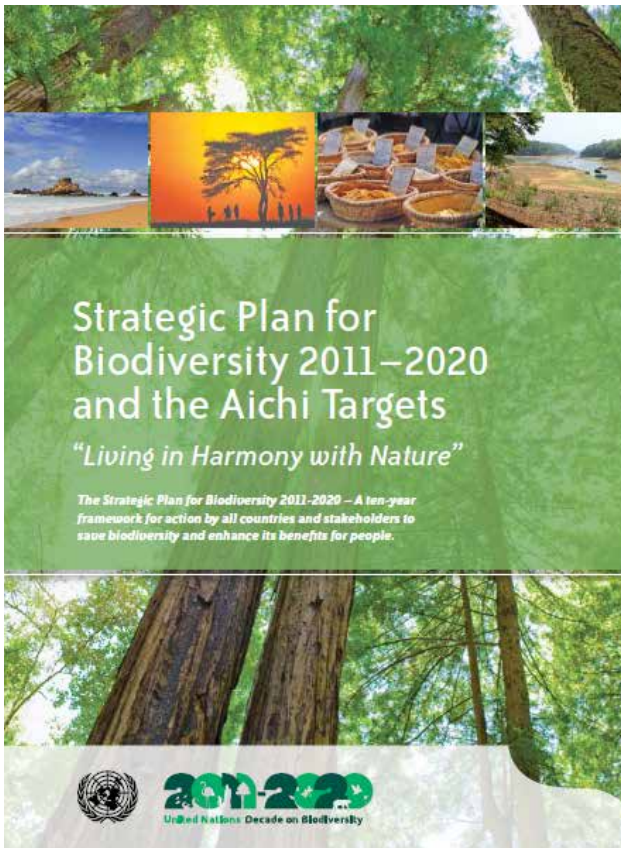




TARGET 11

> By 2025, invasive alien species and pathways are identified, priority species controlled and measures are in place to prevent their introduction and establishment.

National Policy on Biological Diversity 2016 – 2025



TARGET 9

> By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.

Aichi Biodiversity Targets 2011 – 2020

THREAT OF INVASIVE ALIEN SPECIES

Global trade and transportation activities have increased IAS opportunities to cross geographic boundaries and establish in new areas. The Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) Global Assessment Report on Biodiversity and Ecosystem Services, based on a thorough analysis of available data, identified IAS was one of the five main drivers of biodiversity loss. These invasive species are either plants, animals or microorganisms might disturb the natural ecosystem and native species in Malaysia. Common characteristics of IAS are rapid growth, large reproduction capacity, high dispersal ability, broad environmental tolerance and great survival ability.

In urban environments, IAS may threaten public health, reduce recreational quality and affect property value. For example, *Salvinia molesta* has been widely introduced as an ornamental plant. However *S. molesta* grows rapidly and forms dense vegetation mats that reduce water-flow, clog irrigation and drainage canals. It prevents the passage of boats, disturbs fishing and water recreational activities, aquatic industries and provides breeding places for mosquitoes (vector for malaria and dengue fever). *S. molesta* has been included in the Global Invasive Species Database (GISD 2010). The other invasive weed is *Parthenium hysterophorus*, which can cause allergic reactions like dermatitis, asthma and hay fever in humans. This allelopathy potential weed aggressively colonises and outcompetes native species, leading to degradation of natural ecosystems in the invaded area.

The presence of IAS in the agriculture sector (crops, livestock and fisheries) may cause yield reduction and increase production costs. In Malaysia, this sector has contributes 7.3% (RM 99.5 billion) to the Gross Domestic Product in 2019. The potential risk of invasive exotic pathogens such as *Fusarium oxysporum* f. sp. *elaeidis* (Vascular Wilt Disease) to oil palm and *Pseudocercospora ulei* (South American Leaf Blight) to rubber may affect estimated total revenue for export by RM 65 billion and RM 25 billion, respectively. The Malaysian Government has spent hundreds of millions of ringgit for prevention, eradication, containment and control of IAS such as Papaya ringspot virus, *Erwinia papayae* (Papaya Dieback), *Salvinia molesta* (Kariba weed), *Rhynchophorus ferrugineus* (Red palm weevil), *Trachemys scripta elegans* (Red-eared slider), Avian influenza viruses (HPAI), Vibrio parahemolyticus virus and others.

Increased interest in exotic animals may also lead to smuggling and subsequent introduction of IAS into the natural environment. Hence, risk of invasiveness must be conducted for all exotic species to be imported into Malaysia. An integrated management system involving new technologies, suitable combinations of control methods, and enhanced cooperation among government agencies, research bodies, and stakeholders is important in managing IAS effectively.

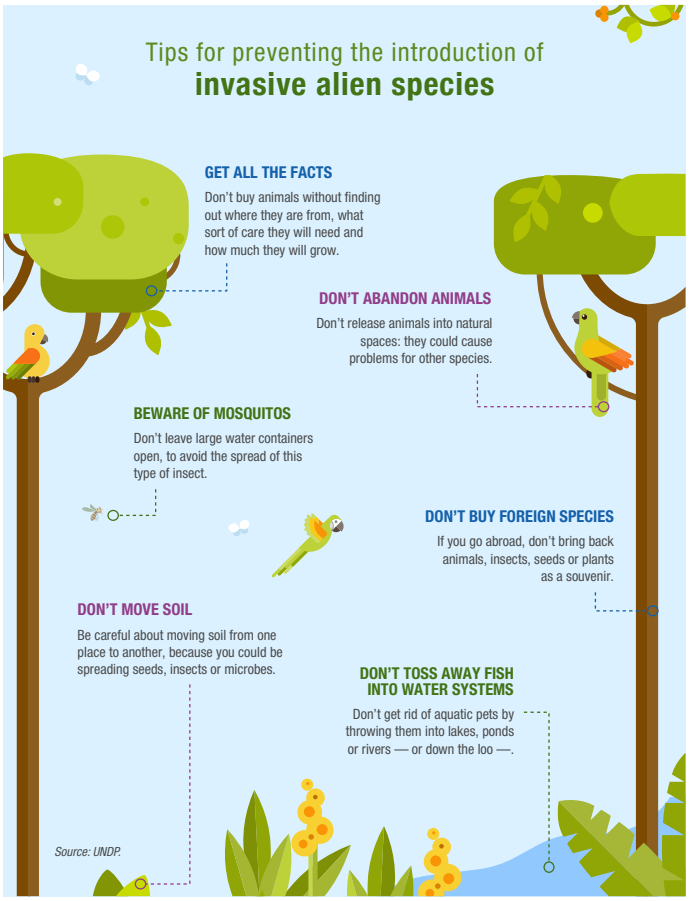


Image Source: https://www.iberdrola.com/

INVASIVE ALIEN SPECIES IN SOUTH EAST ASIA

IPBES estimates that IAS caused USD 33.5 billion of loses every year in South East Asia, effecting environment, human health and agricultural productions.

USD 28.7 billion : Agriculture sector

USD 2.1 billion : Environment

USD 1.85 billion : Human health

WORLD	SOUTH EAST ASIA	MALAYSIA
Approximately		
17,000	**800**	**153**
IAS recorded and established worldwide.	IAS recorded whether introduced or native.	Species have been identified as IAS of concern.
		11
		IAS in Malaysia were listed in 100 of the World's Worst Invasive Alien Species.

Source: IUCN, GISD, CABI, & National Committee on IAS

GOALS, TARGETS AND ACTIVITIES

GOAL 1:
Improve understanding and public awareness about IAS

TARGET 1
Increase research in all aspects of IAS management including understanding their pathways and ecological impacts and develop technologies to contain and control IAS.
1 Activity

TARGET 2
Educate the public at large on the threats of IAS and the problems posed by smuggling of wild animals and plants, accidental imports, escapes from legitimate enterprises, and the pet trade.
1 Activity

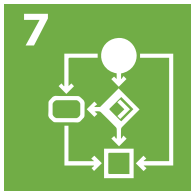
TARGET 3
Strengthen information sharing among relevant stakeholders.
1 Activity

TARGET 4
Intensify extension services to stakeholders so that prevention, control, eradication and mitigation efforts on IAS can be effectively implemented.
2 Activities

TARGET 5
Develop and implement a programme of work to control and manage the risk of IAS from ship ballast water and sediments.
2 Activities

GOAL 2:
Conduct risk assessment on all introduced exotic species before their release

TARGET 6
Establish a formal and transparent mechanism to ensure that all alien species are subject to a rigorous risk assessment.
5 Activities



TARGET 7
Establish response plans and the capacity to contain and eradicate potential invasive species.
5 Activities

GOAL 3:
Strengthen quarantine inspection and enforcement at entry points and international borders

TARGET 8
Enhance the enforcement of legislation on importing, trading and keeping wild animals, fishes and plants.
3 Activities

TARGET 10
Enhance quarantine facilities and improve the skills and capabilities of quarantine, customs and other border officials.
3 Activities

TARGET 9
Implement provisions of the International Maritime Organisation (IMO) Ballast Water Management Convention to safeguard against marine invasive species.
2 Activities

TARGET 11
Strengthen and monitor the implementation of the National Action Plan for the Prevention, Eradication, Containment and Control of IAS.
2 Activities

GOAL 1

IMPROVE UNDERSTANDING AND PUBLIC AWARENESS ABOUT INVASIVE ALIEN SPECIES

Improve the understanding and public awareness of IAS through strengthening of the legal framework in relation to IAS prevention, detection, monitoring, eradication, containment and control; intensifying capacity building for the implementation of the action plan; and enhancing research and development on IAS.

TARGET 1:

1

INCREASE RESEARCH IN ALL ASPECTS OF INVASIVE ALIEN SPECIES MANAGEMENT INCLUDING UNDERSTANDING THEIR PATHWAYS AND ECOLOGICAL IMPACTS AND DEVELOP TECHNOLOGIES TO CONTAIN AND CONTROL INVASIVE ALIEN SPECIES

ACTIVITY 1: Compile and centralize data / scientific reference for IAS on the National Clearing House mechanism.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
1.1	Create team (circulation of IAS research and data)	Research Institution/ Universities	Database (MyBIS - IAS module)	√	√	√	√	√	DOA, USM, UPM, UKM, MOH, MARDEP, SAQ, DOA Sarawak, FRIM
1.2	Create survey / google form (to get information from researchers)	Research Institution/ Universities		√				√	DOA, USM, UPM, UKM, MOH, MARDEP, SAQ, DOA Sarawak, FRIM
1.3	Compilation on papers / research / data related to IAS in Malaysia	Research Institution/ Universities		√				√	DOA, USM, UPM, UKM, MOH, MARDEP, SAQ, DOA Sarawak, FRIM
1.4	Networking with universities (Research Management Office) - Identify researchers conducting studies related to IAS.	Research Institution/ Universities		√				√	MOH, FRIM, UPM, UMT, USM
1.5	Engagement with other industries – to promote information on IAS and database	Agencies, industries, institutions and public		√	√	√	√	√	IAS Secretariat / Bulletin Editorial Board (researchers and experts)
1.6	Secure and allocate funding from related agencies to conduct research related to IAS	Agencies, Research Institution/ Universities		√	√				MAFI, MOHE, MOSTI, KeTSA
1.7	IAS website database	Agencies and stakeholder	Establish IAS section in MyBIS website/ database	√	√	√	√	√	IAS secretariat, KeTSA, All research agencies / universities
1.8	Smartphone application	Agencies and stakeholder	New Malaysian IAS apps in PlayStore			√	√	√	IAS secretariat, KeTSA, All research agencies / universities

TARGET 2:

EDUCATE THE PUBLIC AT LARGE ON THE THREATS OF INVASIVE ALIEN SPECIES AND THE PROBLEMS POSED BY SMUGGLING OF WILD ANIMALS AND PLANTS, ACCIDENTAL IMPORTS, ESCAPES FROM LEGITIMATE ENTERPRISES AND THE PET TRADE

ACTIVITY 2: Conduct Communication, Education and Public Awareness (CEPA) programmes.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
2.1	IAS awareness programme (Webinar - Conference on IAS)	Agencies, industries, institutions and public	1 seminar every 2 years		√	√	√	√	Agencies (DOA, DOF, MOH, FRIM, MARDI), Institution, Industry, Community
			1 webinar every 3 months (1 hour/session)		√	√	√	√	
			IAS Awareness Week		√	√	√	√	
2.2	Module development (interactive programme)	School	1 module	√	√				Agencies (DOA, DOF, MOH, FRIM, MARDI, MOHE, MOSTI etc.), Institution
			1 school competition	√	√				
2.3	Official announcement on IAS	Public	Social media pop-ups (Twitter, FB, Instagram post)	√	√	√	√	√	Agencies (DOA, DOF, MOH, FRIM, MARDI etc.), Institution
			Physical announcement	√	√	√	√	√	
			1 Montage	√	√	√	√	√	

TARGET 3:

STRENGTHEN INFORMATION SHARING AMONG RELEVANT STAKEHOLDERS

ACTIVITY 3: Set up network to share IAS information between institutions and convey it to the stakeholders.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
3.1	Upskill extension services on IAS through development of Subject Matter Expert (SME) and Capacity Building	Agencies, institutions	3 workshops	√		√		√	Agencies (DOA, DOF, MOH, FRIM, MARDI etc.), Institution
3.2	Intensify extension services to farmers - prevention, control, eradication and mitigation efforts on IAS can be effectively implemented	Farmers, Stakeholders	1 Modules for farmers / stakeholders (e.g. Farmer Field School)	√	√	√	√	√	Agencies (DOA, DOF, MOH, FRIM, MARDI etc.)
			5 Trainings/ Workshops	√	√				

TARGET 4:

INTENSIFY EXTENSION SERVICES TO STAKEHOLDERS SO THAT PREVENTION, CONTROL, ERADICATION AND MITIGATION EFFORTS ON INVASIVE ALIEN SPECIES CAN BE EFFECTIVELY IMPLEMENTED

ACTIVITY 4: Strengthen multidisciplinary and interdisciplinary research related to IAS (i.e. impact study, biology and ecology, IAS management and monitoring).

