EVIDENCE TO INFORM A NON-DETRIMENT FINDING FOR GOLDEN SANDFISH (*HOLOTHURIA LESSONI*) IN THE QUEENSLAND SEA CUCUMBER FISHERY

PAUL MCSHANE, MATT KOOPMAN
AND IAN KNUCKEY

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fishwell

CONTENTS

List of Acronyms 3

Executive Summary 4

CITES and non-detriment findings 6

LISTING OF GOLDEN SANDFISH 6

Background 7

BIOLOGY OF GOLDEN SANDFISH 7

THE FISHERY FOR GOLDEN SANDFISH 8

Evidence in support of a non-detriment finding for Golden Sandfish 11

POPULATION TRENDS 11

Density 12

Catch rates 12

MANAGEMENT AND HARVESTING 14

Closures 15

Rotational harvest 15

Harvest Strategy 15

CONTROL MEASURES 16

References 17

List of Acronyms

CITES	Convention on International Trade in Endangered Species
CPUE	Catch per unit effort
DCCEEW	Department of Climate Change, Energy, the Environment and Water
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ETP	Endangered, protected, or threatened species
FAO	Food and Agriculture Organisation
GBR	Great Barrier Reef
GBRMP	Great Barrier Reef Marine Park
GBRMPA	Great Barrier Reef Marine Park Authority
GPS	Global positioning system
MSC	Marine Stewardship Council
MSE	Management strategy evaluation
MSE	Management Strategy Evaluation
MSY	Maximum Sustainable Yield
NDF	Non detriment finding
QDAF	Queensland Department of Agriculture and Fisheries
QSCA	Queensland Sea Cucumber Association
QSCF	Queensland Sea Cucumber Fishery (east coast)
RHA	Rotational harvest arrangement
VMS	Vessel Monitoring System
SCUBA	Self-contained underwater breathing apparatus
TACC	Total Allowable Commercial Catch
WTO	Wildlife Trade Operation

EXECUTIVE SUMMARY

The 2025 Convention on International Trade in Endangered Species (CITES) listing of Golden Sandfish (*Holothuria lessoni*) reflects concerns of depletion of populations of the closely related Sandfish (*H. scabra*) in countries throughout the Indo Pacific region where they are harvested. As a comparatively rare and valuable species, it was deemed vulnerable to overfishing. In Australia, fisheries for Sandfish are demonstrably sustainable with the Western Australian fishery for this sea cucumber gaining Marine Stewardship Council (MSC) certification.

In the Queensland sea cucumber fishery (QSCF), Golden Sandfish are not a target species but a byproduct of fishing for other species particularly Burrowing Blackfish (*Actinopyga spinea*). Under the harvest strategy applicable to the QSCF, Golden Sandfish is a Tier 2 species and not subject to regular assessment. Instead, it is managed against an annual catch trigger of 10 tonnes (t). Over the history of the QSCF, annual catches of Golden Sandfish have always been below the trigger.

Little is known of the biology of Golden Sandfish limiting formal assessment of its population status within the QSCF. There have been no fishery independent surveys or formal assessments undertaken as for Tier 1 species in the QSCF. However, management strategy evaluation (MSE) has been undertaken for Golden Sandfish. Under plausible scenarios of population dynamics, models of stock trajectories under current management arrangements, particularly rotational harvest of management zones within the QSCF, indicate future stock levels at or near target levels (60% of unfished biomass). Similarly, evaluation of catch rates in zones where Golden Sandfish are harvested (as proxies for biomass), reveal biomass levels well above limit reference points (20% of unfished biomass) with many reporting grids recording estimated biomass levels greater than 50% and some above the target level of 60% (B_{60}). Thus, there is little, if any, evidence of overfishing of Golden Sandfish in the QSCF.

As sea cucumbers are harvested within the Great Barrier Reef marine park (GBRMP), more than 37% of habitat is protected from commercial fishing through strictly-enforced closures. Furthermore, the QSCF has relatively few operators: only two vessels operating with an average of six dories with six divers in the water when fishing at any one time. These operators are responsive to a rotational harvest arrangement applicable to 158 zones across the east coast of Queensland including the GBRMP. The marine park excludes 37% of available sea cucumber habitat from commercial fishing. As individual zones are harvested once every three years, with a relatively small proportion of available habitat fished (< 1%), the QSCF is arguably the most conservatively managed sea cucumber fishery in the world. Furthermore, Golden Sandfish are mostly harvested as a byproduct species in fishing for Burrowing Blackfish. Burrowing Blackfish are managed separately to the rest of the QSCF with three dedicated zones. Accordingly, the area where Golden Sandfish are harvested is much smaller than the remaining fishable area of the QSCF.

Illegal fishing, prominent in other fisheries for Golden Sandfish given its relatively high value, is not a concern for the QSCF. The fishery has been independently assessed as being subject to strict and effective compliance. Fishing vessels are required to have vessel monitoring systems (VMS) to track fishing, and there is otherwise enforcement of applicable management arrangements by both marine park and government fishery officers. Intrusions into the GBRMP from foreign fishing vessels and subsequent illegal fishing does not occur.

CITES AND NON-DETRIMENT FINDINGS

CITES is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species. The species covered by CITES are listed in three Appendices, according to the degree of protection they need.

- **Appendix I** includes species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances;
- **Appendix II** includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival; and,
- **Appendix III** contains species that are protected in at least one country.

