Ecosystem-Based Fisheries Management (EBFM) Risk Assessment

of the

Marine Aquarium Fish Managed Fishery 2014

Department of Primary Industries and Regional Development
140 William Street
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SECTION 1 INTRODUCTION

The Department of Primary Industries and Regional Development Fisheries Division (Fisheries) utilises an Ecosystem-Based Fisheries Management (EBFM) approach which considers all relevant ecological, social, economic and governance issues to deliver community outcomes. In order to assess the level of fisheries' impacts and prioritise management activities across these four areas, periodic Ecological Risk Assessments (ERA) are undertaken for fisheries resources in Western Australia (WA).

This document provides a comprehensive overview of the WA Marine Aquarium Fish Managed Fishery (MAF) and identifies some of the potential risks associated with this fishery from an ecological context only. It is anticipated that the other key elements of the EBMF approach being; social, economic and governance issues will be formally considered as part of the next periodic ERA of the MAF.

The MAF is a state-wide hand collection fishery that operates in waters to approximately 30 m in depth. The fishery targets finfish and invertebrate species as well as 'live rock', algae and seagrasses for marine aquarium ornamental display purposes.

Initial scoping work to identify potential issues and risks in accordance with EBFM principles was undertaken by the Department of Fisheries research and management staff. While all target species reviewed by the Department of Fisheries' internal working group were considered to be at 'low risk', it was agreed that a number of species should be subject to more detailed assessment within an external risk assessment workshop, and if necessary expanded or refined, prior to undertaking the risk scoring process. Stakeholders invited to attend the workshop included: commercial fishermen, researchers and managers from the Department of Fisheries and representatives from other State and Commonwealth Government Departments and non-government organisations.

Potential issues were scored using the risk analysis methodology based on the global standard for risk assessment and risk management (AS/NZS ISO 31000). This methodology utilised a consequence-likelihood analysis, which involved the examination of the magnitude of potential consequences from fishing activities and the likelihood that those consequences will occur given current management controls.

The stock status for all retained species in the MAF was assessed using a risk-based approach and the annual catch is managed to a level which results in an acceptable risk to sustainability. The outcomes this ERA will be used to inform a formal Harvest Strategy for the MAF over the period 2016-2021.

SECTION 2 DESCRIPTION OF THE MAF

The MAF is a low volume, high value fishery with effort distributed across the state. Fishing activity is currently focused around the south west Capes region, Perth, Geraldton, Exmouth and Dampier with the greatest concentration in the Pilbara region (Figure 1).

The fishery has the capacity to target more than 1,500 marine aquarium species under the *Marine Aquarium Fish Managed Fishery Management Plan 1995* and other subsidiary legislation under the *Fish Resources Management Act 1994* (FRMA). Targeted species include finfish (including sharks and rays), hard and soft corals, and a range of other invertebrate and plant species.

The MAF is primarily a dive based fishery with capture by hand or with the use of barrier and hand held nets for mobile species such as finfish. More sedentary species such as corals, clams, syngnathiformes, and aquatic plants are generally collected by hand.

Management is primarily achieved through input controls in the form of limited entry to the fishery and through a range of permanent spatial closures as well as through output controls in the form of statutory catch limits for key species or species groups (Fletcher and Santoro, 2013). The estimated value of the MAF is in excess of $2 million per annum with the majority of the product being exported.

The fishery dates back to the early 1960's when operators fished under permits or conditions on Professional Fishing Licences. In 1986, the number of commercial licences endorsed to operate in the fishery was limited to 20; however, this number was increased to 25 following a review of the fishery in 1991. In 1995, the marine finfish component of the fishery was raised to 'managed fishery' status. The MAF was formally established with the introduction of the *Marine Aquarium Fish Management Plan 1995* and thirteen Managed Fishery Licences (MFLs) were granted in accordance with access criteria outlined in Fisheries Management Paper 63 'Management of the Marine Aquarium Fishery' (Department of Fisheries, 1995).

The take of invertebrate species was managed through endorsements on Commercial Fishing Licences (CFLs) until 2005 when a Ministerial Exemption was granted under section 7 of the *FRMA* to enable all MFL holders in the MAF to take invertebrates, seagrasses and algae within prescribed limits. Two years later the *Prohibition on Fishing (Coral, 'Live Rock' and Algae) Order 2007* came into effect under section 43 of the FRMA, which effectively ensured that only MFL holders are able to collect coral and live rock for the aquarium trade.

There are currently 12 MFL holders in the MAF, with most having participated in the ERA process. Fisheries is reviewing the existing management arrangements in consultation with licence holders with a view to consolidating the existing legislative instruments into one new management framework in 2016 (Fletcher and Santoro, 2013).

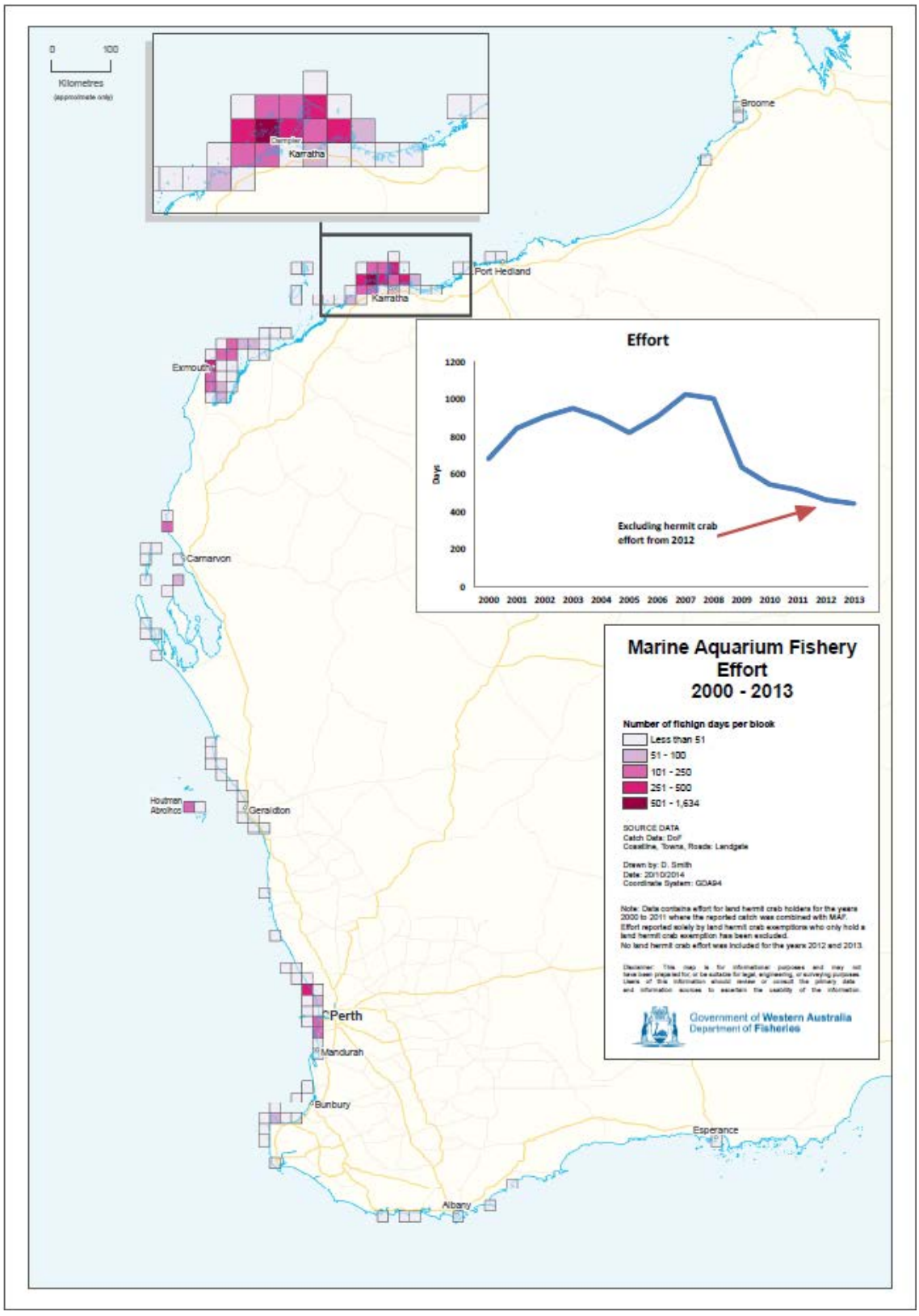

Figure 1 – Areas of fishing effort in the Marine Aquarium Fish Managed Fishery.

2.1 Retained species

The number of marine aquarium fish species targeted and/or landed by the MAF varies from year to year (e.g. in the period from 2005 to 2014 the number of marine aquarium fish species landed ranged from 183 to 288; 170 marine aquarium fish species were recorded in 2014). Operators in the MAF are also permitted to take coral, live rock, algae, seagrass and invertebrates and in 2014, the fishery reported a total of over 321 species or species groups in the landed catch.

For the purposes of this assessment, the range of species targeted by the MAF is divided into the following categories:

1. Finfish (other than syngnathids)
2. Syngnathiformes (*Hippocampus* and pipefish species etc.)
3. Hard and Soft Coral
5. Giant clams
6. Live rock (as defined in the *Fish Resources Management Regulations 1995*)
7. All other invertebrate and aquatic plant (algae and seagrasses) species.

2.1.1 *Finfish*

The MAF targets tropical finfish species in areas such as Exmouth and the Dampier Archipelago, the majority of which are widely distributed across the indo-west pacific region (Figure 2). Dominant species groups include chromis (*Chromis spp.*), blennies (Family Blenniidae), anglefish (Families Chaetodontidae and Pomacanthidae), gobies (Family Gobiidae), wrasse (Family Labridae), damselfish (Family Pomacentridae) and butterflyfish (Family Chaetodontidae)(Table 1).

Table 1 - Summary of the reported catch (number of individuals) of the main fish (excluding Syngnathids) species landed from the MAF.

Species	Common Name	Year					
		2009	2010	2011	2012	2013	2014
Chromis atripectoralis	Black-axil Chromis	50	1,350	1,550	1,010	1,200	2,778
Neopomacentrus cyanomos	Regal Demoiselle	0	0	0	0	0	2,365
Istiblennius meleagris	Spotted Blenny	2,846	1,040	2,081	1,468	1,075	1,669
Chaetodontoplus duboulayi	Scribbled Angelfish	492	1,333	2,275	2,527	1,938	1,333
Chromis	Chromis	2,849	2,650	2,320	400	2,039	1,213
Chelmon marginalis	Margined Coralfish	682	1,266	1,506	1,048	1,429	1,082
Apogonidae/Dinolestidae Undifferentiated	Cardinalfishes	1,766	94	54	0	500	950
Chromis cinerascens	Green Chromis	790	2,998	1,941	2,203	1,052	760

Centropyge joculator	Yellowhead Angelfish	633	554	584	594	494	657
Valenciennea puellaris	Orange-dashed Goby	26	440	1,559	1,250	562	513
Heterodontus portusjacksoni	Shark, Port Jackson	389	197	664	489	270	487
Chaetodontidae/Pomacanthidae	Angelfishes	14	18	28	0	2	440
Trachinops noarlungae	Yellow-headed Hulafish	420	670	1,525	580	230	380
Istiblennius edentulus	Rippled Blenny	0	0	0	0	0	350
Chromis klunzingeri	Black-headed Puller	220	480	575	421	150	310

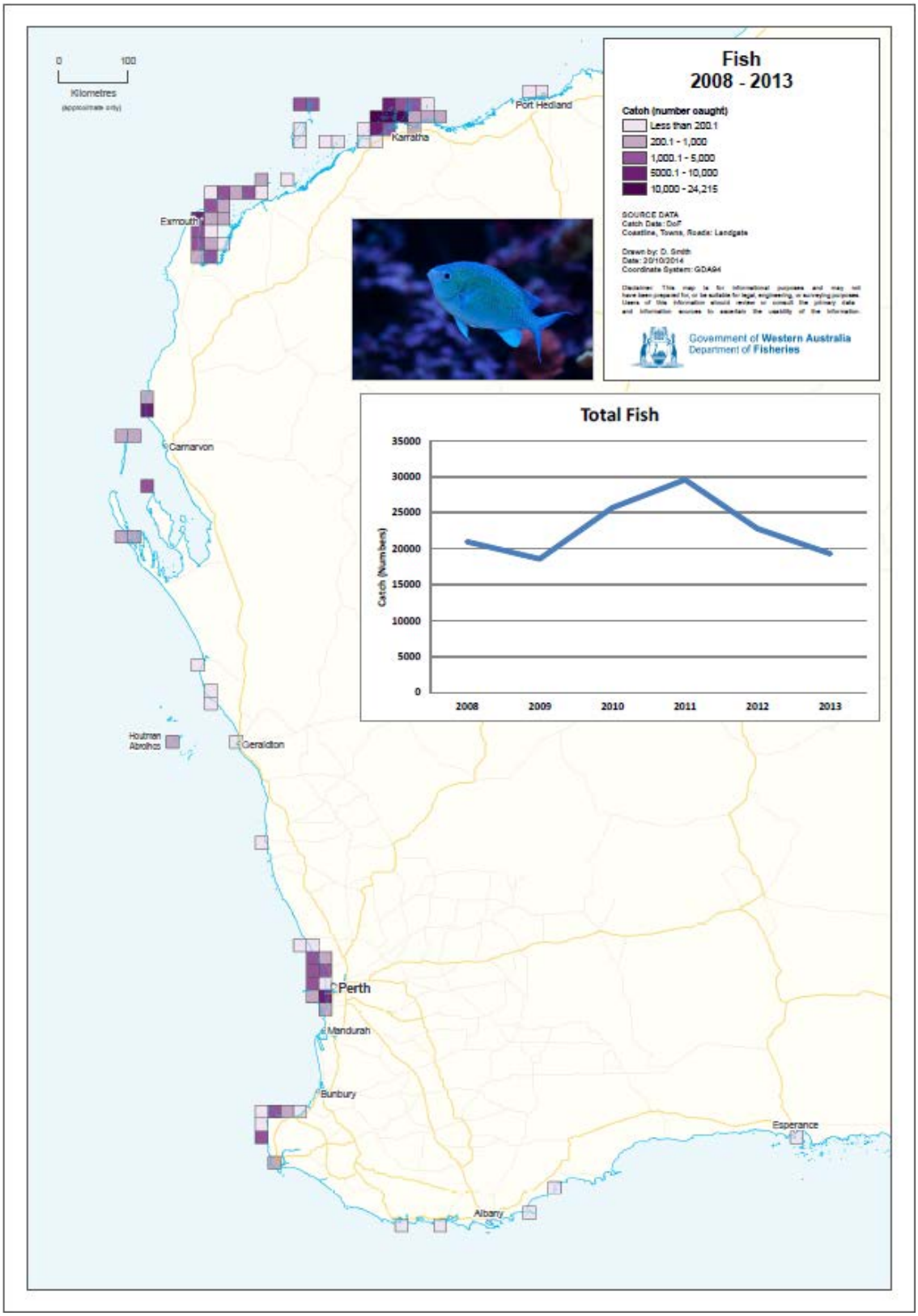

Figure 2 – Catch and distribution of finfish taken by the MAF.

2.1.2 *Syngnathiformes*

The MAF is permitted to take species from the Order Syngnathiformes (i.e. seahorses and pipefish etc.) which are listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), from state waters only (with 3nm). All *Hippocampus* species are listed under Appendix II of the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES), indicating that they are not necessarily threatened with extinction but may become so unless trade is closely controlled. Syngnathids are primarily targeted off Karratha, Exmouth and the Perth coastlines (Figure 3). A summary of the reported catch of Syngnathiformes between 2008 and 2013 is contained at Table 2.

The WA seahorse (*H. subelongatus/elongates)* is restricted to the west coast of Australia. It ranges from Cape Leeuwin north to the Houtman Abrolhos Islands. It is most abundant in muddy habitats and typically estuarine conditions often found on manmade structures such as jetty piles or moorings, in depths between 1 – 25 m. Age at sexual reproduction is between 9 and 12 months with breeding occurring during the warmer months (October to March).

Males possess an abdominal pouch in which embryos develop. Mating is preceded with an elaborate courtship ritual. Females deposit eggs into the pouch, which are then fertilised. Young seahorses develop within the pouch and gestation is around three weeks. For *H. subelongatus* an average of around 360 young are born at around 12 mm in length.

Table 2 - Summary of the reported catch (number of individuals) of Syngnathiformes landed from the MAF.

Species	Common Name	Year					
		2008	2009	2010	2011	2012	2013
Corythoichthys intestinalis	Common Seadragon	0	0	0	0	0	1
Filicampus tigris	Knobby Seahorse	10	0	0	0	0	0
Halicampus brocki	Messmate Pipefish	1	0	0	0	0	0
Haliichthys taeniophorus	Monte Bello Seahorse	1	0	0	11	2	23
Hippocampus angustus	Pipefish Undifferentiated	52	83	59	164	31	68
Hippocampus elongatus	Ribboned Pipefish	1089	165	196	912	1155	1463
Hippocampus montebelloensis	Seadragons/Seahorses-Undifferentiated	1	0	0	0	0	0
Hippocampus spp	Seahorse	17	46	37	6	0	5
Hippocampus tuberculatus	Short-tailed Pipefish	30	23	8	0	0	2
Phyllopteryx taeniolatus	Spotted Pipefish	8	22	13	40	6	2
Pipefish Undifferentiated	Tassled Pipefish	9	1	12	2	0	1

Stigmatopora argus	Tiger Pipefish	0	0	0	0	0	49
Syngnathidae	Western Australian Seahorse	0	0	13	0	0	0
Trachyrhamphus bicoarctata	Western Spiny Seahorse	0	0	0	8	38	21

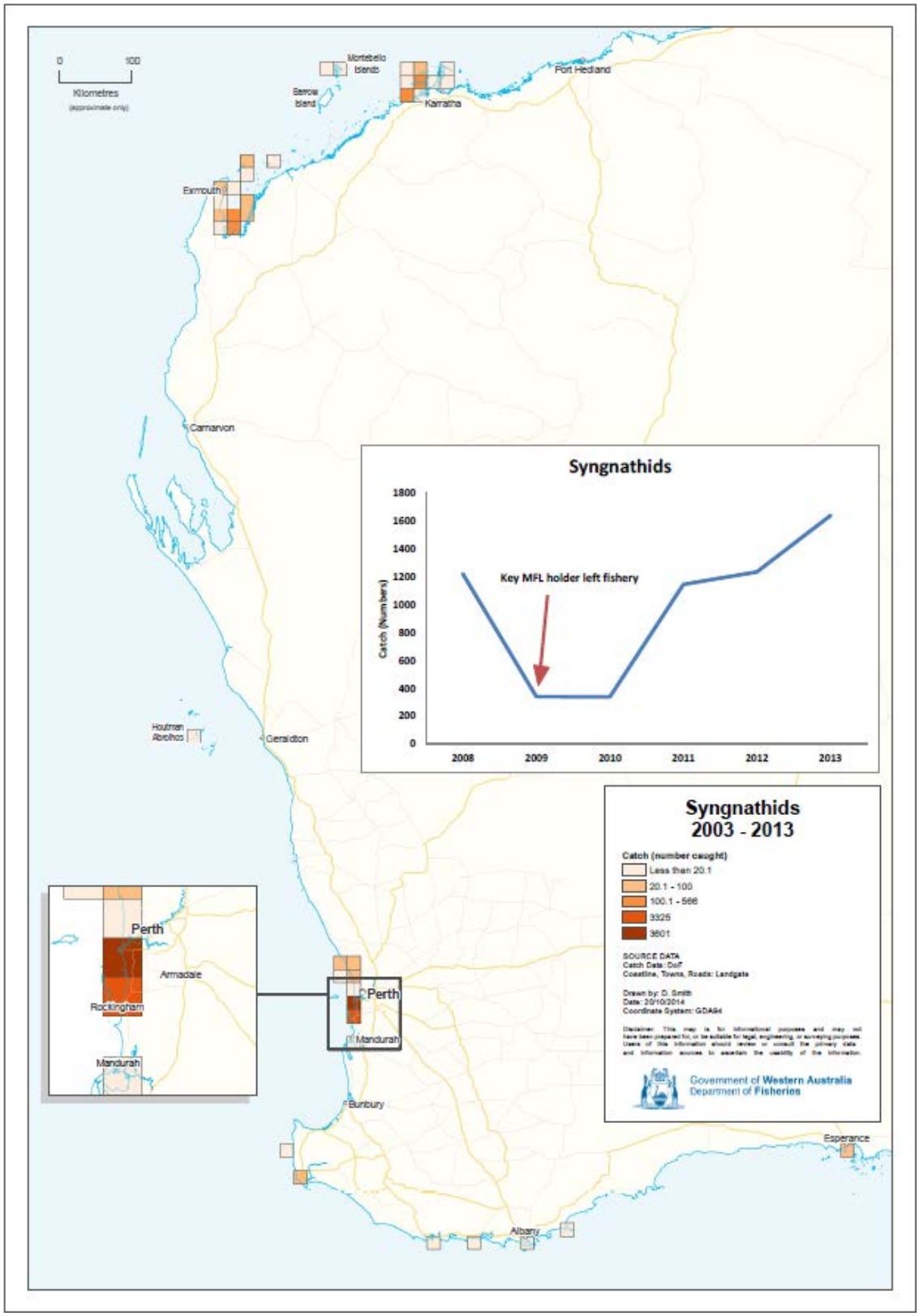

Figure 3 - Catch and distribution of Syngnathids taken by the MAF.

2.1.3 *Hard and Soft Coral*

Hard corals and soft corals (Class Anthozoa and Class Hydrozoa) are primarily targeted by the MAF in the tropical waters off Exmouth and the Dampier Archipelago (Figure 4, Figure 5 and Figure 6). Key species include *Duncanopsammia axifuga, Euphyllia ancora, Trachyphyllia geoffroyi, Euphyllia glabrescens, Catalaphyllia jardinei, Moseleya latistellata* and *Plerogyra sinuosa*, most of which are widely distributed across the indo-west pacific region. Hard corals of the Order Scleractinia are also listed on CITES Appendix II. A summary of the reported catch of corals is contained at Table 3.

Most of the coral species targeted by the MAF occur in turbid 'off reef' environments, as opposed to 'blue water' reef environments where the majority of research and scientific literature is based (Pers. Comm., MAF licence holders). There is little published information about the age (or size) at maturity for corals, but the little there is indicates it is highly variable amongst species and affected by environmental conditions. Corals, which are colonial organisms, can reproduce both sexually and asexually. Asexual reproduction occurs through budding and/or fragmentation, resulting in two or more genetically identical individuals.

Sexual reproduction typically occurs through broadcast spawning. Most corals are hermaphrodites, and coral fecundity is typically correlated with size, with more polyps producing more eggs. Corals mass spawn by releasing eggs and sperm synchronously over several nights at particular times of the year. On the west coast of Australia, this tends to be in March – April (Veron 2000).

Most coral species have two different feeding mechanisms. The majority of their diet is provided from zooxanthellae which live inside the coral polyps in a symbiotic relationship. The zooxanthallae are single celled algae, which share their photosynthetic products with the coral host. In return the coral provides the zooxanthallae with a safe place to live and essential metabolic products for photosynthesis such as carbon dioxide and nitrogenous waste. Corals also feed via polyps which capture a variety of small organisms from demersal plankton to small fish (Vernon 2000).

Table 3 - Summary of the reported catch (kg) of the main coral species landed from the MAF.

