Institutional amnesia pushes fish spawning aggregations towards extirpation

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PERSPECTIVE

Institutional amnesia pushes fish spawning aggregations towards extirpation

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Abstract

1. How institutions create and manage knowledge has been explored in the context of management and business science. However, little effort has been made to understand how, and why, these institutions forget what works or does not work, and no research in this field has been conducted in conservation or fisheries science.
2. This paper examines the concept of institutional amnesia by focussing a lens on fish spawning aggregations and efforts to monitor and protect them in the Mesoamerican Reef.
3. For over 20 years, underwater visual census survey data has been collected periodically at 36 spawning aggregation sites, and grey literature is available since the 1940's, yet managers and conservation practitioners report that abundance tendencies for 48% of grouper and snapper spawning species across the 36 sites are '*Unknown*', despite measurable >99% declines in fish abundance in some cases.
4. This text examines the reasons why site managers are uncertain in their reporting. The central argument is that institutional amnesia (resulting from factors such as staff turnover, ineffective institutional learning, poor record keeping and a lack of storytelling) is contributing to suboptimal ecological outcomes for spawning aggregations, which are likely to continue unless measures are taken to ensure the continuity of institutional knowledge.

KEYWORDS
institutional amnesia, marine conservation, shifting baselines

1 | INSTITUTIONAL AMNESIA

The shifting baseline concept popularized by Pauly (1995), in which change is measured against previous reference points which may themselves not reflect the true early state, has been documented in fisheries worldwide (e.g. Parsons et al., 2009; Sáenz-Arroyo et al., 2005). Research on the shifting baseline phenomena in marine science has tended to focus on the individual or on generational changes (e.g. Muldrow et al., 2020; Sáenz-Arroyo et al., 2005), yet institutions set agendas and implement policy over long time periods and individual knowledge should contribute to the institution. The 'memory' of these institutions plays a significant role in how these actions get implemented, and as such, how organizations create, manage, and recall knowledge is of particular

interest. Organizations who learn and manage their knowledge successfully are considered more effective (Douglas, 1986). In management circles, many texts have been written about how organizations learn, but as Pollitt (2000) highlighted over two decades ago, few texts have been written about how they forget. Pollitt (2000) states that '*while new information technologies have provided us with the ability to store, retrieve, manipulate and communicate more data, faster than ever before, at the same time many of our public institutions seem to be losing their memories*'. Institutional amnesia therefore refers to the tendency of organizations to forget or ignore past events or information that may be relevant or inconvenient to their current goals or beliefs. This can occur at both the individual and collective levels within an organization, and can result in a lack of historical awareness or a failure to learn from past mistakes. Institutional amnesia can have negative consequences, as it can prevent an organization from recognizing and addressing problems or challenges that have arisen in the past, and can contribute to a culture of denial or avoidance of difficult issues. Organizations with institutional amnesia are likely to keep trying to periodically replicate solutions that have not worked in the past, unsuccessfully implement solutions others have successfully applied but in different contexts and fail to value the knowledge of long-term staff (Pollitt, 2000).

In the two decades since Pollitt's paper (Pollitt, 2000), little progress has been made across management science to reduce organizational forgetting. The few studies that exist on institutional memory loss have focussed on public policy and government (Stark, 2018; Stark & Head, 2019), business (de Holan & Phillips, 2004) and disaster management (Heideman, 2016; Stark, 2019). Institutional amnesia has not been studied in conservation or fisheries science. Considering that long-term marine conservation initiatives rely on effective institutions for impact, this omission appears to be significant. This manuscript uses efforts to monitor and protect fish spawning aggregations in the Mesoamerican Reef as an example of how institutional amnesia leads to suboptimal conservation outputs and provides suggestions and recommendations on how to overcome these hurdles.

2 | THE FISH SPAWNING AGGREGATIONS OF THE MESOAMERICAN REEF

Fish spawning aggregations (FSAs) are large, temporary gatherings of fish that meet for reproduction (Sadovy de Mitcheson & Colin, 2012). In transient spawning aggregations, fish can migrate long distances to spawn at specific sites, during specific times of year (Colin, 2012). Sites can be multispecific, hosting a range of different species throughout the year (Heyman & Kjerfve, 2008). Most transient spawners are large bodied, with long lifespans and late maturity, and concentrate the majority of their annual reproductive output at the spawning site (Colin, 2012). FSA are critical lifecycle events for many commercial fish species, including groupers (Epinephelidae) and snappers (Lutjanidae) (Erisman et al., 2018), and FSA sites are hotspots for biodiversity and reproductive potential (Erisman et al., 2017).