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
4.1	Initiate strategic partnership to develop database established on IoT	All agencies	3 species of IAS (using existing sector) - Hotspot map of selected IAS species	√	√	√	√	√	All related agencies (DOA, DOF, DVS, MOH, FRIM, MARDI etc.), Institution, Industry
4.2	Surveillance programme on current situation of IAS by sector to get baseline data (specific on IAS target), eg. plants, animals, fisheries	All agencies and institutions	Pest control and management for 5 targeted IAS	√	√	√	√	√	All related agencies (DOA, DOF, DVS, MOH, FRIM, MARDI etc.), Institution, Industry
			2 inter-agency collaborations	√	√	√	√	√	
			Peer-reviewed publication	√	√	√	√	√	
			2 Innovations – new technology (improved varieties, biocontrol, test kits)	√	√	√	√	√	

ACTIVITY 5: Strengthen existing IAS working groups (updating current status of IAS).

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
5.1	IAS Technical Working Group	Technical experts from all agencies	Addition new experts / agencies	√	√	√	√	√	IAS Secretariat

TARGET 5:

DEVELOP AND IMPLEMENT A PROGRAMME OF WORK TO CONTROL AND MANAGE THE RISK OF INVASIVE ALIEN SPECIES FROM SHIP BALLAST WATER AND SEDIMENTS

ACTIVITY 6: Include IAS as priority in ballast water management programmes.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
6.1	Develop SOPs on ballast water	Agencies (e.g. DOF, MARDEP, MOH), universities	Numbers of SOPs and guidelines		√	√			Agencies (e.g. DOF, MARDEP), Institution, Industry
6.2	Develop SOPs on shipping assisted bio-organisms	Agencies (e.g. DOF, MARDEP, MOH), universities	Numbers of SOPs and guidelines		√	√			Agencies (e.g. DOF, MARDEP), Institution, Industry

ACTIVITY 7: Conduct follow-up monitoring on IAS in ballast water.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
7.1	Monitoring programme	Agencies (e.g. DOF) and universities	Numbers of scheduled reports	√	√	√	√	√	Agencies (e.g. DOF, MARDEP, MOH, Institution, Industry)

GOAL 2

CONDUCT RISK ASSESSMENT ON ALL INTRODUCED EXOTIC SPECIES BEFORE THEIR RELEASE

Establish a formal and transparent mechanism for risk assessment of alien species and initiate response plans and the capacity to contain and eradicate potential IAS before their release into Malaysia. Risk analyses conducted by the responsible authorities are consistent with Malaysia's international biosecurity obligations including those under WTO, IPPC, OIE and WHO.

TARGET 6:

ESTABLISH A FORMAL AND TRANSPARENT MECHANISM TO ENSURE THAT ALL ALIEN SPECIES ARE SUBJECT TO A RIGOROUS RISK ASSESSMENT

ACTIVITY 8: Form a committee to review current mechanism of assessment for introduced exotic species.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
8.1	Meeting for the endorsement of technical committees	MOH, DWNP, DOA, DOF, DVS, MARDI, MARDEP, Universities	Establishment of 2 technical committee (national and sector level)	√					Sectoral coordinator All related agencies
			Annual national meeting	√	√	√	√	√	DOA (IAS Secretariat)
			Biannual sectoral meeting	√	√	√	√	√	Sectoral coordinator

ACTIVITY 9: Strengthen criteria and methods of evaluation and assessment for introduced exotic species before and after their release.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
9.1	Conference on IAS Risk Assessment	MOH, DWNP, DOA, DOF, DVS, MARDI, MARDEP, Universities	Number of conferences			√		√	All related agencies
9.2	Training Workshop on strengthening IAS Risk Assessment criteria by sector	Related agencies	Number of workshops	√	√	√	√	√	Sectoral coordinator
9.3	Workshop on Risk Assessment for each sector	Related agencies	Number of workshops	√	√	√	√	√	Sectoral coordinator
			Documentation of improved risk assessment for every sector (SOP for risk assessment, technical paper, screening method)	√	√	√	√	√	

9.4	Research on effective control measures	All related agencies	Technical paper/ report/ academic papers	√	√	√	√	√	Related research agencies and institutions
9.5	Assessment by authorised body to verify and validate available methods/testing	Related agencies	Assessment report	√	√	√	√	√	

ACTIVITY 10: Revision of SOP for the importation of alien species.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
10.1	Workshop on SOP for the importation of alien species	MOH, DWNP, DOA, DOF, DVS, MARDI, MARDEP, Universities	Importation SOP for: i. Plant and Forestry ii. Animal and Wildlife iii. Fisheries and Marine	√	√				Sectoral coordinator/ MARDEP, All related agencies
10.2	Import risk assessment	MOH, DWNP, DOA, DOF, DVS, MARDI, MARDEP, Universities		√	√				Sectoral coordinator/ MARDEP, All related agencies
10.3	Publication of updated guideline for the importation of alien species into Malaysia	MOH, DWNP, DOA, DOF, DVS, MARDI, MARDEP, Universities	Documentation			√	√	√	Sectoral coordinator/ MARDEP, All related agencies

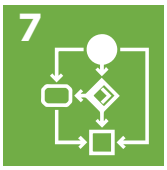
ACTIVITY 11: Enhancement of inspection, sampling and screening method for transboundary alien species.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
11.1	Hands-on training for personnel	Related agencies	Number of training/ personnel	√	√	√	√	√	MAQIS, DVS, DOA, DOF, MARDEP, SAQ, DOA Sarawak, All related agencies
11.2	Procurement of effective screening tools	MAQIS, DVS, DOA, DOF MARDEP, SAQ, DOA Sarawak,	Number of intercept species recorded	√	√				MAQIS, DVS, DOA, DOF, MARDEP, SAQ, DOA Sarawak, All related agencies
11.3	Targeted inspection and sampling for alien species	MAQIS, DVS, DOA, DOF MARDEP, SAQ, DOA Sarawak,	Number of inspection and samples	√	√	√	√	√	MAQIS, DVS, DOA, DOF, MARDEP, SAQ, DOA Sarawak, All related agencies

ACTIVITY 12: Research and development by agencies on risk assessment of alien species.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
12.1	Establish technical working group committee for research	Related agencies	Form technical working group	√					All research agencies / universities
12.2	Proposal for national, international and industry funding	Researcher from various agencies and institutions	Numbers of proposal		√	√	√	√	All research agencies / universities
12.3	Research networking with Invasive Species Specialist Group (ISSG)	Researcher from various agencies and institutions	Number of publication/ technical paper	√	√	√	√	√	All research agencies / universities
12.4	Formal invitation to potential grant funders	MAFI, MOHE, MOSTI, KeTSA	Amount of allocated research funding	√					IAS secretariat, MAFI and KeTSA

TARGET 7:



ESTABLISH RESPONSE PLANS AND THE CAPACITY TO CONTAIN AND ERADICATE POTENTIAL INVASIVE SPECIES

ACTIVITY 13: Development of early detection/intercept method/tools for potential invasive species.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
13.1	Development method / identification tool / Pre-screening method	MOH, DWNP, DOA, DOF, DVS, MARDI, MARDEP	Number of detection / intercept method/ tools	√	√	√	√	√	Sectoral coordinator, All related agencies
13.2	Development of Identification kits/ rapid test / protocol / optimization	MOH, DWNP, DOA, DOF, DVS, MARDEP	Number of detection/ intercept species recorded	√	√	√	√	√	Sectoral coordinator, All related agencies
13.3	Join the ISSG, Early Detection and Rapid Response Programme	Sectoral agencies	Number of participations			√			Sectoral coordinator, All related agencies

ACTIVITY 14: Improvement of containment, eradication and control method and procedure.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
14.1	Procurement of effective containment equipment	Related agencies	Number of improve methods and equipment			√	√		Sectoral coordinator, All related agencies
14.2	Procurement of effective eradication chemical / equipment	Related agencies	Number of workshops organised			√	√		Sectoral coordinator, All related agencies
14.3	Prospecting for potential of biological control agent	Researcher from various agencies and institutions	Number of new biological control agent prospect	√	√	√	√	√	Sectoral coordinator, All related agencies
14.4	Identification and adopt suitable product and technologies	Related agencies	Number of products adopted	√	√	√	√	√	Sectoral coordinator, All related agencies

ACTIVITY 15: Capacity building on detection, containment, eradication and control of IAS.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
15.1	Simulation exercise	MOH, DWNP, DOA, DOF, DVS, MARDEP	Number of trainings / participants	√	√	√	√	√	Sectoral coordinator, All related agencies
15.2	Training on sampling method	MOH, DWNP, DOA, DOF, DVS, MARDEP	Technical transfer from oversea	√	√	√	√	√	Sectoral coordinator, All related agencies
			Expert consultation / training	√	√	√	√	√	Sectoral coordinator, All related agencies
15.3	Trained personnel for alien species detection and quarantine	MOH, DWNP, DOA, DOF, DVS, MARDEP	Number of trained personnel	√	√	√	√	√	Sectoral coordinator, All related agencies
15.4	Attachment programme	MOH, DWNP, DOA, DOF, DVS, MARDEP	Number of trained personnel		√			√	Sectoral coordinator, All related agencies

ACTIVITY 16: Upgrade post entry quarantine facilities.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
16.1	Sourcing of equipment and space for post entry quarantine facilities	Agencies and relevant industries (e.g. Aquaculture, shipping, port authority)	By 2025, all major entry point equipped with complete quarantine facilities.	√	√	√	√	√	Sectoral coordinator, All related agencies

ACTIVITY 17: Establishment of emergency response team and SOP to contain and eradicate IAS.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
17.1	Formation of Emergency response team at sectoral agencies	MOH, DWNP, DOA, DOF, DVS, MARDEP	Number of team (according to region)	√					Sectoral coordinator, All related agencies
17.2	Regular IAS emergency response drill / exercise	MOH, DWNP, DOA, DOF, DVS, MARDEP	Number of cases responded	√	√	√	√	√	Sectoral coordinator, All related agencies

GOAL 3

STRENGTHEN QUARANTINE INSPECTION AND ENFORCEMENT AT ENTRY POINTS AND INTERNATIONAL BORDERS

Strengthen quarantine enforcement and inspection at Malaysia's entry points and international borders by amplifying enforcement and improve the facilities and capabilities of the border officials in controlling and preventing the entry and spread of noxious plants, plant pests, animals, carcasses, fish, agricultural produce, soils, microorganisms and food which are imported into and exported out of Malaysia as well as ensuring discharge of ballast water from ships coming from other countries are safe and free from any risk of IAS.

TARGET 8:

ENHANCE THE ENFORCEMENT OF LEGISLATION ON IMPORTING, TRADING AND KEEPING WILD ANIMALS, FISHES AND PLANTS

ACTIVITY 18: Harmonising the list of IAS and enforcement between Peninsular Malaysia, Sabah and Sarawak.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
18.1	Sectoral Meeting	DOA/ DVS (Peninsular, Sabah and Sarawak), DOF (Federal include Sarawak)/ DOF Sabah/ MPOB)	Sectoral meeting to harmonise IAS list/ enforcement is being established minimum once a year	√	√	√	√	√	DOA (plant and forestry)/ DVS (Peninsular, Sabah and Sarawak), DOF (Federal include Sarawak)/ DOF Sabah/ MPOB
			Updating list of IAS in Malaysia	√	√	√	√	√	
			Updating of the enforcement guidelines for IAS	√	√	√	√	√	
18.2	Streamlining the management, prevention and enforcement efforts between agencies	DOA/ DVS (Peninsular, Sabah and Sarawak), DOF (Federal include Sarawak)/ DOF Sabah/ MPOB/ MAQIS	1 Meeting/ year/ agencies	√	√	√	√	√	DOA (plant and forestry)/ DVS (Peninsular, Sabah and Sarawak), DOF (Federal include Sarawak)/ DOF Sabah/ MPOB
			Report	√	√	√	√	√	

ACTIVITY 19: Improving information exchange and harmonisation of IAS issues.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
19.1	Notification to IUCN on updated IAS list	All related agencies	Once in 2 years			√		√	Secretariat IAS, All related agencies
19.2	Networking with regional and international IAS experts	All related agencies	Minimum 3 joint activities with Regional and International bodies	√	√	√	√	√	All related agencies
19.3	Networking with border control agencies of other countries	All related agencies	All related agencies are being established minimum once a year	√	√	√	√	√	All related agencies

ACTIVITY 20: To review and possibly include specific IAS (based on risk assessment) in the national legislation.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
20.1	Review the IAS list based on risk assessment	DOA, DVS, DOF (include Sarawak / Sabah)	At least two revision activities in 5 years	√			√		MAFI, DWNP, DOA (Plant and Forestry), DOF (Fisheries and Marine), DVS (Animal and Wildlife)

TARGET 9:

9 IMO

IMPLEMENT PROVISIONS OF THE INTERNATIONAL MARITIME ORGANIZATION (IMO) BALLAST WATER MANAGEMENT CONVENTION TO SAFEGUARD AGAINST MARINE INVASIVE SPECIES