In accordance with Articles III and IV of CITES, export permits for species included in Appendix II shall be granted only when a Scientific Authority of the State of export has advised that such export will not be detrimental to their survival: a determination known as a "non-detriment finding" (NDF). This advice should be "based on the scientific review of available information on the population status, distribution, population trend, harvest and other biological and ecological factors, as appropriate, and trade information relating to the species concerned".

As a Party to CITES, Australia's responsibility for the implementation of CITES is given effect through the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Under the EPBC Act, all fisheries from which product is exported, undergo assessment to ensure they are managed in an ecologically sustainable way in line with the Guidelines for the Ecologically Sustainable Management of Fisheries (the Guidelines). These Guidelines aid in ensuring that rigorous and transparent assessments are conducted in close cooperation with fisheries agencies, the fishing industry and the wider community. Specimens being exported from Australia for commercial purposes must come from a Wildlife Trade Operation (WTO) approved fishery under a CITES export permit, issued by the Department of Climate Change, Energy, the Environment and Water (DCCEEW). This permit can only be issued if a positive NDF has been made for that species, meaning that the level of take of that species has been found to be not detrimental to, or contribute to, trade which is detrimental to the survival of the species in the wild.

LISTING OF GOLDEN SANDFISH

At the 20th meeting of the Conference of Parties held during 2025 in Samarkand (Uzbekistan), the Secretariat recommended listing of Golden Sandfish that inhabit Australian waters in Appendix II of CITES (CITES 2025). The FAO Expert Panel advising CITES noted that there is little information on population trends of Golden Sandfish throughout its range but that it was assumed that it was equally affected by overfishing as Sandfish (*H. scabra*) which has declined by more than 50% over the past 50 years (FAO 2025). The panel also emphasised the relative rarity of Golden Sandfish with populations in relatively shallow water that are more susceptible to the impacts of environmental changes or human activities. In particular, given the relatively

high value of this species, illegal fishing in the Indo Pacific region, including in marine protected areas, is reported as a sustainability concern (FAO 2025).

Notably, no information from Australian fisheries for Golden Sandfish was presented for consideration by CITES although the expert panel noted that new information from the QSCF showed a stable trend in catch from 2007 to 2023 (FAO 2025). There was no information presented to the panel on catches of Golden Sandfish from other Australian regions (FAO 2025).

BACKGROUND

BIOLOGY OF GOLDEN SANDFISH

The biology of sea cucumbers is relevant to their vulnerability to fishing and sustainable fisheries management. Most of the available information on the biology of sea cucumbers relevant to fisheries management comes from the studies of Conand (1981, 1993) on populations of various species from New Caledonia. These studies reveal interspecific differences in biology particularly in size at maturity and in fecundity.

Golden Sandfish are widely distributed in the Indo Pacific region (Purcell et al. 2023). They inhabit inner reef flats and coastal lagoons or coastal seagrass beds or sandflats between 0 and 30 m depth.

Golden Sandfish has been previously considered a variety of the common sandfish *Holuthuria scabra* but has since been classified as a separate species (*H. lessoni*) (Uthicke et al. 2005, Massin et al. 2009). Golden Sandfish are generally found in deeper offshore waters than the inshore shallow waters favoured by Sandfish (*H. scabra*) (Skewes et al. 2014).

In general, sea cucumbers are dioecious broadcast spawners with males and females in equal proportions (Conand 1993). They usually spawn in summer months (Conand 1993, Purcell et al. 2023). Golden Sandfish reach sexual maturity at around two years at a length of 21.5 cm equivalent to a total weight of 480 g (Skewes et al. 2014, Wickens et al. 2024). As sedentary, spatially-dispersed animals, the reduction of population density of sea cucumbers by fishing can threaten reproductive viability (Babcock et al. 1991, Mercier and Hamel 2009, Anderson et al. 2011, Purcell et al. 2013). Thus, there is a need to conserve sufficient reproductive potential in harvested populations of sea cucumbers (Murphy et al. 2021).

Compared with other exploitable species, the early life history of sea cucumbers including Golden Sandfish is poorly understood. Few juveniles are found in surveys targeting fishable populations within the QSCF (Knuckey and Koopman 2016, Koopman and Knuckey 2021). A likely explanation is that juvenile habitat differs from that of adults and that migration from shallow sediments or sea grass habitat to deeper habitat occurs particularly on reef tops where adults are relatively abundant (Hamel and Mercier 1996, Schiell and Uthicke 2006, Slater et al. 2010, Wolfe and Byrne 2017, Murphy et al. 2021).

Measurement of growth rates in sea cucumbers is compromised by the plasticity in length of individuals and the difficulty in sampling juveniles in wild populations (Purcell et al. 2013, 2018) Similarly, tag-recapture studies used to estimate growth in other fished animals are generally unsuccessful in sea cucumbers because of a lack of hard parts and the tendency to shed tags (Conand 1993; Reichenbach 1999; Shiell 2006; Kinch et al. 2008; Purcell et al. 2009, 2016).

Limited information is available on the natural mortality (*M*) for sea cucumbers in general and Golden Sandfish in particular. A recent review of harvest strategies for populations of sea cucumbers for the Queensland sea cucumber fishery (east coast) (QSCF) assumed an *M* of 0.4 was appropriate for most species including Golden Sandfish (Skewes et al. 2014).

Thus, biological parameters used to assess stocks of sea cucumber, including Golden Sandfish are usually inferred from the biology of other species of sea cucumber, or simply assumed, rather than empirically derived (Skewes et al. 2014, Wickens et al. 2024).