Species	Common Name	Year					
		2009	2010	2011	2012	2013	2014
Corallimorphus	Corallimorphus	0	0	45	72.5	1,869	2,318
Zoanthidae Undifferentiated	Zoanthid anemones	2,184	1,606	799	527.5	1,712	1,576
Zoanthidea Undifferentiated	Anemones & Corals	56	105	35	736.6	404	632
Sarcophyton	Toadstool coral	166.2	174.1	203.4	118.8	314.6	448
Corallimorpharia Undifferentiated	Coral-like anemones	1,899	2,233	2,932	3,725	1,009	418

Lobophyllia	*Lobophyllia*	4,662.8	430.2	438.5	293.2	555.9	333.5
Euphyllia ancora	Anchor coral	414.8	605.6	599.7	491.8	344.8	330.9
Euphyllia paraancora	Branching hammer coral	0	0	0	29	269	330
Duncanopsammia axifuga	stony coral (Duncan coral)	548	877.4	407.3	456.4	326.5	318.8
Symphyllia	*Symphyllia*	169.4	289.8	225.6	189.9	74.8	296
Scleractinia Undifferentiated	Hard corals(kg)	16	4	16.4	18.15	222.4	290
Euphyllia glabrescens	Torch coral	149.8	374.1	402	504.6	246.6	277.5
Goniopora	*Goniopora*	102.5	68.4	156.1	145.1	235.9	225.8
Alcyonacea	Soft coral & Sea fans - undifferentiated	6	0.4	0.6	10.8	243	197
Trachyphyllia geoffroyi	stony coral (*Trachyphyllia* brain coral)	503.5	640.4	470.9	266.3	230	180.15
Acropora	*Acropora* (corals)	333.3	193.5	285.6	186.2	98.4	163.6
Plerogyra sinuosa	stony coral (green bubble)	0	22	380	30	60	155
Catalaphyllia jardinei	Elegant coral	11	23.15	16	265.2	0	129.5
Zoanthus	*Zoanthus* (colony polyps)	744	669	558	513	395	109
Echinophyllia	*Echinophyllia* (chalice corals)	511	293	222.4	197.3	109.3	90.9
Acanthastrea	Acanthastrea (large polyp stony corals)	100.3	72.4	102.2	129.5	174.5	90.7
Cynarina	Cynarina	10.4	83.85	118.6	34.9	7	58.8
Euphyllia	*Euphyllia*	31	46.2	150	0	10	54
Favia	*Favia* coral (brain coral)	481	267.1	243.8	140.6	136.4	44
Turbinaria	*Turbinaria* (cup corals)	165.3	271.3	169	94.2	149.1	41

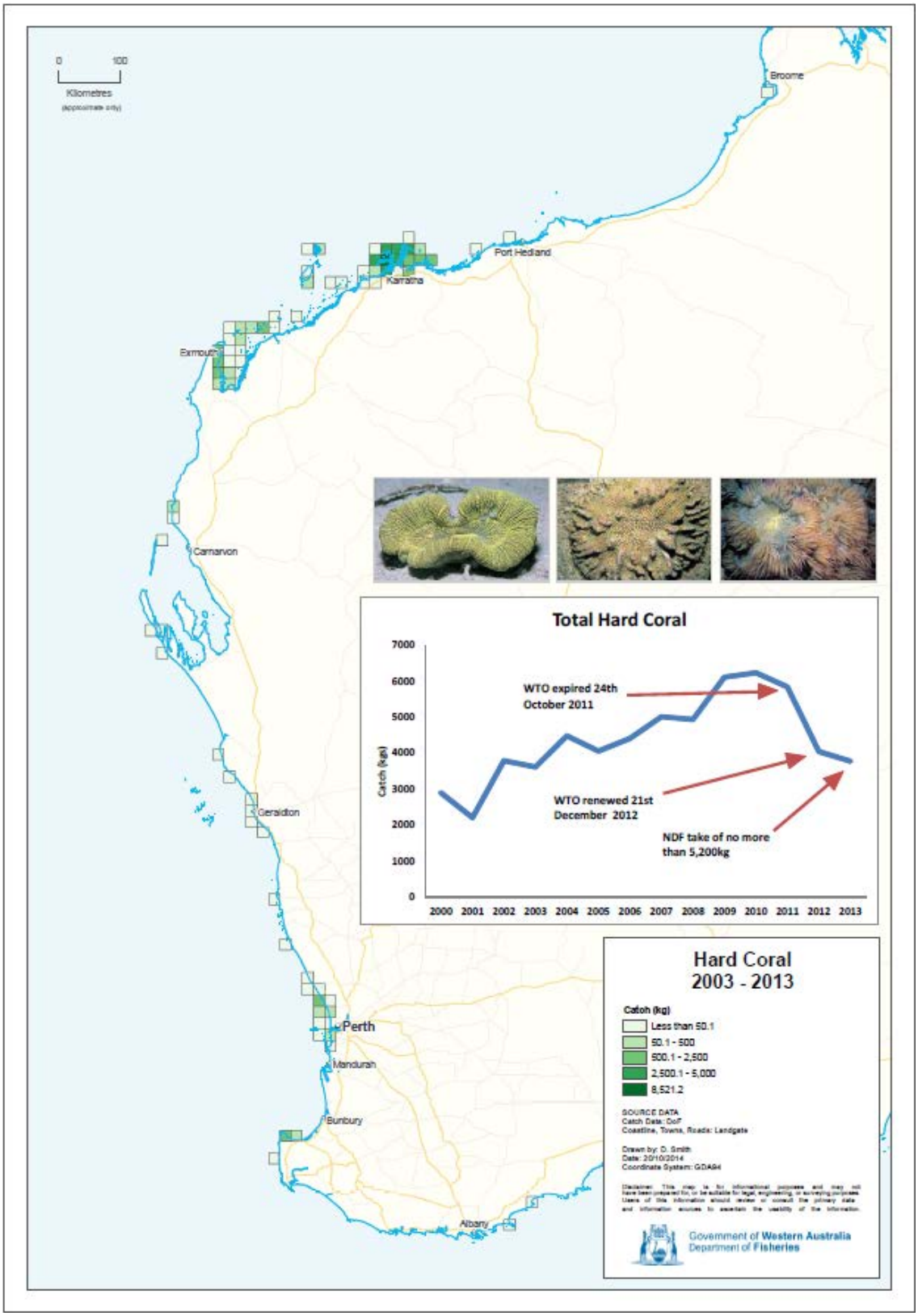

Figure 4 – Catch and distribution of hard coral taken by the MAF.

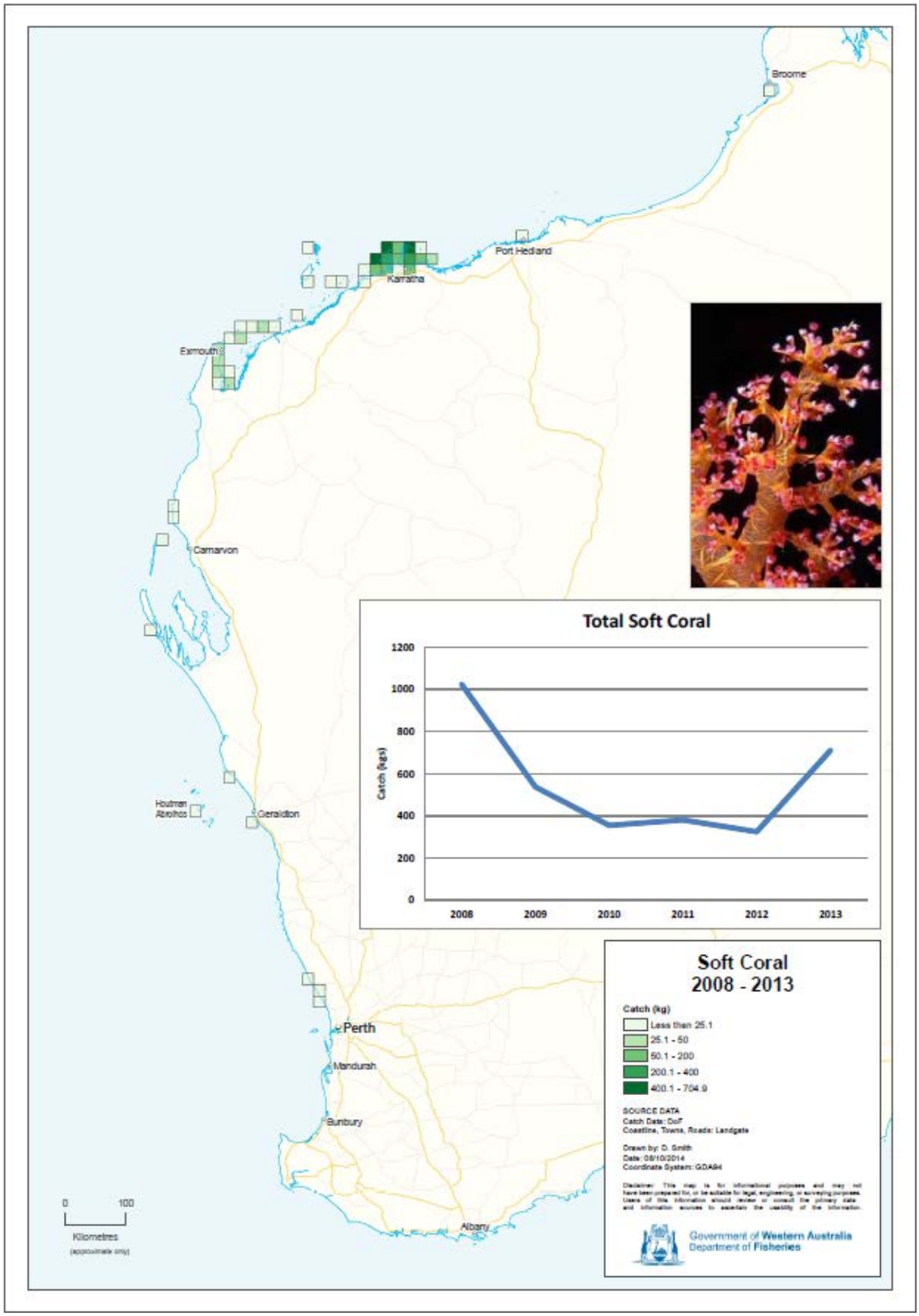

Figure 5 – Catch and distribution of soft coral taken by the MAF.

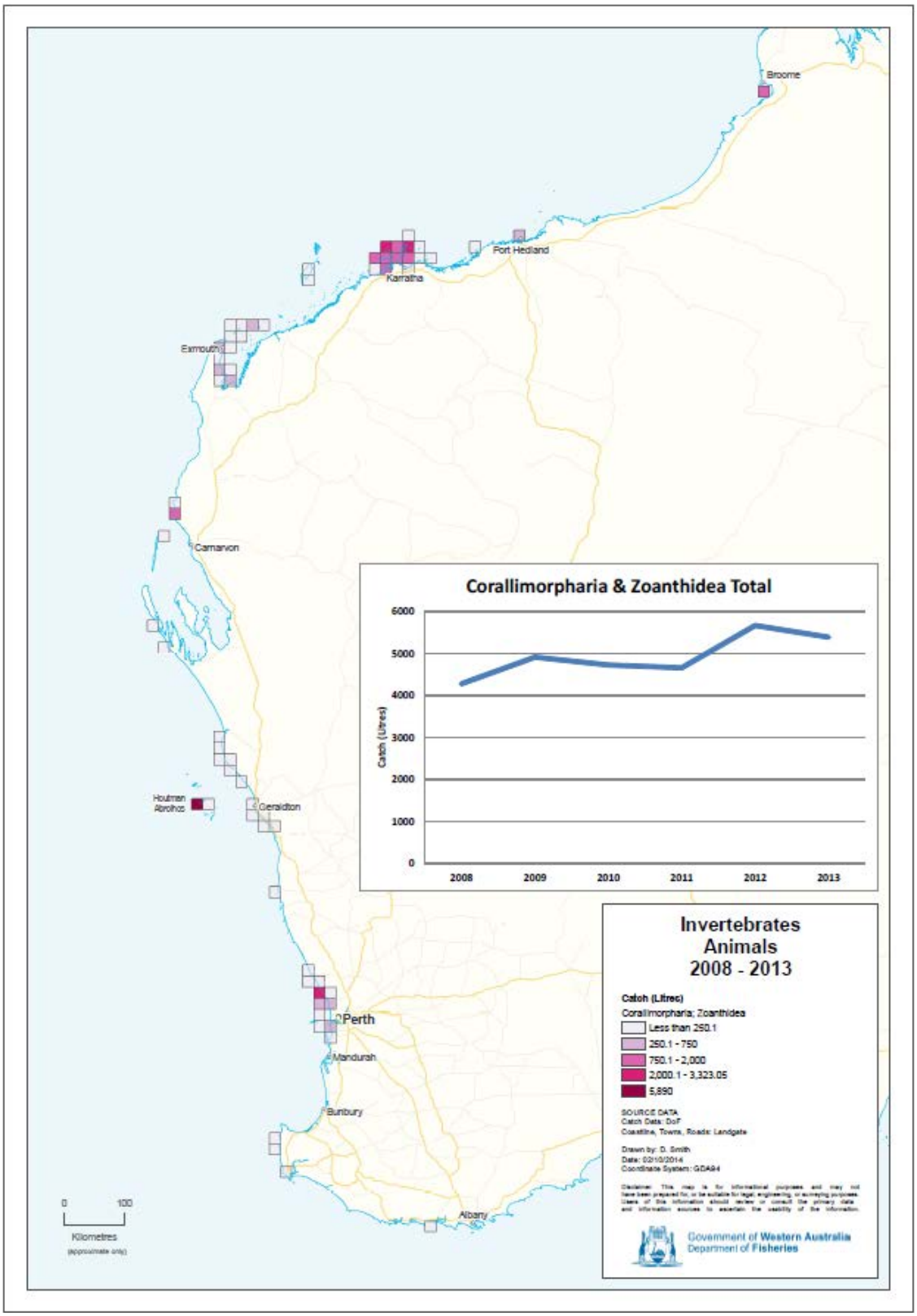

Figure 6 – Catch and distribution of Corallimorpharia and Zoanthidea corals taken by the MAF.

2.1.4 *Giant clams*

Giant clams in the Family Tridacnidae occur from the Red Sea and eastern Africa, through the Indian Ocean, to South-east Asia, Australasia, Melanesia, Micronesia and Polynesia in the eastern Pacific (Copland and Lucas 1988; CITES 2006; Othman et al. 2010). Two species of tridacnid clams have been reported by the MAF (*Tridacnea maxima* and *T. squamosa*) primarily from the Exmouth and Karratha regions (Figure 7), however, is likely that catches have also comprised of a recently discovered species *T. ningaloo*, which is similar in appearance to *T. maxima* (Penny and Willan 2014).

T. maxima and *T. squamosa* are both widely distributed throughout the Indo-Pacific and there are suggestions that the distribution of *T. ningaloo* extends from Ningaloo Reef, Western Australia, to the Solomon Islands, and possibly even to higher northern latitudes (Huelsken et al. 2013). All Tridacninae species are listed on CITES Appendix II.

Adult tridacnid clams are usually simultaneous hermaphrodites. They become sexually mature as males at two or more years of age and subsequently become hermaphrodites with gonads containing spermatogenic and oogenic tissue. The initial growth of tridacnid clam juveniles is relatively slow, and they may reach 20 – 40 mm in the first year. Thereafter growth is rapid in larger species.

Similar to corals, tridacnid clams have a symbiotic relationship with a photosynthetic dinoflagellae (zooxanthallae) which live in the mantle tissues. Adult clams receive 70 – 100 % of their nutrients from the algae and the rest is from filter feeding.

A study on the abundance of *T. maxima* on intertidal rocky platforms in the Ningaloo Marine Park observed densities varying between 0.04 to 8.27m^2 (Black et al. 2011). Furthermore, an assessment of available benthic habitat data[1] indicates over 50 km^2 of intertidal bare reef habitat exists in the Ningaloo Marine Park, Barrow Islands and Montebello Islands, and the Dampier/Karratha region. Based on the lower density range observed in the Ningaloo Marine Park (0.04m^2), the population of *T. maxima* occurring on intertidal bare reef habitat in these three areas could exceed 2 million individuals. Noting that tridacna clams are also found on other habitat types (including subtidal bare reef and intertidal and subtidal coral reef) and as they are also widely distributed outside of the three areas listed above, this population estimate for *T. maxima* is likely to be conservative.

Only a small proportion of the population of tridacnid clams is targeted by the MAF based on size (up to 30cm width) and colour to meet market demand. An annual capacity of 2,400 tridacnid clams has been in place since 2005. A summary of the reported catch of giant clams is contained in Table 4.

[1] Marine habitat data sourced from Department of Parks and Wildlife (DPaW) based on studies undertaken by various organisations in marine parks and marine management areas between 1985 and 2002. Habitat mapping for all of the studies has been classified into eleven broad categories based on the Shallow-water Marine Habitat Classification Scheme (Bancroft, 2003).

Table 4 - Summary of the reported catch of giant clam species landed from the MAF.

Species	Common Name	Year					
		2008	2009	2010	2011	2012	2013
Tridacna maxima	Elongate giant clam	854	768	1180	864	426	425
Tridacna squamosa	Fluted giant clam	16	44	69	53	30	77

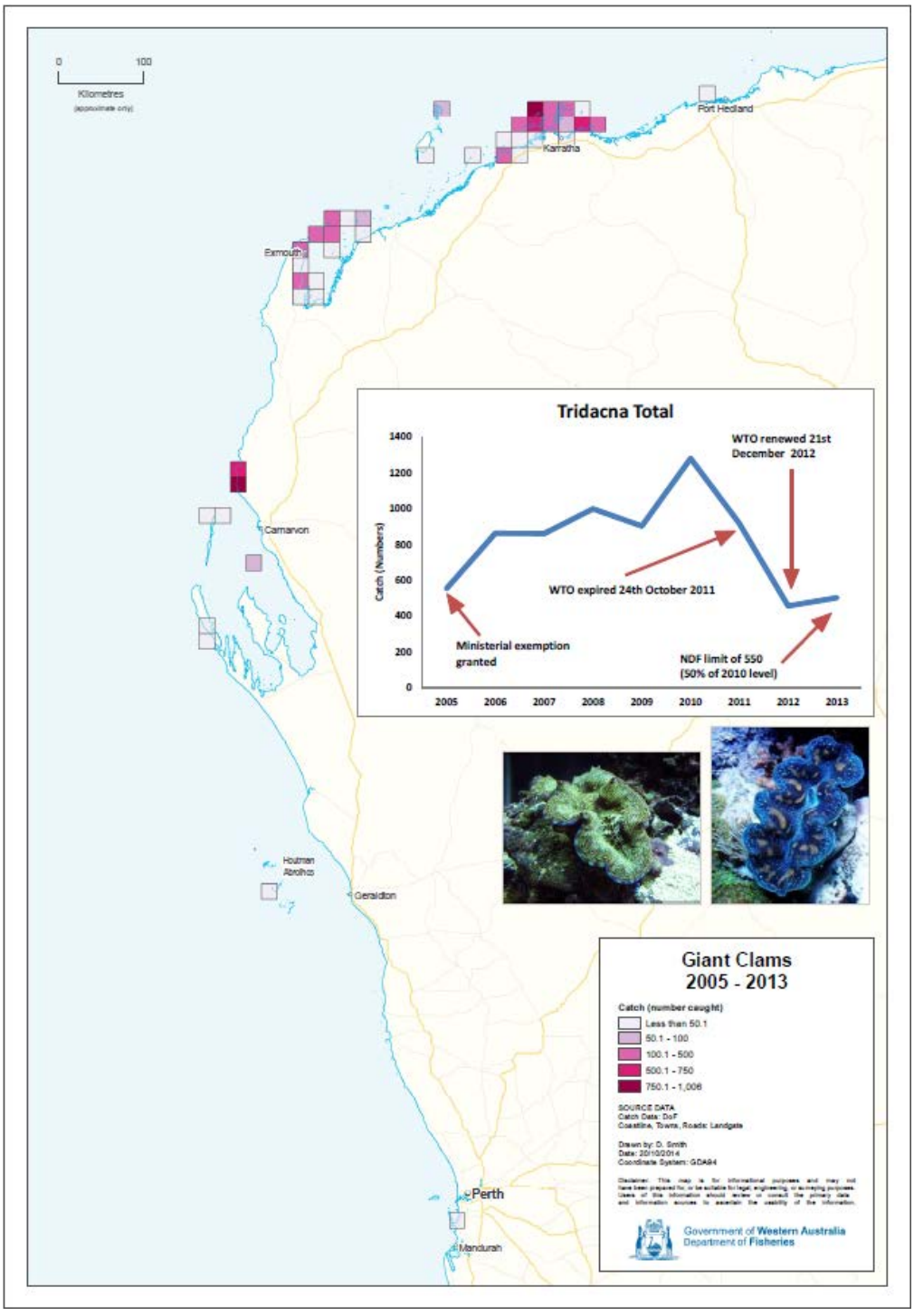

Figure 7 - Catch and distribution of giant clams taken by the MAF.

2.1.5 ***'Live Rock'***

'Live rock' is the common term used to describe the skeletal remains of hard corals which are encrusted in coralline algae and various other invertebrate species. 'Live rock' is defined under Schedule 7 of the *Fish Resource Management Regulations 1995* (FRMR) as 'Family Corallinaceae; Classes Polychaeta, Crinoidea, Ascidiacea and Ophiuroidea; Phyla Bryozoa and Porifera; and dead fish of Classes Anthozoa and Hydrozoa'. 'Live rock' is primarily collected from waters off Perth, Houtman Abrolhos Islands, Exmouth and Karratha (Figure 8). A summary of the reported catch of 'live rock' is contained in Table 5.

'Live rock' forms the foundations of 'living reef' aquariums. Common rations of 'live rock' and live coral are in the order of 10:1, supporting increased market demand for 'live rock' over live coral. 'Live rock' also forms an important part of the filtration system in marine aquaria, providing a natural refuge for denitrifying bacteria. The calcium carbonate in 'live rock' may also assist in maintaining desired water chemistry parameters in aquaria, in particular by helping to maintain constant pH by release of calcium carbonate.

Although 'live rock' may be considered as fish habitat, it is also a renewable resource with reefs accumulating considerable amounts of calcium carbonate every year. Studies on the Great Barrier Reef (GBR) estimate that the 2,500 reefs that make up the GBR accumulate more than 5 million tonnes of calcium carbonate per year (Harriott 2001). Many of the branching species of corals, such as *Acropora spp* are known to grow very quickly at up to 20 cm per year. These species make up the bulk of loose rubble or 'live rock' because they are easily broken off during storms and are affected by bleaching events (Veron 2000).

Table 5 - Summary of the reported catch (kg) of 'live rock' landed from the MAF.