Fishing FSAs is not considered sustainable, nor economically optimal, as the market receives an oversupply of a single species at a specific time, and prices are driven down (Sadovy & Domeier, 2005). However, large quantities of fish can be caught quickly, with minimum effort, and the spatiotemporal predictability of FSAs has led to the establishment of specific fisheries around aggregations worldwide. Overall, 54% of FSAs have not been assessed by scientists and managers, and of those that have, 55% are in decline, and 8% have disappeared (SCRFA, 2018). Management actions often include catch and effort control, as well as seasonal and spatial closures (Chollett et al., 2020). Spatial FSA closures, through small no-take areas, have been a preferred tool in some tropical contexts (Erisman et al., 2017; Fulton et al., 2018; Hamilton et al., 2011).

Covering 457,536 km^2, the Mesoamerican Reef ecoregion is a globally recognized biodiversity hotspot that includes the world's second longest barrier reef, extending over 1000 km from Cabo Catoche in Mexico to the Bay Islands in Honduras (Chollett et al., 2017). The importance of FSAs for fisheries in the Mesoamerican Reef has been documented for over 80 years. Reports from Belize (then British Honduras) from 1944 described an FSA: '*The groupers congregate here in almost countless numbers in late December or early January; it is reported that they are so closely packed as to hide the white sand bottom*' (Caye Glory, Belize; Thompson, 1944), and by the 1960's visiting researchers were studying the Mexican and Belizean fisheries that had built up around the FSA sites (Craig, 1966, 1969; Solís-Ramírez, 1966)—'*According to the fishermen, a grouper fishery… operated during December and January at Mahahual. In 1965, fishermen told [the interviewer] that they took 20 to 30 tons of grouper during this [time]*' (Miller, 1982).

The introduction of SCUBA allowed scientists to move from fisheries dependent monitoring to visual counts and during the 1990's Belize became a hotspot for spawning aggregation management and conservation, with NGOs, philanthropic foundations and the Belize Fisheries Department working with small-scale fishers to propose a network of marine reserves on spawning sites. By 2001, a national survey of FSAs had begun, with multiple stakeholders working towards evaluating the status of the sites and creating the appropriate policy and legislation to ensure sustainable fisheries (Gibson et al., 2007). The Belize Spawning Aggregation Working Group was created to support this process and in 2003, eleven marine reserves were created to protect FSAs. A further two sites were protected by the zoning of existing protected areas.

Under the guidance of the Mesoamerican Barrier Reef System Project, efforts spilled over into neighbouring Mexico and Honduras, where, beginning almost from zero, researchers began identifying FSA by documenting the traditional ecological knowledge of local fishers (Sosa-Cordero et al., 2002). During this period (2000–2005), fieldwork did not generally involve site characterization or SCUBA diving but generated lists of potential sites for others to explore. For example, in 2005 in Mexico, the NGO Amigos de Sian Ka'an (Franquesa-Rinos & Loreto-Viruel, 2006) began diving and mapping

TABLE 1 Total number of FSA sites and their protection and validation status in the MAR, adapted from (Fulton et al., 2020).

Country	Total sites	Protected	Visually verified and protected	Unprotected	Protected but not verified
Mexico	8	5	5	3	0
Belize	16	16	10	0	6
Guatemala	1	1	0	0	1
Honduras	11	8 (seasonal closure)	6	3	2

potential sites, using similar methodologies to those employed in Belize. This work continued through 2009 at which point seven sites had been visually verified as FSAs (ASK & COBI, 2010). In Honduras, the study was limited to the Tela area and highlighted the large data gaps and need for exploratory fieldwork (RPI, 2003). Investigation in Guatemala was constrained by institutional capacity and restricted Caribbean coastline and focussed on more estuarine species such as common snook *Centropomus undecimalis* (RPI, 2003).

By 2020, the Mesoamerican Reef had 30 marine reserves (22 fully protected, eight seasonally protected in Honduras) purporting to protect FSA (Table 1). All these sites are protected, on paper, by national legislation, but management and enforcement levels vary significantly across sites. Of these 30, 21 had been visually verified by researchers and managers as FSAs. The remaining nine sites are also protected, but without conclusive verification of being an FSA site.

3 | FORGETTING OUR FISH SPAWNING AGGREGATIONS: CAYE GLORY

The arrival of SCUBA allowed researchers to begin visual surveys, but by the time researchers were regularly diving on FSAs in the 1990s, populations were already severely depleted. This research, built on a shifted baseline, guided future management. However, by using Caye Glory, Belize (also known as Emily in some literature) as an example we can see that institutional amnesia also needs to be considered to understand how we can better manage these sites.