The fishery for Golden Sandfish

The QSCF operates in coastal waters including the Great Barrier Reef Marine Park (GBRMP) (Figure 1). Historically, most fishing for sea cucumbers has occurred north of Townsville (19 degrees south) although most catches of Golden Sandfish occur further south (see below). About 37% of sea cucumber habitat around the Great Barrier Reef (GBR) has been permanently closed to commercial fishing since 2004, including Ashmore and Boot Reefs which are outside the GBRMP (Figure 1).

Most sea cucumbers caught in the QSCF are Burrowing Blackfish (55% of total catch), White Teatfish (*Holothuria fuscogilva*) (16%), Prickly Redfish (*Thelenota ananas*) (9%) and Curry Fish (*Stichopus hermanni*) (6%) (DCCEEW 2024). Golden sandfish are harvested in Queensland as a bycatch species whilst targeting other species of sea cucumber particularly Burrowing Blackfish in lagoon areas (Skewes et al 2014) and thus represent a much smaller proportion of the total harvest of sea cucumbers in the QSCF.

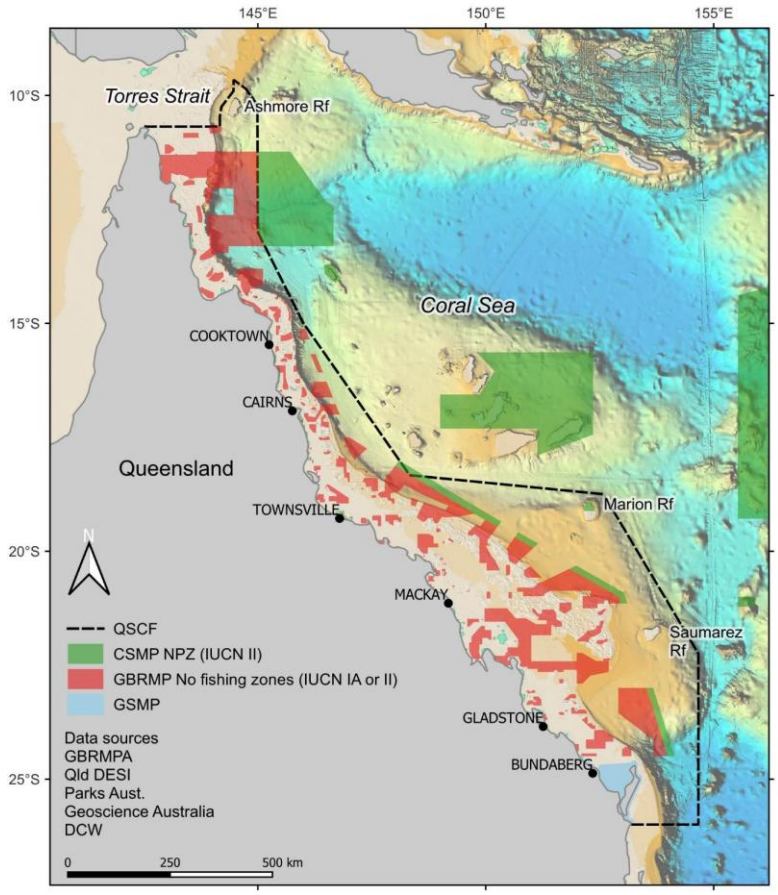

Figure 1. The spatial extent of the QSCF showing no fishing areas within the Great Barrier Reef Marine Park. (Figure taken from Skewes 2023).

Although it is one of Australia's oldest fisheries, contemporary management of the QSCF began during the 1980s when catches increased to meet rising demand in Asia. The fishery extends along the entire length of the State's shoreline, from New South Wales to the Northern Territory border, but the commercial fishery only operates from Tin Can Bay (26^{o}S) to Cape York (10^{o}S) along the GBR.

The QSCF is a hand collection only fishery so there is no bycatch, damage to the benthic environment and limited, if any, interactions with endangered, protected or threatened (ETP) species (DCCEEW 2024). Catches and catch rates are recorded by fishers within reporting grids (Figure 2). Rotational zones (fished every three years) overlap with reporting grids (Figure 3).

Since 2004, the number of licences permitted to harvest sea cucumber from the QSCF has reduced from 35 to just 18 authorities (Authority Holders) owned primarily by two entities. The Queensland Sea Cucumber Association (QSCA) represents these Authority Holders. As there are only two quota holders in the fishery, they work closely together under a joint fishing agreement. This is another layer of sustainability protection for the QSCF as it eliminates the "race to fish" mentality as every landing is shared according to each party's quota percentage.

The QSCF operates mostly within the GBRMP, and operations are subject to provisions governing the use of resources within the World Heritage Area. This would make the QSCF one,

if not, the most “controlled” and consequently, best managed fisheries in Australia and certainly the best managed sea cucumber fishery in the world.