Species	Common Name	Year					
		2008	2009	2010	2011	2012	2013
'Live Rock'	'Live Rock'	4174	3336	15720	16548	19576	14013

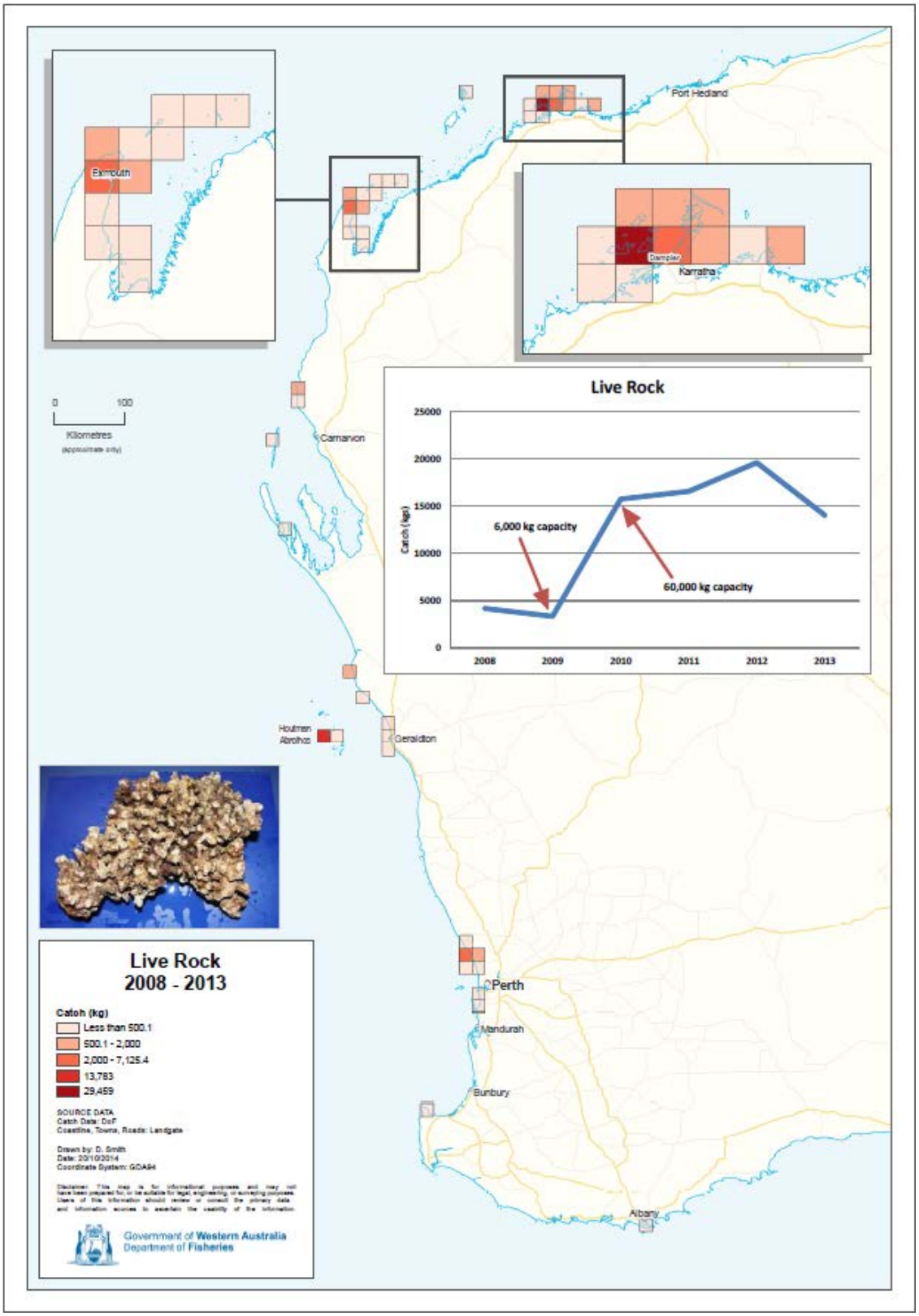

Figure 8 – Catch and distribution of 'live rock' taken by the MAF.

2.1.6 *Other Invertebrates and Aquatic Plants*

The MAF also retains varying amounts of other invertebrate and aquatic plant species which broadly fall into the following scientific categories; Ascidians (Class Ascidiacea); Algae and Seagrass; Brittle Stars (Class Ophiuroidea); Decapods (Order Decapoda); Feather Stars (Class Crinoidea); Jellyfish (Class Scyphozoa); Mantis shrimp (Order Stromatopoda); Molluscs (Phylum Molusca); Polychaetes (Class Polychaeta); Sea Anemones (Order Actiniaria); Sea Cucumbers (Class Holothuroidea); Sea Stars (Class Asteroidea) Sea Urchins (Class Echinoidea) and Sponges (Phylum Porifera).

These species are usually collected opportunistically by operators in the MAF on a state-wide basis (Figure 9 and Figure 10) while targeting other species. Amounts can vary significantly from year to year due to market demand. Over 40,000 individual invertebrate species and in excess of 300 litres of algae and seagrass was landed by the MAF in 2014.

2.2 Bycatch Species

Due to the highly selective nature of the MAF there is no reported bycatch species.

2.3 Endangered and Threatened Species

There have been no reported interactions with Endangered and Threatened species by operators in the MAF.

2.4 Habitat Impacts

The MAF is a hand collection dive/wade fishery with a small number of licence holders (12) operating from small trailer boats and impacts from the fishery on the benthos (i.e. anchor damage etc.) is minimal. For the purpose of this assessment, corals and 'live rock' are considered under targeted retained species rather than habitat.

2.5 Other activities capturing marine aquarium species

No other commercial fisheries are permitted to capture marine species for aquarium display purposes in WA. Each year small volumes of marine aquarium species are collected for public benefit and other commercial purposes via Ministerial Exemptions issued under Section 7 of the FRMA. These Exemptions are typically granted on a case-by-case basis for aquaculture broodstock, research, education or for public aquarium display purposes where sourcing specimens from the MAF is not practical.

There is no documented recreational fishery for marine aquarium species in WA and the level of take is believed to be negligible. If members of the public wish to collect specimens for their own private aquariums they are permitted to do so, but are restricted to normal recreational bag limits and, for some species, size limits. There is a total prohibition on the recreational take of coral, live rock and listed fish such as leafy and weedy sea dragons.

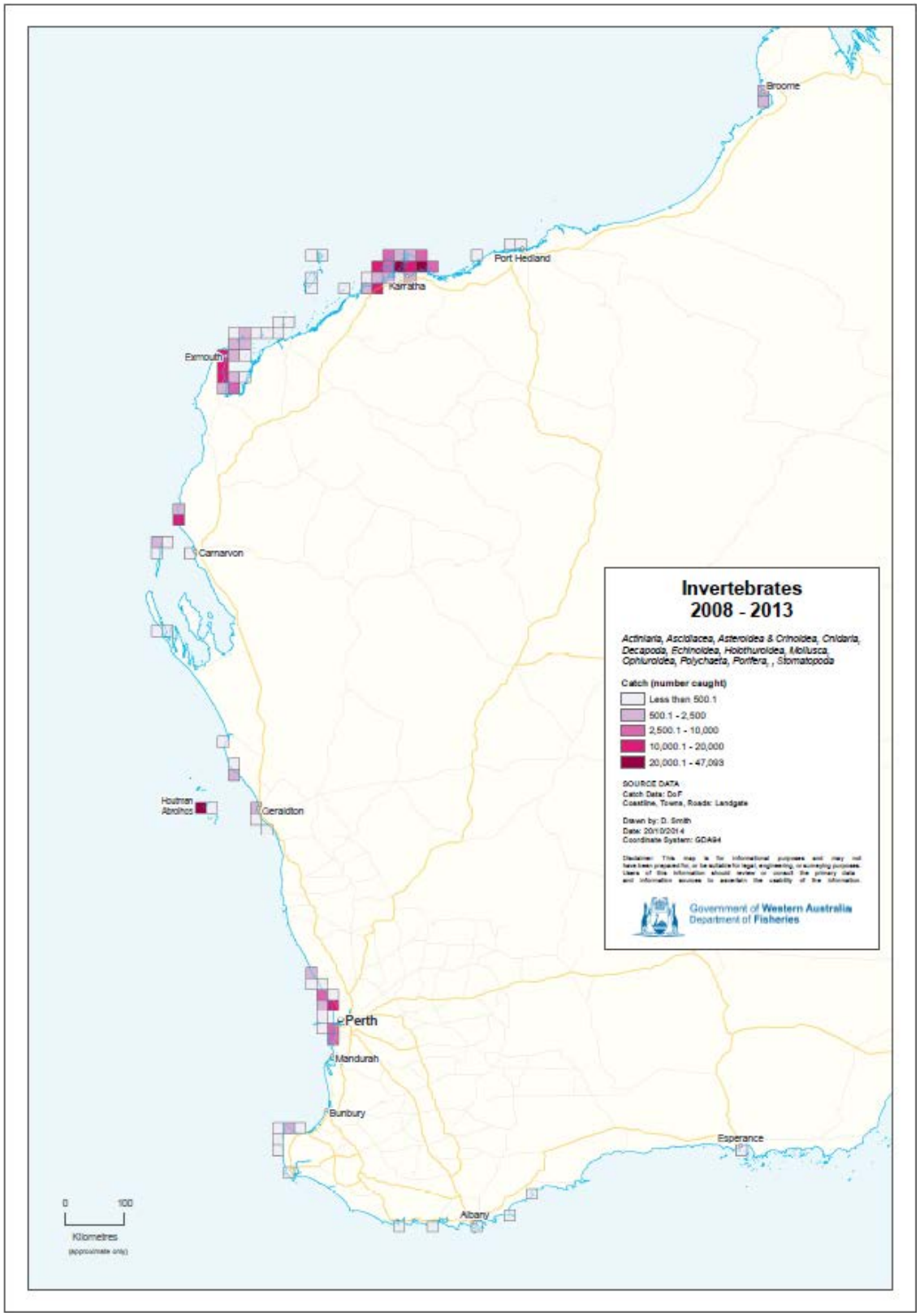

Figure 9 - Catch and distribution of invertebrate species taken by the MAF.

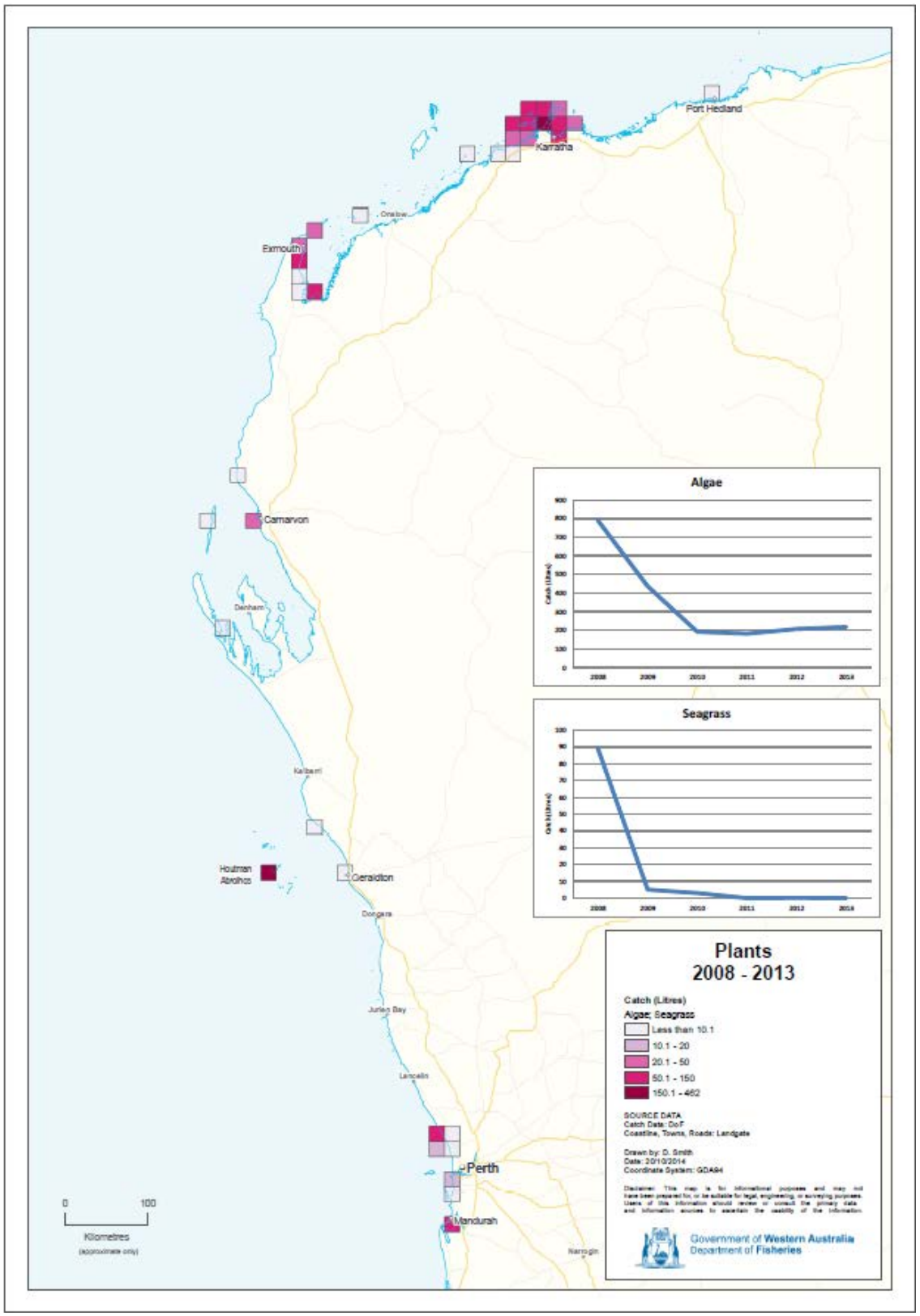

Figure 10 – Catch and distribution of aquatic plants taken by the MAF.

SECTION 3 MANAGEMENT

3.1 Legislation

The MAF is managed by Fisheries under the following legislation:

- *Fish Resources Management Act 1994*;
- *Fish Resources Management Regulations 1995* (FRMR);
- FRMA Part 6 – *Marine Aquarium Fish Managed Fishery Management Plan 1995*;
- FRMA Section 7 (Ministerial Exemptions);
- FRMA Section 43 *Prohibition on Fishing (Coral, 'Live Rock' and Algae) Order 2007.*

Fishers must also comply with the requirements of:

- Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999;*
- *Western Australian Marine Act 1982*;
- Western Australian *Wildlife Conservation Act 1950*; and
- Western Australian *Conservation and Land Management Act 1984*.

It is important to note that the current management plan is scheduled to be replaced by the *Marine Aquarium Fish Managed Fishery Management Plan 2017* in late 2017, and the FRMA will also be replaced by the *Aquatic Resource Management Act 2016* in the near future.

3.2 Management Arrangements

This fishery is managed primarily through input controls in the form of limited entry to the fishery and permanent closed areas. There are 12 licences in the fishery; however, only six licences are permitted to take hard corals and most soft corals within a Total Allowable Commercial Catch (TACC) of 7,500 kg (all 12 licences are permitted to take coral like anemone groups such as corallimorphs and zoanthids in the Class Anthozoa). An industry TACC of 60 tonnes of 'live rock' also applies.

Although there are no statutory limits on finfish, there is an upper trigger limit of 2,000 for species from the Syngnathid family (seahorses and pipefish), which are listed under the EPBC Act. Annual catch limits also apply to most other invertebrate and aquatic plant species including a TACC for giant clams of 2,400 individuals.

Non-statutory limits for individual CITES species (i.e. coral, giant clams and seahorses) have been in place since 2013, to enable the fisher to comply with requirements of the EPBC Act to maintain WTO export approval.

Licensees are not permitted to operate within any waters closed to fishing (e.g. Rowley Shoals, Reef Protected Areas, sanctuary zones). The fishery is permitted to operate in general-purpose zones of marine parks for the collection of fish and some invertebrates.

Fish caught in this fishery may not be used for food purposes, and operators are not permitted to take non-finfish species covered by other specific commercial management arrangements or management plans.

3.3 Harvest Strategy

Fisheries is finalising a formal harvest strategy for the marine aquarium fish resource. Harvest strategies establish the decision rules that seek to ensure appropriate levels of harvest to meet the ecological, economic and social objectives established for a resource (Department of Fisheries, 2015).

Harvest strategies are based on performance indicators in relation to a set of reference levels that separates acceptable performance from unacceptable performance. For the MAF the reference levels are:

- a target level (where you want the indicator to be);
- a threshold level (where you review your position); and
- a limit level (where you don't want the indicator to be)

Harvest strategies specifically articulate the values for the reference levels and the control rules define what management actions should occur in relation to the value of each indicator approaching or crossing the target, threshold or limit levels. The performance indicators and reference levels for the MAF will be based on maintaining an acceptable level of risk in accordance with this ERA.

3.4 Compliance

The primary objective of Fisheries regarding compliance is to encourage voluntary compliance through education, awareness and consultation activities and to discourage non-compliance through a penalty based system.

Management arrangements are enforced under a Operational Compliance Plan (OCP). The OCP is informed and underpinned by a compliance risk assessment conducted for the fishery. The OCP has the following objectives:

- To provide clear and unambiguous direction and guidance to Fisheries and Marine Officers for the annual delivery of compliance in this fishery;
- To protect the fisheries' environmental values, whilst providing fair and sustainable access to the fisheries' commercial and social values;
- To encourage voluntary compliance through education, awareness and consultation activities; and
- To provide processes which ensure that the fisheries are commercially viable in the international market yet environmentally sustainable in the local context.

Compliance strategies and activities that are used in the fishery include:

- land and sea patrols;

- inspections of MAF species at wholesale and retail outlets;
- inspection in port;
- at-sea inspection of fishing boats;
- aerial surveillance;
- undertaking covert operations and observations;
- monitoring of entitlement and vessel movements; and
- intelligence gathering and investigations.

3.5 Environmental Context

The MAF targets species that inhabit intertidal and nearshore waters of WA from the South Australian border in the south to the Northern Territory border in the north (total gazetted area of 20 781 km^2).

The waters of WA are heavily influenced by the warm, low-nutrient, southward-flowing Leeuwin Current. The northern tropical regions have a variety of habitats, including sand/mud flats, mangroves, seagrasses, macroalgae, filter-feeding communities, corals and soft-bottom areas, and high species diversity (DEWHA 2008).

Further south, the waters along the Gascoyne Coast represents a transition between the tropical waters of the North West Shelf and the temperate waters of the West Coast. The majority of fish stocks are tropical in nature, although some temperate species can be found at the northern extent of their range. The transition in climate and ocean currents and the range of coastal landforms in this region combine to provide varied and complex marine habitats and associated species (Roberts et al. 2012).

South of Kalbarri, the waters of the West Coast Bioregion are predominately temperate, although the warm, Leeuwin Current provides for the existence of coral reefs at the Houtman Abrolhos Islands and the extended southward distribution of many tropical species. From a global perspective, the west coast is characterised by low levels of nutrients and high species diversity, including a large number of endemic species (CoA 2008).

The waters of the South Coast are also low in nutrients, due to the seasonal winter presence of the Leeuwin Current and limited terrestrial run-off. Fish stocks in this region are predominantly temperate, with many species' distributions extending across southern Australia. The South Coast is a high-energy environment and is heavily influenced by large swells generated in the Southern Ocean. A mixture of seagrass and kelp habitats occur along the south coast, and the benthic invertebrate communities, e.g. sponges, ascidians and byrozoans, found in the eastern stretches of the coast are among the world's most diverse in soft sediment ecosystems (CoA 2008).

3.6 Monitoring and Assessment Procedures

3.6.1 *Commercial Catch and Effort Reporting*

Commercial fishers are required to report all retained species catches (kilograms, litres or number of individuals), effort (time fished), location (10x10nm blocks) and all ETP species interactions. This information has been reported in statutory monthly catch and effort (CAES) returns (from 1977) as well as separate daily logbook returns (from 2008) where the location reporting moved to the recording of GPS co-ordinates.

Information obtained through CAES and daily logbook data includes:

- licensing/administrative details (nominated operator/master's name, date signed, managed fishery licence (MFL), Licensed Fishing Boat (LFB) number, boat name and Fishing Boat Licence (FBL) details);
- fishing effort details (year, month, start and end times, crew names, point of landing, sea based holding facility GPS coordinates, 10x10nm block number, days fished per month and per block, hours fished, hours spent searching and method of collection (wade, dive, snorkel); and
- catch details (including GPS coordinates, 10x10nm block number, record of all catch by weight for hard and soft coral (excluding Order Corallimorpharia and Order Zoanthidea) and live rock; by volume for algae, seagrass, Order Corallimorpharia and Order Zoanthidea; and by numbers of individuals for all other catch).

This information is collated by the Fisheries' 'Statistics and Data Analysis' (SADA) Branch annually and published in the State of the Fisheries reports to inform fisheries management and the general public on the performance of the fishery.

3.6.2 *Stock Assessment*

The different methods used by Fisheries to assess the status of aquatic resources in WA have been categorised into five broad levels, ranging from relatively simple analyses of annual catches and catch rates, through to an integrated model that synthesises catch, effort, catch rates and age structure data to estimate fishing mortality and spawning biomass (Fletcher and Santoro 2015). The level of assessment varies among resources and is determined based on the level of ecological risk, the biology and population dynamics of the relevant species, the characteristics of the fisheries exploiting the species, data availability and historical level of monitoring.

Irrespective of the types of assessment methods used, all stock assessments undertaken by Fisheries take a risk-based, weight-of-evidence approach (Fletcher 2015). This requires specifically the consideration of each available line of evidence, both individually and collectively, to generate the most appropriate overall assessment conclusion. The lines of evidence include the outputs that are generated from each available quantitative method, plus any qualitative lines of evidence such as biological and fishery information that describe the inherent vulnerability of the species to fishing.

The harvest strategy for the MAF is based on a *constant catch approach*, where the annual catch level is relatively small compared to stock levels and therefore unaffected by normal levels of recruitment variation. Consistent with this approach the stock status for all

marine aquarium species is based on an analysis of annual catch and assessed using a risk-based approach. The annual catch is managed within a level which results in an acceptable risk to sustainability as determined through periodic risk assessments.

The Department is currently undertaking a joint FRDC funded research project (FRDC Project Number 2014-029) with the Queensland and Northern Territory Governments aimed at collection baseline data on abundance and distribution of commercial important inter-reef coral species. It is anticipated that the outcomes of this three year project may support higher level stock assessment of coral species in the future.

3.6.3 *Reference levels*

A set of reference levels have been established to separate acceptable from unacceptable performance using the risk-based approach.

The reference levels for the annual catch of all MAF species is based on the Risk/Category Levels determined through the ERA process as follows:

- **Target** - Risk Category/Level is at or below 'Medium';
- **Threshold** - Risk Category/Level is at 'High'; and
- **Limit** - Risk Category/Level is at 'Severe'.

SECTION 4 RISK ASSESSMENT METHODOLOGY

The Department of Fisheries implemented a Ecosystem Based Fisheries Management (EBFM) approach as the primary strategy to achieve the goal of ESD for fisheries in WA. EBFM deals with the aggregate management of all fisheries-related activities within an ecosystem or bioregion and takes into account the impacts of fishing on retained species, discarded bycatch species, protected species, habitats and the broader ecosystem — regarded as 'ecological assets / components' — and the social, economic and governance outcomes. In utilising a broad EBFM approach, managers are required to consider a wide and diverse set of issues.

Risk assessments offer a means to filter and prioritise the various identified issues for management and have been used in fisheries management in Australia for over a decade (Fletcher et al. 2002). The risk analysis methodology utilised for the MAF risk assessments was based on the global standard for risk assessment and risk management (AS/NZS ISO 31000), which has been adopted for use in a fisheries context (see Fletcher et al. 2002, Fletcher 2005; Fletcher 2015).

The risk assessment process which is an essential part of implementation of risk management is summarised in Figure 11. The first stage involves establishing the context or scope of the risk assessment – which includes which activities, stakeholders and geographical extent will be covered, the objectives to be delivered, timeframe for the assessment and what is considered acceptable performance need to be established.