Catches in Caye Glory were historically so high that an experienced crew could catch 1200–1800 Nassau grouper per season (Craig, 1966), with 300 boats heading to the site during spawning periods in the 1960's. Craig (1969) estimated that 90 metric tons of grouper could be caught in a season in 1969, but also commented that overfishing had begun decades earlier. Jacques Cousteau, exploring the site in 1976, commented '*I think it would be very important to protect this area against any [fishery] improvement as a way to protect the [livelihoods] of these fishermen for years to come… The area to protect is tiny, but it would be enough*' (Cousteau, 1976). What Cousteau discussed with the British Honduran fisheries minister in 1976 still applies: small protected areas are recognized as an effective management tool for protecting spawning fishes (Erisman et al., 2017). Caye Glory was protected, 27 years later in 2003, after just 18 fish were caught in 2001 (Paz & Grimshaw, 2001). Available monitoring data in the almost two decades post-protection show little recovery (Figure 1).

A recent Mesoamerican Reef fish spawning aggregations status report (Fulton et al., 2020) found 15 published papers and grey literature that referenced either landings or visual census data on the Caye Glory site, spanning a century. Despite data points from 1944 (Thompson, 1944), estimates of 100,000 individuals in the 1960's (Heyman & Wade, 2007), and SCUBA surveys from 2019 with 238 fish (Cho-Ricketts, 2019), managers of the site reported the overall tendency for the Critically Endangered Nassau grouper as '*Unknown*'. Tendencies for the less well-studied black grouper, yellowfin grouper, tiger grouper, dog snapper, mutton snapper and cubera snapper were also reported as '*Unknown*'. Despite also reporting that illegal fishing pressure was also unknown, increasing enforcement was the principal management recommendation.

This result was not unique to the Caye Glory site. Indeed, across the 36 known and suspected spawning aggregation sites, '*Unknown*' was the most commonly reported status for changes in species abundances (48% of 103 data points), while '*Decreasing*' (34%), '*Stable*' (10%), '*Increasing*' (8%), and '*Extinct*' (1%) made up the remainder. While a high proportion of '*Unknown*' could be expected in some sites where data collection has been limited (e.g. Honduras), most Belizean sites have over 20 years of, albeit, intermittent monitoring data and yet Belize had an '*Unknown*' reporting rate of 60% for 45 species spawning across 16 FSA. In the context of institutional knowledge management, it is also important to note that interviewed practitioners who reported '*Unknown*' as a tendency for fish abundance at FSA (Fulton et al., 2020) were reporting on the FSA *they managed*.

4 | AMNESIA AND AGGREGATIONS

The shifting baseline phenomenon (Pauly, 1995) has been reported for the aggregation-forming fish species in other regions (Bravo-Calderon et al., 2021; Sáenz-Arroyo et al., 2005), for other species across the Caribbean (Jackson, 1997; McClenachan & Cooper, 2008), as well as for coral reef scientists (Muldrow et al., 2020). A shifting baseline is certainly at play in the Mesoamerican Reef, where a spawning aggregation with just 1000 fish is considered a 'large' or 'unique' site, by both scientists and managers (Fulton et al., 2020). NGOs in the region now describe aggregations of '100s to 1000s' of fish as normal spawning aggregations in reports and on social media