ACTIVITY 21: Develop regulations and act in ballast water management.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
21.1	Drafting National Regulation	MOT, MIMA, MARDEP, Port Authorities, DOE, NSWMD	1 regulation on ballast water management	√	√	√	√	√	MIMA, MARDEP

ACTIVITY 22: Develop reception facilities for ballast water treatment.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
22.1	Coordinating within all related agencies	MOT, MIMA, MARDEP, Port Authorities, DOE, NSWMD	1 reception facilities at major ports				√		MOT, MIMA, MARDEP

TARGET 10:

ENHANCE QUARANTINE FACILITIES AND IMPROVE THE SKILLS AND CAPABILITIES OF QUARANTINE, CUSTOMS AND OTHER BORDER OFFICIALS

ACTIVITY 23: Upgrade quarantine facilities consist of basic quarantine inspection facilities and mini laboratories.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
23.1	Facilities for inspection, detection and interception centre for potential IAS	Border officers: MAQIS, MFDA, DOA Sarawak, SAQ, Port Authorities, Relevant Industries	Establishment of Three Further Inspection Centre (FIC)	√		√		√	MAQIS, CUSTOMS, MFDA, DOA Sarawak, SAQ, All related agencies
			Two (2) One-stop Inspection Centre at major entry points	√	√	√	√	√	
23.2	Sourcing of equipment and space for quarantine	MOH, DWNP, DOA, DOF, DVS, MARDEP	Inventory of new equipment and acquired space	√					Sectoral coordinator, All related agencies

ACTIVITY 24: Improve knowledge, skill and capabilities of enforcement officials through capacity building.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
24.1	Hands-on trainings	Border officers: MAQIS, MFDA, DOA Sarawak, SAQ	7 Hands-on trainings / year	√	√	√	√	√	MAQIS, CUSTOMS, MFDA, DOA Sarawak, SAQ, All related agencies
24.2	Competency training	Border officers: MAQIS, MFDA, DOA Sarawak, SAQ	1 Competency training / year	√	√	√	√	√	MAQIS, CUSTOMS, MFDA, DOA Sarawak, SAQ, All related agencies
24.3	Written guidelines and procedures	Border officers: MAQIS, MFDA, DOA Sarawak, SAQ	3 manuals / guidelines / SOP	√	√	√	√	√	DOA (Plant and Forestry) DOF (Fisheries and Marine) DVS (Animal and Wildlife) MAQIS, CUSTOMS, MFDA, DOA Sarawak, SAQ

ACTIVITY 25: Establish emergency response exercise / Immediate actions upon identification and detection of IAS.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
25.1	Establish IAS emergency response manual	All related agencies	1 IAS emergency response manual developed	√	√	√	√	√	DOA (Plant and Forestry) DOF (Fisheries and Marine) DVS (Animal and Wildlife)
25.2	Pre-council Meeting	All related agencies	Reports on emergency preparedness and response plan		√	√	√	√	DOA (Plant and Forestry) DOF (Fisheries and Marine) DVS (Animal and Wildlife)

TARGET 11:

11

STRENGTHEN AND MONITOR THE IMPLEMENTATION OF THE NATIONAL ACTION PLAN FOR THE PREVENTION, ERADICATION, CONTAINMENT AND CONTROL OF INVASIVE ALIEN SPECIES

ACTIVITY 26: Presentation of NAP progress report to National IAS steering committee.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
26.1	Sectoral Meeting	IAS Committee	2 times/year		√	√	√	√	IAS Secretariat, All related agencies

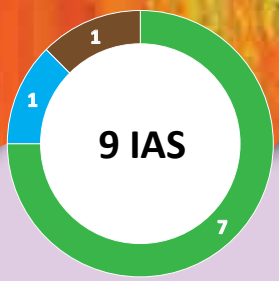
ACTIVITY 27: Strengthen the implementation of the enforcement.

No.	Sub-activities	Target Group	Key Performance Indicator	Implementation					Implementing Sector / Agency
				2021	2022	2023	2024	2025	
27.1	Training to improve personnel competency, In-house training	All related agencies	5 In-house trainings/ year	√	√	√	√	√	All related agencies
27.2	Guidelines / SOP	All related agencies	1 SOP updated for all relevant activities / year.	√	√	√	√	√	All related agencies
27.3	Upgrade the existing laboratories, equipment and facilities for each sector	All related agencies	1 Upgraded biosecurity laboratory	√	√	√	√	√	All related agencies
27.4	Streamlining enforcement activities between agencies	All related agencies	1 Meeting/ year/ agencies, Report	√	√	√	√	√	All related agencies

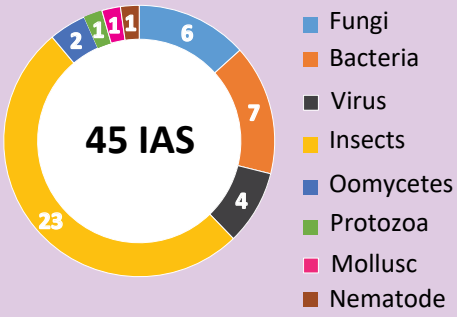
IAS OF CONCERN

AGRICULTURE AND FORESTRY

PLANTS

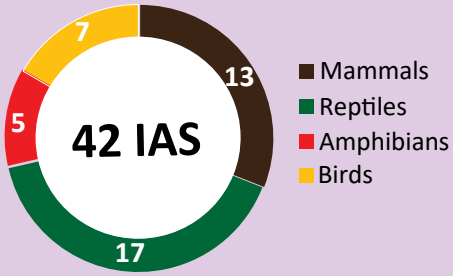


PLANT PESTS

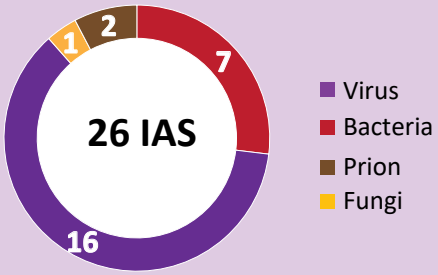


ANIMAL AND ANIMAL-BORNE DISEASE

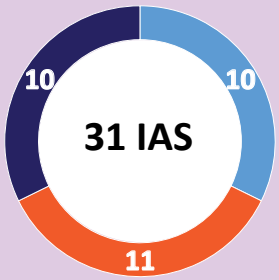
ANIMALS



ANIMAL-BORNE DISEASES



FISHERIES AND MARINE



CRITERIA FOR RISK ASSESSMENT

AGRICULTURE AND FORESTRY

PLANT PESTS

No.	Common Name	Scientific Name / Pathogen	Distribution		
			Peninsular Malaysia	Sabah	Sarawak
1	African Rhinoceros Beetle	*Oryctes monoceros*	Not Present	Not Present	Not Present
2	American Palm Cixiid / Planthopper (Lethal Yellowing Vector)	*Myndus crudus*	Not Present	Not Present	Not Present
3	American Palm Weevil (Red Ring Disease Vector)	*Rhynchophorus palmarum*	Not Present	Not Present	Not Present
4	Bacterial Panicle Blight	*Burkholderia glumae & Burkholderia gladioli*	Present	Not Present	Not Present
5	Moko Disease of Banana	*Ralstonia solanacearum* species complex Phylotype II	Present	Present	Not Present
6	Black Pod Disease	*Phytophthora megakarya*	Not Present	Not Present	Not Present
7	Blood Disease of Banana	*Ralstonia solanacearum* species complex Phylotype IV	Present	Present	Not Present
8	Boas Rhinoceros Beetle	*Oryctes boas*	Not Present	Not Present	Not Present
9	Bogia Coconut Syndrome	*Candidatus* phytoplasma noviguineense (16srIV)	Not Present	Not Present	Not Present
10	Bud Rot Disease of Oil Palm	*Phytophthora palmivora* (South American Strain)	Not Present	Not Present	Not Present
11	Cadang Cadang Disease	Coconut Cadang-Cadang Viroid (CCCVd)	Not Present	Not Present	Not Present
12	*Ceratocystis* Wilt Disease of Acacia	*Ceratocystis fimbriata*	Present	Present	Present
13	*Cercospora* Leaf Spot	*Cercospora elaiedis*	Not Present	Not Present	Not Present
14	Chlorotic Ring Disease	Potyvirus SCMV strain	Present	Not Present	Not Present
15	Chrysomelid Beetle	*Hispoleptis elaieidis*	Not Present	Not Present	Not Present
16	Cocoa Mirid	*Distantiella theobroma*	Not Present	Not Present	Not Present
17	Cocoa Mirid	*Sahlbergella singularis*	Not Present	Not Present	Not Present
18	Cocoa Swollen Shoot Virus Disease	Cocoa Swollen Shoot Virus (CSSV)	Not Present	Not Present	Not Present
19	Coconut Rhinoceros Beetle - Guam Biotype	*Oryctes rhinoceros*	Not Present	Not Present	Not Present
20	Fall Armyworm	*Spodoptera frugiperda*	Present	Present	Present
21	Frosty Pod Rot of Cocoa	*Moniliophthora roreri*	Not Present	Not Present	Not Present
22	Golden Apple Snail	*Pomacea canaliculata*	Present	Present	Present
23	Guava Fruitfly	*Bactrocera correcta*	Present	Not Present	Not Present
24	Khapra Beetle	*Trogoderma granarium*	Not Present	Not Present	Not Present

PLANT PESTS

No.	Common Name	Scientific Name / Pathogen	Distribution		
			Peninsular Malaysia	Sabah	Sarawak
25	Lace Bug	*Leptopharsa gibbicarina*	Not Present	Not Present	Not Present
26	Leaf Miner	*Hispoleptis subfasciata*	Not Present	Not Present	Not Present
27	Lethal Wilt	*Candidatus* Phytoplasma *asteris*	Present	Not Present	Not Present
28	Lethal Yellowing Disease of Coconut	*Candidatus* Phytoplasma *palmae* (16Sr-IV)	Not Present	Not Present	Not Present
29	Nettle Caterpillar	*Darna catenatus*	Not Present	Not Present	Not Present
30	Nettle Caterpillar	*Darna metaleuca*	Not Present	Not Present	Not Present
31	Oil Palm Slug Caterpillar	*Darna furva*	Not Present	Not Present	Not Present
32	Papaya Dieback	*Erwinia papayae* & *Erwinia mallotivora*	Present	Present	Not Present
33	Papaya Ringspot Virus	*Papaya ringspot virus*	Present	Present	Not Present
34	Pentatomid (Vector of *P. staheli*)	*Lincus lobuliger*	Not Present	Not Present	Not Present
35	Pentatomid (Vector of *P. staheli*)	*Lincus lethifer*	Not Present	Not Present	Not Present
36	Pentatomid (Vector of *P. staheli*)	*Lincus spurcus*	Not Present	Not Present	Not Present
37	Red Palm Weevil	*Rhynchophorus ferrugineus*	Present	Not Present	Not Present
38	Red Ring Disease of Palm	*Rhadinaphelenchus cocophilus*	Not Present	Not Present	Not Present
39	South American Leaf Blight (SALB)	*Pseudocercospora ulei*	Not Present	Not Present	Not Present
40	South American Palm Weevil	*Dynamis borassi*	Not Present	Not Present	Not Present
41	Sudden Wilt Disease of Oil Palm / Marchitez sorpresiva	*Phytomonas staheli*	Not Present	Not Present	Not Present
42	Vascular Wilt Disease of Oil Palm	*Fusarium oxysporum* f. sp. *elaeidis*	Not Present	Not Present	Not Present
43	Weevil (Red Ring Disease Vector)	*Limnobaris calandriformis*	Not Present	Not Present	Not Present
44	West Indian Cane Weevil (Red Ring Disease Vector)	*Metamasius hemipterus*	Not Present	Not Present	Not Present
45	Witches's Broom Disease	*Moniliophthora perniciosa*	Not Present	Not Present	Not Present

Bacterial Panicle Blight / Bacterial Grain Rot

Burkholderia glumae and *Burkholderia gladioli*

Author(s): Assoc. Prof. Dr. Noor Hana Hussain (UiTM)

Photo source: DOA

The stem below the infected panicle remains green. Small clusters of panicle do not develop properly during panicle fill and the panicles remain upright rather than bending down with the weight of the grains.

Photo source: DOA

The infected grains develop light to medium brown discoloration (dual-tone symptom) of the lower third to half of the hulls.

Impact on:

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Refer glossary for details

Burkholderia glumae and *Burkholderia gladioli* are the causative agents of bacterial panicle blight (BPB) or grain rot, the worst seed borne disease of paddy in the world. *Burkholderia glumae* is more virulent and is commonly detected in BPB diseased paddy plants. Unlike *Burkholderia glumae* which is only seed borne, *Burkholderia gladioli* is both seed and soil borne. Outbreaks of BPB are influenced by high temperatures (35°C to 40°C) and high relative humidity (≥95%). Severely infected panicles remain upright with grains unfilled. Serious outbreaks of this disease can cause an estimated up to 80% loss in yield.

First detected in Japan in 1956, bacterial blight disease has now been reported in North, South and Central America (Gulf of Mexico, Dominican Republic, Venezuela, Ecuador, Brazil, Panama, Colombia, Nicaragua and Costa Rica), Africa (states in the south and Tanzania) and Asia (Japan, Korea, Vietnam, Philippines, India, Indonesia, Malaysia, Sri Lanka, Thailand and China). Currently, there is no effective control of this disease.

Fusarium Wilt Disease of Oil Palm

Fusarium oxysporum f. sp. *elaeidis*

Author: Dr. Khairulmazmi Ahmad (UPM)

Photo source: www.plantvillage.psu.edu

Young tree showing symptoms of Fusarium Wilt of Oil Palm (wilting and drying leaves).