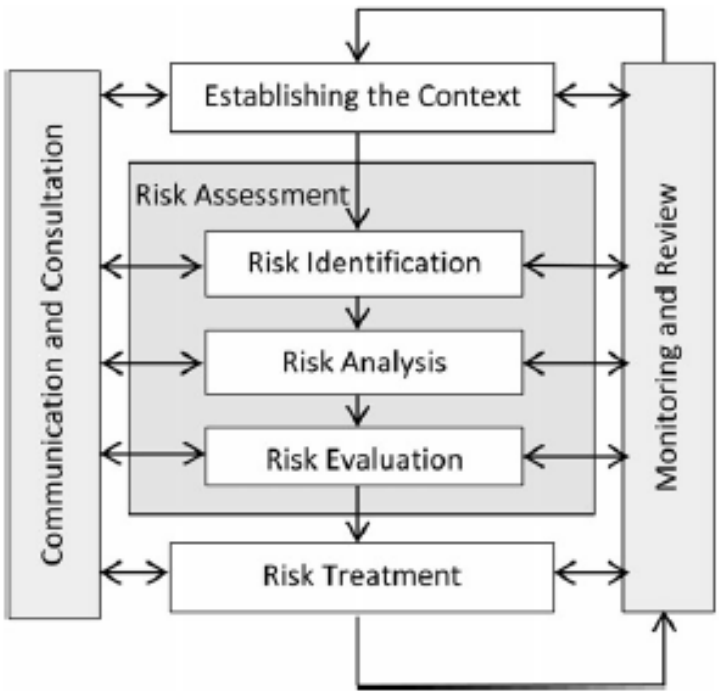

Figure 11 - Position of risk assessment within the risk management process (modified from SA 2012).

Risk identification involves the process of recognising and describing risks, which involves the identification of risk sources and their causes. Once the risks are identified they are scored by the risk analysis process. This process involves the examination of the sources of risk (issue identification), the potential consequences (impacts) associated with each issue and the likelihood (probability) of a particular level of consequence actually occurring. The combination produces a risk score.

Risk evaluation is completed by comparing the risk score with those associated with different levels of risk which is compared to established levels of risk. The risk evaluation step uses the risk levels to help make decisions about which risks need treatment.

Risk treatment involves addressing the issues with levels of risk which are considered undesirable. This involves identifying the likely monitoring and reporting requirements and associated management actions, which can either address and/or assist in reducing the risk to acceptable levels.

An important part of the risk assessment and risk management process is communication and consultation with stakeholders. The MAF ERA involved a high level of consultation through:

- Provision of a background document prior to the workshop explaining the purpose, background, risk assessment process and preliminary identification of issues;
- Workshop – inviting a wide range of stakeholders to participate in the risk identification and scoring process; and
- Risk assessment report summarising the results, justification, evaluation and treatment (this report) which was published on the Department of Fisheries' website.

4.1 Scope

This risk assessment covers commercial fishing for marine aquarium species using had collection methods as a part of the MAF. The geographical extent of the ERA covers all state waters.

The current ERA of the MAF identifies some of the potential risks associated with this fishery from an ecological context only. It is anticipated that the other key elements of the EBFM approach being; social, economic and governance issues will be formally considered as part of the next periodic ERA of the MAF.

For the purpose of this assessment, risk was defined as *the uncertainty associated with achieving a specific management objective or outcome* (adapted from Fletcher 2015). The aim is to ensure the 'risk' of an unacceptable impact is kept to an acceptable level. The calculation of a risk in the context of the MAF ERA is the five years following assessment i.e. 2015 to 2020.

4.2 Issue Identification

The first step in the ERA process was to identify the issues relevant to the MAF. This step is equivalent to the 'hazard identification' process used in most risk assessment procedures.

Issues where identified through the consideration of:

- Previous risk assessments undertaken in the fishery under the EPBC Act 1999 to achieve approval for Wildlife Trade Operations;
- Outcomes of assessments under the EBPC Act 1999;
- A pre-assessment Departmental workshop involving research and management staff on 12 September 2014; and
- Consultation with industry and external stakeholders prior to and during the ERA workshop on 23 October 2014.

4.2.1 *Previous Risk Assessments*

In 2004, the MAF underwent a risk assessment as a part of the assessment for Wildlife Trade Operations under the EPBC Act 1999 (Smith et al. 2010). This ERA has subsequently been internally reviewed by the Department in 2008, 2011 and 2013 as a part of the WTO renewal process.

4.2.2 *Assessment under the EBPC Act 1999*

As an export fishery, the MAF requires 'Wildlife Trade Operation' (WTO) export approval by the Commonwealth, Department of the Environment (DoE) under section 303 of the EPBC Act 1999.

A WTO may be approved for up to three years and may contain conditions which are aimed at ensuring that the operation of the fishery is consistent with the provisions of the EPBC Act.

As the fishery also targets species listed under Appendix II of the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES) i.e. hard corals, giant clams and seahorses a 'Non-Detrimental Finding' (NDF) for each CITES listed species must be made before the fishery can be declared an approved WTO. NDF's are prepared in accordance with guidelines endorsed by CITES signatory nations and take into consideration all factors which could potentially affect the long term sustainability of listed species.

The fishery was first declared an approved WTO in 2005, and has subsequently been reassessed in 2008, 2011 and 2014. In 2011, DoE adopted a more rigorous NDF assessment requirement as part of the WTO approval process. This assessment process required, amongst other things, fishery independent estimates of abundance and the determination of sustainable harvest levels for all CITES listed species.

In view of the large fishable area available to the MAF, the wide range of target species, the lack of baseline data, and the limited resources available to establish and continue

ongoing research and monitoring, the Department of Fisheries was not able to provide the level of information requested by the Commonwealth Government to generate positive NDF findings for CITES listed species. This resulted in the loss of the WTO export approval for both CITES (and by default non-CITES listed species). However in 2012, based on external scientific advice (Penn, 2011; CSIRO, 2011), agreement was reached to restrict the take of hard corals and giant clams to a precautionary level with the NDFs supporting a short term (12 month) WTO, which expired in December 2013.

A subsequent reassessment of the MAF during 2013 was supported by the development of a draft harvest strategy (Department of Fisheries, 2013a). The draft harvest strategy was considered by the CITES Scientific Authority for Marine Species, and resulted in revised precautionary harvest levels to support NDFs for CITES listed species (Australian Government, 2014). The new NDFs for CITES listed species supported the current 3 year WTO which expires in October 2016.

A full list of previous assessments and outcomes can be found on the DoE website at: *https://www.environment.gov.au/marine/fisheries/wa/marine-aquarium*.

4.2.3 *Pre-assessment Workshop*

A preliminary risk assessment was undertaken by an internal Departmental Working Group on 2 September 2014. This preliminary assessment involved:

- Review of all available information on key target (top ten) species for each generic target category; and
- Identification of species deemed to require detailed risk assessment on the following basis:
  - Quantities caught;
  - Vulnerability based on distributional range;
  - Endemism; and
  - Conservation status (noting all CITES listed species were subjected as a matter of course to more detailed assessment).

While all target species reviewed by the Department of Fisheries' internal working group were considered to be at 'low risk', it was agreed that a number of species should be subject to more detailed assessment within an external risk assessment workshop forum. These are listed in Table 6.

Table 6 - List of species deemed by the Department of Fisheries' internal working group to warrant more detailed assessment in an external risk assessment workshop.

Category	**Species**
Finfish (Targeted finfish species that are endemic to Western Australia)	*Trachinops brauni* (Bluelined Hulafish) *Trachinops noarlungae* (Yellowheaded Hulafish) *Amphiprion clarkia* (Clarke's Anemonefish, yellowtail clownfish)
Syngnathids	*Hippocampus subelongatus* (Western Australian seahorse) *Hippocampus angustus* (Western spiny seahorse) *Hippocampus tuberculatus* (Knobby seahorse)

All three *Hippocampus* species were identified as being of particular interest in the 2014 NDF.	*Trachyrhamphus bicoarctata* (Short-tailed pipefish)
Hard coral (All hard coral species are CITES listed, however, only those hard coral species identified in the 2014 NDF report as being of particular concern were included for detailed assessment along with three additional endemic species).	*Duncanopsammia auxifuga* (Whisker coral) *Euphyllia ancora* (Hammer coral) *Trachyphyllia geoffroyi* (Brain coral) *Euphyllia glabrecens* (Torch coral) *Cataphyllia jardinei* (Elegant coral) *Moseleya latistellata* (Stony coral) *Symphyllia wilsoni* (Brain coral) *Plerogyra sinuosa* (Bubble coral) *Scolymia australis* (Doughnut coral)
Tridacna clams (CITES listed)	*Tridacna maxima* (Giant elongate clam) *Tridacna squamosa* (Giant fluted clam)
Invertebrates Actiniaria Corallimorpharia (coral like anemones)	*Entacmaea quadricolor* (Bubbletip anemone) *Heteractis malu (*Delicate sea anemone) Undifferentiated catch (not identified at species level)

4.2.4 *Consultation with industry and external stakeholders*

Prior to the workshop a background overview paper was circulated to all workshop participants. This included all relevant information including:

- Risk assessment methodology to be used;
- Key steps in the ERA process;
- List of key target species over the past five years;
- Process, rationale and outcomes of the preliminary risk assessment;
- A list of species deemed to warrant more detailed risk assessment evaluation; and
- A summary of key biological attributes, catch history and trends for species deemed to warrant further assessment.

Workshop participants were requested to review the risk assessment methodology adopted and the process, rationale and outcomes of the preliminary ERA, including the draft risk rating and the associated justification and management measures. As part of the formal ERA workshop, participants were also given the opportunity to add to the list of species to be considered as part of the risk assessment process.

4.3 Risk Assessment Process and Reporting

The risk assessment process assists in separating minor acceptable risks from major, unacceptable risks and prioritising management actions. Once the components and issues were identified for the MAF, the process to prioritise each was undertaken using the ISO 31000-based qualitative risk assessment methodology. This methodology utilises a consequence-likelihood analysis, which involved the examination of the magnitude of potential consequences from fishing activities and the likelihood that those consequences will occur given current management controls (Fletcher 2015).

Consequence and likelihood analyses range in complexity; in this assessment we used a 5 x 5 level system, with the consequence levels ranging from 1 (e.g. minor impact/consequence to fish stocks) to 5 (e.g. catastrophic consequences for fish stocks) and likelihood levels ranging from 1 ('remote', i.e. < 5 % probability) to 5 ('certain', i.e. > 90 % probability). Scoring involved an assessment of the likelihood that each level of consequence is actually occurring or is likely to occur within the next five years. Note that if an issue was not considered to have any measurable impact, it was considered to be 0 consequence; however, this was only permitted where the likelihood of each other consequence level occurring was 0 (i.e. so remote that it is considered essentially impossible in the next five years). The scores for each of the consequence and likelihood levels were then multiplied to determine the risk score, i.e. Risk = the highest Consequence × Likelihood (Figure 12).

The ERA used a set of pre-defined consequence and likelihood levels to assess the potential consequences of commercial fishing on ecological sustainability of retained species (**Table 7** - Risk levels applied to all assets by the Department of Fisheries WA (modified from Fletcher 2005)). The level of consequence for the retained species of the MAF was based at the stock / population level.

The formal risk analysis was conducted at a stakeholder workshop held on 23 October 2014 at the WA Fisheries and Marine Research Laboratories in Hillarys, Perth. Stakeholders invited during the workshop included industry representatives from the MAF, Western Australia Museum, James Cook University of North Queensland, Curtin University (WA), Department of Parks and Wildlife (WA), University of Western Australia, consultant marine scientists, Western Australian, Northern Territory and Queensland Government fisheries management agencies, Commonwealth Department of the Environment and the Western Australian Fishing Industry Council (WAFIC) and, the WA Department of Fisheries (full attendance and participant list provided in Appendix 1). The group at the workshop made a realistic estimate of the risk level for each issue, based on the combined judgement of the participants at the workshop, who collectively were considered to have appropriate expertise on the areas examined.

Based on the calculated score, each issue was assigned a Risk Assessment within one of five categories: Negligible, Low, Medium, High or Severe (Table 7). The rationale for classifying issues at each risk level was documented at the workshop and forms the basis this report. This allows all stakeholders and interested parties to see the rationale and notes for the final Risk Assessments.

		Likelihood				
		Remote (1)	Unlikely (2)	Possible (3)	Likely (4)	Certain (5)
Consequence	Minimal (1)	1	2	3	4	5
	Moderate (2)	2	4	6	8	10
	High (3)	3	6	9	12	15
	Major (4)	4	8	12	16	20
	Catastrophic (5)	5	10	15	20	25

Figure 12 - Standard Consequence — Likelihood Risk Matrix (based on AS 4360 / ISO 31000; adapted from Department of Fisheries 2015)

Table 7 - Risk levels applied to all assets by the Department of Fisheries WA (modified from Fletcher 2005)

Risk Category / Level	Description	Likely Reporting & Monitoring Requirements	Likely Management Action
1 Negligible	Acceptable; Not an issue	Brief Notes – no monitoring	Nil
2 Low	Acceptable; No specific control measures needed	Full Notes needed – periodic monitoring	None specific
3 Medium	Acceptable; With current risk control measures in place (no new management required)	Full Performance Report – regular monitoring	Specific management and/or monitoring required
4 High	Not desirable; Continue strong management actions OR new / further risk control measures to be introduced in the near future	Full Performance Report – regular monitoring	Increased management activities needed
5 Severe	Unacceptable; Major changes required to management in immediate future	Recovery strategy and detailed monitoring	Increased management activities needed urgently

SECTION 5 ISSUES AND BACKGROUND INFORMATION

This section provides an overview of the issues that were scored at the workshop using the using the ISO 31000-based qualitative risk assessment methodology.

5.1 Finfish

Although the MAF has reported landing up to 288 individual finfish species each year, only three species were identified as warranting detail assessment through the ERA process.

5.1.1 *Clark's anemonefish (Amphiprion. clarkii)*

Spatial distribution: Widely distributed in tropical waters from the Indo-West Pacific and is considered by MAF industry operators to be widespread throughout WA but not abundant.

Habitat: Inhabits lagoons and outer reef slopes to 60 metres in depth. Lives in association with sea anemones and is often dependent upon them for habitat and nesting sites (mucus coat protects it from anemone stings).

Reproduction: Occurs in small family groups consisting of a breeding pair and several juvenile males. They are known to be protandous hermaphrodites, with the dominant male changing sex in the absence of a dominant female.

Harvest level: Predominately taken from Exmouth and the Dampier Archipelago with annual catches varying between 300 and 1,700 individuals over the period 2003 to 2013 (Figure 13).

Rationale for inclusion: Inter-dependency between fish and habitat; complex social and reproductive structure.

Risk rating and justification **(C1, L1 = 1 NEGLIGIBLE):** Widespread distribution and recently major shift in stock sourced for market to aquarium breed individuals indicating a likely further reduction in wild catch in the future.

Treatment: No change to the existing management required.

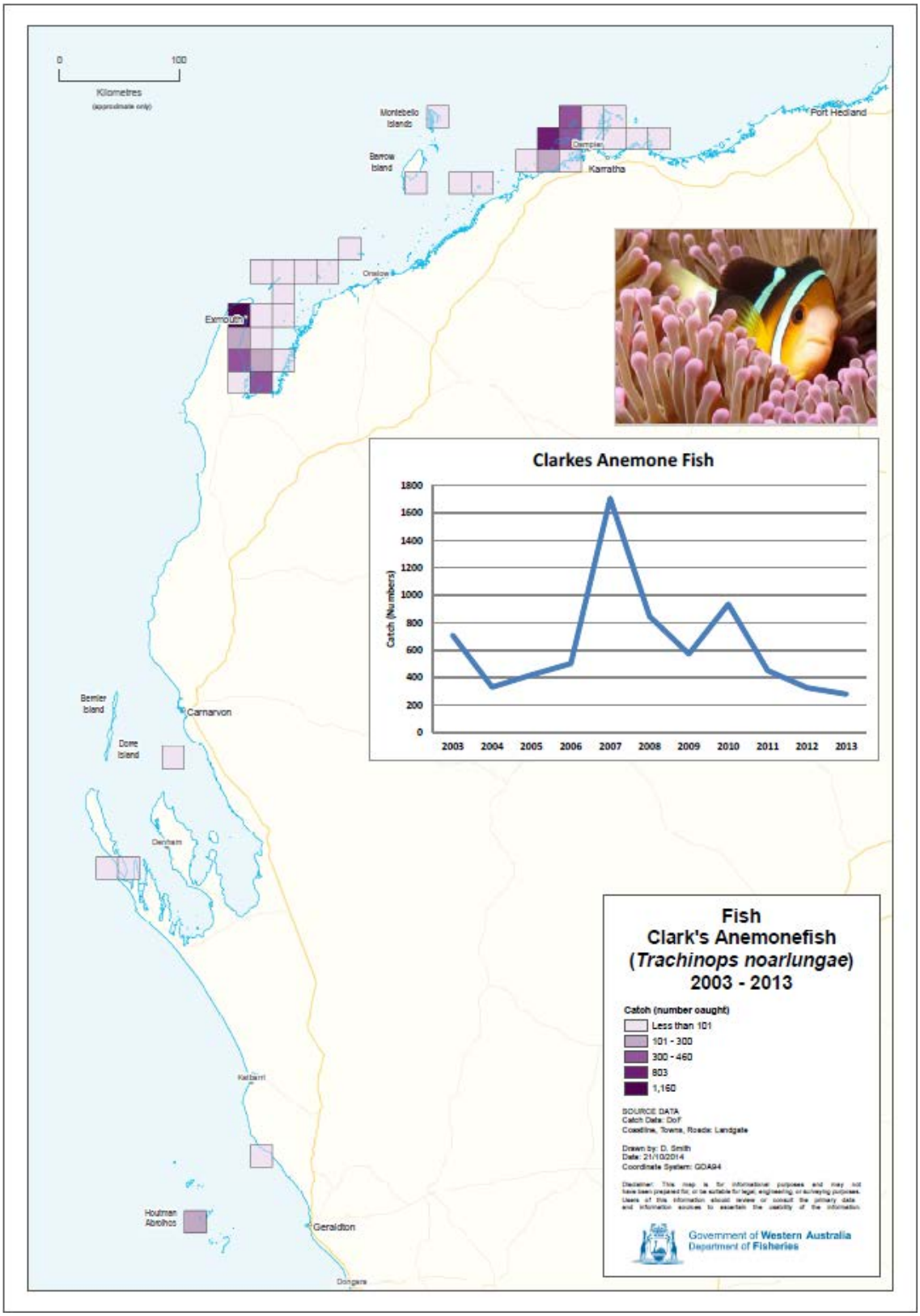

Figure 13 – Catch and distribution of Clark's Anemone fish.

5.1.2 *Blue-lined and yellow-lined hulafish (Trachinops brauni* **and** *T. noarlungae)*

Spatial distribution: Endemic to southern WA (Recherche Archipelago to the Houtman Abrolhos Islands).

Habitat: Observed in small aggregations on in-shore coral reefs, and in larger schools near the entrance to caves and large overhangs, to depth of at least 50 metres.

Reproduction: In at least one species of *Trachinops*, males brood relatively low numbers of eggs by wrapping their body around the egg mass.

Harvest level: Targeted off the Perth metropolitan area. Annual catches of both species has varied between approximately 100 and 2,000 individuals over the period 2003 to 2013 (Figure 14 and Figure 15).

Rationale for inclusion: Endemism.

Risk rating and justification **(C1, L1 = 1 NEGLIGIBLE):** Reported catches are low given abundance and schooling nature of fish. Fish range extends to deeper waters and beyond diving depth providing a level of protection (natural refuge).

Treatment: No change to the existing management required.

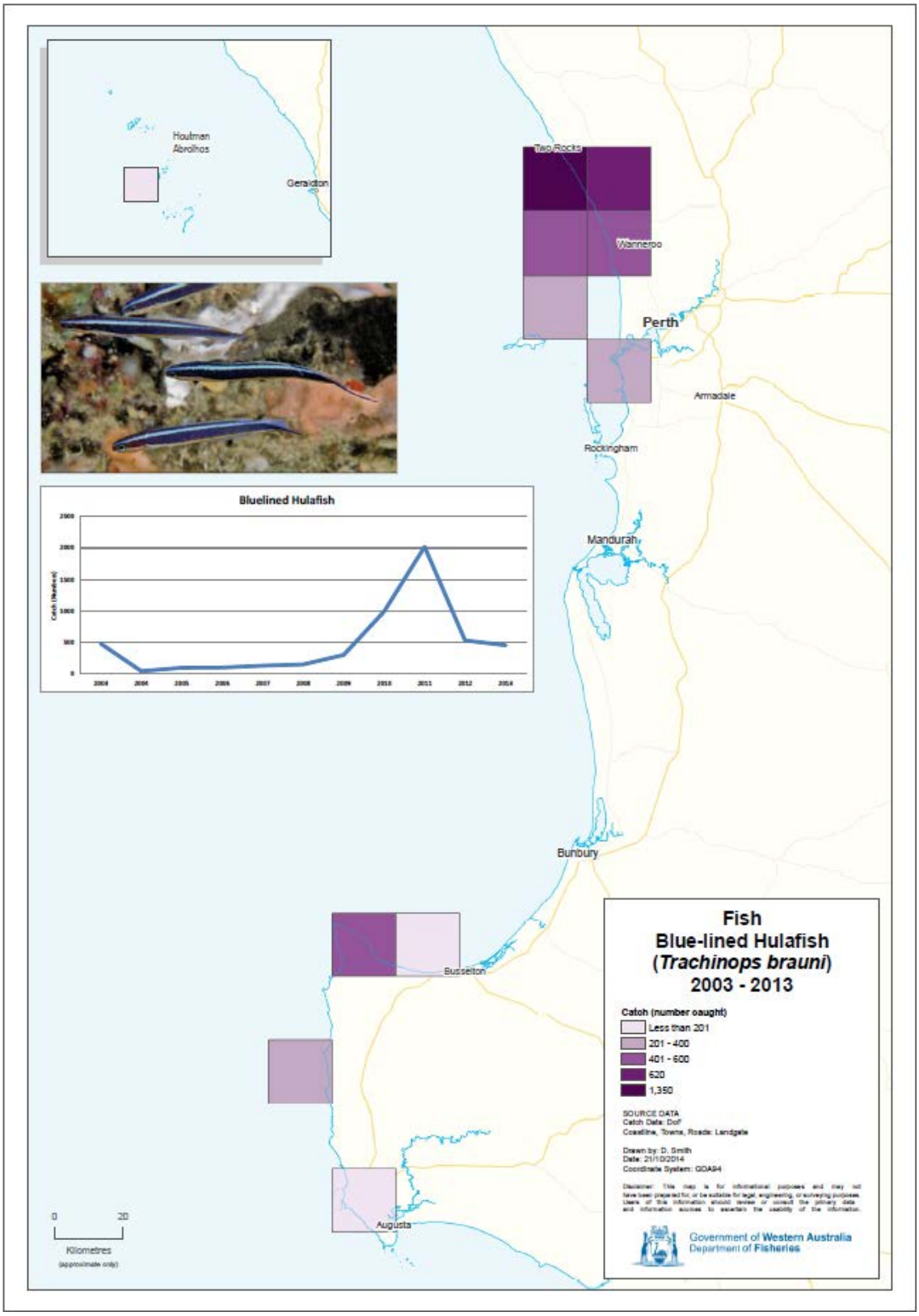

Figure 14 – Catch and distribution of blue-lined hulafish.