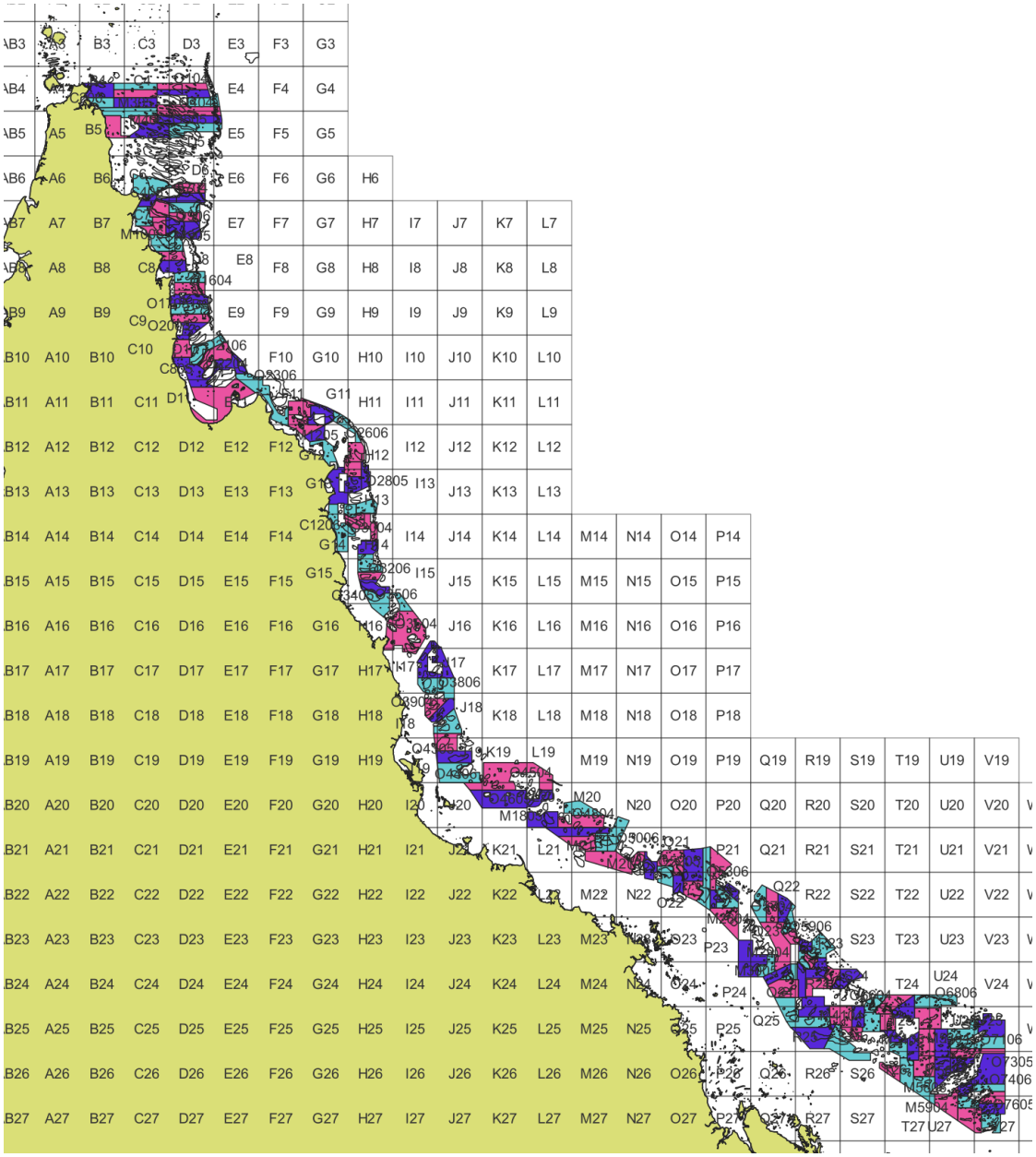

Figure 2. Reporting grids and rotational zones (coloured pink, blue and purple) used for reporting and management of the QSCF.

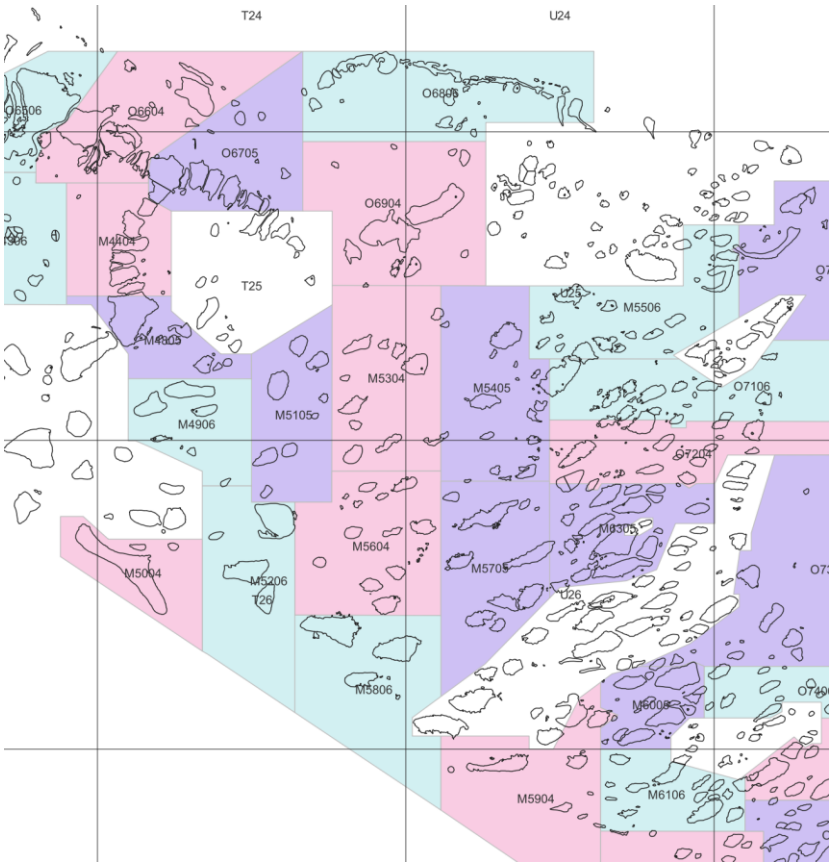

Figure 3. Overlap of rotational zones with reporting grids. Coloured zones are each fished every three years.