Photo source: www.plantvillage.psu.edu

Young oil palm tree died after serious *F. oxysporum* f. sp. *elaeidis* infestation.

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Photo source: Dr. Babs. Ritchi, CABI

Discoloration at plant base is the symptom of Fusarium Wilt Disease.

Fusarium wilt disease is one of the most destructive diseases of oil palm. Yield losses of up to 50% have been recorded in several countries. The disease was first described in Zaire and has subsequently been diagnosed in several countries in Central and Western Africa. Currently, it has been spread in South American countries such as Brazil and Colombia. This disease has yet to be detected in Malaysia, however, it has been listed as a quarantine pest. With nearly 6 million hectares of oil palm plantation, prevention of this disease is a priority in Malaysia.

Disease symptoms on immature palms are leaves in the middle of the crown become yellow or brown. The discolouration spreads to the lower leaves and the palm eventually desiccates and dies. Integrated disease control and planting resistant cultivars are the effective method of control for this disease and have successfully reduced losses in some affected areas from 20-30% to less than 3%.

South American Leaf Blight of Rubber

Pseudocercospora ulei (Syn: *Microcyclus ulei*)

Author(s): Mrs. Patahayah Mansor (FRIM) & Dr. Rozeita Laboh (MARDI)

Photo source: DOA

Pseudocercospora ulei infects young aerial parts of rubber plants such as leaf petioles, inflorescence and stems. Infection of the young stems causes shoot dieback. Severe infection shows stunting of trees, possess few leaves and dead branches and stems.

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The invasive potential of South American Leaf Blight (SALB) has been illustrated by the devastating impact on attempts to develop rubber production in South America. It has become a great threat to rubber growing countries especially in the Asia and the Pacific region as most of the cultivated natural rubber tree genotypes in this region are susceptible to the disease. The causal pathogen *Pseudocercospora ulei* is known to only infect species within the genus Hevea. The main reasons that this disease threatens plantations include the rapid dissemination of spores, the high capacity for destruction and the difficulty in controlling the fungus. Premature leaf falls caused by *P. ulei* leads to dieback of trees and economic losses.

There are neither chemical nor biological control measures proven can effectively eradicate the disease. Even though the distribution is still restricted to its continent of origin, potential is high for it to spread around the world via trade and human movement. A quarantine law has been established for inbound international air travellers from SALB countries to reduce the possibility of the spread of *P. ulei* from South American countries to Malaysia.

Photo source: DOA

Symptoms observed on the undersurface of the leaf. Lesions appear as dark olive green and covered with conidia on young leaves.

Photo source: DOA

Pycnidia formed at the edges of the lesions on the upper mature leaf surface. Shot holes developed as leaf tissues at the center of disease lesions die and drop-off.

Bud Rot Disease of Oil Palm

Phytophthora palmivora (South American Strain)

Author(s): Dr. Mohd Hefni Rusli (MPOB)

Photo Source: Jameel M. Al-Khayri, via www.researchgate.net

Thousands of oil palms dying in Colombia from infection by *Phytophthora palmivora.*

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Bud rot, caused by *Phytophthora palmivora*, is one of the major diseases of oil palm in Latin America. The disease affect the yield of fresh fruit bunches (FFB) and the quality of the crude palm oil extract. In Colombia, the disease has destroyed more than 70 000 ha of oil palm in the western and central growing region. The pathogen has a cosmopolitan presence that includes Southeast Asia, but to date, bud rot has not been reported in this region.

Pathogenicity tests Malaysian *P. palmivora* isolates were not pathogenic to oil palms and Amplified Fragment Length Polymorphisms (AFLP) analysis shows a clear clade separation between Malaysian and Colombian isolates.

P. palmivora can be controlled through cultural and sanitary methods such as adequate drainage and balanced soil fertility. *P. palmivora* is a soil-borne pathogen, therefore importation of potting material/soil from high risk countries need to be enquired with the Department of Agriculture.

Oil palm produces more than 36 percent of world's vegetable oil while only planted on 5.1% of the 251 million hectares planted with vegetable oil crops worldwide. Malaysia's oil palm products were exported to more than 150 countries with total value exceeding 40 billion Malaysian Ringgit annually. Therefore, Malaysia will put the best effort to protect the industries from this disease.

Photo Source: David Guest, via www.researchgate.net

Matured trees showing symptoms of Bud Rot Disease of Oil Palm.

PLANTS

No.	Common Name	Scientific Name	Distribution		
			Peninsular Malaysia	Sabah	Sarawak
1	Acacia	*Acacia mangium*	Present	Present	Present
2	Alligator weed	*Alternanthera philoxeroides*	Not Present	Not Present	Not Present
3	Bitter vine	*Mikania micrantha*	Present	Present	Present
4	Crofton weed / Mexican devil	*Ageratina adenophora*	Not Present	Present	Not Present
5	Giant sensitive tree	*Mimosa pigra*	Present	Present	Present
6	Itchy grass	*Rottboellia cochinchinensis*	Present	Present	Present
7	Kariba weed	*Salvinia molesta*	Present	Present	Present
8	*Parthenium* weed	*Parthenium hysterophorus*	Present	Present	Not Present
9	River tamarind	*Leucaena leucocephala*	Present	Present	Present

Source: DOA

Parthenium weed (*Parthenium hysterophorus)*

Source: DOA

Bitter vine (*Mikania micrantha)*

Source: © Hunter Regional Weeds 2018

Alligator weed (*Alternanthera philoxeroides)*

Source: Tree-Nation

Acacia (*Acacia mangium)*

Kariba Weed

Salvinia molesta

Author(s): Mr. Salahaudin Maili Mohd Rasli (DOA Sabah)

Salvinia molesta.

Photo source: DOA Sabah

Paddy field infested with *S. molesta* in Kota Belud, Sabah.

Impact on:

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Photo source: Koperasi Pelancongan Mukim Batu Puteh Kinabatangan Berhad (KOPEL Bhd.)

Bird's eye view of Lake Tungog, Kinabatangan, Sabah infested with *S. molesta.*

Salvinia molesta is one of the most destructive invasive weeds, threatening natural ecosystems and agroecosystems worldwide. Salvinia can form thick floating mats, cause habitat alteration and loss or degradation of native biodiversity (animals and plants). This invasive weed can be found in many types of waterbodies such as slow-moving rivers, ponds, water catchment and irrigated rice fields. In Malaysia, one of the most notable infestations can be found in naturally occurring oxbow lakes in Kinabatangan, Sabah. Mechanical and physical control have been used to eradicate this weed, but most of these approaches are ineffective and uneconomical. The *Cyrtobagous salviniae* weevil was introduced to Malaysia in the 1980s as the biological control for *S. molesta.* The host specific *C. salviniae* is highly effective in peninsular Malaysia and has recently been distributed to establish its population in other *S. molesta* infested areas in Sabah.

ANIMAL AND ANIMAL-BORNE DISEASE

ANIMALS

No.	Common Name	Scientific Name	Distribution		
			Peninsular Malaysia	Sabah	Sarawak
1	American bullfrog	*Lithobates catesbeianus*	Present (escaped from farming)	Not present	Not present
2	Black mamba	*Dendroaspis polylepis*	Not present	Not present	Not present
3	Blue viper	*Trimeresurus insularis*	Not present	Not present	Not present
4	Brown rat	*Rattus norvegicus*	Present	Present	Present
5	Brown tree snake	*Boiga irregularis*	Not present	Not present	Not present
6	Brushtail possum	*Trichosurus vulpecula*	Not present	Not present	Not present
7	Bufo toad	*Rhinella marina*	Present	Present	Present
8	Caribbean tree frog	*Eleutherodactylus coqui*	Not present	Not present	Not present
9	Chinese softshell turtle	*Pelodiscus sinensis*	Present	Present	Present
10	Common myna	*Acridotheres tristis*	Present	Present	Present
11	European starling	*Sturnus vulgaris*	Present	Present	Present
12	Golden fronted leafbird	*Chloropsis aurifrons*	Present	Present	Present
13	Greater bandicoot rat	*Bandicota indica*	Present	Not present	Not present
14	Green anaconda	*Eunectes murinus*	Not present	Not present	Not present
15	Green iguana	*Iguana iguana*	Present	Present	Present
16	Grey squirrel	*Sciurus carolinensis*	Not present	Not present	Not present
17	House mouse	*Mus musculus*	Present	Present	Present
18	Indian bullfrog	*Hoplobatrachus tigerinus*	Present but not in the wild (escaped from farming)	Present but not in the wild (escaped from farming)	Not present
19	Javan spitting cobra	*Naja sputatrix*	Not present	Not present	Not present
20	Large-billed crow	*Corvus macrorhynchos*	Present	Present	Present
21	Large-eyed pit viper	*Trimeresurus macrops*	Not present	Not present	Not present
22	Lesser bandicoot rat	*Bandicota bengalensis*	Present	Not present	Not present
23	Malaysian house rat	*Rattus rattus diardii*	Present	Present	Present
24	Nutria	*Myocastor coypus*	Not present	Not present	Not present
25	Oriental water dragon	*Physignathus cocincinus*	Present	Present	Present
26	Peach-faced lovebird	*Agapornis roseicollis*	Not present	Not present	Not present

ANIMALS

No.	Common Name	Scientific Name	Distribution		
			Peninsular Malaysia	Sabah	Sarawak
27	Philippine cobra	*Naja philippinensis*	Not present	Not present	Not present
28	Philippine pit viper	*Trimeresurus flavomaculatus*	Not present	Not present	Not present
29	Red deer	*Cervus elaphus*	Not present	Not present	Not present
30	Red fox	*Vulpes vulpes*	Not present	Not present	Not present
31	Red-eared slider	*Trachemys scripta*	Present	Present	Present
32	Red-vented bulbul	*Pycnonotus cafer*	Present	Not present	Not present
33	Rock pigeon	*Columba livia*	Present	Present	Present
34	Ryukyu mouse	*Mus caroli*	Present	Not present	Not present
35	Samar cobra	*Naja samarensis*	Not present	Not present	Not present
36	Serval cat	*Leptailurus serval*	Present	Present	Present
37	South American rattlesnake	*Crotalus durissus*	Not present	Not present	Not present
38	Stoat	*Mustela erminea*	Not present	Not present	Not present
39	Taiwanese bullfrog	*Hoplobatrachus rugulosus*	Not present	Present	Not present
40	Timber rattlesnake	*Crotalus horridus*	Not present	Not present	Not present
41	Western diamondback rattlesnake	*Crotalus atrox*	Not present	Not present	Not present
42	White-lipped pit viper	*Trimeresurus albolabris*	Not present	Not present	Not present

Brown Rat

Rattus norvegicus

Author(s): Mrs. Shuerni Mohamad Razi (DOA), Ms. Tan Poai Ean (PERHILITAN) & Mr. Ikhwan Harris Ramli (DOA)

Photo Source: © Josef hlasek via http://www.hlasek.com/

The brown rat is a true omnivore and will consume almost anything.

Impact on:

Environment

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Photo Source: © Josef hlasek via http://www.hlasek.com/

Native to central Asia, the brown rat now enjoys a worldwide distribution.

Rattus norvegicus has brown fur on the back with pale grey fur on its belly. The adults normally weigh 150 - 300g, and may reach up to 500g, and are up to 390mm long. They have relatively small ears, which usually do not cover the eyes when pulled forward.

R. norvegicus is globally widespread and costs the primary industry hundreds of millions of dollars per year. It has caused or contributed to the extinction or range reduction of native mammals, birds, reptiles and invertebrates through predation and competition. It restricts the regeneration of many plant species by eating seeds and seedlings, eats food crops and spoils human food stores by urinating and defecating in them.

Infestation by rodents also affect human health as they are known to be the vector of various diseases such as plague (through rat flea), leptospirosis, salmonella, tapeworm (via urine and droppings), rat-bite fever, rat mite dermatitis and many more.

Red-eared Slider

Trachemys scripta elegans

Author(s): Ms. Tan Poai Ean (PERHILITAN) & Mrs. Shuerni Mohamad Razi (DOA)

Photo source: Thomas C. Brennan.

Red-eared sliders compete with native turtle species for food, habitat, and other resources.

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The red-eared slider (*Trachemys scripta elegans*) has been the most popular turtle in the pet trade with more than 52 million individuals exported from the United States to foreign markets between 1989 and 1997. Their aggressiveness, omnivorous diet and ability to adapt to various habitats, gives them great potential for impacting indigenous species and ecosystems. Red-eared sliders probably compete directly for space and food with native freshwater turtles. Indeed, both native and invasive freshwater turtles are predators of amphibian tadpoles.

Continuous releasing of exotic pet turtles in natural ecosystems increases the risk of parasite transmission to native species. Native turtles have no immunity to parasites and diseases carried by red-eared sliders. All reptiles, including red-eared slider also shed Salmonella. Salmonella bacteria and the salmonellosis diseases that it causes are not harmless. Indeed, it can be deadly to humans.

Photo Source: The Star

Photo Source: Bernama

Thousands of smuggled red-eared slider hatchlings seized by Malaysia Customs.

Brown Tree Snake

Boiga irregularis

Author(s): Ms. Tan Poai Ean (PERHILITAN) & Mrs. Shuerni Mohamad Razi (DOA)

Photo source: U.S. Geological Survey

A Brown Treesnake (BTS) eating a white tern on northern Guam. BTS are capable of consuming very large prey items, and the snake successfully swallowed the tern.

Photo source: ©Dickinson College

Brown tree snakes have contributed to the loss of many native forest species in Guam.