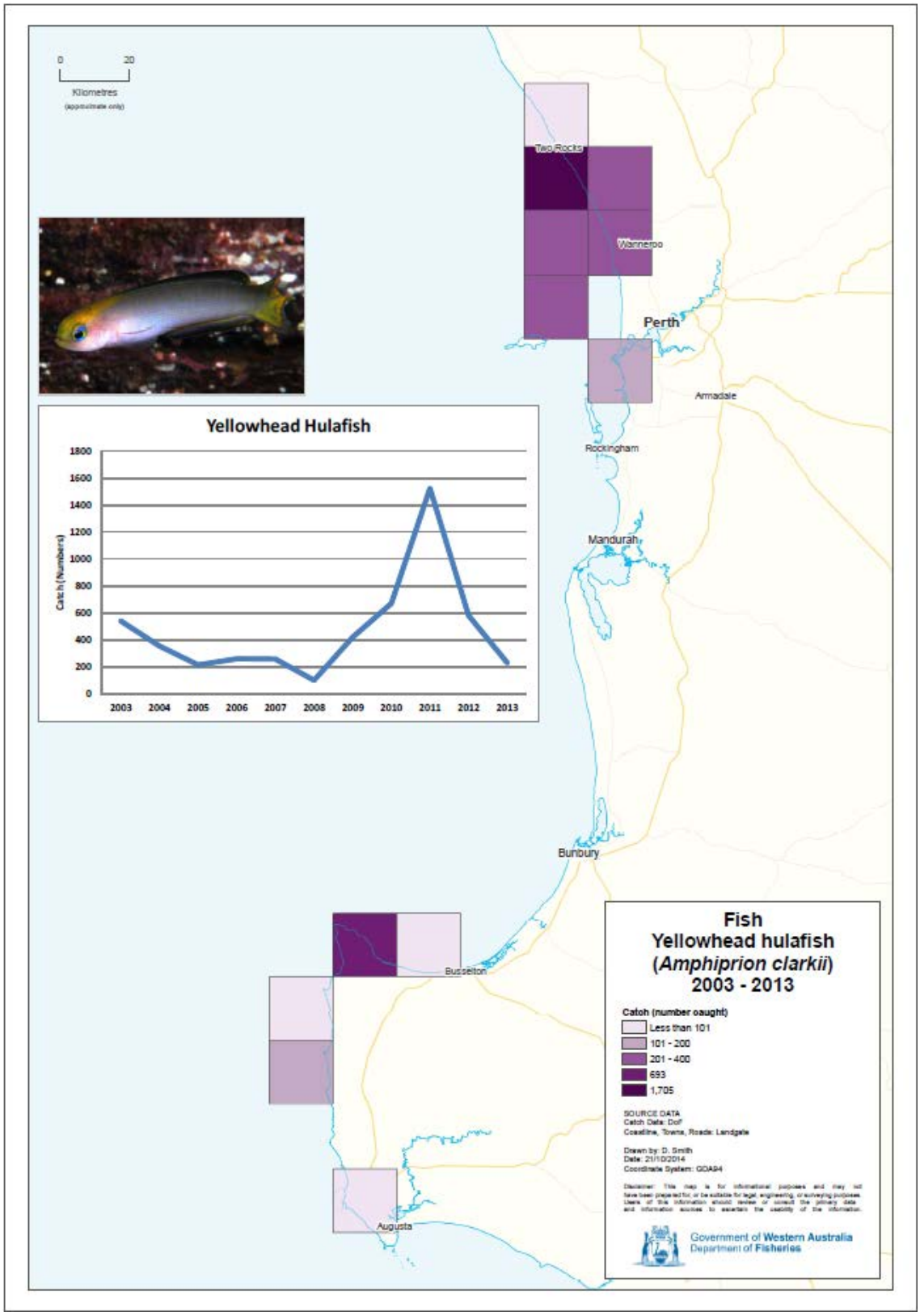

Figure 15 – Catch and distribution of yellowhead hulafish.

5.2 Syngnathids

The three *Hippocampus* species identified by DoE as being of particular concern in the 2014 NDF report and one pipefish species identified during the pre-assessment workshop were included for detailed assessment through the ERA process.

5.2.1 *Hippocampus elongatus/subelongatus (Western Australian Seahorse)*

Spatial distribution: Endemic to Western Australia.

Habitat: Typically shallow, sheltered water including estuaries, lagoons, shallow coastal environments, coral reefs. Observed to congregate around naturally occurring complex structures such as rock and rock outcrops, seagrass beds, sponges and marcroalgal matts as well as introduced substrate such as jetties, mooring ropes, pylons, shipwrecks etc.

Reproduction: Brood of sizes typically range from fewer than 100 eggs to several thousand. During mating female transfers eggs to the male pouch (for most Hippocampus species) or simple skin folds (vascularised brood area at the same location as the tail) where they are fertilised and remain for between 0 – 45 days (dependent on water temperature and species). If no brood pouch, young leave the male as they hatch from the egg. If there is a brood pouch, young are commonly retained for some time after they hatch. Pouch is sealed and has been described as 'male pregnancy' or live birth. Brood areas (pouches) do facilitate gas/nutrient exchange with the parent, but are located exterior to the body cavity. Sexual maturity thought to be between 6 – 12 months or size related. Mating systems complex due in part to male brooding and sex-role reversal. Some Hippocampus species form monogamous pair bonds for a breeding period. Many exhibit little evidence of mate fidelity. Clutch production highly variable and often occur more than once 'per season'. Increased water temperature thought to increase fecundity by speeding up the breeding cycle, as well as onset and duration of egg gestation.

Harvest level: Catch effort is spread across a number of locations and animals are caught to order. NDF level set at 525 individuals for 2014-2016. Annual catch up to 1,500 individuals over the period 2003 to 2013 (Figure 16).

Rationale for inclusion: Identified as species of concern by DoE. Endemic to Western Australia.

Risk rating and justification **(C1, L1 = 1 NEGLIGIBLE):** Industry constraints (limited access points, limited number of licences), distribution and low catch level suggests a negligible risk.

Treatment: No change to the existing management required. Identification issues make a detailed risk assessment problematic. Suggest more accurate species identification. MAF industry is encouraged to take *Hippocampus species* samples to the WA museum for formal identification to ensure accurate CAES records.

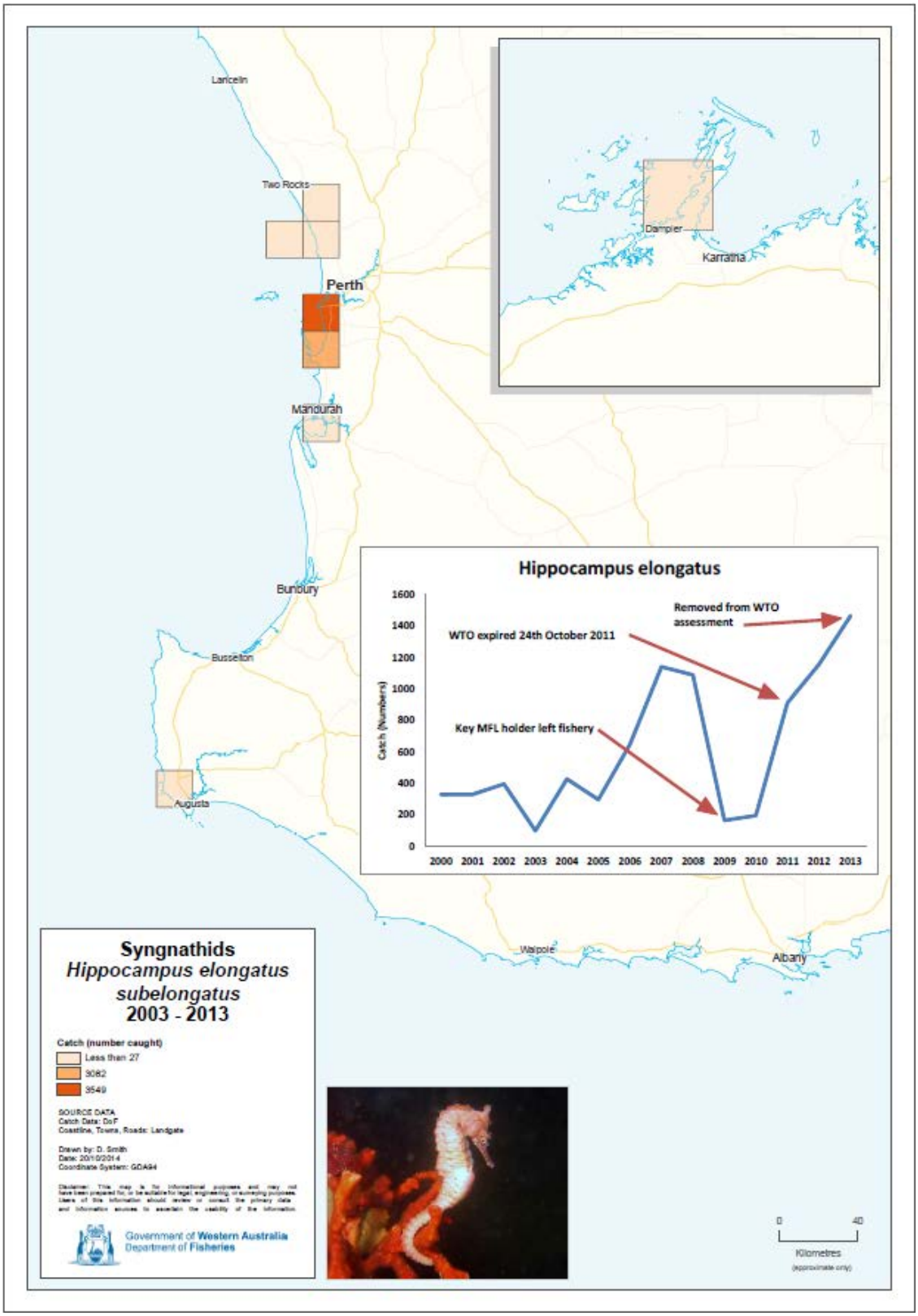

Figure 16 – Catch and distribution of *Hippocampus elongatus/subelongatus.*

5.2.2 *Hippocampus angustus (Western Spiny Seahorse)*

Spatial distribution: Northern Australia, Shark Bay – north.

Habitat: Same as *Hippocampus elongates* (above).

Reproduction: Same as *Hippocampus elongates* (above).

Harvest level: Catch effort is spread across a number of locations and animals are caught to order. NDF level set at 96 individuals for 2014-2016. Annual catch up to 200 individuals over the period 2003 to 2013 (Figure 17).

Rationale for inclusion: Identified as species of concern by DoE.

Risk rating and justification **(C1, L1 = 1 NEGLIGIBLE):** Industry constraints (limited access points, limited number of licences), distribution and low catch level suggests a negligible risk.

Treatment: No change to the existing management required. Identification issues make a detailed risk assessment problematic. Suggest more accurate species identification. MAF industry is encouraged to take *Hippocampus species* samples to the WA museum for formal identification to ensure accurate CAES records.

5.2.3 *Hippocampus tuberculatus (Knobby Seahorse)*

Spatial distribution: Northern Australia, Perth – north.

Habitat: Same as *Hippocampus elongates* (above).

Reproduction: Same as *Hippocampus elongates* (above).

Harvest level: Catch effort is spread across a number of locations and animals are caught to order. NDF level set at 83 individuals for 2014-2016. Annual catch up to 30 individuals over the period 2003 to 2013 (Figure 18).

Rationale for inclusion: Identified as species of concern by DoE.

Risk rating and justification **(C1, L1 = 1 NEGLIGIBLE):** Industry constraints (limited access points, limited number of licences), distribution and low catch level suggests a negligible risk.

Treatment: No change to the existing management required. Identification issues make a detailed risk assessment problematic. Suggest more accurate species identification. MAF industry is encouraged to take *Hippocampus species* samples to the WA museum for formal identification to ensure accurate CAES records.

5.2.4 *Trachyrhamphus bicoarctata (Short-tailed pipefish)*

Spatial distribution: Indo-West Pacific.

Habitat: Inhabits subtidal lagoon and seaward reefs, usually among algae or seagrasses. Often seen on sand and mud areas, prone to currents; usually soft bottom to about 25 m.

Reproduction: Similar to *Hippocampus elongates* (above).

Harvest level: Annual catch up to 100 individuals over the period 2003 to 2013 (Figure 19).

Rationale for inclusion: Little known about WA pipefish populations.

Risk rating and justification **(C1, L1 = 1 NEGLIGIBLE):** Industry constraints (limited access points, limited number of licences), distribution and low catch level suggests a negligible risk.

Treatment: No change to the existing management required. Identification issues make a detailed risk assessment problematic. Suggest more accurate species identification. MAF industry is encouraged to take *Hippocampus species* samples to the WA museum for formal identification to ensure accurate CAES records.

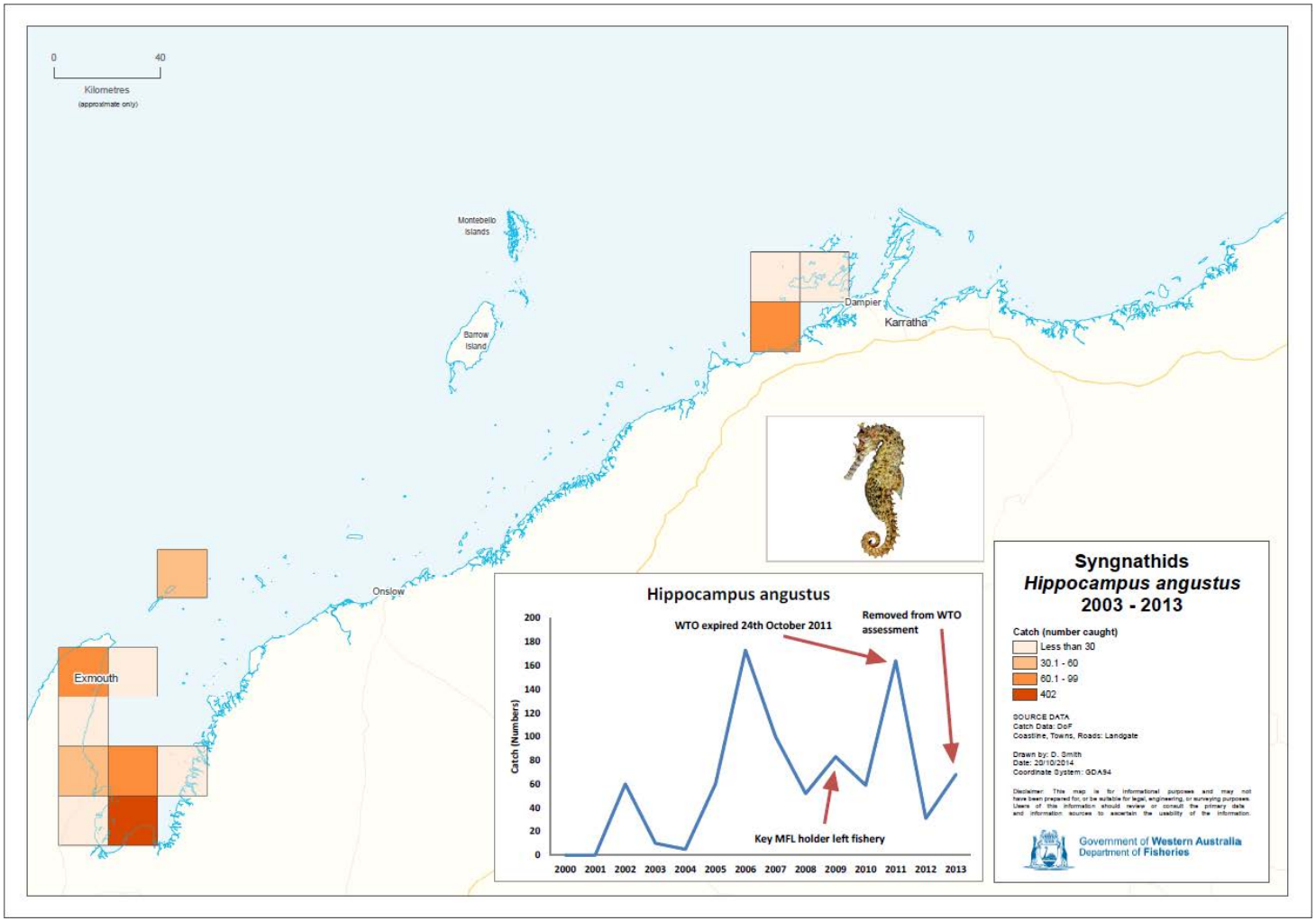

Figure 17 – Catch and distribution of *Hippocampus angustus.*

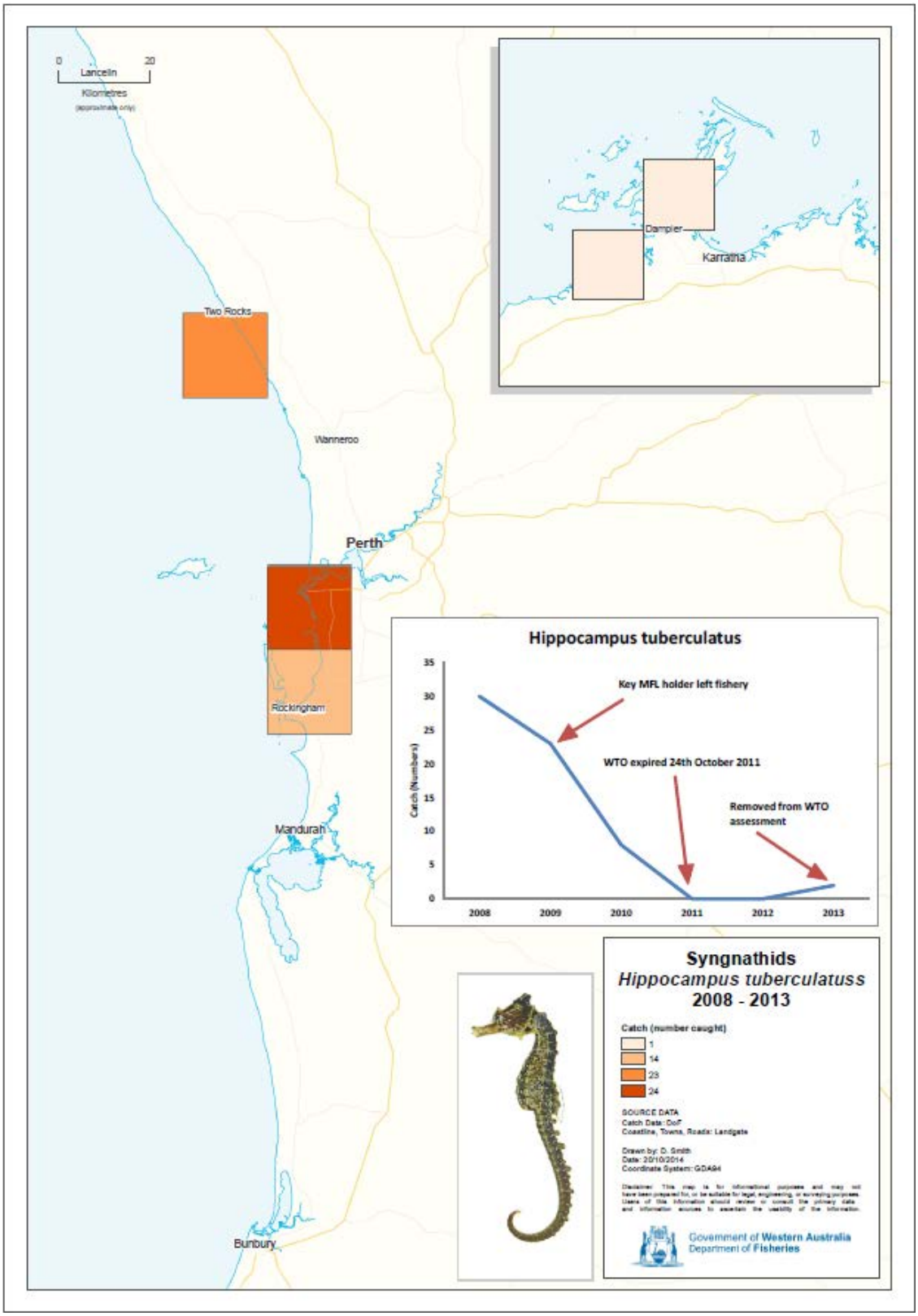

Figure 18 - Catch and distribution of *Hippocampus tuberculatus.*

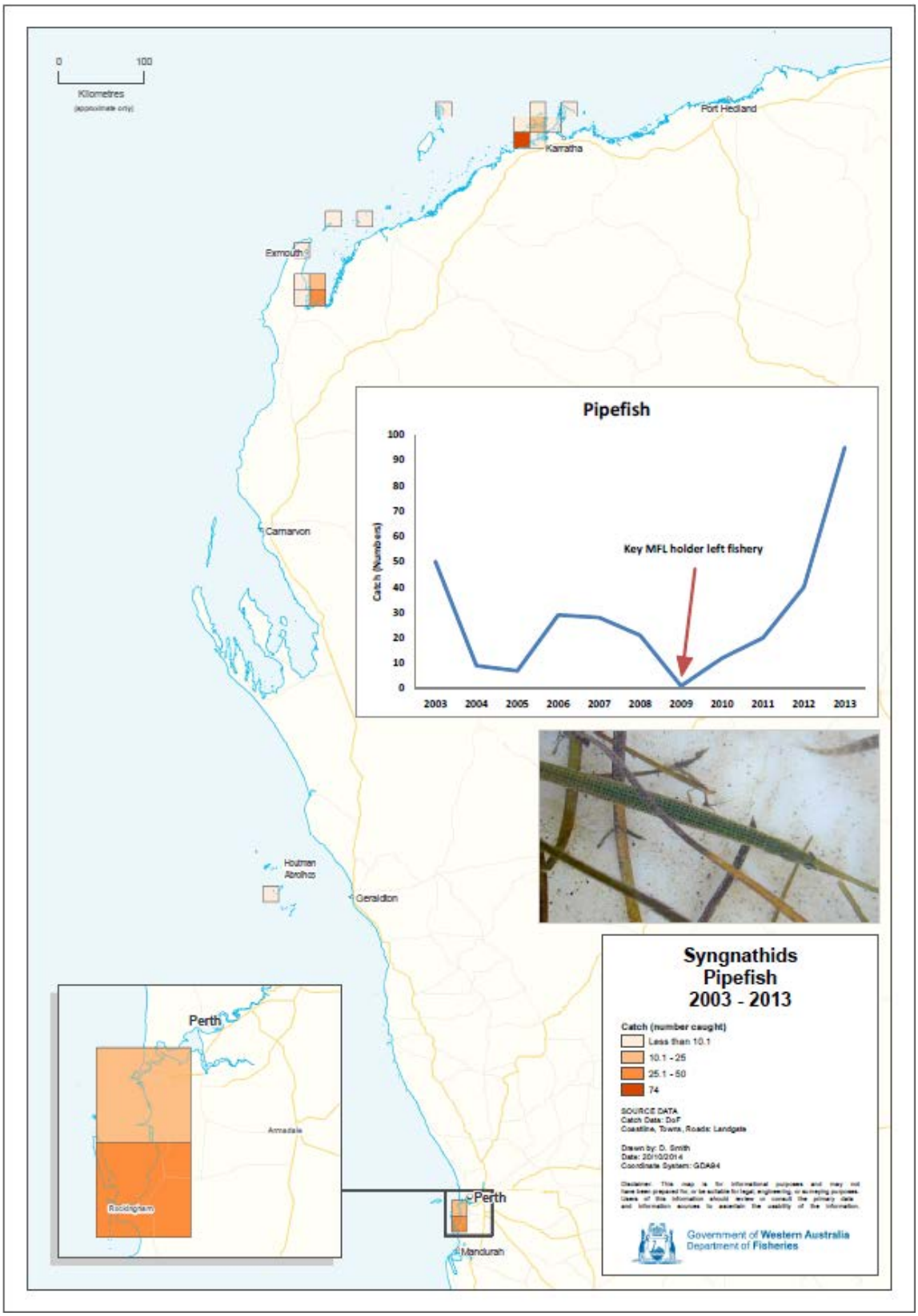

Figure 19 – Catch a distribution of pipefish.