EVIDENCE IN SUPPORT OF A NON-DETRIMENT FINDING FOR GOLDEN SANDFISH

In response to three species of sea cucumbers being listed in CITES Appendix II, Di-Simone et al. (2021) note that non-detriment findings should include the following information:

1. Population levels (trends, density, biomass).
2. Management and harvesting (harvest strategies, performance indicators, fishing mortality).
3. Control measures (conservation strategies, monitoring and compliance).

This information is summarised below in support of a non-detriment finding for Golden Sandfish.

POPULATION TRENDS

The Food and Agriculture Organisation (FAO) Expert Panel advising CITES noted that there is little information on population trends of Golden Sandfish throughout its range. However, panel assumed that Golden Sandfish was equally affected by overfishing as the closely related Sandfish (*H. scabra*) which has declined by more than 50% over the past 50 years (FAO 2025). In contrast, the available evidence shows that Australian fisheries for Sandfish are sustainably managed with the Western Australian fishery certified by MSC (Hart et al. 2022). If there is a direct correlation between the population status of Sandfish and Golden Sandfish as suggested

(FAO 2025), then Golden Sandfish populations in Australia are sustainably harvested. The species-specific data on population trends for Golden Sandfish are summarised below.

Density

There have been no dedicated fishery-independent surveys for Golden Sandfish in the QSCF and density data are unavailable. Instead, population status is inferred from mandatory fisher logbook data including catch and catch rate by reporting grid (as summarised below).

Catch rates

Catch rates are often used as a proxy for biomass including for sea cucumbers (Hart et al. 2022). Using a method applied to Western Australian Sandfish stocks (Hart et al. 2022), catch rate reference points were applied to Golden Sandfish assuming that the geometric mean catch rate (over the available historical time series) is equivalent to 50% B_0. This allows for reference points linked to the current Queensland sea cucumber harvest strategy B_{lim} (20% B_0) and B_{targ} (60% B_0) (QDAF 2021).

Within the QSCF, catches and catch rates of Golden Sandfish are greatest in the South particularly between 20° and 24° S (Figure 4).

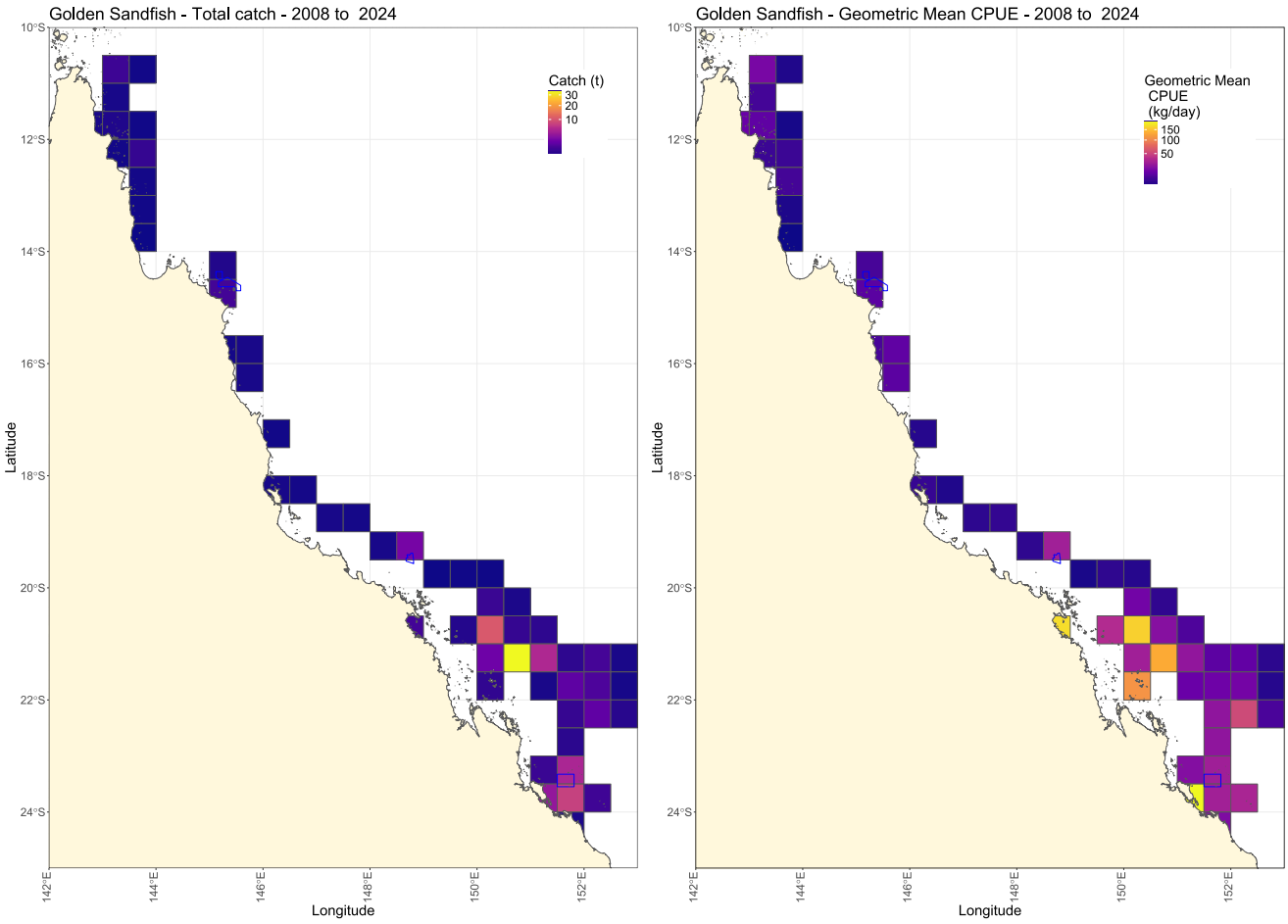

Figure 4. Historical catches and catch rates of Golden Sandfish within reporting grids for the QSCF.