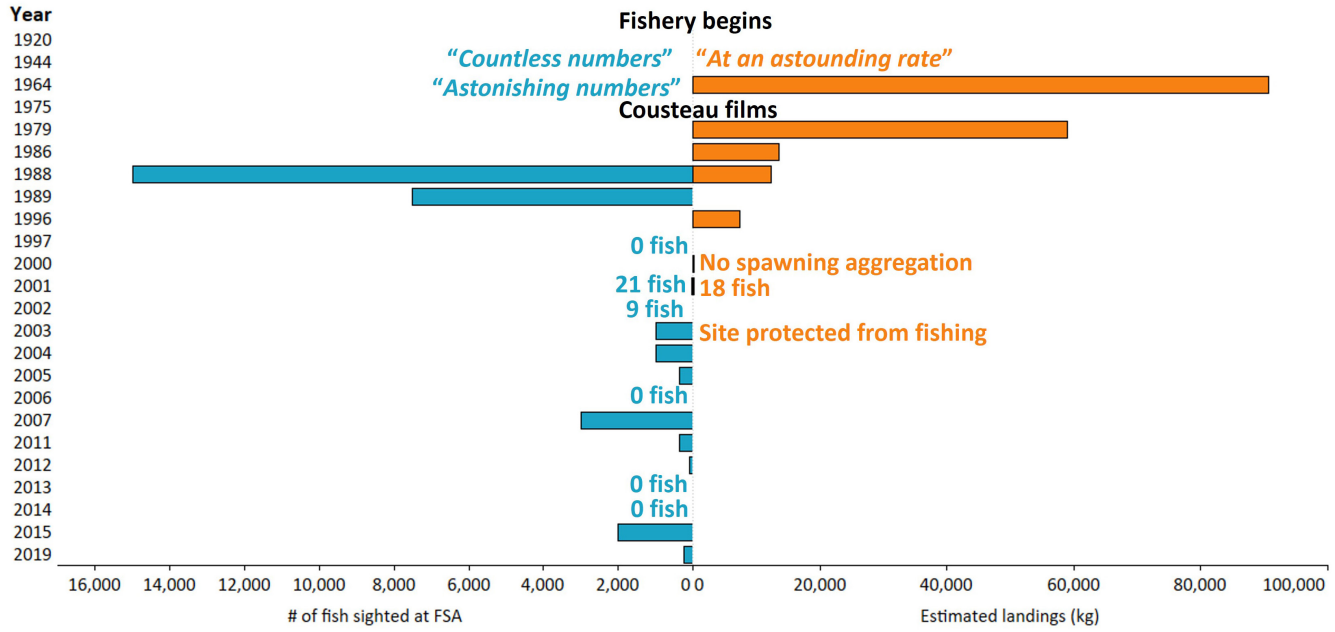

FIGURE 1 Reconstructed and estimated landings at Caye Glory (Emily), principally based on table 4 of Paz and Truly (2007). Additional sources from Thompson (1944), Craig (1966, 1969), Cousteau (1976), Carter (1988, 1989), Carter et al. (1994), Jacobs (1998), Paz and Grimshaw (2001), Sala and Ballesteros (2001), Heyman and Requena (2002), Paz and Truly (2007), Perez and Tewfik (2016) and Cho-Ricketts (2019). Number of fish caught converted to landing weight using 3.7 kg per fish average (Nemeth et al., 2006).

(Healthy Reefs Institute, 2021). And, while we should recognize that today's normal is a significant decrease from the abundances documented by fishery researchers in the 1940s and 1960s (Paz & Truly, 2007), long-term institutional memory, archival capacity and mechanisms for knowledge management could have helped avoid a shifting baseline.

Despite the difficulties around monitoring spawning aggregations (both technically and financially) in the Mesoamerican Reef, an abundance of data is available. Why do managers consider that they do not have adequate information to state the abundance tendency of a critically endangered fish? Staff continuity appears to be part of the cause. While practitioners surveyed by Fulton et al. (2020) were not asked how long they personally had been managing their sites, two practitioners in Mexico, two in Honduras, and one in Belize who had been in their posts for over a decade (in some cases several decades) had a wealth of information about FSA sites, including sites that they did not currently manage. This over-dependency on individuals (who at some point will leave their employment or retire) to maintain the historical memory continues to feed the shifting baselines on FSA health. It is also likely exacerbated by the high proportion of government and NGO staff working in this area of science and management (being posts with a propensity for a high turnover due to political changes and funding cycles, respectively). This high turnover contributes to poor data management. Data may not be collected properly (e.g. drift from an established monitoring protocol, (Heyman et al., 2004) as field staff are unsure how to replicate proceedures), be ineffectively recorded or archived, or just not consulted to inform decision making.

Pollitt (2000) also identifies poor policy learning as a sign of institutional amnesia. Organizations with amnesia repeatedly implement the same actions despite their continued failure to get results. While illegal fishing is, and will always be, a threat to FSAs, increased enforcement is the *only* tool in most managers' playbooks. A 20-year review of coral reef health in Belize (Alves et al., 2022) found continued declines in reef health, both inside and outside of no-take zones, with all no-take zones reported to have moderate to good enforcement. Protection status of the site was not predictive of variations in reef health, but ocean temperature anomalies were (Alves et al., 2022). Fully-protected MPA sites in the Mesoamerican Reef have considerably higher grouper and snapper biomass than other MPA zoning categories (McField et al., 2022) which suggests that enforcement and compliance in those key areas are at least somewhat effective. Despite these results, both Alves et al. (2022) and spawning site managers (Fulton et al., 2020) conclude that managers must continue to increase enforcement capacity. NGOs have been encouraging the governments of the four countries to increase enforcement for over 25 years. Belize is the anomaly in the region (in that it has somewhat effective enforcement compared to the other three countries, where it is effectively null), yet it is never enough. More recent studies from developing countries show that involving communities in management leads to more effective ecological outcomes (Fidler et al., 2022), yet a top-down approach has been preferred in the Mesoamerican Reef, and managers show little willingness to learn from past failed efforts to improve enforcement.