5.3 Coral

The six hard coral species identified by DoE as being of particular concern in the 2014 NDF report and the three endemic corals identified during the pre-assessment workshop were included for detailed assessment through the ERA process. To enable the MAF's aspiration for a level of growth in the allowable harvest to be considered, a doubling of the historic harvest level (2003 to 2008) of all coral species over the next five year period (2015 to 2020) was also formally assessed through the ERA process.

5.3.1 *Duncanopsammia auxifuga (Whisker coral)*

Spatial distribution: Common throughout Northern Australia recorded from the Kimberley south to Geraldton, however, reported to be globally rare. Considered to be the most common coral species off Exmouth by MAF operators.

Habitat: Occurs in inter-reef habitat to 30m (where majority of collection occurs) and as shallow as 2m in coastal waters. Favours turbid, silty/sandy inter-tidal waters (not open clear water) with strong currents, typical of the near shore environment of North West WA. Considered to successfully survive there because polyps have spaces which let sand/mud particles through (sieve like) and so avoids being smothered. Typically found in colonies of branching or clustered individuals near the foundation of a reef. Usually attach to solid substrate but in areas where soft horizontal substrates predominate.

Reproduction: Broadcast spawners, often releasing large numbers of eggs and sperm into the water column where fertilisation occurs. Spawning is often synchronised by lunar phases and/or water temperature. This enhances the chance of fertilisation, as sex cells are receptive only for a short period of time, and are quickly dispersed by the currents. Larvae develop from fertilised eggs and remain planktonic for days to weeks, until they settle and transform (metamorphose) into founder polyps – often tens to hundreds of kilometres away from their parents.

Harvest level: Small single colonies popular because of strong base. Industry advice indicates that it grows back from collection after a year fallow and can therefore opportunistically work the same site over a period of time (years). NDF level set at 550 kilograms for 2014-2016. Annual catch has varied between approximately 100 and 900 kilograms over the period 2003 to 2013 (Figure 20).

Rationale for inclusion: Identified as species of concern by DoE.

Risk rating and justification **(C3, L1 = 3 LOW):** Broadcast spawners. CAES data indicates spread effort within fishing range. Anecdotal MAF industry advice indicates repeated take within same range for long period and no sign of depletion. Small portion of stock targeted due to market preference for size and colour characteristics. Industry constraints (limited access points, limited number of licences), distribution and low catch level suggests a low risk.

Treatment: No change to the existing management required. An assessment of doubling the historic harvest over the next five year period resulted in no material change to the risk rating.

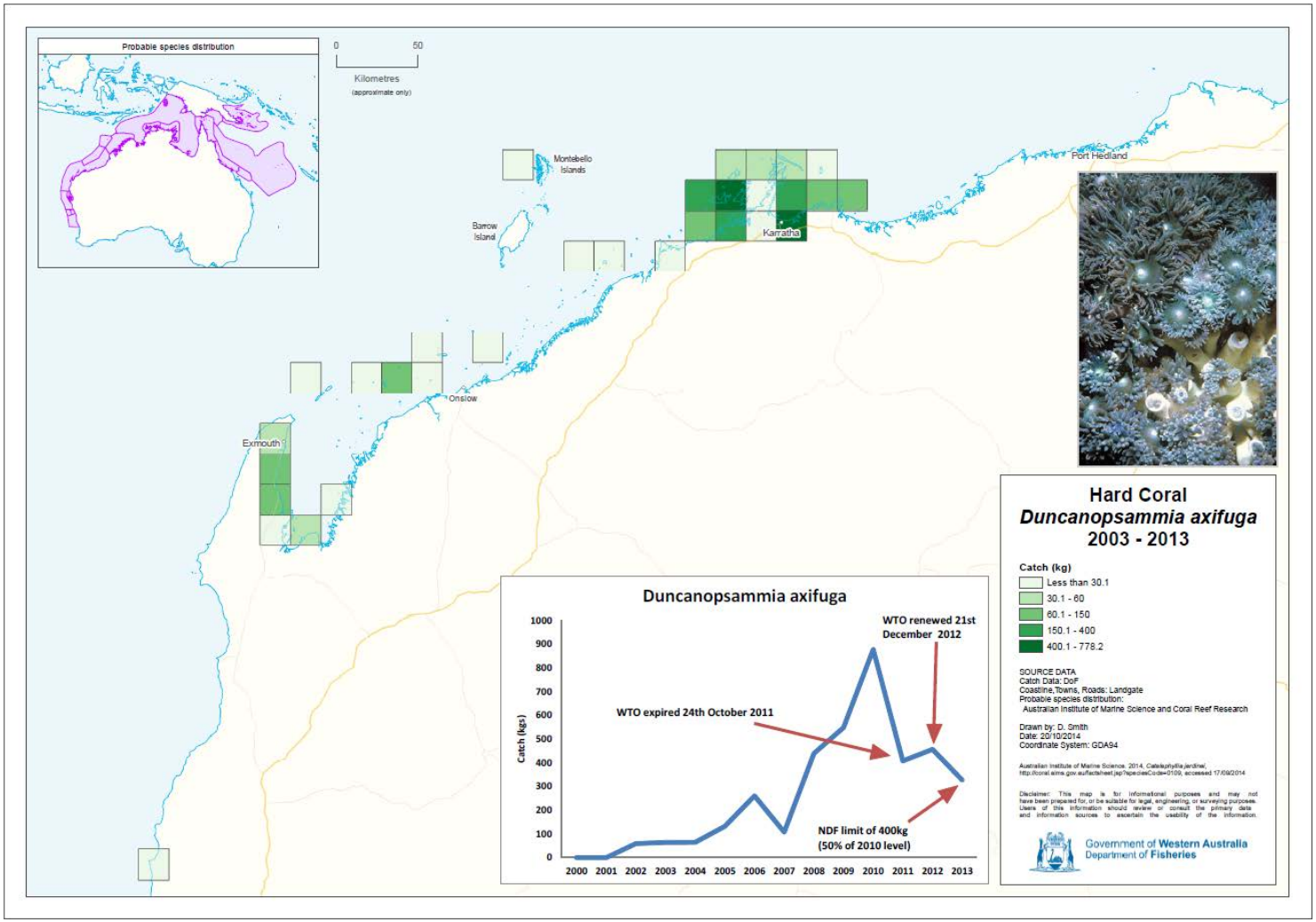

Figure 20 – Catch and distribution of *Duncanopsammia auxifuga*.

5.3.2 *Euphyllia ancora (Hammer coral)*

Spatial distribution: Reported to be very common but patchy distribution in WA, particularly common between the Houtman Abrolhos Islands and Broome.

Habitat: Found on reef slopes - intertidal to deeper waters (max 30 m). Common on reef slopes in large colonies, often clustered together on the same reef. Prefer turbid water and thrive with bright indirect light and a gentle current. Large colonies also found in shallow environments exposed to moderate wave action. Euphyllia spp. all have commensal shrimp species associated with them. Sweeper tentacles with nematocysts are a defensive adaptation of Euphyllia corals – highly toxic to other coral species.

Reproduction: Gonochoric broadcast spawner. Also capable of asexual reproduction - sweeper tentacles can stick to substrate and break off where they can form new colonies; tentacle tips with swollen acrospheres can become detached and the drifting tips (sealed like neutrally buoyant water balloons) can stick onto any surface, colonizing and potentially damaging other corals.

Harvest level: Fragments collected by hand from parent colony. Small single colonies also collected. The death of any individual branch of any of the phaceoid species does not affect the colony as a whole. NDF level set at 500 kilograms for 2014-2016. Annual catch has varied between approximately 100 and 600 kilograms over the period 2003 to 2013 (Figure 21).

Rationale for inclusion: Identified as species of concern by DoE.

Risk rating and justification **(C2, L1 = 2 NEGLIGIBLE):** Commonly found, broadcast spawner, readily colonises from breakage. Small portion of stock targeted due to market preference for size and colour characteristics. Industry constraints (limited access points, limited number of licences), distribution and low catch level suggests a low risk.

Treatment: No change to the existing management required. An assessment of doubling the historic harvest over the next five year period resulted in no material change to the risk rating.

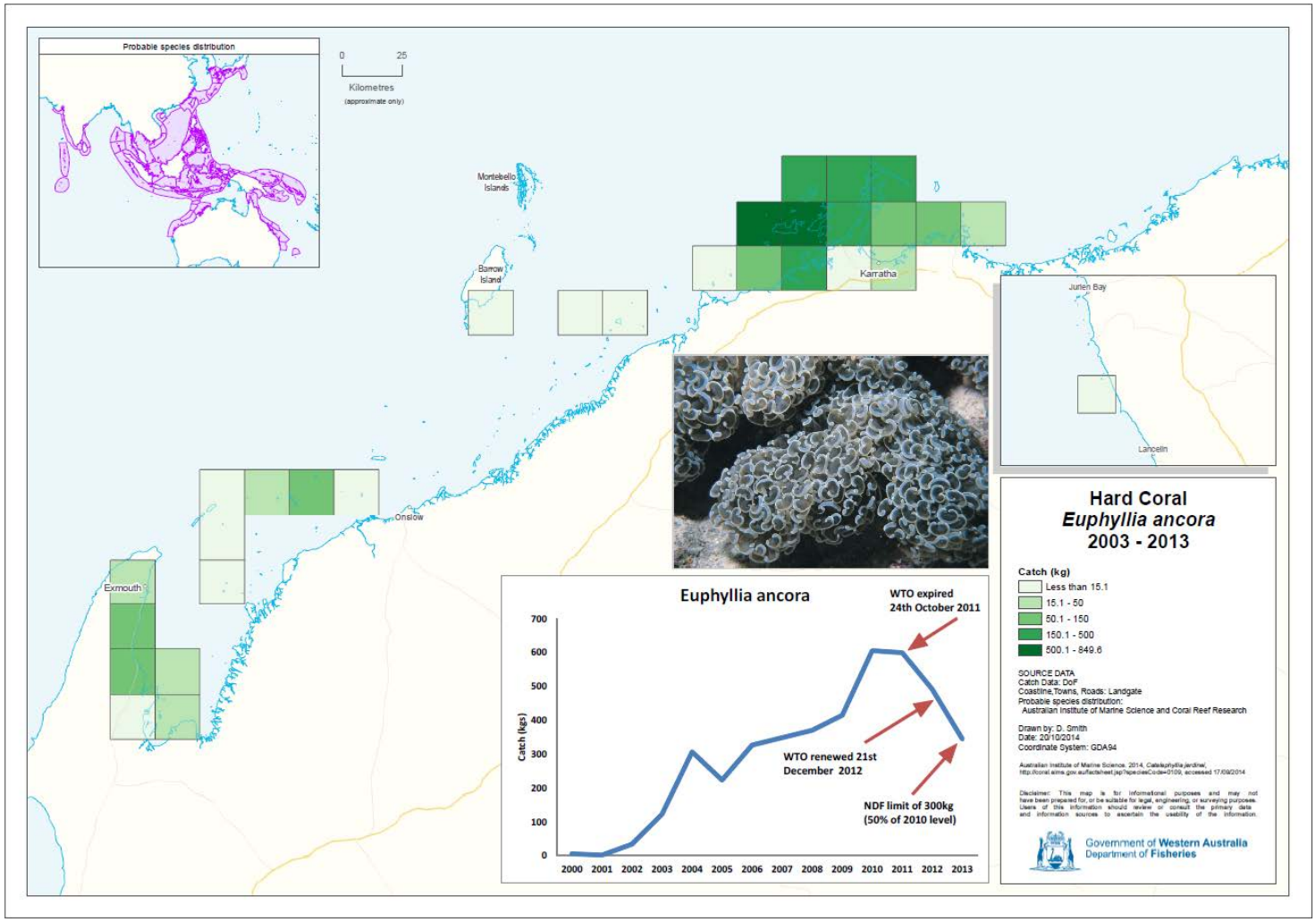

Figure 21 – Catch and distribution of *Euphyllia ancora.*

5.3.3 *Trachyphyllia geoffroyi (Brain coral)*

Spatial distribution: Global distribution, reported as rare on reefs but common around continental islands and some inter-reef areas. Common between Exmouth Gulf and Port Hedland. Smaller colonies are more common as large colonies are known to be impacted by cyclones. Large individuals observed in the sheltered waters of the Dampier Archipelago.

Habitat: Unique solitary corals (occasionally colonial). Commonly found between intertidal and 17 m depth, very common at 10 m depth. Prefers areas of strong current. Many small individuals observed. Some found in muddy bottoms in protected areas including seagrass beds, sandy bottoms near reef base. Free living corals. Typically attached while immature and become detached as they mature (attachment scars often present). Frequently found where there are other free living corals (such as Fungia).

Reproduction: Broadcast spawners, often releasing large numbers of eggs and sperm into the water column where fertilisation occurs. Spawning is often synchronised by lunar phases and/or water temperature. This enhances the chance of fertilisation, as sex cells are receptive only for a short period of time, and are quickly dispersed by the currents. Larvae develop from the fertilised eggs, and remain planktonic for days to weeks, until they settle and transform (metamorphose) into founder.

Harvest level: Picked up by hand (unattached to benthic substrate). NDF level set at 450 kilograms for 2014-2016. Annual catch has varied between approximately 50 and 600 kilograms over the period 2003 to 2013 (Figure 22).

Rationale for inclusion: Identified as species of concern by DoE.

Risk rating and justification **(C2, L1 = 2 NEGLIGIBLE):** As solitary single animals where whole polyp is removed through collection slightly increases risk. Populations are considered to be dense and common, although vulnerable to cyclone damage. Small portion of stock targeted due to market preference for size and colour characteristics. Industry constraints (limited access points, limited number of licences), distribution and low catch level suggests a low risk.

Treatment: No change to the existing management required. An assessment of doubling the historic harvest over the next five year period resulted in no material change to the risk rating.

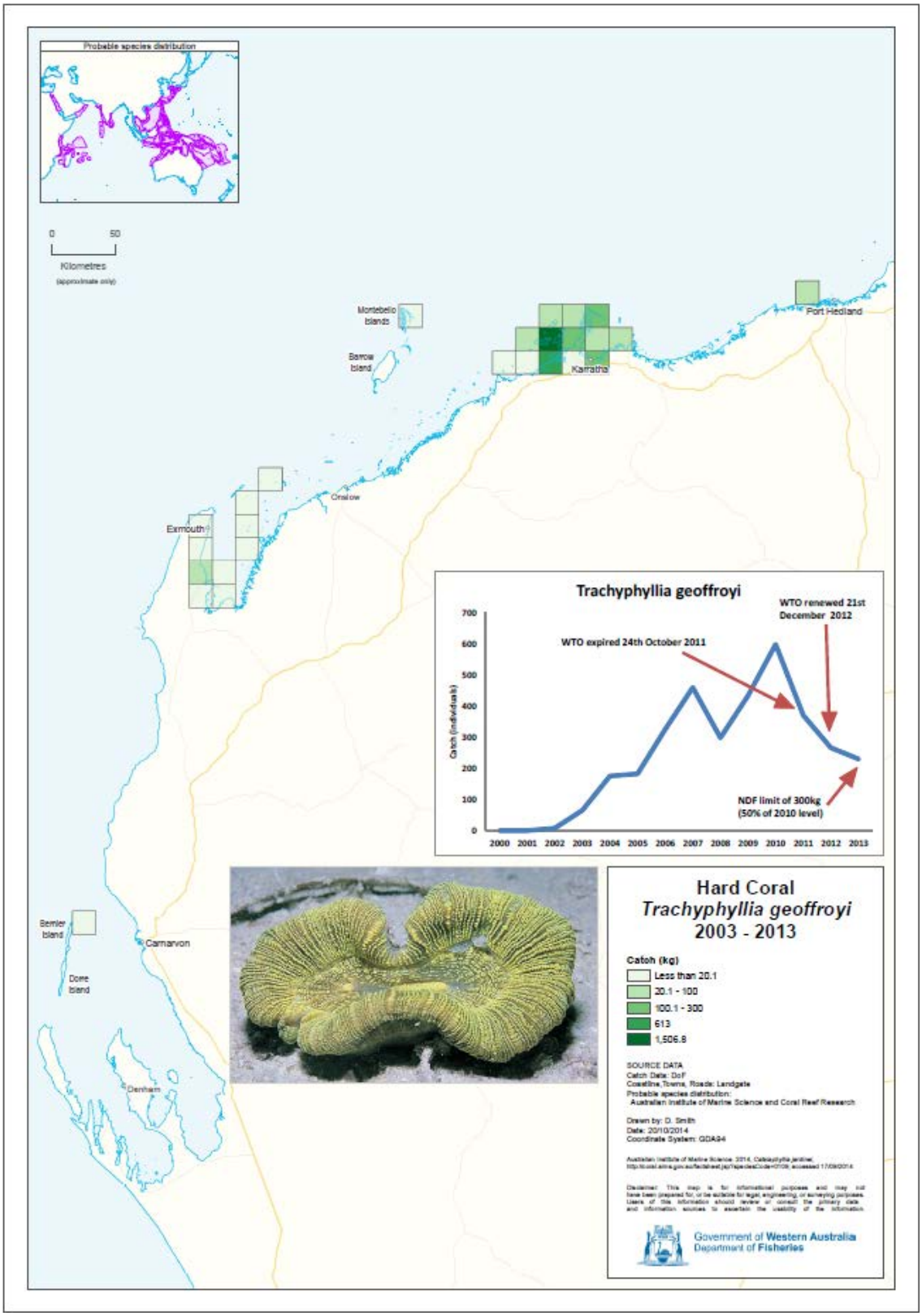

Figure 22 – Catch and distribution of *Trachyphyllia geoffroyi*.

5.3.4 *Euphyllia glabrecens (Torch coral)*

Spatial distribution: Considered by industry to be widely distributed between Exmouth – south end of Barrow Island; Montebello Islands, Cleaverville Reef. Large quantities washed up on 80 Mile Beach. Common off Port Hedland. Not observed in Shark Bay by industry. Found out of the water at low tide to 17 metres.

Habitat: Occupies a wide variety of habitats, mainly on reefs (not inter tidal). Most common on reef slopes, often in deeper waters than most other species collected for aquarium trade. Large colonies are usually found in shallow environments exposed to moderate wave action (0-80m). Very light in weight and known to be tolerant to bleaching/ high temperature variability and desiccation (survives in warm rock pools). Preference for (possibly relies on) silty water, where it is thought to feed from small invertebrate animals. Typically found in dense concentrations of the same colour in particular areas. *Euphyllia spp.* all have commensal shrimp species associated with them, and usually colonial, although single polyps of some species may be common. The skeleton of this distinctive coral is obscured day and night by its extended fleshy polyps. The growth form is phaceloid in which the corallites arise from a separate encrusting base. They are usually dome-shaped. Have specially adapted long sweeper tentacles with powerful stinging cells that are used in defence or to attack other corals growing nearby, which may be extended day and night to capture prey.

Reproduction: Hermaphroditic brooder. Rapid grow rate.

Harvest level: MAF industry reports that a good size 'torch' taking 2 -3 years to grow to 'marketable' size', emphasiszing fast rate of growth. NDF level set at 320 kilograms for 2014-2016. Annual catch has varied between approximately 150 and 500 kilograms over the period 2003 to 2013 (Figure 23).

Rationale for inclusion: Identified as species of concern by DoE.

Risk rating and justification **(C2, L1 = 2 NEGLIGIBLE):** Rapid growth. Small portion of stock targeted due to market preference for size and colour characteristics. Industry constraints (limited access points, limited number of licences), distribution and low catch level suggests a low risk.

Treatment: No change to the existing management required. An assessment of doubling the historic harvest over the next five year period resulted in no material change to the risk rating.

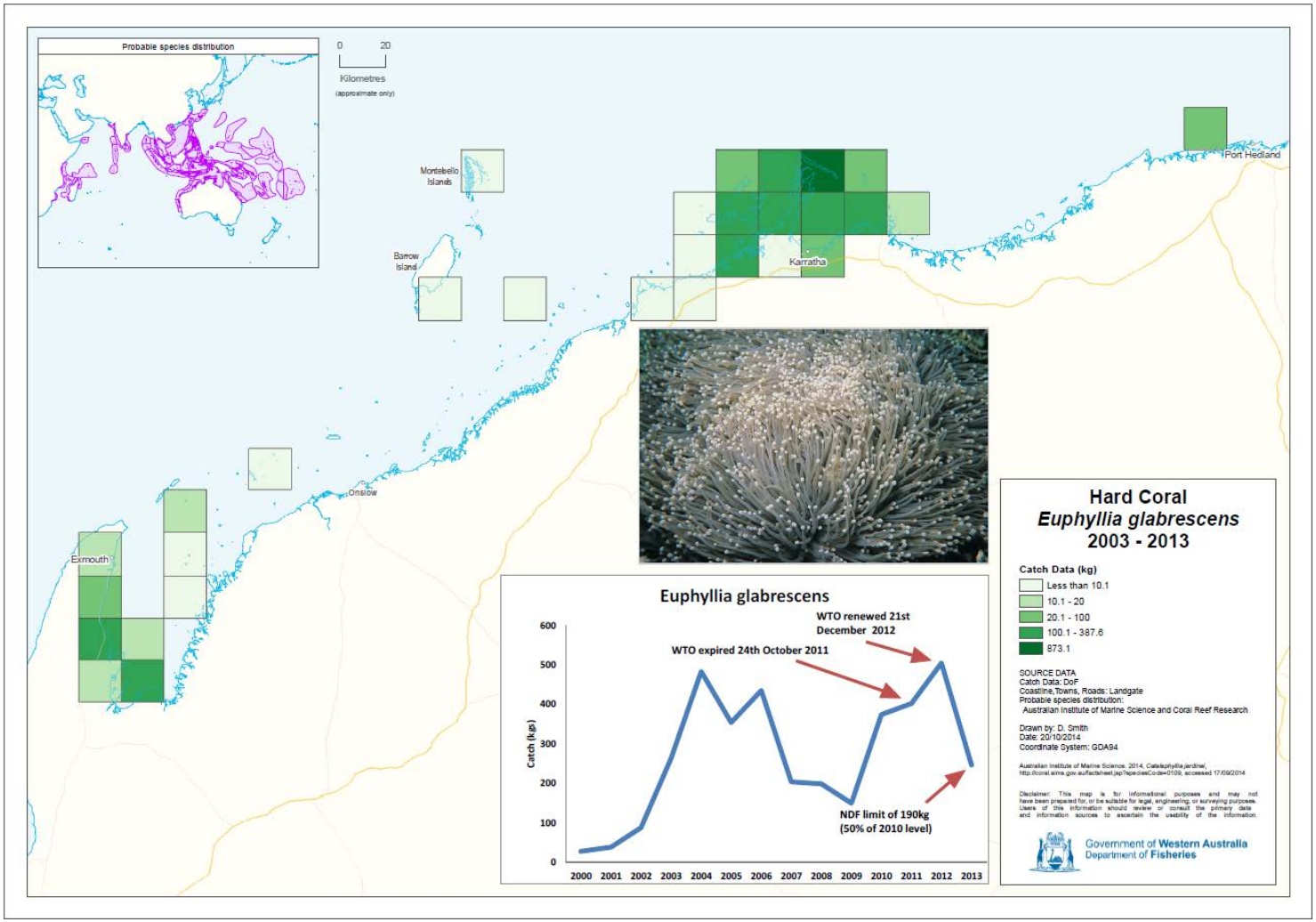

Figure 23 – Catch and distribution of *Euphyllia glabrecens*.