For Golden Sandfish, grids that provided 80% of the cumulative catch over the history of the fishery (2008-2024) are ranked from highest to lowest catch (Figure 5). Recorded catch rates within reporting grids over the most recent three years of data are assessed relative to the long-term average catch rate which is assumed to be a proxy for the maximum sustainable yield i.e. B_{50} (Hart et al. 2022, Figure 5). Recent catch rates are all above the limit reference point and generally showing an increasing trend indicative of increased biomass (Figure 5). In particular, high catch grids (R25 and Q24) (see Figure 2 for location) show increasing trends with Q24 (also S25) at or above B_{50}. Proxy biomass by reporting grid is further illustrated in Figure 6.

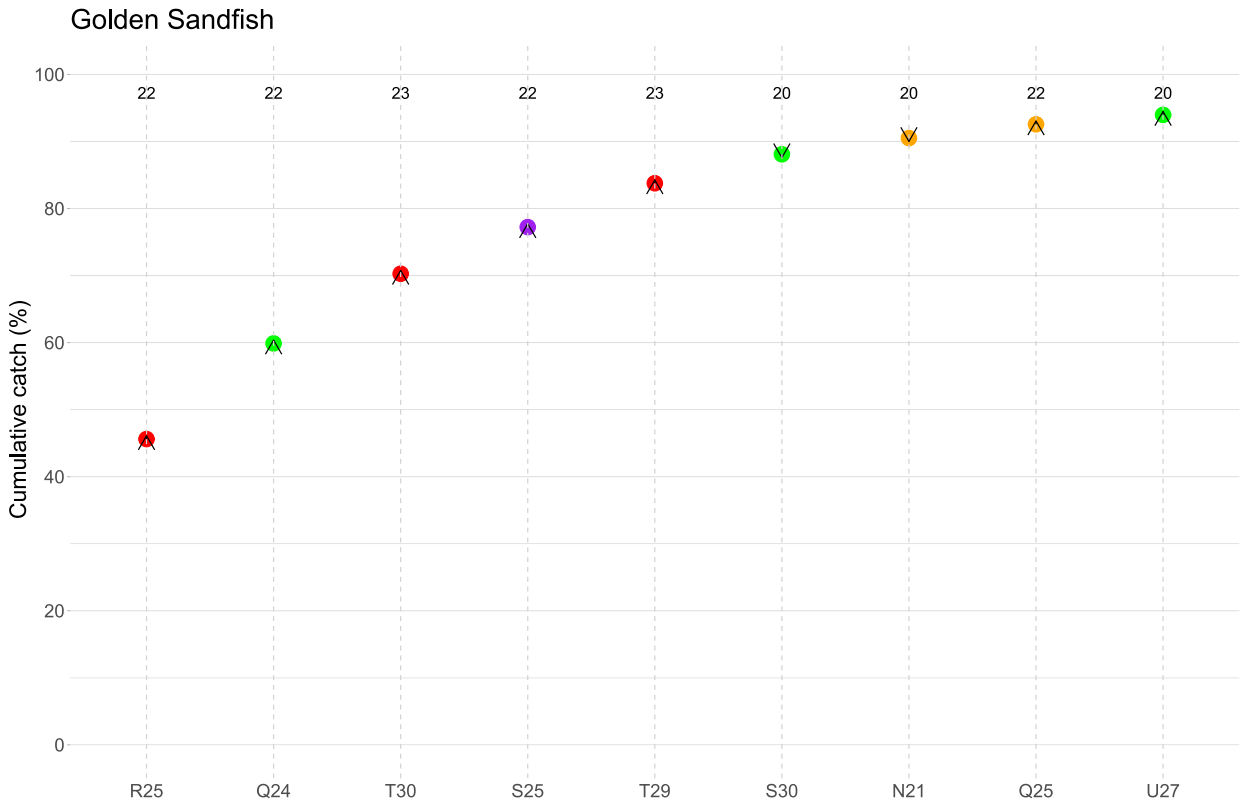

Figure 5. Cumulative catch of Golden Sandfish (from 2008-2024) including reporting grids representing 80% of the total commercial catch. Arrows denote increasing or decreasing CPUE for each reporting grid. For data points presented, purple denotes 1.2 x long term average CPUE i.e. B_{60} or greater (i.e. B_{targ} in the harvest strategy), green represents the long-term average CPUE i.e. B_{50} or greater, yellow represents 0.8 x long term CPUE i.e. B_{40} or greater and red is 0.4 long term average CPUE i.e. B_{20} or greater (i.e. B_{lim} in the harvest strategy).

As shown in Figure 5 and Figure 6, Golden Sandfish stocks in the QSCF are well above the limit reference point as specified in the harvest strategy (QDAF 2021) suggesting healthy populations.