Finally, scholars of institutional amnesia also recognize '*intentional forgetting*' (Kluge & Gronau, 2018), particularly if forgetting is advantageous. Considering that five of the Belizean FSAs protected by statutory instrument in 2003 or 2009 currently have no recorded spawning activity (Fulton et al., 2020), it appears that some of the reasons for why they were protected have been forgotten. Adaptive management to improve marine reserve design for the FSAs would imply further investigation, which has not occurred, and this amnesia creates benefits. The sites are always counted as part of the protected FSA network and are used to bolster claims of effective conservation and sustainable management (e.g. The Commonwealth Charter, 2020). It should be noted that the sites are fully protected from fishing, providing ecological benefits beyond their original purpose, but we cannot claim they protect FSAs.

5 | RECOVERING OUR INSTITUTIONAL MEMORY

Organizations will always forget, and a future in which institutional amnesia is completely eliminated is improbable (Stark, 2020). Scholars also note that not all amnesia is negative or even accidental (de Holan, 2011), as selective amnesia can allow us to forget those ideas and practices that do not work, or conversely, forget we have a problem in the first place (e.g. not having spawning fish in a protected spawning site). Having said this, steps can be taken to improve our institutional memory of the Mesoamerican Reef FSAs:

Reduce churn. NGOs and government (the main stakeholders involved in this case study) are notorious for high staff turnover. Short-term contracts, and funding and election cycles break continuity leading to processes, procedures and information being lost. While this situation is unlikely to change in the short-term, funding organizations can look to provide continuity funding and a long-term vision, increasing stability for NGOs.

Increase the participation of local research institutions. Scientists have been recognized as important agents for continuity (Stark, 2018) and knowledge transfer. The Mesoamerican Reef does not have many strong academic institutions or local researchers. Most research is conducted by visiting scientists who take their knowledge with them when they leave, and many promising local researchers leave to pursue further research abroad. Reducing this brain drain would keep institutional memories alive.

Strengthen local NGOs. The presence of international NGOs often brings funding and highly trained staff. However, experiences in peacekeeping show that local NGOs are key stakeholders for institutional memory as they remain in situ when the international organizations move on to the next big thing (Heideman, 2016). Durable local NGOs also retain more accessible records (Heideman, 2016). Finally, 'poaching' of local staff by international NGOs should be disincentivised (Stark, 2020) to ensure local expertise.

Improve record keeping. Although Belize has maintained a centralized, and well-managed country-level FSA database since the early 2000's (http://www.spagbelize.org/), there is no regional data sharing mechanism, nor regional body that brings together institutions that work on FSAs, as there are for corals (AGRRA, 2022). The lack of a regional database, where data can be consulted, tracked, and shared (Pittman & Heyman, 2020), may contribute to institutional amnesia. Creating a database is not however, a panacea. While Belize's FSA database has proved effective at collecting data, it appears not to have been able to effectively share that information back to practitioners and managers. Legislation to guarantee long-term monitoring and open data would be a logical step but both government will and budget is lacking. The Healthy Reefs Report Cards (McField et al., 2022), supported by philanthropy, provides an example of the importance of long-term data collection and reporting to hold decision-makers to account.

Tell stories. Storytelling is a neglected dimension of organizational memory building (Stark, 2020). Creating narratives around why certain things are done the way they are is an effective way of passing down knowledge. In disaster relief, overlapping contracts and handovers between staff ensured continuity of information (Stark, 2020), as incumbents could learn directly from experienced staff, a procedure not common in NGOs and government. Research should also be published in peer-review journals and not just delivered to funders as reports that are not generally available to a wider audience.

Institutional memory loss is poorly studied in management (Stark & Head, 2019) and has not been studied at all in conservation or resource management science. From a limited study of tropical fish spawning aggregations this amnesia appears to be contributing to suboptimal ecological outcomes for marine resources which are likely to continue unless measures are taken to ensure the continuity of institutional knowledge. This article represents a first step for including institutional amnesia in marine conservation science and I encourage scholars and practitioners to reflect, introspect and take steps to avoid collective forgetting.

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CONFLICT OF INTEREST STATEMENT

The author declares no conflicts of interest.

DATA AVAILABILITY STATEMENT

All data used are cited in the document and drawn from the academic publications or grey literature. If the grey literature cannot be found online (try https://gigantesdelpasado.org/ first), the author can provide a copy upon request.

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