5.3.5 *Cataphyllia jardinei (Elegant coral)*

Spatial distribution: This species is widespread and rare throughout tropical waters of the Indian and Pacific Oceans. Industry reports it commonly occurs between Exmouth to Karratha, between 0 – 19 metres.

Habitat: Prefers protected, turbid waters with a gentle current (so as not to lift them from soft substrate) 0 – 30 m deep. Common in lagoonal areas with soft or muddy bottom and inner reef areas where they are commonly found with seagrass. Often temporarily attached to substrate when young but break away to become free living when mature. Cone shaped base which is buried in soft substrate. Inflated polyps and waving tentacles make them look similar to an anemone.

Reproduction: Gonochoric broadcast spawners, often releasing large numbers of eggs and sperm into the water column where fertilisation occurs. Spawning is often synchronised by lunar phases and/or water temperature. This enhances the chance of fertilisation, as sex cells are receptive only for a short period of time, and are quickly dispersed by the currents. Larvae develop from the fertilised eggs, and remain planktonic for days to weeks, until they settle and transform (metamorphose) into founder polyps – often tens to hundreds of kilometres away from their parents. Characteristically slow grower.

Harvest level: Heavily collected and potentially vulnerable to localised depletion. For this reason a precautionary daily limit in Dampier region (5 kg per day) applies. NDF level set at 180 kilograms for 2014-2016. Annual catch has varied between approximately 50 and 500 kilograms over the period 2003 to 2013 (Figure 24).

Rationale for inclusion: Identified as species of concern by DoE.

Risk rating and justification **(C2, L1 = 2 NEGLIGIBLE):** Potential catch impact is higher due to slow rate of growth, removal of whole colony, high value, and anecdotal evidence of possible localised depletion in Dampier Archipelago. Small portion of stock targeted due to market preference for size and colour characteristics. Industry constraints (limited access points, limited number of licences), distribution and low catch level suggests a low risk.

Treatment: No change to the existing management required. An assessment of doubling the historic harvest over the next five year period resulted in no material change to the risk rating.

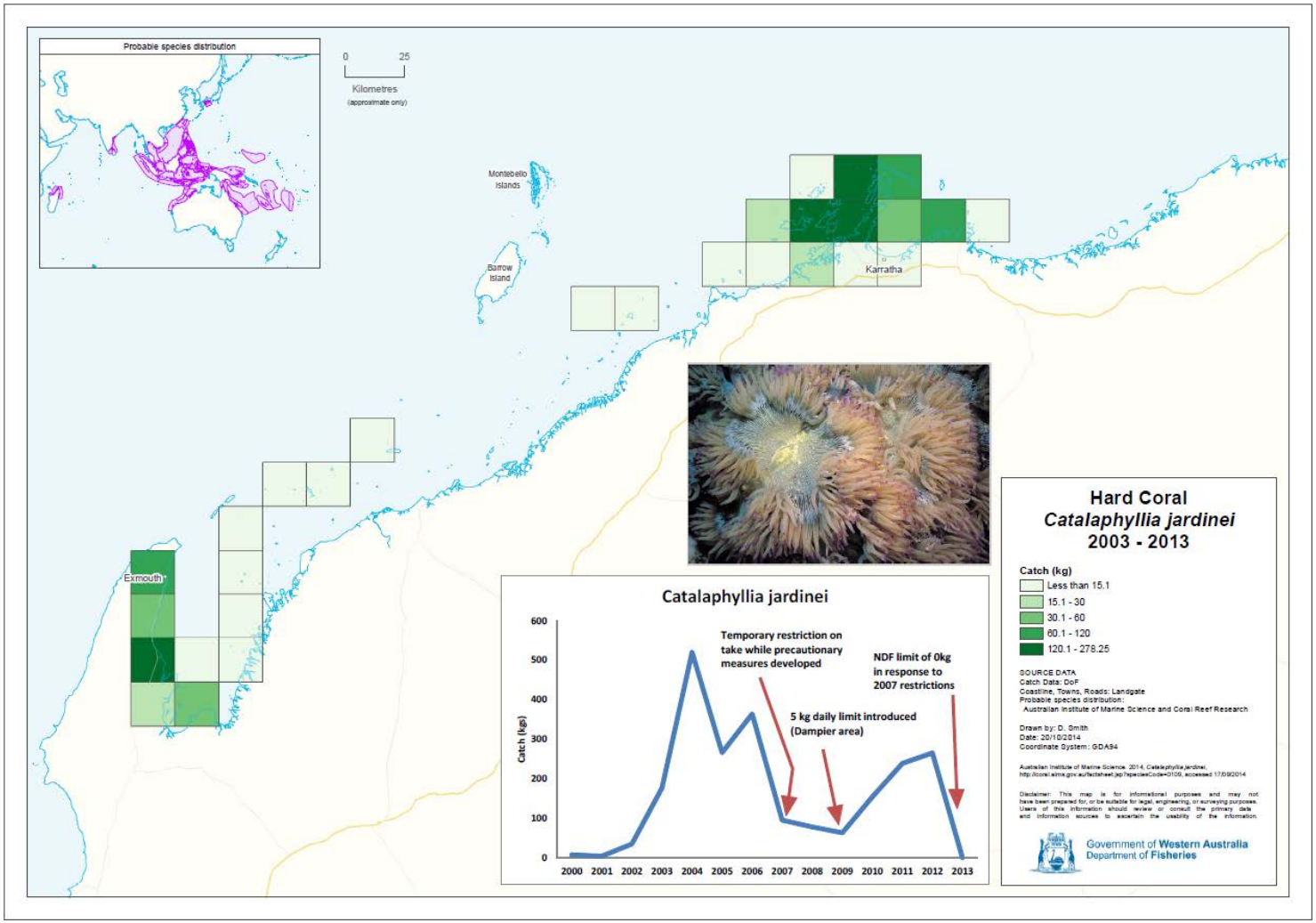

Figure 24 – Catch and distribution of *Cataphyllia jardinei.*

5.3.6 *Moseleya latistellata (Stony coral)*

Spatial distribution: In the Indo-West Pacific, this species is found in the central Indo-Pacific, Australia, Southeast Asia, Japan and East China Sea. This is an uncommon species. In WA common from Shark Bay to Port Hedland. Found to 20 metres. Extends south to the Abrolhos Islands.

Habitat: This species is restricted to turbid water with muddy substrates. It is also occurs in muddy areas exposed at low tide. This species occurs in shallow, tropical reef environments. Colonies are generally small, consisting of one or several corallites, and are often unattached. This species is found on the back and fore slope of the reef and in lagoons to 10 m.

Reproduction: Hermaphroditic brooder.

Harvest level: Taken by hand as single colonies – does not fragment well. NDF level set at 150 kilograms for 2014-2016. Annual catch to 300 kilograms over the period 2003 to 2013 (Figure 25).

Rationale for inclusion: Identified as species of concern by DoE.

Risk rating and justification **(C1, L1 = 1 NEGLIGIBLE):** Small portion of stock targeted due to market preference for size and colour characteristics. Industry constraints (limited access points, limited number of licences), distribution and low catch level suggests a low risk.

Treatment: No change to the existing management required. An assessment of doubling the historic harvest over the next five year period resulted in no material change to the risk rating.

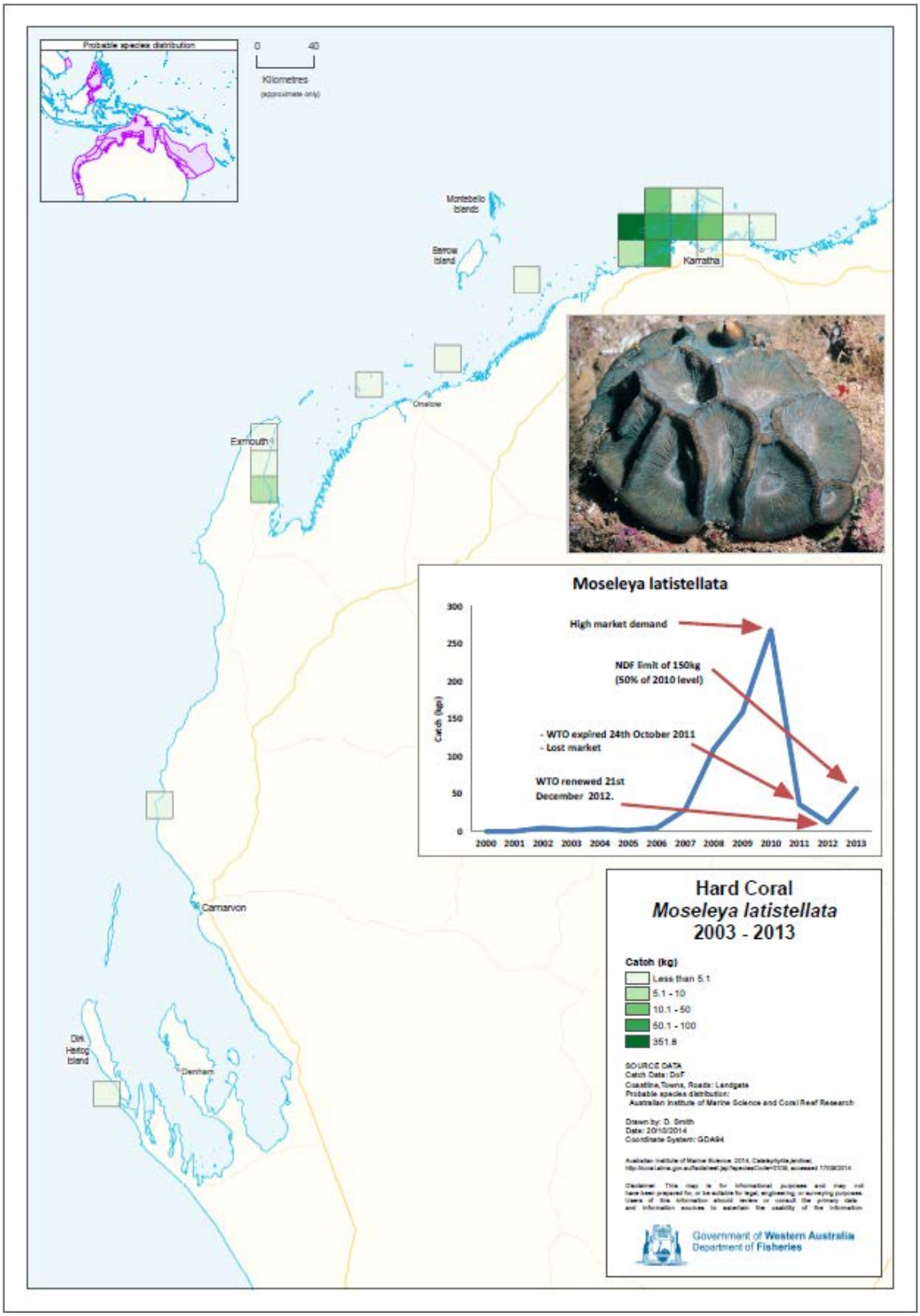

Figure 25 – Catch and distribution of *Moseleya latistellata*.

5.3.7 *Symphyllia wilsoni (Brain coral)*

Spatial distribution: Potentially endemic to Australia. Coastal reefs between Cape Naturaliste and Karratha. Unusually uncommon but very conspicuous. Common around Rottnest and Abrolhos Islands.

Habitat: Found on subtidal rocky foreshores of temperate localities from 3-15 m.

Reproduction: Hermaphroditic brooder.

Harvest level: MAF licencees typically collect whole colonies by hand. Annual catch to 600 kilograms over the period 2003 to 2013 (Figure 26).

Rationale for inclusion: Potential endemism.

Risk rating and justification **(C2, L1 = 2 NEGLIGIBLE):** Higher risk rating in view of potential endemism and harvest of take whole colony. However, considered to be a hardy, robust and common species with widespread WA distribution. Small portion of stock targeted due to market preference for size and colour characteristics. Industry constraints (limited access points, limited number of licences), distribution and low catch level suggests a low risk.

Treatment: No change to the existing management required. Potential for species to be endemic to WA. Industry is encouraged to forward samples to the WA Museum for accurate species identify confirmation. An assessment of doubling the historic harvest over the next five year period resulted in no material change to the risk rating.

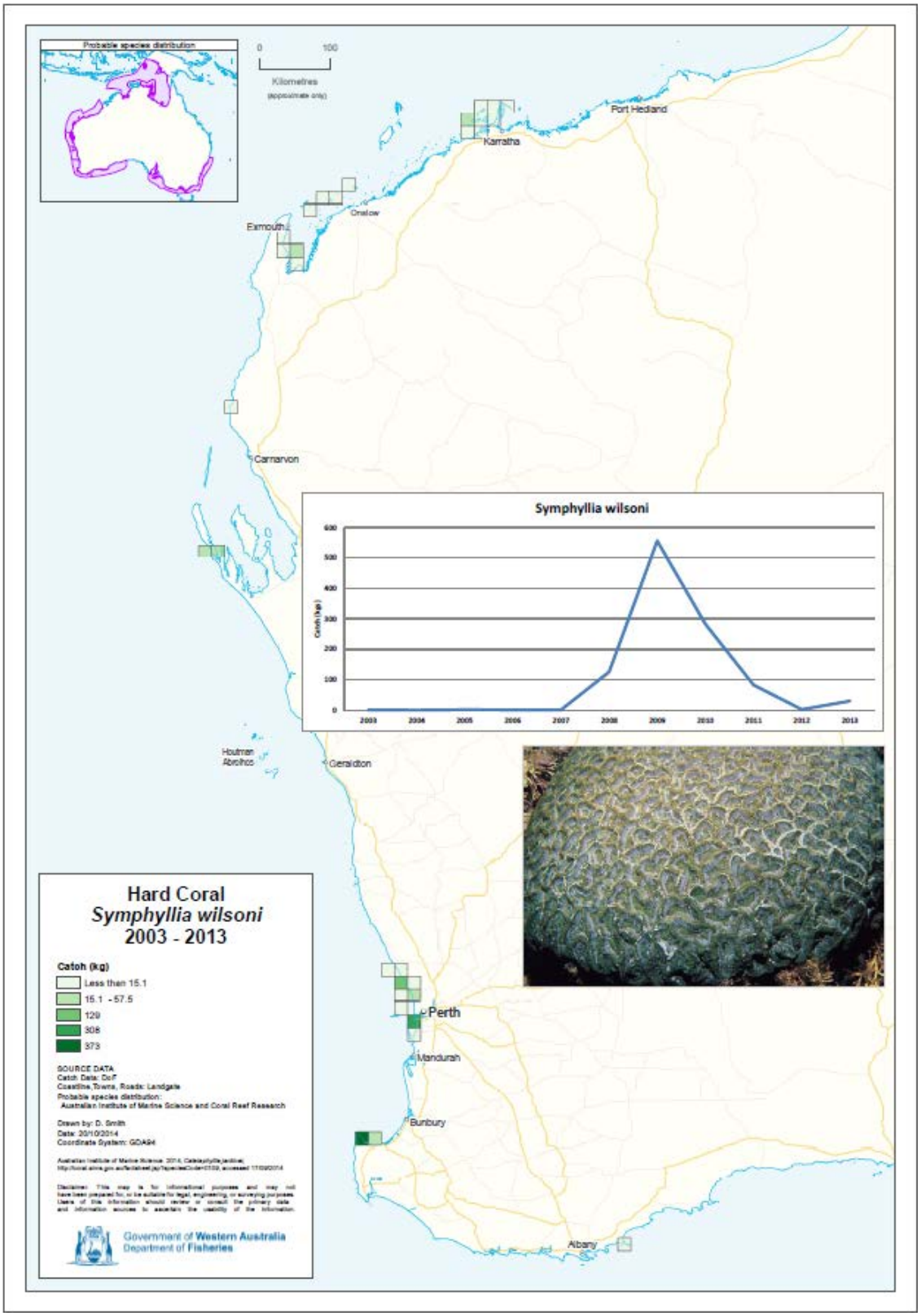

Figure 26 – Catch and distribution of *Symphyllia wilsoni.*

5.3.8 *Plerogyra sinuosa (Bubble coral)*

Spatial distribution: Indian and Pacific Oceans, ranging from the Red Sea, Gulf of Aden and southwest Indian Ocean, across the northern Indian Ocean to Southeast Asia, Japan and the East China Sea, and into the West and Central Pacific Ocean.

Habitat: Frequently found on protected reefs in lagoons, where it grows on vertical faces or under overhangs. Large colonies are often found on flat surfaces in turbid waters. It is known to occur between depths of 3 and 35 metres.

Reproduction: Little is known about the specific reproductive biology of the bubble coral, although it is likely to be able to reproduce both sexually and asexually.

Harvest level: Annual catch to 400 kilograms over the period 2003 to 2013 (Figure 27).

Rationale for inclusion: IUCN listed as 'near threatened'.

Risk rating and justification **(C2, L1 = 2 NEGLIGIBLE):** Small portion of stock targeted due to market preference for size and colour characteristics. Industry constraints (limited access points, limited number of licences), distribution and low catch level suggests a low risk.

Treatment: No change to the existing management required. An assessment of doubling the historic harvest over the next five year period resulted in no material change to the risk rating.

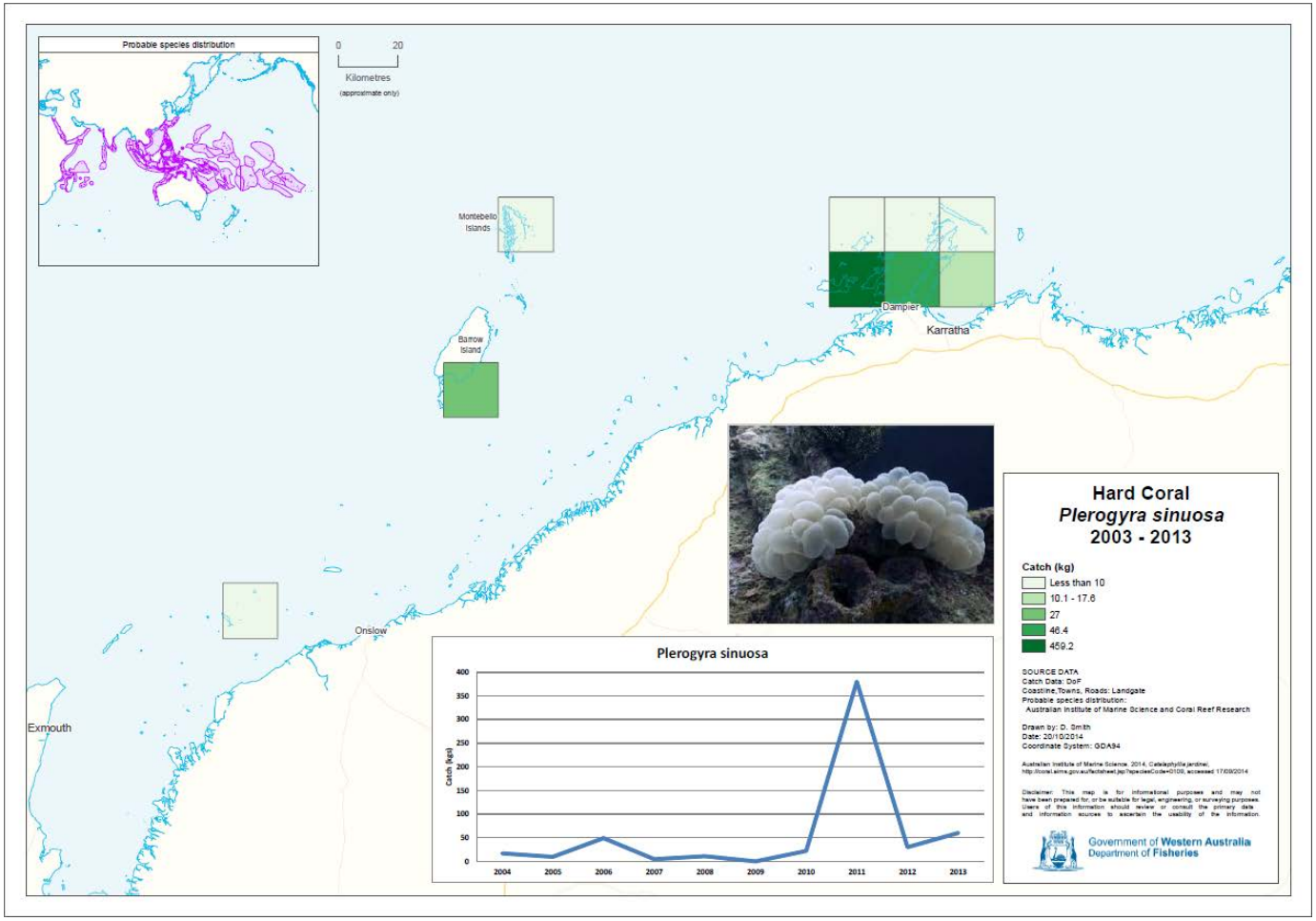

Figure 27 – Catch and distribution of *Plerogyra sinuosa.*

5.3.9 *Scolymia australis (Doughnut coral)*

Spatial distribution: Central Indo-Pacific, Japan and the East China Sea, eastern, southern and southwestern Australia, and the oceanic southwest Pacific and Micronesia. Lord Howe Island east of Sydney. Commonly found along south coast, in WA north to Rottnest Island. Uncommon but conspicuous elsewhere.

Habitat: Relatively common in deep reef environments (10 – 40m), or on rocky headlands in high latitudes. Attached to substrate by a broad or narrow stem. Seldom found in areas of dense coral growth in shallow areas.

Reproduction: Hermaphroditic brooder.

Harvest level: Annual catch to 6 kilograms over the period 2003 to 2013 (Figure 28).

Rationale for inclusion: Potential high market demand.

Risk rating and justification **(C1, L1 = 1 NEGLIGIBLE):** Industry constraints (limited access points, limited number of licences), distribution and very low catch level suggests a low risk. An assessment of doubling the historic harvest over the next five year period resulted in no material change to the risk rating.

Treatment: No change to the existing management required. An assessment of doubling the historic harvest over the next five year period resulted in no material change to the risk rating.

5.3.10 **Other hard coral species**

Participants at the workshop identified the following six additional hard coral species for formal assessment through the ERA process on the basis that they were considered potentially vulnerable:

- *Cynaria lacrymalis;*
- *Acanthastrea lordhowensis;*
- *Blastomussa wellsi;*
- *Blastomussa merleti;*
- *Euphyllia paraancora;* and
- *Euphyllia cristata.*

Risk rating and justification **(C1, L1 = 1 NEGLIGIBLE):** All six additional coral species were assessed as having a negligible risk rating on the basis that extremely low levels have been reported by the MAF. An assessment of doubling the historic harvest over the next five year period resulted in no material change to the risk rating.

Treatment: No change to the existing management required. An assessment of doubling the historic harvest over the next five year period resulted in no material change to the risk rating.