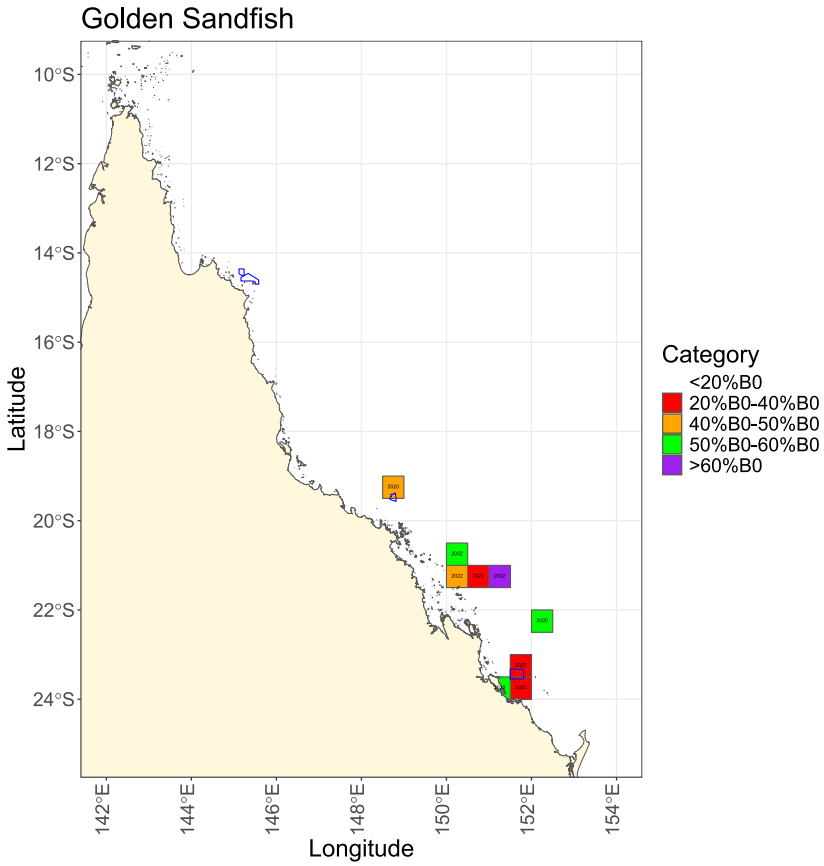

Figure 6. Proxy biomass estimates for Golden Sandfish within reporting grids in the QSCF.

Management and Harvesting

The fishery for Golden Sandfish in the QSCF is subject to conservative fishery management including:

- Permanent closed areas (within the GBRMP);
- Rotational harvest arrangements (areas open to fishing once every three years);
- A harvest strategy with a conservative 10t annual catch trigger that is intended to be reviewed and updated every five years.

The management strategy evaluation (MSE) of the rotational harvest arrangement (Skewes et al. 2014, Plagányi et al. 2015, Wickens 2024) showed improved biological and economic performance when implementing rotational harvests compared with no spatial rotation. This finding was robust across sea cucumber species with different life history characteristics and stochastic recruitment. Under plausible scenarios, given the known biology of Golden Sandfish, populations within the QSCF remained above the target reference point B_{60} as specified in the harvest strategy (Wickens et al. 2024). The risk of depletion of Golden Sandfish has been assessed as low (DCCEEW 2024, Wickens et al. 2024).

Closures

About 37% of the available habitat of the GBR for Golden Sandfish is closed to fishing through heavily enforced no-take zones (Koopman and Knuckey 2021). Protection allows the accumulation of fecund individuals that can provide recruits to fished populations (Sale et al. 2005). "Spillover" is often promoted as a benefit of marine protected areas whereby populations (typically mobile taxa such as fish) protected from fishing expand to neighbouring depleted populations (Roberts and Polunin 1991). For sedentary animals such as sea cucumbers on disaggregate reef habitat, movement from protected to fished population is unlikely (Uthicke et al. 2004).

Protection from fishing allows the accumulation of fecund individuals that can provide recruits to fished populations maintaining genetic heterogeneity in the stock (Sale et al. 2005, Johnson et al. 2018). About 90% of reefs fished in the QSCF are within 20 km of closed areas (McCook et al. 2010). These closed areas present additional safeguards to sea cucumber populations and are an import source of larvae and recruits to fished areas. However, there is little, if any, information on the early life history of Golden Sandfish. More generally, larval dispersal of Golden Sandfish among reefs is likely. The closely related Sandfish has a planktonic larval phase of 3 to 7 weeks (Minami 2011), during which larvae can be transported over large distances (~ 200km) (Wolanski et al. 2013). Assuming a similar early life history implies connectivity of Golden Sandfish populations in the QSCF across most of the GBR and with neighbouring populations in the Torres Strait. The broad distribution of Golden Sandfish within the Indo-Pacific is further evidence of panmictic populations of this species. However, the available evidence suggests that the QSCF is a source rather than a sink for sea cucumber larvae (Fontoura et al. 2022, Skewes 2023), and the presence of protected areas preserves this ecosystem service independent of fishing pressure.

Rotational harvest

In the Rotational Harvest Arrangement, the fishery is divided into 158 rotational zones that are grouped into three rotations (Smith and Roelofs 2011). Each rotation is only open to fishing during one of every three years. The order in which the rotations are made open to fishing is the same for each three-year period. Each rotational zone can only be fished for a maximum of 15 days per year by only one operator unless otherwise agreed. The MSE of rotational spatial harvests (Skewes et al. 2014, Plagyani et al. 2015, Wickens et al. 2024) showed improved biological and economic performance compared with no spatial rotation and that this finding was robust across sea cucumber species with different life history characteristics and stochastic recruitment. In particular, MSE revealed that populations of Golden Sandfish were conserved under current management arrangements (Wickens et al. 2024).