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Brown tree snake (*Boiga irregularis*), also called brown catsnake is a slender, mildly venomous, primarily arboreal snake of the family Colubridae that is considered to be one of the most aggressive invasive species in the world. They generally are a light brown in colour with distinctively large heads with opisthoglyphous (rearward) fangs and big bulbous eyes characteristic of the genus Boiga (and in keeping with nocturnal habits).

This 1 to 3m long snake is native to Papua New Guinea, the Solomon Islands, and the northern and eastern coasts of Australia. The Brown Tree Snake was brought accidentally to several islands in the Pacific shortly after World War II where it successfully established local populations due to obviously unoccupied niches and plentiful native prey. The most devastating consequences of its introduction are known from Guam, where it led to decimation of vertebrate species including flying foxes, several small terrestrial mammals, and lizards as well as the extinction of eight of the 11 endemic bird species in the 1980s.

ANIMAL-BORNE DISEASES

No.	Disease Name	Scientific Name / Pathogen	Distribution		
			Peninsular Malaysia	Sabah	Sarawak
1	African horse sickness	Orbivirus	Present	Not present	Not present
2	African Swine Fever	African Swine Fever Virus	Not present	Not present	Not present
3	Anaplasmosis	*Anaplasma phagocytophilum*	Not present	Not present	Not present
4	Anthrax	*Bacillus anthracis*	Not present	Not present	Not present
5	Blastomycosis	Blastomyces	Not present	Not present	Not present
6	Botulism	*Clostridium botulinum*	Not present	Not present	Not present
7	Eastern equine encephalomyelitis (EEE), Western equine encephalomyelitis (WEE)	Eastern equine encephalitis virus, Western equine encephalitis virus	Not present	Not present	Not present
8	Ebola Disease	Filoviridae	Not present	Not present	Not present
9	Equine coital exanthema	Equine alphaherpesvirus type 3	Not present	Not present	Not present
10	Foot and Mouth Disease (FMD)	Picornavirus	Present	Not present	Not present
11	Glanders	*Burkholderia mallei*	Not present	Not present	Not present
12	Highly Pathogenic Avian Influenza (HPAI)	Avian influenza viruses	Not present	Not present	Not present
13	Mad Cow Disease	Bovine spongiform encephalopathy (BSE)	Not present	Not present	Not present
14	Marburg disease	Marburg marburg virus	Not present	Not present	Not present
15	Middle East respiratory syndrome (MERS)	Middle East respiratory syndrome coronavirus (MERS-CoV)	Not present	Not present	Not present
16	Nairobi sheep disease	Orthonairovirus	Not present	Not present	Not present
17	Peste des petits ruminants	Mobilivirus	Not present	Not present	Not present
18	Rabies	Lyssavirus	Present	Not present	Present
19	Rickettsia	*Rickettsia* spp.	Not present	Not present	Not present
20	Rift Valley Fever	Phlebovirus	Not present	Not present	Not present
21	Scrapie	Transmissible spongiform encephalopathies (TSEs)	Not present	Not present	Not present
22	Transmissible gastroenteritis	Transmissible gastroenteritis virus	Not present	Not present	Not present
23	Tularaemia	*Francisella tularensis*	Not present	Not present	Not present
24	Venzuelan equine encephalomyelitis	Venezuelan equine encephalitis virus	Not present	Not present	Not present
25	West Nile Fever	Flavivirus	Not present	Not present	Not present
26	Yersiniosis	genus Yersinia	Not present	Not present	Not present

Anthrax

Bacillus anthracis

Author(s): Dr. Roseliza Roslee (DVS), Dr. Mariani Hashim (DVS), Dr Asrol Sany Arshad (DVS) & Dr. Florence C.H. Lee (IMR)

Photo source: North Dakota Department of Agriculture

Cow infected with Anthrax.

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Photo Source: James H. Steele (CDC)

A skin lesion caused by anthrax.

Anthrax is caused by *Bacillus anthracis*. It is primarily a disease of high mortality rate among herbivorous animals, although all mammals, including humans, and some avian species can contract it. The disease has worldwide distribution and is a zoonosis. Transmission route is usually through ingestion or breathing in of spores, with presentation as cutaneous, gastro intestinal, pulmonary or severe meningitis.

Bacillus anthracis is also one of the most likely agents to be used in a biological attack, as the spores are extremely resistant to natural conditions and can survive for several decades in the environment. Suspected cases of Anthrax in Malaysia were reported in 1948 and 1968, which were later confirmed as other Bacillus species. Malaysia has remained Anthrax free.

Photo source: N Engl J Med 2009; 361:178

Lesion on left cheek and periorbital edema.

Highly Pathogenic Avian Influenza (HPAI)

Avian influenza viruses

Author(s): Dr. Roseliza Roslee (DVS), Dr. Mariani Hashim (DVS), Dr Asrol Sany Arshad (DVS) & Dr. Florence C.H. Lee (IMR)

Photo source: Bernama

Cloacal swab is taken from poultry for detection of HPAI.

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Asian Highly Pathogenic Avian Influenza (HPAI) (H5N1) virus occurs mainly in birds, highly contagious among them and especially deadly for poultry. The virus was first detected in 1996 in geese in China. Asian H5N1 was first detected in humans in 1997 during a poultry outbreak in Hong Kong and has since been detected in poultry and wild birds in more than 50 countries in Africa, Asia, Europe, and the Middle East.

The first event of HPAI in Peninsular Malaysia was reported in a flock of free-range chickens in the village of Pasir Pekan, Kelantan on 19 August 2004. The subsequence HPAI event occurred in the states of Penang, Perak and Federal Territory of Kuala Lumpur in 2006, whereas the third event occurred in the state of Selangor in 2007. The fourth event occurred in the state of Kelantan in 2017.

On 4 August 2018, HPAI was confirmed in Sabah by the Veterinary Research Institute (VRI). The outbreak had spread to 7 villages in Tuaran district of Sabah state. The HPAI event in Sabah was the first case in East Malaysia and the authorities managed to control and eradicate the outbreaks within 43 days. The Delegate of Malaysia to the OIE declares that Malaysia is free from infection with HPAI viruses in poultry, as of 15 December 2018.

Photo source: Dr. David E. Swayne (APHIS, USDA)

Hemorrhagic skin visible on the feet of a chicken with avian influenza.

Photo source: Dr. David E. Swayne (APHIS, USDA)

Hemorrhagic skin visible on the unfeathered head regions of a chicken with avian influenza.

FISHERIES AND MARINE

FISHERIES

No.	Common Name	Scientific Name	Distribution		
			Peninsular Malaysia	Sabah	Sarawak
1	African Catfish	*Clarias gariepinus*	Present	Present	Present
2	Amazon Redtail Catfish	*Phractocephalus hemioliopterus*	Present	Present	Not Present
3	Asian Redtail Catfish	*Hemibagrus wyckioides*	Present	Present	Not Present
4	Black Tilapia	*Oreochromis mossambicus* *Oreochromis niloticus*	Present	Present	Present
5	Earth-eater	*Geophagus surinamensis*	Present	Not Present	Not Present
6	Midas Cichlid	*Ampilophus citrinellus*	Present	Not Present	Present
7	Peacock Bass	*Cichla* spp.	Present	Not Present	Not Present
8	Red Swamp Crayfish	*Procambarus clarkii*	Present	Present	Not Present
9	Australian Red Claw Crayfish / Freshwater Lobster	*Cherax quadricarinatus*	Present	Present	Present
10	Zebra Tilapia	*Heterotilapia buttikoferi*	Present	Not Present	Not Present

Source: FRI Glami Lemi, DOF

Earth-eater (*Geophagus surinamensis)*

Source: FRI Glami Lemi, DOF

Peacock Bass (*Cichla* spp.)

Source: DOF

Asian Redtail Catfish (*Hemibagrus wyckioides)*

Red Swamp Crayfish

Procambarus clarkii

Author(s): Dr. Haslawati Baharuddin (DOF), Dr. Kua Beng Chu (DOF) & Dr. Noor Khalidah Abdul Hamid (USM)

Photo Source: FRI Glami Lemi

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Red Swamp Crayfish, *Procambarus clarkii.*

The Red swamp crayfish *(Procambarus clarkii)* is native to the coastal plain of the Gulf from the Florida panhandle to Mexico, widely introduced all over the world, due to its importance in aquaculture and aquarium trade. It is reported to be the world's most successfully translocated freshwater species. The species has remarkable ability to successfully colonise a wide range of habitats, due to its extraordinary ecological plasticity; resistant gene pool to changes in population; biological and life cycle adaptation to environmental changes; good tolerance to a wide range of salinity, oxygen and temperature; fast growth rate and flexible feeding strategy.

The burrowing behaviour cause damage to rice fields, and river banks erosion will increase turbidity, may induce cyanobacterial bloom. *P. clarkii* is also the carrier for many pathogens, parasites and diseases that may affect human. Once established, this species may quickly cause serious ecological, economic damage and also may affect human health.

Australian Red Claw Crayfish / Freshwater Lobster

Cherax quadricarinatus

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Photo Source: FRI Glami Lemi, Department of Fisheries Malaysia

The Red claw crayfish from Machap Reservoir, Kluang, Johor.

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Photo Source: FRI Glami Lemi, Department of Fisheries Malaysia

The potential invasion and established population of Red Claw in Perai River, Penang.

The Red Claw Crayfish, *Cherax quadricarinatus* is a freshwater crustacean native to northern Australia and Papua New Guinea. It is physically robust, tolerant of a broad range of environmental conditions, simple reproductive cycles, quick growth rates combined with large size and edibility, making it the ideal candidate for aquaculture and aquarium industries. These characteristics, together with diverse feeding conditions and ecosystems, have made them an effective invasive species, thus developed feral communities in many parts of the world, likely through escapees.

Red Claw can affect aquatic environments through changes in natural habitats, direct predation, competition with native species, and the introduction of diseases. Like other crayfishes, *C. quadricarinatus* served as the intermediate host to several pathogens that can infect humans; the digenean lung flukes, Paragonimus species, rickettsia-like parasites, and enteric bacteria *Vibrio cholera*, *V. mimmicus*, enterococcids and *Escherichia coli*. A new bacterium *Coxiella cheraxi* is confirmed to be a close relative to *C. burnetti*, an agent to the Q-fever disease.

Cultured Red Claw is also prone to White Spot Syndrome Virus (WSSV) and Yellow Head Virus (YHV) that can be transmitted to native shrimp species. Another new crustacean virus, the Decapod Iridescent Virus 1 (DIV1), has also been detected in farmed red claw crayfish, posing a new threat to the shrimp farming industry.

FISHERY DISEASES

No.	Disease Name	Scientific Name / Pathogen	Distribution		
			Peninsular Malaysia	Sabah	Sarawak
1	Acute hepatopancreatic necrosis disease	Vibrio parahemolyticus (V p AHPND)	Present	Present	Present
2	Edwardsieliosis	*Edwardsiella tarda*	Present	Not present	Not present
3	Hepatopancreatic microsporidiosis (HPM)	*Enterocytozoon hepatopenaei*	Present	Present	Present
4	Infection with Infectious Spleen and Kidney Necrosis Virus (ISKNV)	Megalocytivirus	Present	Not present	Not present
5	*Infection with Perkinsus olseni*	*Perkinsus olseni*	Not Present (unconfirmed)	Not Present (unconfirmed)	Not present
6	Red sea bream iridoviral disease (RSIV)	*Red sea bream iridovirus*	Not present	Present	Not present
7	Taura syndrome	Taura syndrome virus	Not present	Not present	Not present
8	Viral covert mortality disease (VCMD) of shrimps	*Covert mortality nodavirus (CMNV)*	Not present	Not present	Not present
9	Viral nervous necrosis (VNN)	Betanodavirus	Present	Present	Not present
10	White tail disease	*Macrobrachium rosenbergii nodavirus (MrNV)*	Present	Not present	Not present
11	Yellow head virus genotype 1 disease (YHV1)	*Yellow head virus genotype 1*	Not present	Not present	Not present

Yellow head virus genotype 1 disease (YHV1)

Yellow head virus genotype 1 disease

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Photo source: DV Lightner

Yellow head disease in giant black tiger prawn (*Penaeus monodon*); note yellowheads of infected prawns on the left. Prawns on the right are normal

Yellow head virus genotype 1 (YHV1) is one of the genotypes in the YHV and known as a viral infection of marine shrimps. Moribund shrimp exhibit a soft and yellowish cephalothorax in comparison to the brown hepatopancreas of a healthy shrimp. The YHV1 targets tissues are lymphoid organ, haemocytes, haematopoietic tissue, gill lamellae, spongy connective tissue of the subcutis, gut, antennal gland, gonads, nerve tracts and ganglia.

Mortality could occur within a few days of the first appearance of shrimp showing gross signs of congregation at the edges of the pond and yellowish discoloration at hepatopancreas. YHV1 is highly fatal, contagious and can trigger up to 100% mortality in juvenile to sub-adult shrimp. YHV1 is on the list of diseases notified to the World Organization for Animal Health.

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Red sea bream iridoviral disease (RSIVD)

Red sea bream iridovirus

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Photo source: via https://www.fis.com/

RSIVD infected fish with severe anaemic of the gills

Red sea bream iridovirus is a Megalocytivirus virus and has caused Red Sea Bream Iridoviral Disease (RSIVD). RSIVD is a leading cause of mortality in farmed red sea bream (*Pagrus major*) and more than 30 other marine fish species, primarily belonging to Perciformes and Pleuronectiformes orders.