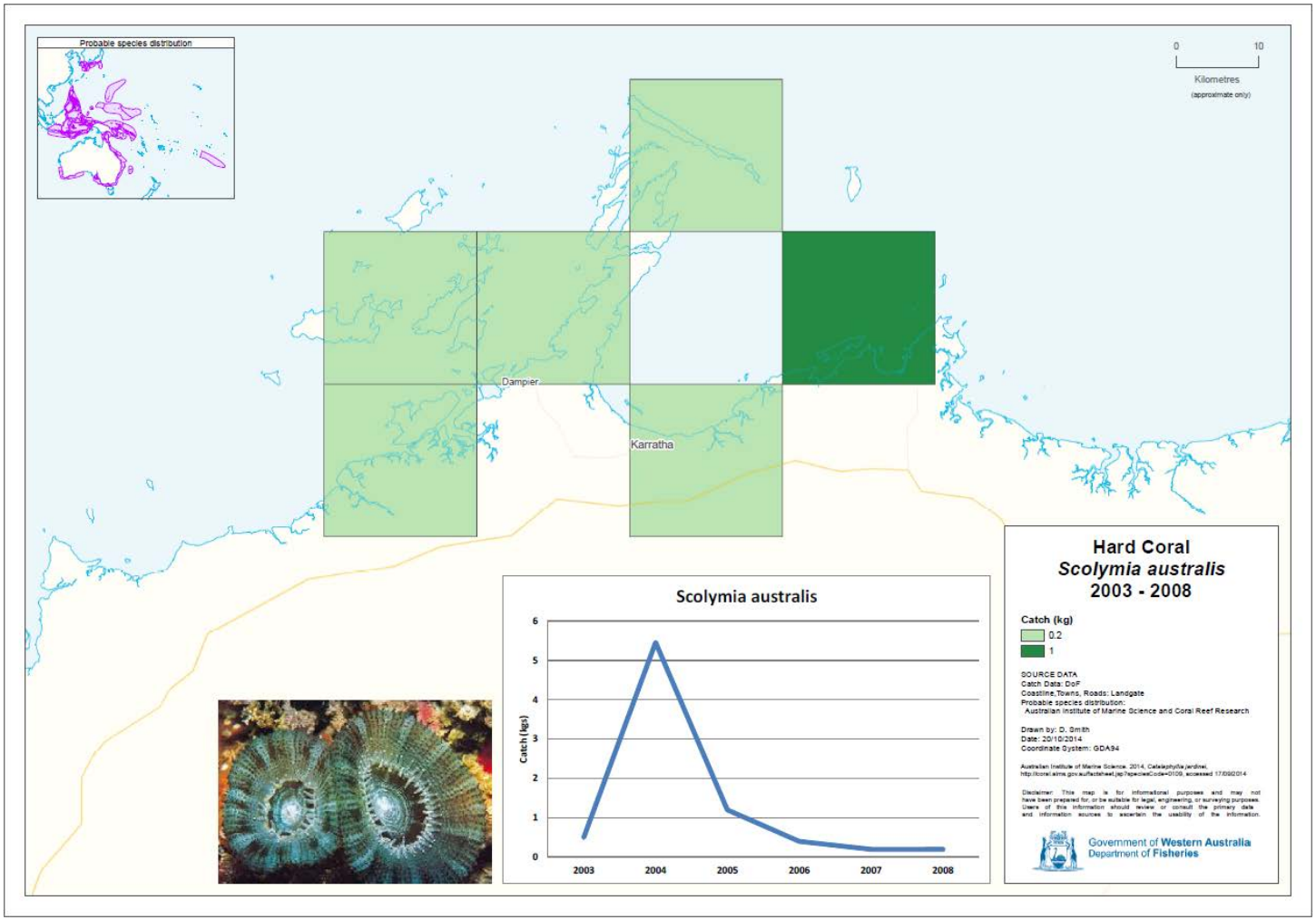

Figure 28 – Catch hand distribution of *Scolymia australis*.

5.4 Giant Clams

Two species of giant clams taken by the MAF and identified by DoE as being of particular concern in the 2014 NDF were included for detailed assessment through the ERA process.

5.4.1 *Tridacna maxima (Giant Elongate Clam)*

Spatial distribution: Houtman Abrolhos Islands north. The global distribution of giant clams varies between species, however they generally occur within the Indo-Pacific Region, with *T. maxima* having the widest distribution, stretching from East Africa and the Red Sea to Polynesia. Monitoring work undertaken by the Department of Fisheries in 2011 indicates significant populations of *T. maxima* at the Cocos (Keeling) Islands and studies undertaken by the Australian Institute for Marine Science (AIMS) in the Great Barrier Reef, West Pacific, and Ashore, Cartier and Mermaid Reef systems between 1981 – 2003 indicate a wide population distribution.

Habitat: Restricted to oligotrophic or shallow (less than 20 metres) clear water to ensure adequate light for photosynthesis to occur, and are usually found on coral reefs.

Reproduction: Protandrous hermaphrodites; become simultaneous hermaphrodites, as they grow. This means that they first reach sexual maturity as males and then later develop ovaries which function simultaneously with the testes, i.e. they produce both eggs and sperm. Timing on spawning appears to depend upon location, with sperm first to be released, followed by egg production. Gamete release acts as a trigger for nearby giant clams' eggs to spawn, which ensures the fertilization of eggs leads to clumping of individuals. Fertilised eggs form planktonic filter feeding veliger larvae, which swim and drift in suspension for several days and area subject to a high mortality rate. After approximately 8 – 9 days a muscular foot begins to develop, and the juvenile clams are able to attach to substrate and become sessile. It is thought that a degree of 'selective exclusion' occurs in the early life history stages where settlement is dependent on the presence of suitable substrate. Growth rates after settlement are usually slow and *T. maxima* reaches sexual maturity at approximately 2 years of age.

Harvest level: Annual catch between 400 and 1,200 individuals over the period 2003 to 2013 (Figure 29).

Rationale for inclusion: Identified as species of concern by DoE.

Risk rating and justification **(C1, L1 = 1 NEGLIGIBLE**): Collection focuses on small (4 – 6 inch), young brightly coloured specimens in view of the aquarium tank size restrictions (industry representatives report that only approximately 1 in 20 of the found specimens are actually collected). Industry constraints (limited access points, limited number of licences), distribution and very low catch level suggests a negligible risk.

Treatment: Spatial management considered unnecessary, otherwise no management change required. In view of species identification issues with *T. maxima* and *T. ningaloo*, the next ERA should include a detailed review of existing management arrangements in the light of additional data to ensure sustainable take of both species.

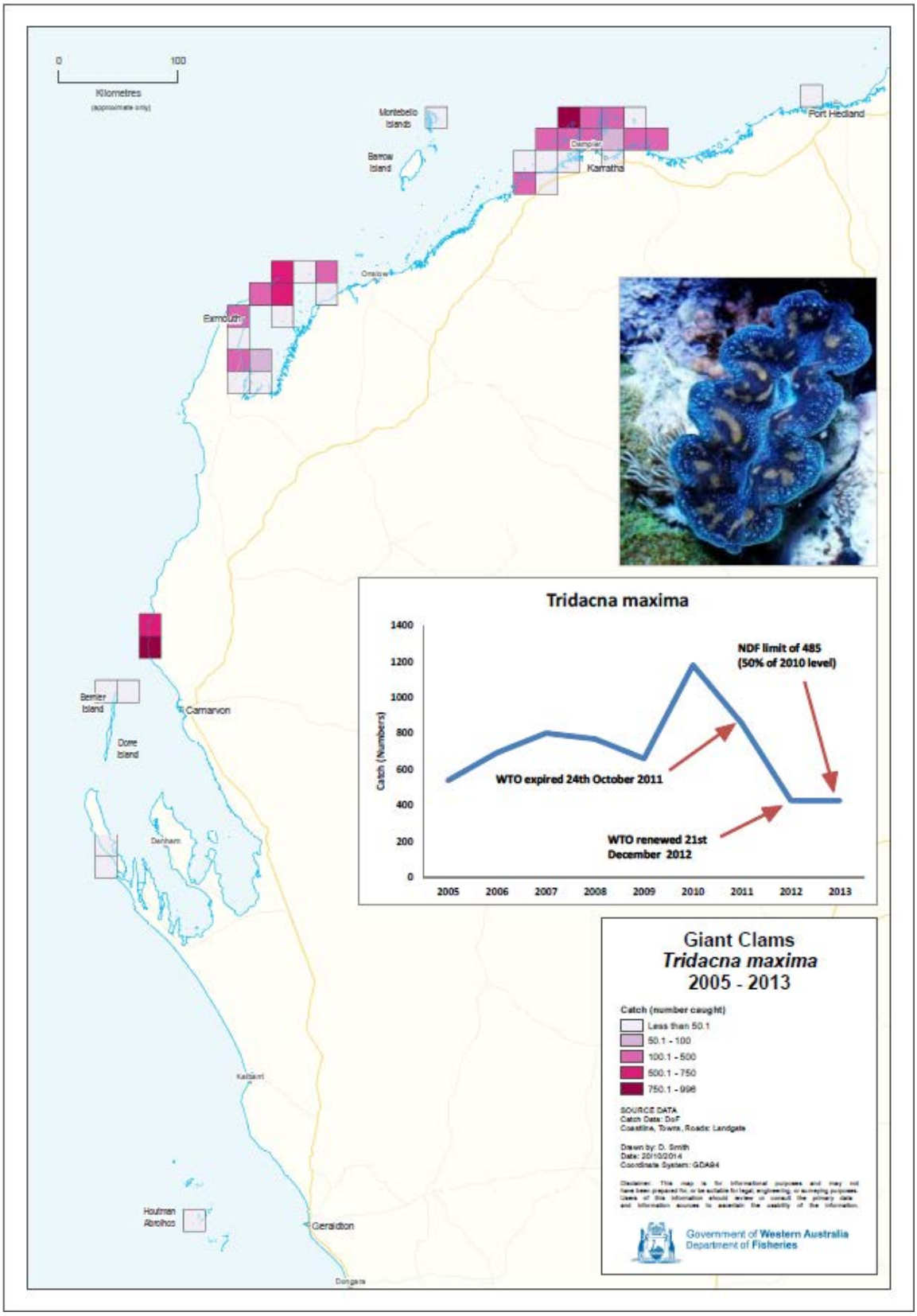

Figure 29 – Catch and distribution of *Tridacna maxima*.

5.4.2 *Tridacna squamosa (Giant Fluted Clam)*

Spatial distribution: Ningaloo north. The global distribution of giant clams varies between species, however they generally occur within the Indo-Pacific Region. Studies undertaken by the Australian Institute for Marine Science (AIMS) in the Great Barrier Reef, West Pacific, and Ashore, Cartier and Mermaid Reef systems between 1981 – 2003 indicate a wide population distribution.

Habitat: Restricted to oligotrophic or shallow (less than 20 metres) clear water to ensure adequate light for photosynthesis to occur and are usually found on coral reefs.

Reproduction: Protandrous hermaphrodites; become simultaneous hermaphrodites, as they grow. This means that they first reach sexual maturity as males and then later develop ovaries which function simultaneously with the testes, i.e. they produce both eggs and sperm. Timing on spawning appears to depend upon location, with sperm first to be released, followed by egg production. Gamete release acts as a trigger for nearby giant clams' eggs to spawn, which ensures the fertilization of eggs leads to clumping of individuals. Fertilised eggs form planktonic filter feeding veliger larvae, which swim and drift in suspension for several days and area subject to a high mortality rate. After approximately 8 – 9 days a muscular foot begins to develop, and the juvenile clams are able to attach to substrate and become sessile. It is thought that a degree of 'selective exclusion' occurs in the early life history stages where settlement is dependent on the presence of suitable substrate. Growth rates after settlement are usually slow and *T. squamosa*: reaches male maturity at approximately 3 – 4 years (5 cm in length), and female maturity at approximately 15 cm in length.

Harvest level: Annual catch up to 120 individuals over the period 2003 to 2013 (Figure 30).

Rationale for inclusion: Identified as species of concern by DoE.

Risk rating and justification **(C1, L1 = 1 NEGLIGIBLE**): Collection focuses on small (4 – 6 inch), young brightly coloured specimens in view of the aquarium tank size restrictions (industry representatives report that only approximately 1 in 20 of the found specimens are actually collected). Industry constraints (limited access points, limited number of licences), distribution and very low catch level suggests a negligible risk.

Treatment: Spatial management considered unnecessary, otherwise no management change required.

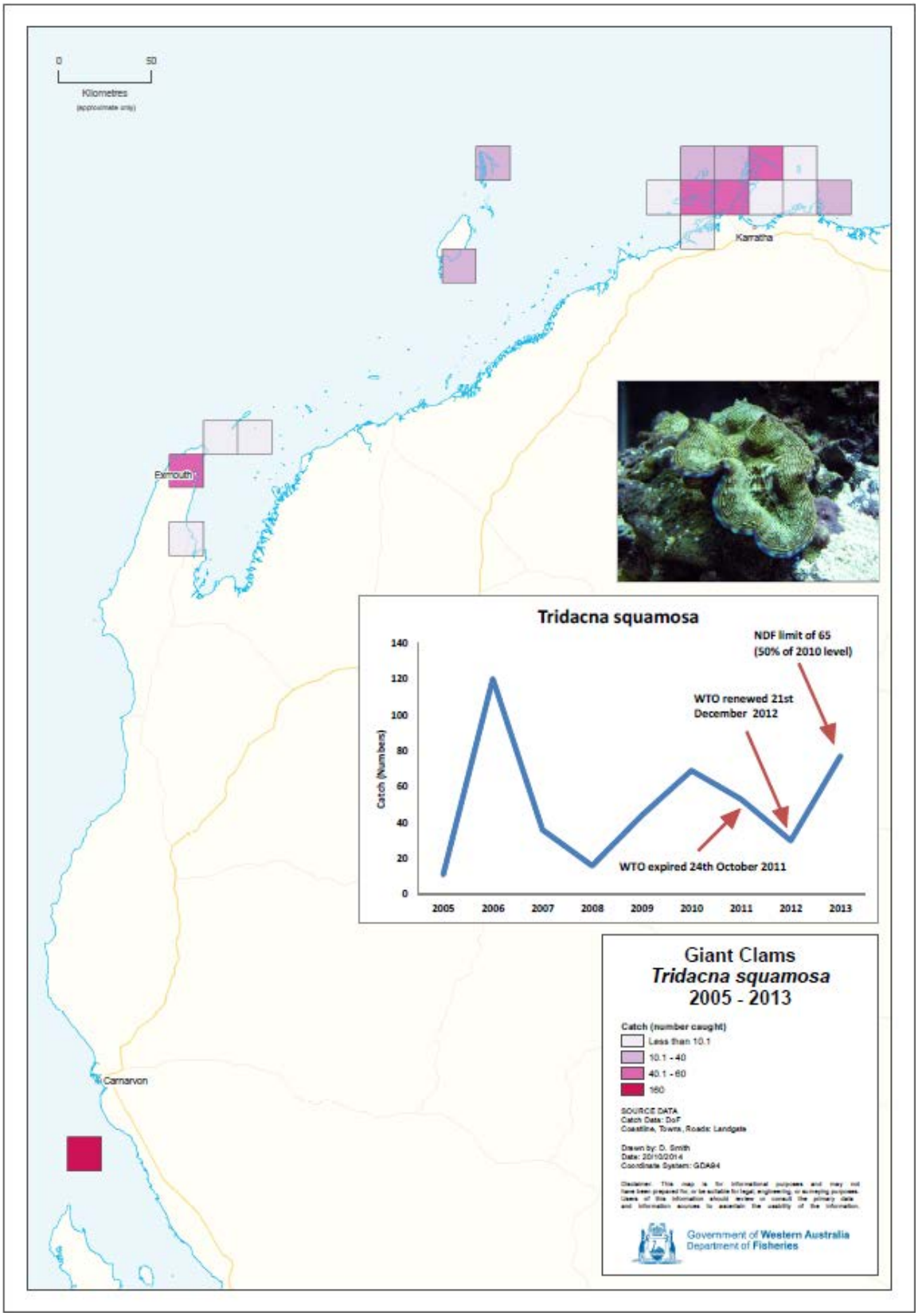

Figure 30 – Catch and distribution of *Tridacna squamosa*.

5.5 Invertebrates

Three invertebrate species identified during the pre-assessment workshop and at the ERA workshop were included for detailed assessment through the ERA process.

5.5.1 *Entacmaea quadricolor (Bubbletip Anemone)*

Spatial distribution: Widespread throughout the tropical waters of the Indo-Pacific area, including the Red Sea. Very common in temperate and tropical waters of WA – reported catches from Abrolhos Islands to Dampier area (Figure 31).

Habitat: Coral reefs and reef lagoons. Large solitary adult specimens are often found in deeper waters with more dimly lit conditions. Smaller, younger specimens are often located in groups or colonies nearer to the surface, in bright sunlight.

Reproduction: Sexual and asexual (budding, binary fission (the polyp separates into two halves), and pedal laceration). Readily reproduces in captivity.

Harvest level: Annual catch between 1,000 and 2,500 individuals over the period 2003 to 2013.

Rationale for inclusion: Known to form symbiotic relationships with several species of anemone fish, shrimps and crabs.

Risk rating and justification **(C1, L1 = 1 NEGLIGIBLE**): Reported by industry to be broadly distributed, with effort focused on accessible areas. Typically found in very dense numbers, and focus of effort is on large individuals. Up to 25% of colony is taken over multiple sites over a period of time in the same area, demonstrating good recovery rate. Industry constraints (limited access points, limited number of licences), distribution and very low catch level suggests a negligible risk.

Treatment: No change to the existing management required.

5.5.2 *Heteractis malu (Delicate Sea Anemone)*

Spatial distribution: Ranging from Japan in the north, to the islands of Hawaii, and to Australia. Reported catches from Albany to Dampier area (Figure 31).

Habitat: Found burrowing in sediment areas around coral reefs and reef lagoons. Anemones can retract completely into sediment; most common in shallow, quiet waters.

Reproduction: Sexual and asexual (budding, binary fission (the polyp separates into two halves), and pedal laceration).

Harvest level: Annual catch between 600 and 2,000 individuals over the period 2003 to 2013.

Rationale for inclusion: Known to form symbiotic relationships with with *A. clarkii*.

Risk rating and justification **(C1, L1 = 1 NEGLIGIBLE**): Reported to be extremely common, with repeated collection by operators over the same area with little effect on

numbers. Industry constraints (limited access points, limited number of licences), distribution and very low catch level suggests a negligible risk.

Treatment: No change to the existing management required.

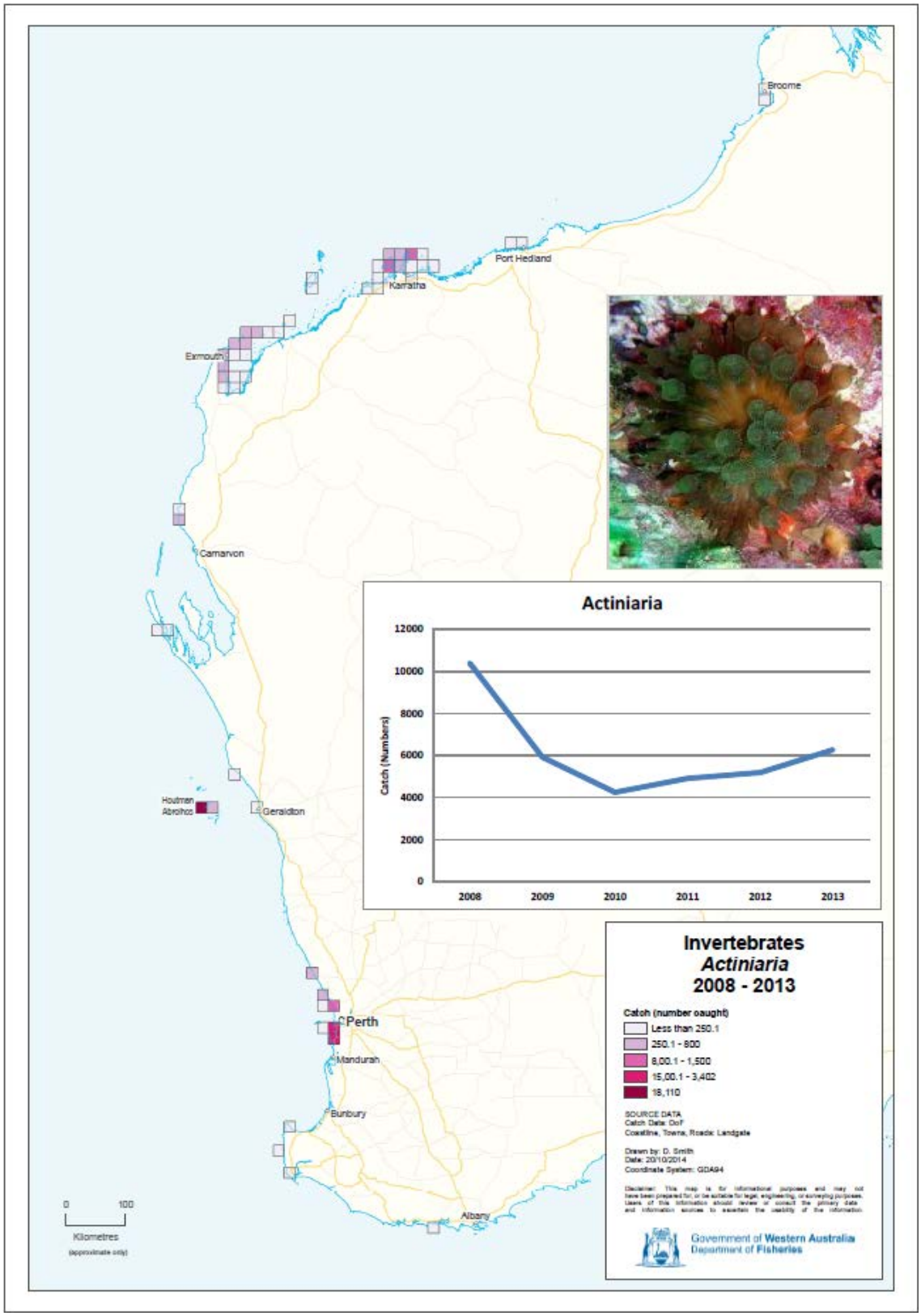

Figure 31 – Catch and distribution of anemones (Family Actiniaria).

5.5.3 *Corallimorpharia (coral like anemones)*

Spatial distribution: Widespread throughout the tropical waters of the Indo-Pacific area. (Figure 31).

Habitat: Occur in a wide range of marine habitats, and are associated with phase shifts in coral reefs that change from hard-coral dominated to soft-coral dominated. Found in large colonies or “mats”.

Reproduction: Sexual and asexual (budding, binary fission (the polyp separates into two halves), and pedal laceration).

Harvest level: Annual catch between 1,000 and 4,000 litres over the period 2003 to 2013 (Figure 31).

Rationale for inclusion: Undifferentiated catch (not identified at genus/species level.

Risk rating and justification **(C1, L1 = 1 NEGLIGIBLE**): Reported to be extremely common, with repeated collection by operators over the same area with little effect on numbers. Industry constraints (limited access points, limited number of licences), distribution and very low catch level suggests a negligible risk.

Treatment: No change to the existing management required.

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APPENDIX 1 ERA WORKSHOP ATTENDANCE

Name	Stakeholder category
S Marns	MAF Managed Fishery Licence holder
W Mackenzie Brown	
D J Dufall	
D Gebbetis	
S Hawke	
B Mitchell	
F Horn	Western Australian Fishing Industry Council
Mark Cammilleri	
Z Richards (Curator, Coral)	WA Museum
S Wilson	WA Dept of Parks and Wildlife
J Stoddart	Marine Expert (coral)
S Slack Smith (molluscs)	Marine Expert (molluscs)
M Pratchett	Marine Expert
E Harvey	Curtin University
A Roelofs	Queensland Fisheries
M Grubert	NT Fisheries
S Sly	
E Needham	
K Cameron	Commonwealth Department of Environment
D Rothenfluh	
C Syers	WA Department of Fisheries
S Newman	
S O'Donoghue	
K Green	
B Wise	
C Bruce	
E Bunbury	