Harvest Strategy

A harvest strategy for the QSCF was implemented in September 2021 (QDAF 2021) with the main objective of attaining maximum economic yield. Within the harvest strategy, this is established as a target reference point (B_{targ}) equivalent to 60% of unfished biomass (QDAF 2021). Similar to many other commercial fisheries, a limit biomass level (B_{lim}) is set at 20% of

unfished biomass. These reference points apply to all sea cucumbers harvested in the QSCF including Golden Sandfish (QDAF 2021).

Under the QSCF harvest strategy, Golden Sandfish are managed as Tier 2 species where catch triggers are used to inform increases in fishing mortality (QDAF 2021). Under the decision rules for Tier 2 species, if the annual harvest of Golden Sandfish exceeds the prescribed trigger level of 10 t then a competitive total allowable commercial catch (TACC) will be set at the trigger level and an assessment will be required to determine the level of fishing required to achieve the target level of B_{60}. Annual catches of Golden Sandfish have been consistently below the trigger specified in harvest strategy (QDAF 2021) (Figure 7). This reflects reduced effort and catches of Burrowing Blackfish, particularly in the last three years as Golden Sandfish are caught as a byproduct.

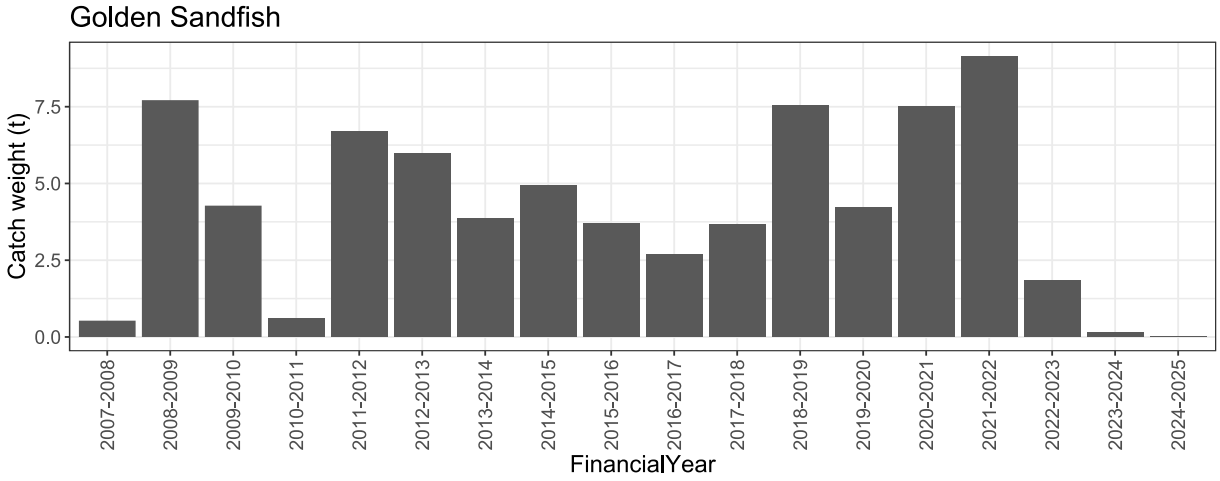

Figure 7. Annual variation in catch (t) of Golden Sandfish in the QSCF. Data are from Koopman and Knuckey (2025).

CONTROL MEASURES

The QSCF is a limited entry fishery with 18 licences, however these are held by only two operators who can nominate no more than three persons to take or sell sea cucumbers under the licence. Only hand harvesting is allowed while free diving or using hookah or SCUBA. VMS is required on vessels at all times, and the use of up to four dories at most (which do not require VMS) is permitted. Dories must not exceed seven metres length, limiting weather conditions when fishing can safely occur. Like other dive-based fisheries, operators in the QSCF require a permit from the Great Barrier Reef Park Authority (GBRMPA) to operate within the GBRMP.

An industry initiative implemented in 2019 has each of the two operators responsible for the same fished rotation zones each year, meaning only one operator can access a given zone every year, for 15 days at most. In addition to the other industry and management initiatives/regulations, the contract harvesters have become the guardians of each of these zones to ensure each is sustainably harvested.

The QSCA in partnership with the Queensland Department of Primary Industries (QDPI), has been a leader in implementing innovative management approaches for the sea cucumber fishery. More than two decades ago, the introduction of a rotational harvest arrangement helped distribute fishing effort and prevent the over exploitation of local populations (Smith and Roelofs 2011, Plagányi et al. 2015, Wickens et al. 2024). Furthermore, the QSCA is working closely with Macquarie University under a current Australian Research Council Linkage project. This research aims to develop advanced survey and data analysis approaches for various Australian sea cucumber species particularly targeting current knowledge gaps.

The CITES listing of Golden Sandfish follows concerns *inter alia* of illegal fishing across its habitat range (CITES 2025, FAO 2025). However, the GBR applies strict enforcement across the GBRMP with constant GPS vessel monitoring systems in place for commercial fishers. Compliance is undertaken by Fisheries Queensland and GBRMPA. Port-based and at-sea compliance checks are undertaken both randomly and based on prior reports. Compliance managers consider vessels in the QSCF (QDAF pers. comm.) as lower risk, as they have stable crews, there is no competition for quota and skippers and crew exhibit cooperative behaviour. The risk of illegal fishing in the QSCF has been assessed as low given effective enforcement and other control measures (DCCEEW 2024) and the lower risk of illegal vessel intrusions from foreign nations given the isolation of most of the GBR.

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