Globally, the RSIVD had caused significant mortality in high value cultured marine fish such as grouper, perch, sea bream, and sea bass. Juvenile to adult fish are susceptible to the disease, and often the susceptibility of juveniles usually is higher than adults. The RSIV infected fish appear to exhibit changes in skin colour and have severe anaemic, petechiae of the gills, and enlargement of the spleen. RSIVD is on the list of diseases notified to the World Organization for Animal Health.

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MARINE

No.	Common Name	Scientific Name	Distribution		
			Peninsular Malaysia	Sabah	Sarawak
1	Black striped mussel	*Mytilopsis sallei*	Present	Not present	Not present
2	Bushy bryozoan	*Amathia distans*	Present (unconfirmed)	Present (unconfirmed)	Present (unconfirmed)
3	Charru mussel	*Mytella strigata formerly known as Mytella charruana*	Present (unconfirmed)	Present (unconfirmed)	Present (unconfirmed)
4	Dinoflagelates (Harmful Algal Bloom, HAB)	*Alexandrium minutum*	Present	Not present	Not present
		Alexandrium tamarense	Present	Not present	Not present
		Alexandrium tamiyavanichii	Present	Not present	Present
		Cochlodinium polykrikoides	Present	Present	Present
		Gymnodinium catenatum	Present	Present	Present
		Karlodinium australe	Present	Not present	Not present
		Pyrodinium bahamense var. compressum	Present	Present	Not present
5	Elkhorn sea moss	*Kappaphycus alvarezi*	Present	Present	Not present
6	Freshwater hydroids	*Cordylophora caspia*	Present (unconfirmed)	Present (unconfirmed)	Present (unconfirmed)
7	Hair algae	*Bryopsis pennata*	Present	Not present	Not present
8	Pacific oyster	*Crassostrea gigas*	Present	Present	Present
9	Sea anemone	*Diadumene lineata*	Present (unconfirmed)	Present (unconfirmed)	Present (unconfirmed)
10	Snowflake coral	*Carijoa rissei*	Present	Not present	Not present

Harmful Algal Bloom (HAB) Dinoflagellates

Alexandrium tamarense **(Lebour) Balech 1995**
Alexandrium minutum **Halim 1960**
Alexandrium tamiyavanichii **Balech 1994**
Pyrodinium bahamense var. compressum **(Böhm) Steidinger, Tester & F.J.R.Taylor**
Cochlodinium polykrikoides **Margalef 1961**
Gymnodinium catenatum **H.W.Graham 1943**
Karlodinium australe **Salas, Bolch & Hallegraeff 2005**

Author(s): **Assoc. Prof. Dr. Azman Abdul Rahim (UKM) & Dr. Shahriman Mohd Ghazali (UKM)**

Photo source : Azman Abdul Rahim (UKM)

Penang algae bloomed in June 2007. This photo was taken on the northeast of Pulau Jerejak, Penang.

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Dinoflagellate is a group of phytoplankton comprising unicellular algae with a distinctive morphological flagella feature. Dinoflagellates are highly survival organisms due to its asexual reproduction as well as its ability to germinate dormant cysts that could withstand extreme conditions including translocation via shipping ballast water exchange. Many species can form algal blooms across many coastal regions around the world.

Some members of dinoflagellates are toxic therefore their blooms are known as harmful algal blooms (HAB) much able to intoxicate marine animals that feed on them as well as humans via tertiary consumption. Episodes of HAB in Malaysia are a fairly regular occurrence involving the six species in the IAS list which resulted in loss of human life as well as significant loss in aquaculture revenue.

Snowflake Coral

Carijoa riisei

Author(s): Assoc. Prof. Dr. Azman Abdul Rahim (UKM) & Dr. Shahriman Mohd Ghazali (UKM)

Photo source: Mohd Fahmy Yusof (UKM)

Suspected *Carijoa riisei* detected from the waters of Kuantan, Pahang.

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The snowflake coral (*Carijoa riisei*) originated from the tropical western Atlantic ocean but has invaded tropical coral reefs all around the world via ballast water exchanges. This species is considered hardy and can survive in less than ideal waters and thrives really well in coral reef ecosystems. Its ability to rapidly reproduce and colonise marine substrates outpaces the growth and smothers slow growing hard coral species leading to lower biodiversity and productivity of coral reef habitats.

The snowflake coral has been detected at waters of Pulau Payar Marine Park in Kedah and also suspected to be present at the east coast of Pahang. Snowflake coral invasion is a major ecological concern which not only reduces coral reef asthetics but also the respective tourism industry. Action had been taken to eradicate *C. riisei* by organizing 'Snowflake Clean-up Program' involving multiple government agencies and stakeholders.

Photo source: Mohd Fahmy Yusof (UKM)

Continuous reef health monitoring have the potential to address the complex interactions between reefs and possible key threats such as the favouring algae and faster-growing invertebrates over hard corals.

THE WAY FORWARD

Conference of the Parties (COP) to the Convention on Biological Diversity (CBD) has recognised that there is an urgent need to minimise the spread and impact of **Invasive Alien Species** (**IAS**). As stated in Article 8(h) of the Convention: '*Each Contracting Party shall, as far as possible and as appropriate, prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species*'.

Malaysia became a Party to the CBD on 22 September 1994 by ratification and by doing so, this country is obligated to implement COP decisions to the best of its ability.

The Malaysian government has taken immediate action to address IAS that was reiterated under Target 9 of the Aichi Biodiversity Targets associated with the CBD's Strategic Plan for Biodiversity 2011-2020. Target 9 reads: '*By 2020, invasive alien species and pathways are identified and prioritised, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment*'.

Decision VI/23 under the CBD reaffirmed the importance of this **National Action Plan on Invasive Alien Species (NAP IAS)** as a means of developing a comprehensive approach to fulfill the obligations under Article 8(h). By using Decision VI/23 as a guideline and other countries' action plan as references, the National IAS Committee had defined the necessary goals and processes in establishing the **NAP IAS**.

NAP IAS provides a comprehensive approach to minimise the spread and impact of IAS. In order to be effective, each goal in the National Action Plan has been developed in a manner that is relevant and achievable within the target period. Some of the issues that had been overlooked before had been addressed including the update and harmonisation of the IAS's list with the input from participants representing various government agencies and research institutions during the brainstorming and preparation of the **NAP IAS**. Relevant parties will now plan their upcoming IAS management activities according to the NAP IAS 2021-2025, including enforcement, detection, prevention, monitoring, eradication, containment and effective control of any potential and established IAS in the country.

Effective development of **NAP IAS** necessitates the identification and building of cooperative programmes of work among government agencies, as well as the creation of constructive dialogue between the government and relevant stakeholders. Bringing key people to the table and facilitating discussions on IAS will raise awareness of the issue; its potential impacts to agriculture sectors affecting crop production, livestock, fisheries and ultimately human health as well as biodiversity; and the required resources and funding.

In order to prevent the introduction and be able to manage IAS efficiently, sufficient understanding of the biology and interaction between alien species with the local ecosystem is important. Currently, study related to IAS is not considered as a priority and usually not allocated with sufficient funding. Increased awareness of the challenges posed by IAS could result in far greater attention being given to the issue in policy and budget allocation. Networking among IAS experts in the country will be improved and research on IAS will be allocated with adequate funding.

The survey by FRIM in 2018 revealed that 87.6% out of 3,260 respondents interviewed have a low understanding of IAS. The survey also found that 35% of respondents have never heard of the term IAS. In order to improve public understanding of IAS: Communication, Education and Public Awareness (CEPA) action plan on biodiversity 2020-2025 has been developed to fulfill Indicator 11.1 in National Policy on Biological Diversity (NPBD): '*By 2025 public awareness on IAS will double compared to 2016*'.

Malaysia Biodiversity Information System (MyBIS)

Database of biodiversity and IAS should frequently be updated and made readily accessible to the public. Malaysia Biodiversity Information System (MyBIS) is a one-stop repository and national biodiversity database, which provides and facilitates access to information on biodiversity studies and management in Malaysia. Created in accordance with Article 18(3), it has evolved into a global network of websites with the CBD website (www.cbd.int) as its central node, and MyBIS as national nodes of the network.

Our Mission

1. To collate information related to Malaysia's biodiversity from a variety of sources.
2. To provide easy access to and make available for public circulation, provided by various stakeholders.
3. To create public awareness on biodiversity and environmental issues.
4. To provide updated statistical and analysis on biodiversity data.

The database can be accessed via www.mybis.gov.my through desktop, tablet or mobile. With these interfaces, users can easily search for information about Malaysian biodiversity.

MyBIS User Guide

1. QR CODE

By scanning MyBIS QR Code, users are enabled to find more information related to the species of interest via MyBIS website. The QR code reader apps can be downloaded from Google Play Store (for Android users) or Apple App Store (for iOS or iPhone users).

2. SPECIES SERIAL NUMBER (SSN)

Each species in MyBIS has its own unique identifying number. This species serial number enables users to search for a particular species quickly in MyBIS website without scanning the QR code.

- To search on Web:

  Go to the internet browser i.e. Google Chrome, Mozilla Firefox, Internet Explorer, etc. and insert the following URL: www.mybis.gov.my/sp/xxxxx (replace xxxxx with the SSN)

- Using Telegram apps:
  1. Open Telegram app
  2. Search contact 'mybisgovmy'
  3. Start search using SSN

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ABBREVIATIONS & ACRONYMS

AFLP	Amplified Fragment Length Polymorphisms
APEC	Asia-Pacific Economic Cooperation
APHIS	Animal and Plant Health Inspection Service
BPB	Bacterial Panicle Blight
BSE	Bovine spongiform encephalopathy
BWMC	Convention for the Control and Management of Ships' Ballast Water and Sediments
CAAM	Civil Aviation Authority of Malaysia
CABI	Centre for Agriculture and Bioscience International
CBD	Convention of Biological Diversity
CCCVd	Coconut Cadang-Cadang Viroid
CDC	Centers for Disease Control and Prevention
CEPA	Communication, Education and Public Awareness
CHM	Clearing House Mechanism
CIQ	Customs, Immigration And Quarantine
CIQS	Customs, Immigration, Quarantine and Security
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMNV	Covert mortality nodavirus
COP	Conference of the Parties
CPB	Cartagena Protocol on Biosafety
CPM	The Commission on Phytosanitary Measures
CSSV	Cocoa Swollen Shoot Virus
DID	Department of Irrigation and Drainage
DIV1	Decapod Iridescent Virus 1
DOA	Department of Agriculture
DOA Sabah	Department of Agriculture Sabah
DOA Sarawak	Department of Agriculture Sarawak
DoE	Department of Environment
DOF	Department of Fisheries
DOF Sabah	Department of Fisheries Sabah
DVS	Department of Veterinary Services
DVS Sabah	Department of Veterinary Services Sabah
DVS Sarawak	Department of Veterinary Services Sarawak
DWNP	Department of Wildlife and National Park Peninsular Malaysia
EEE	Eastern equine encephalomyelitis
ENSO	El-Nino Southern Oscillation
FAO	Food and Agriculture Organization
FDPM	Forestry Department of Peninsular Malaysia
FDS	Forest Department Sarawak
FELDA	Federal Land Development Authority
FFB	Fresh Fruit Bunches
FIC	Further Inspection Centre
FMD	Foot and Mouth Disease
FRI	Fisheries Research Institute
FRIM	Forest Research Institute Malaysia
GISD	Global Invasive Species Database
HAB	Harmful Algal Bloom
HPAI	Asian Highly Pathogenic Avian Influenza
HPM	Hepatopancreatic microsporidiosis
IAS	Invasive Alien Species
ICPM	Interim Commission on Phytosanitary Measures

ABBREVIATIONS & ACRONYMS

ICQS	Immigration, Customs, Quarantine and Security
IMO	International Maritime Organization
IMR	Institute for Medical Research
IOD	Indian Ocean Dipole
IoT	Internet of Thing
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPPC	International Plant Protection Convention
ISKNV	Infectious Spleen and Kidney Necrosis Virus
ISPM	International Standards for Phytosanitary Measures
ISSG	Invasive Species Specialist Group
IUCN	International Union for Conservation of Nature
KASA	Ministry of Environment and Water
KePKAS	Ministry of Tourism, Culture and Environment, Sabah
KeTSA	Ministry of Energy and Natural Resources
KKIA	Kota Kinabalu International Airport
KLIA	Kuala Lumpur International Airport
KLIA2	Kuala Lumpur International Airport 2
KOPEL Bhd.	Koperasi Pelancongan Mukim Batu Puteh, Kinabatangan Berhad
MAFI	Ministry of Agriculture and Food Industries
MAFI Sabah	Ministry of Agriculture and Food Industry Sabah
MANRED	Ministry of Modernisation of Agriculture, Native Land and Regional Development Sarawak
MAQIS	Malaysian Quarantine & Inspection Services
MARDEP	Marine Department
MARDI	Malaysian Agriculture Research and Development Institute
MCB	Malaysian Cocoa Board
MERS	Middle East respiratory syndrome
MERS-CoV	Middle East respiratory syndrome coronavirus
MFDA	Malaysian Fisheries Development Authority
MIMA	Maritime Institute of Malaysia
MJO	Madden Julian Oscillation
MMEA	Malaysian Maritime Enforcement Agency
MOA	Ministry of Agriculture and Agro-based Industry
MOF	Ministry of Finance
MOH	Ministry of Health
MOHA	Ministry of Home Affairs
MOHE	Ministry of Higher Education
MOSTI	Ministry of Science, Technology & Innovation
MOT	Ministry of Transport
MPIB	Malaysian Pineapple Industry Board
MPIC	Ministry of Plantation Industries and Commodities
MPOB	Malaysian Palm Oil Board
MRB	Malaysian Rubber Board
MrNV	Macrobrachium rosenbergii nodavirus
MyBIS	Malaysia Biodiversity Information System
NAP	National Action Plan
NBCT	North Butterworth Container Terminal
NPBD	National Policy on Biological Diversity
NSWMD	National Solid Waste Management Department

ABBREVIATIONS & ACRONYMS

NWG	National Working Group
OIE	World Organisation for Animal Health
POIC	Palm Oil Industrial Cluster
RMCD	Royal Malaysian Customs Department
RSIVD	Red Sea Bream Iridoviral Disease
SALB	South American Leaf Blight
SAQ	Sabah Agricultural Quarantine
SCMV	Sugarcane Mosaic Virus
SFD	Sabah Forestry Department
SFI	Sabah Forest Industries Sdn. Bhd.
SOP	Standard Operating Procedure
SWD	Sabah Wildlife Department
TSEs	Transmissible spongiform encephalopathies
UiTM	Universiti Teknologi MARA
UKM	Universiti Kebangsaan Malaysia
UM	Universiti Malaya
UMK	Universiti Malaysia Kelantan
UMS	Universiti Malaysia Sabah
UMT	Universiti Malaysia Terengganu
UNCLOS	United Nations Convention on the Law of the Sea
UNIMAS	Universiti Malaysia Sarawak
UPM	Universiti Putra Malaysia
USDA	United States Department of Agriculture
USM	Universiti Sains Malaysia
VCMD	Viral covert mortality disease
VNN	Viral nervous necrosis
WAHIS	World Animal Health Information System
WEE	Western equine encephalomyelitis
WHC	World Heritage Convention
WHO	World Health Organization
WSSV	White Spot Syndrome Virus
WTO	World Trade Organization
YHV	Yellow Head Virus
YHV1	Yellowhead virus genotype 1

GLOSSARY OF TERMS

Term	Definition
Agroecosystems	Natural ecosystems that have been modified for the production of food or fiber.
Aichi Biodiversity Targets	A set of 20 global targets under the Strategic Plan for Biodiversity 2011-2020 which are grouped under 5 strategic goals.
Algal Blooms	Rapid increase in the population of algae in an aquatic system.
Alien species	A species, subspecies or lower taxon, introduced outside its natural past or present distribution; includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce.
Allelopathy	Direct or indirect interaction, whereby allelochemicals released by one organism influence the physiological processes of other neighbouring organism.
Arboreal	Live in or around tree.
Ballast Water	Fresh or saltwater held in the ballast tanks and cargo holds of ships. It is used to provide stability and manoeuvrability during a voyage when ships are not carrying cargo, not carrying heavy enough cargo, or when more stability is required due to rough seas.
Bilateral Agreements	Agreement between two countries in which each side agrees to fulfil their commitment which can range from legal obligations to non-binding agreements of principle.
Multilateral Agreements	Agreement between three or more countries in which each side agrees to fulfil their commitment which can range from legal obligations to non-binding agreements of principle.
Biocontrol	Pest control strategy making use of living natural enemies, antagonists or competitors and other self-replicating biotic entities.
Biological control	Refer 'Biocontrol'.
Clearing House Mechanism	Information exchange platform of the Convention on Biological Diversity.
Conference of the Parties	Governing body of the Convention on Biological Diversity (CBD), and advances implementation of the Convention through the decisions it takes at its periodic meetings.
Containment	Application of phytosanitary measures in and around an infested area to prevent spread of a pest.
Convention on Biological Diversity	Signed by 150 government leaders at the Rio Earth Summit, this convention is dedicated to promoting sustainable development through 3 main objectives, i- The conservation of biological diversity; ii- The sustainable use of the components of biological diversity; and, iii- The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.
Ecological Plasticity	The ability of an organism to change in response to stimuli or inputs from the environment. The response may involve a change in morphology, physiological state, or behaviour, or some combination of these.
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.
El-Nino Southern Oscillation	Recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean.
Endemic	Disease that occurs in a certain place or group of people.
Entry Points	A passage for international entry or exit of travellers, baggage, cargo, containers, conveyances, goods and postal parcels.
Eradication	Application of phytosanitary measures to eliminate a pest from an area.
Establishment	The process of an alien species in a new habitat successfully producing viable offspring with the likelihood of continued survival.
Exotic Species	An organism that exists in the free state in an area but is not native to that area. Also refers to animals from outside the country in which they are held in captive or free-ranging populations.

GLOSSARY OF TERMS

Term	Definition
Feral	Exotic animals which have established themselves in the wild.
Food Security	All people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life.
Gross Domestic Product	The total value of goods produced and services provided in a country during one year.
Hard Coral Species	Species of coral which create skeletons out of calcium carbonate (also known as limestone), a hard substance that eventually becomes rock.
High Risk Countries	Countries in African continent which are endemic to Bud Rot Disease of Oil Palm.
Host Specific	Capable of living solely on or in one species of host.
Indian Ocean Dipole	Sustained changes in the difference between sea surface temperatures of the tropical western and eastern Indian Ocean.
Internet of Thing	Network of physical objects -"things"- that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet.
Introduction	The movement by human agency, indirect or direct, of an alien species outside of its natural range (past and present). This movement can be either within a country or between countries or areas beyond national jurisdiction.
Invasive Alien Species	An alien species whose introduction and/or spread threaten biological diversity.
Madden Julian Oscillation	Eastward moving disturbance of clouds, rainfall, winds, and pressure that traverses the planet in the tropics and returns to its initial starting point in 30 to 60 days, on average.
Marine Substrates	Earthy material that exists in the bottom of a marine habitat, like dirt, rocks, sand, or gravel.
Native Species	Plants, animals, fungi, and microorganisms that occur naturally in a given area or region.
Non-Native Species	A species, subspecies or lower taxon, introduced outside its natural past or present distribution.
Noxious Plants	Any plant designated by government as injurious to public health, agriculture, recreation, wildlife or property.
Pathogenic	Capable of causing disease.
Pathogens	Organism that causes disease.
Pathways	Any means that allows the entry or spread of a pest.
Propagules	A vegetative structure that can become detached from a plant and give rise to a new plant.
Quarantine	Official confinement of regulated articles for observation and research or for further inspection, testing or treatment.
Quarantine Pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled.
Risk	The likelihood and magnitude of an event.
Risk Assessment	The assessment of the consequences of the introduction and of the likelihood of establishment of an alien species using science-based information.
SALB Countries	Countries endemic to South American Leaf Blight disease (SALB) caused by *Pseudocercospora ulei* fungus on hevea.
Stakeholders	Individual, group, or party that has an interest in an organization and the outcomes of its actions.
Subject Matter Expert	Professionals who have specialized knowledge in a pertinent field that to the extent it makes them uniquely qualified to provide guidance and strategy regarding the specialization.

GLOSSARY OF TERMS

Term	Definition
Turbidity	Optical characteristic of water and is a measurement of the amount of light that is scattered by material in the water when a light is shined through the water sample. The higher the intensity of scattered light, the higher the turbidity.
Vector	Any living or non-living carrier that transports living organisms intentionally or unintentionally.
Webinar	An event held virtually which is attended exclusively by an online audience.
Zoonosis	Infectious disease that is transmitted between species from animals to humans (or from humans to animals).

IMPACT SCORING	0 (none/negligible)	1 (low)	2 (moderate)	3 (high)
Environment				
Economy				
Human Health				

APPENDIX I :
RELEVANT LAWS, AGREEMENTS AND INTERNATIONAL ORGANISATIONS

LAWS

Acts:

i. Access to Biological Resources and Benefit Sharing Act 2017
ii. Animal Act 1953 (Revised 2006)
iii. Animal Feed Act 2009
iv. Biosafety Act 2007
v. Custom Act 1967
vi. Destruction of Disease-bearing Insects Acts 1975 (Amendment 2002)
vii. Environmental Quality Act 1974
viii. Fisheries Act 1985
ix. Food Act 1983
x. Hydrogen Cyanide (Fumigation) Act 1953
xi. International Trade in Endangered Species Act 2008
xii. Irrigation Areas Act 1953 (Revised 1989)
xiii. Malaysia Quarantine And Inspection Services Act 2011
xiv. Malaysian Maritime Enforcement Agency Act 2004
xv. National Parks Act 1980
xvi. National Forestry Act 1984
xvii. Pesticides Act 1974
xviii. Plant Quarantine Act 1976
xix. Prevention and Control of Infectious Diseases Act 1988
xx. Wildlife Conservation Act 2010

Ordinances:

i. Animal Ordinance 1953
ii. Merchant Shipping Ordinance 1952 (Amendment 2007)
iii. Wild Life Protection Ordinance 1998

Subsidiary Laws:

i. Animal Importation Order 1962
ii. Animal Rules 1962
iii. Federal Animal Quarantine Station (Management and Maintenance) by-laws 1984
iv. Fisheries (Fish Disease Control Compliance for Exports and Import) Regulations 2012
v. Fisheries (Maritime) Regulations 1967
vi. Fisheries (Prohibition of Import, etc., of Fish) Regulation 1990 (Amendment 2011)
vii. Plant Quarantine Regulations 1981
viii. Regulation of Quarantine and Inspection Services Malaysia (Fees and Charges) 2013
ix. Regulation of Quarantine and Inspection Services Malaysia (Issuance of Permit, License and Certification) 2013
x. Regulation of Quarantine and Inspection Services Malaysia (Quarantine and Inspection) 2013
xi. Regulation of Quarantine and Inspection Services Malaysia (Quarantine Procedures) 2013
xii. Regulation of Quarantine and Inspection Services Malaysia (Registration of Importer, Exporter and Agent) 2013
xiii. Regulations Fisheries (Marine Culture System) 1990
xiv. The Fisheries Regulations (Control Of The Endangered Fish Species) 1999 (Amendment 2008, Amendment 2019)

INTERNATIONAL AGREEMENTS AND ORGANISATIONS

i. Cartagena Protocol on Biosafety (CPB)
ii. Convention on Biological Diversity (CBD)
iii. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
iv. Convention on Wetlands of International Importance (Ramsar Convention)
v. International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention)
vi. International Plant Protection Convention (IPPC)
vii. Kyoto Protocol
viii. United Nations Convention on the Law of the Sea (UNCLOS)
ix. World Heritage Convention (WHC)
x. Food and Agriculture Organization (FAO)
xi. International Marine Organization (IMO)
xii. International Union for Convention of Nature (IUCN)
xiii. World Organization for Animal Health (OIE)
xiv. World Trade Organization (WTO)

APPENDIX II :
ORGANISATIONS INVOLVED IN IMPLEMENTION OF NAP IAS

Ministry of Agriculture and Food Industries (MAFI)*

- Policy and Strategic Planning Division
- Legal Division

  Crop, Livestock & Fishery Industries Division

  Agricultural Skills Training Division (BLKP)
- Department of Agriculture (DOA)
- Department of Fisheries (DOF)
- Department of Veterinary Services (DVS)
- Malaysian Agriculture Research and Development Institute (MARDI)
- Malaysian Quarantine & Inspection Services (MAQIS)
- Malaysian Pineapple Industry Board (MPIB)

Ministry of Energy and Natural Resources (KeTSA)

- Biodiversity Management Division

  Forestry Management Division
- Department of Wildlife and National Park Peninsular Malaysia (DWNP)
- Forestry Department of Peninsular Malaysia (FDPM)
- Forest Research Institute Malaysia (FRIM)

Ministry of Health (MOH)

- Disease Control Division

  State Health Departments
- Institute for Medical Research (IMR)

Ministry of Home Affairs (MOHA)

Malaysian Maritime Enforcement Agency (MMEA)

Ministry of Environment and Water (KASA)

- Department of Environment (DOE)

  Department of Irrigation and Drainage (DID)

  Department of Biosafety

Ministry of Finance (MOF)

- Royal Malaysian Customs Department (RMCD)

Ministry of Transport (MOT)

- Marine Department Malaysia (MARDEP)
- Maritime Institute of Malaysia (MIMA)

Ministry of Higher Education (MOHE)

- Universiti Malaya (UM)
- Universiti Sains Malaysia (USM)
- Universiti Teknologi MARA (UiTM)
- Universiti Putra Malaysia (UPM)
- Universiti Kebangsaan Malaysia (UKM)

  Universiti Malaysia Sarawak (UNIMAS)

  Universiti Malaysia Sabah (UMS)
- Universiti Malaysia Terengganu (UMT)
- Universiti Malaysia Kelantan (UMK)

Ministry of Plantation Industries and Commodities (MPIC)

- Malaysian Palm Oil Board (MPOB)
- Malaysian Rubber Board (MRB)
- Malaysian Cocoa Board (MCB)

Ministry of Agriculture and Food Industry (MAFI Sabah)

Department of Veterinary Services (DVS Sabah)

Department of Fisheries Sabah (DOF Sabah)

- Department of Agriculture Sabah (DOA Sabah)

Chief Minister's Department of Sabah

Sabah Forestry Department (SFD)

Ministry of Tourism, Culture and Environment, Sabah (KePKAS)

Sabah Wildlife Department (SWD)

Ministry of Modernisation Of Agriculture, Native Land And Regional Development Sarawak (MANRED)

- Department of Agriculture Sarawak (DOA Sarawak)

  Department of Veterinary Services Sarawak (DVS Sarawak)

Ministry of Urban Development & Natural Resources

Forest Department Sarawak (FDS)

Natural Resources and Environment Board Sarawak

Sarawak Forestry Corporation

Note:

- **Members of the National Committee on IAS**
- *** Formerly known as Ministry of Agriculture and Agro-based Industry (MOA)**

APPENDIX III :
LIST OF WORKSHOPS PARTICIPANTS

Four workshops were held between 2017 and 2020 in order to develop the list of IAS of concern and prepare the five years plan (2021-2025) for IAS management in Malaysia. These series of workshops were attended by experts from various government agencies and research institutions involved in management and research of IAS. The National Committee on IAS would like to thank all of them for their efforts and contributions in preparing this document. List of the workshops and its participants are as follows;

1. WORKSHOP ON ESTABLISHMENT OF 'TOP IAS IN MALAYSIA' 2017 - 2018, 8th – 11th OCTOBER 2017, NEGERI SEMBILAN.

No.	Name	Agency
1.	Dr. Vickneshwaran Muthu	MOH
2.	Datin Jatil Aliah Timin	DOA
3.	Ms. Lailatul Jumaiyah Saleh Huddin	DOA
4.	Mr. Ikhwan Harris Ramli	DOA
5.	Mr. Mohd Sanusi Mohd Kassim	DOA
6.	Mrs. Shuerni Mohd Razi	DOA
7.	Ms. Norhayati Madiha	DOA
8.	Mrs. Faridah Md Nor	DOA
9.	Mr. Misman Marisino	DOA
10.	Mr. Mohd Ghazali A. Manap	DOF
11.	Mr. Mohd Mukriz Mohd Kasim	DOF
12.	Mr. Muhamad Sufiyan Salmi	DOF
13.	Mr. Ramley Abu Bakar	DOF
14.	Dr. Sabariah Ismail	DVS
15.	Dr. Mariani Hashim	DVS
16.	Dr. Rozanah Asmah Abdul Samad	DVS
17.	Mrs. Asmah Salowi	DOA SARAWAK
18.	Mr. Yazid Bostamam	DOA SARAWAK
19.	Mr. Teo Su Sin	DOA SABAH
20.	Mr. Helmy Tariq Othman	FDPM

No.	Name	Agency
21.	Mr. Muhamad Bokhari Fadzin	DWNP
22.	Mrs. Rahmah Ilias	DWNP
23.	Dr. Yasmin Mohd Hasni	MARDEP
24.	Dr. Rosliza Jajuli	MARDI
25.	Dr. Razean Haireen Mohd Razali	MARDI
26.	Dr. Mohd Farid Ahmad	FRIM
27.	Mrs. Patahayah Mansor	FRIM
28.	Ms. Ong Su Ping	FRIM
29.	Prof. Dr. Abol Munafi Ambok Bolong	UMT
30.	Assoc. Prof. Dr. Nadirah Musa	UMT
31.	Dr. Lokman Nor Hakim Norazmi	UMT
32.	Dr. Mohd Zafri Hassan	UPM
33.	Mr. Mohd Mahmud @ Mansor	UMK
34.	Assoc. Prof. Dr. Azman Abd Rahim	UKM
35.	Dr. Shahriman Mohd Ghazali	UKM
36.	Dr. Mariana Hj. Ahmad	IMR
37.	Mr. Navies Maisin	LKM
38.	Dr. Maizatul Suriza Mohamed	MPOB
39.	Dr. Adam Malik Ahmad Zambri	MRB
40.	Mr. Mohd Khairol Izam Azman	MPIB

2. WORKSHOP ON FINALIZING MALAYSIA INVASIVE ALIEN SPECIES LIST, 1st - 4th JULY 2019, PENANG.

No.	Name	Agency
1.	Dr. Vickneshwaran Muthu	MOH
2.	Datin Jatil Aliah Timin	DOA
3.	Mrs. Sabariah Kamis	DOA
4.	Mr. Chong Seng Kiet	DOA
5.	Mrs. Juliana Megat	DOA
6.	Ms. Lailatul Jumaiyah Saleh Huddin	DOA
7.	Mr. Ikhwan Harris Ramli	DOA
8.	Mr. Mohd Sanusi Mohd Kassim	DOA
9.	Ms. Maliza Hazin @ Ab. Rahman	DOA
10.	Mrs. 'Izzah Syazana Za'bi	DOA
11.	Mrs. Shuerni Mohd Razi	DOA
12.	Ms. Norhayati Madiha	DOA
13.	Ms. Farah Nadiah Nor Hassan	DOA
14.	Mr. Muhammad Nur Hakiki Miskam	DOA
15.	Mr. Misman Marisino	DOA
16.	Mr. Mohd Ghazali A. Manap	DOF
17.	Mr. Azaharie Anuar	DOF
18.	Mr. Kamarul Anwar Mohamed Zabri	DOF
19.	Dr. Kua Beng Chu	DOF
20.	Mr. Muhamad Sufiyan Salmi	DOF
21.	Ms. Masazurah A. Rahim	DOF
22.	Dr. Rohaiza Yahaya	DVS
23.	Mrs. Roseliza Roslee	DVS
24.	Mr. Yazid Bostamam	DOA SARAWAK
25.	Mr. Teo Su Sin	DOA SABAH
26.	Mr. Helmy Tariq Othman	FDPM
27.	Mr. Muhamad Bokhari Fadzin	DWNP
28.	Ms. Tan Poai Ean	DWNP
29.	Dr. Rozeita Laboh	MARDI
30.	Mrs. Siti Noor Aishikin Abdul Hamid	MARDI
31.	Dr. Mohd Farid Ahmad	FRIM
32.	Mrs. Patahayah Mansor	FRIM
33.	Prof. Dr. Abol Munafi Ambok Bolong	UMT
34.	Assoc. Prof. Dr. Nadirah Musa	UMT
35.	Dr. Mohd Zafri Hassan	UPM
36.	Mr. Mohd Mahmud @ Mansor	UMK
37.	Assoc. Prof. Dr. Azman Abd Rahim	UKM
38.	Dr. Shahriman Mohd Gazali	UKM
39.	Dr. Mariana Hj Ahamad	IMR
40.	Ms. Saripah Bakar	LKM
41.	Mrs. Maizatul Suriza Mohamed	MPOB
42.	Dr. Adam Malik Ahmad Zambri	MRB
43.	Dr. Murnita Mohmad Mahyudin	MRB
44.	Mr. Mohd Ikram A. Hamid	MPIB
45.	Mr. Abdul Razak Muhiddin	MPIB

3. WORKSHOP ON REASSESSMENT OF NAP ON IAS, 23th – 26th SEPTEMBER 2019, NEGERI SEMBILAN.

No.	Name	Agency
1.	Mr. Nor Azmi Ahmad	KeTSA
2.	Dr. Vickneshwaran Muthu	MOH
3.	Datin Jatil Aliah Timin	DOA
4.	Mr. Azizi Hashim	DOA
5.	Mrs. Sabariah Kamis	DOA
6.	Mr. Mohd Irwan Zahrul Mohd Yusoff	DOA
7.	Mrs. Azian Harun	DOA
8.	Ms. Lailatul Jumaiyah Saleh Huddin	DOA
9.	Mrs. Mona Lizah Dolah	DOA
10.	Mr. Ikhwan Harris Ramli	DOA
11.	Mr. Mohd Sanusi Mohd Kassim	DOA
12.	Ms. Maliza Hazin @ Ab. Rahman	DOA
13.	Mrs. Shuerni Mohd Razi	DOA
14.	Ms. Norhayati Madiha	DOA
15.	Mrs. Siti Nurkhairun Nisa Yusman	DOA
16.	Mrs. Faridah Md Nor	DOA
17.	Ms. Farah Nadiah Nor Hassan	DOA
18.	Mr. Misman Marisino	DOA
19.	Mr. Mohd Ghazali A. Manap	DOF
20.	Mr. Albert Apollo Chan	DOF
21.	Dr. Haslawati Baharuddin	DOF
22.	Dr. Maria Jamli	DVS
23.	Mr. Wee Poh Leong	DOA SARAWAK
24.	Mr. Salahaudin Maili Mohd Rasli	DOA SABAH

No.	Name	Agency
25.	Mr. Abdul Muhyi Mohamad Hatta	MAQIS
26.	Mr. Suresh Sundramurthy	DOE
27.	Mr. Faizal I'zham Pikri	DWNP
28.	Ms. Tan Poai Ean	DWNP
29.	Dr. Julyus Melvin Mobilik	MARDEP
30.	Dr. Rozeita Laboh	MARDI
31.	Mrs. Siti Noor Aishikin Abdul Hamid	MARDI
32.	Dr. Mohd Farid Ahmad	FRIM
33.	Ms. Ong Su Ping	FRIM
34.	Prof. Dr. Abol Munafi Ambok Bolong	UMT
35.	Assoc. Prof. Dr. Khairulmazmi Ahmad	UPM
36.	Dr. Mohd Zafri Hassan	UPM
37.	Dr. Norhafizah Md Zain	UMK
38.	Mr. Helmy Tariq Othman	FDPM
39.	Assoc. Prof. Dr. Salmah Yaakop	UKM
40.	Dr. Noraziyah Abd Aziz Shamsuddin	UKM
41.	Dr. Shamsiah Abdullah	UiTM
42.	Dr. Farah Alia Nordin	USM
43.	Dr. Florence Lee Chi Hiong	IMR
44.	Dr. Maizatul Suriza Mohamed	MPOB
45.	Dr. Adam Malik Ahmad Zambri	MRB
46.	Dr. Murnita Mohmad Mahyudin	MRB
47.	Ms. Nurul Asyikin Zakaria	MIMA

4. WORKSHOP ON FINAL DRAFT REVIEW OF NAP IAS 2021-2025, 21st – 24th SEPTEMBER 2020, SELANGOR.

No.	Name	Agency
1.	Mrs. Yusliza Jamalut	MAFI
2.	Dr. Khairul Naim Adham	KeTSA
3.	Mr. Quek Yew Aun	KeTSA
4.	Dr. Vickneshwaran Muthu	MOH
5.	Mr. Arizal Arshad	DOA
6.	Mrs. Sabariah Kamis	DOA
7.	Ms. Lailatul Jumaiyah Saleh Huddin	DOA
8.	Mr. Christopher John Biai	DOA
9.	Mrs. Azean Ahmad	DOA
10.	Mrs. Nur Azarina Abu Bakar	DOA
11.	Ms. Wan Nur Aimi Shabuddin	DOA
12.	Mrs. Azian Harun	DOA
13.	Mrs. Lucyana Anak Dominic Ritay	DOA
14.	Mr. Ikhwan Harris Ramli	DOA
15.	Mr. Mohd Sanusi Mohd Kassim	DOA
16.	Ms. Maliza Hazin @ Ab. Rahman	DOA
17.	Mrs. 'Izzah Syazana Za'bi	DOA
18.	Mrs. Shuerni Mohd Razi	DOA
19.	Ms. Norhayati Madiha	DOA
20.	Mrs. Faridah Md Nor	DOA
21.	Mr. Muhammad Nur Hakiki Miskam	DOA
22.	Mr. Misman Marisino	DOA
23.	Mrs. Khazlita Adzim Abdol Aziz	DOF
24.	Mrs. Azizul Fariha Ghazali	DOF
25.	Mr. Albert Apollo Chan	DOF
26.	YM Raja Yana Meleessa Raja Haroon Arashid	DOF
27.	Dr. Haslawati Baharuddin	DOF
28.	Dr. Mariani Hashim	DVS
29.	Dr. Asrol Sany Arshad	DVS
30.	Dr. Roseliza Roslee	DVS
31.	Mr. Salahaudin Maili Mohd Rasli	DOA SABAH
32.	Mr. Mohd Reydzuan Yong	FDPM
33.	Mr. Abdul Muhyi Mohamad Hatta	MAQIS
34.	Mr. Mohd Noor Hashim	MAQIS
35.	Mr. Syed Fuad Syed Putra	MAQIS
36.	Mr. Mohd Suhaimi Sulaiman	DWNP
37.	Mr. Mohamad Amir Fikri Yahya	MARDEP
38.	Dr. Rozeita Laboh	MARDI
39.	Dr. Mohd Farid Ahmad	FRIM
40.	Mrs. Patahayah Mansor	FRIM
41.	Ms. Ong Su Ping	FRIM
42.	Prof. Dr. Abol Munafi Ambok Bolong	UMT
43.	Assoc. Prof. Dr. Khairulmazmi Ahmad	UPM
44.	Dr. Mohd Zafri Hassan	UPM
45.	Mr. Mohd Mahmud @ Mansor	UMK
46.	Assoc. Prof. Dr. Azman Abdul Rahim	UKM
47.	Assoc. Prof. Dr. Salmah Yaakop	UKM
48.	Dr. Noraziyah Abd Aziz Shamsudin	UKM
49.	Dr. Shahriman Mohd Ghazali	UKM
50.	Assoc. Prof. Dr. Noor Hana Hussain	UiTM
51.	Dr. Noor Khalidah Abdul Hamid	USM
52.	Dr. Florence Lee Chi Hiong	IMR
53.	Dr. Mohd Hefni Rusli	MPOB
54.	Dr. Adam Malik Ahmad Zambri	MRB
55.	Ms. Nurul Ashikin Zakaria	MIMA

APPENDIX IV :
RECOMMENDED READINGS

1. Decision Adopted By The Conference Of The Parties To The Convention On Biological Diversity At Its Eighth Meeting VIII/27 *Alien Species That Threaten Ecosystems, Habitats Or Species (Article 8 (H)): Further Consideration Of Gaps And Inconsistencies In The International Regulatory Framework.* Retrieved from https://www.cbd.int/decision/cop/?id=11041

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