Historical ecology of the Noosa Estuary fisheries

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Cover photo: Landing place at Noosa River, a sketch extracted from an 1870 survey of the Noosa river and surrounds. Reproduced with permission of the Museum of Lands, Mapping and Surveying.

Executive Summary

Humans have been reliant upon marine resources for centuries, but in recent years concern has grown about the declining health of marine ecosystems. Yet our ability to judge the extent to which marine ecosystems have been degraded is impeded due to a lack of long-term data, making it difficult to know what appropriate management or restoration targets should be. This study aims to develop an understanding of historical fisheries productivity in the Noosa Estuary. It aims to inform the Noosa community about ecological changes that occurred prior to their lifetimes, and to provide insights into the species that inhabited the Noosa River and their changing abundance over time.

The Noosa region has been populated for centuries by the Kabi Kabi Traditional Owners, who harvested species such as mullet, pipis and oysters, potentially trading these resources with inland indigenous populations. When European settlers arrived in the region, the Kabi Kabi people were the first commercial fishers, trading or selling oysters and other species to the settlers. Archaeological and historical sources suggest that rock oysters and other shellfish were highly abundant throughout the Noosa River and Lakes up until the late 19th century. Oysters often perform a key role in coastal ecosystems as they provide habitat upon which other species depend upon for food and shelter.

During the late 19th century, an increasing demand for oysters led to sections of the river and lakes being privatised and leased to settlers. By the turn of the 20th century, millions of oysters had been removed from the Noosa system, destined for consumption in Brisbane and other Australian cities. Despite high levels of exploitation, the beds continued to operate until the 1920s, after which oyster leasing was largely discontinued. The decline in oysters was likely to due to a number of factors, including declining water quality (with links to disease), overexploitation, reduced market demand and increased competition from New South Wales and New Zealand suppliers. Today, oyster abundance is much lower in the Noosa system and any functional role they historically played no longer exists.

By the end of the 19th century, settlers also operated fisheries for mullet, jewfish, tailor, bream, whiting and flathead, in addition to other species. At first, fish were sold to local residents and as far away as Gympie. However, improved transport networks, the establishment of the ice works and later the Fish Board at Tewantin, enabled fish to be transported to Brisbane. The Noosa River and Lakes provided a significant quantity of commercial fish, and from the 1920s also supported a large, if seasonal, recreational fishing population, who were drawn to the natural beauty of Noosa and the high quality fishing.

Commercial fishing records are limited and for the most part do not provide us with Noosa-specific catch. It is clear from the available records that landings of the main species have always been variable, and no significant declines in catch are recorded, although the numbers of commercial fishers have declined over time. Recreational catches were not recorded in government records, with the exception of one to two years, but catches were recorded in popular media such as newspapers, which recorded recreational and competition landings over a period of nearly 70 years, from 1913-1980. These records, though limited, suggest a decline in recreational catch rates during this period. While it cannot be stated definitively why this pattern occurs, interviews with long-term fishers and residents suggests that this was likely due to declines in fish abundance, rather than changes in targeting behaviour.

The historical record points to significant changes in the Noosa River and Lakes: Oysters – once plentiful – are commercially and functionally extinct; commercial and recreational fisheries still exist, but historical records backed up by interviews with local fishers, depict a more productive system formally than exists today. The reasons for these changes are difficult to resolve, but in addition to over a century of reasonably heavy exploitation, the Noosa River has been subject to development pressure since the 1970s, and as a result has been greatly altered from its early state. While historical data cannot provide quantitative estimates of change for the Noosa Estuary fisheries, they provide insights into how productive the system once was, and provide the beginnings of an evidence base upon which more informed decisions can be made.

Acknowledgements

This project would not have been possible without the librarians, Councillors, historians, recreational and commercial fishers, Kabi Kabi Traditional Owners and residents, who gave up their time to provide published information, cultural and personal observations. I am extremely grateful to all. In particular:

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We acknowledge the Kabi Kabi Traditional Owners who provided cultural knowledge and collective memories of the Noosa River and Lakes region. They provided the following statement for this report:

“The recovery or restoration of shellfish reefs (including oyster reefs and fisheries) in Southern Queensland offers significant prospects to renew the cultural links of Traditional Owners to their Traditional Estates. The need to convey to stakeholders the importance of recognising and acting on such

aspirations and on the legacy of millennia of Kabi Kabi Traditional Owners of the Noosa River area and the wider Sunshine Coast cannot be overstated.

As Aboriginal Traditional Owners we are obligated by custom to recognise and safeguard our history and continued connection to Country through the maintenance of our past, present and future. We acknowledge and pay respect to our Ancestors who continue to be present in our Country and who guide us as the contemporary custodians and decision-makers for the wellbeing of our land, waters and culture. We pay respect to our Elders who are guiding and helping us.

Our aspirations, vision and the actions of our daily life is to unite and address the issues of degradation to our traditional Country and the ongoing erosion of the values of our cultural heritage sites, landscapes and waterways. Our vision is to restore shellfish reefs and fisheries of the Noosa, Maroochy and Mooloolah Rivers. We welcome the opportunity to collaborate with our non-Indigenous brothers and sisters who are making a valuable contribution to Caring for Country. Our chief priority, as our goals are implemented, is to reach out to all people within the Sunshine Coast and surrounds and to engage with all who are interested in our country and our culture to play a more active role in caring for our part of the Earth. The Earth is our Mother. As she is healed we will also be healed."

Kerry Jones, Arnold Jones and Bridgette Davis

Kabi Kabi Traditional Owners, Sunshine Coast
(& lease holders of the historical Maroochy River Oyster Lease)

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Introduction

Historical ecology

Humans have lived adjacent to, and relied upon food and other resources from our rivers and coasts for millennia (Erlandson et al. 2008). Yet in recent decades levels of exploitation and alteration of these ecosystems has occurred at unprecedented rates, resulting in widespread ecological degradation (Myers and Patz 2009). Our ability to recognise (and potentially reverse) this degradation is, however, hampered by a lack of information on past conditions. In many cases we simply do not know what ecosystems looked like, or how abundant fish and shellfish populations were prior to the commencement of exploitation and coastal development. This lack of long-term knowledge is reinforced by contemporary ecological datasets, which commonly span just a matter of years or at most a few decades in length, and which therefore only provide us with information on ecosystems after major changes have already occurred (Jackson et al. 2001).

A lack of information on historical conditions results in a phenomenon called the 'shifting baseline syndrome' (Pauly 1995). Shifting baselines describes a situation where we fail to appreciate the environmental changes that occurred prior to our lifetimes. The older generation may recall past environments that look quite different to today, but this knowledge does not necessarily get translated to younger generations (Sáenz-Arroyo et al. 2005; Fig. 1). Likewise, many older individuals are probably unaware of changes that occurred prior to their lifetimes, and so forth. Therefore, with each subsequent generation a shift occurs in what is perceived to be a 'natural' environment. This applies to both terrestrial and coastal changes: it can affect what we perceive to be a 'normal' abundance of mangroves along the river, or a 'healthy' fish resource. The shifting baseline syndrome is a problem for resource management as without an appreciation of past change, we are less likely to recognise continuing degradation or attempt to halt further adverse effects.

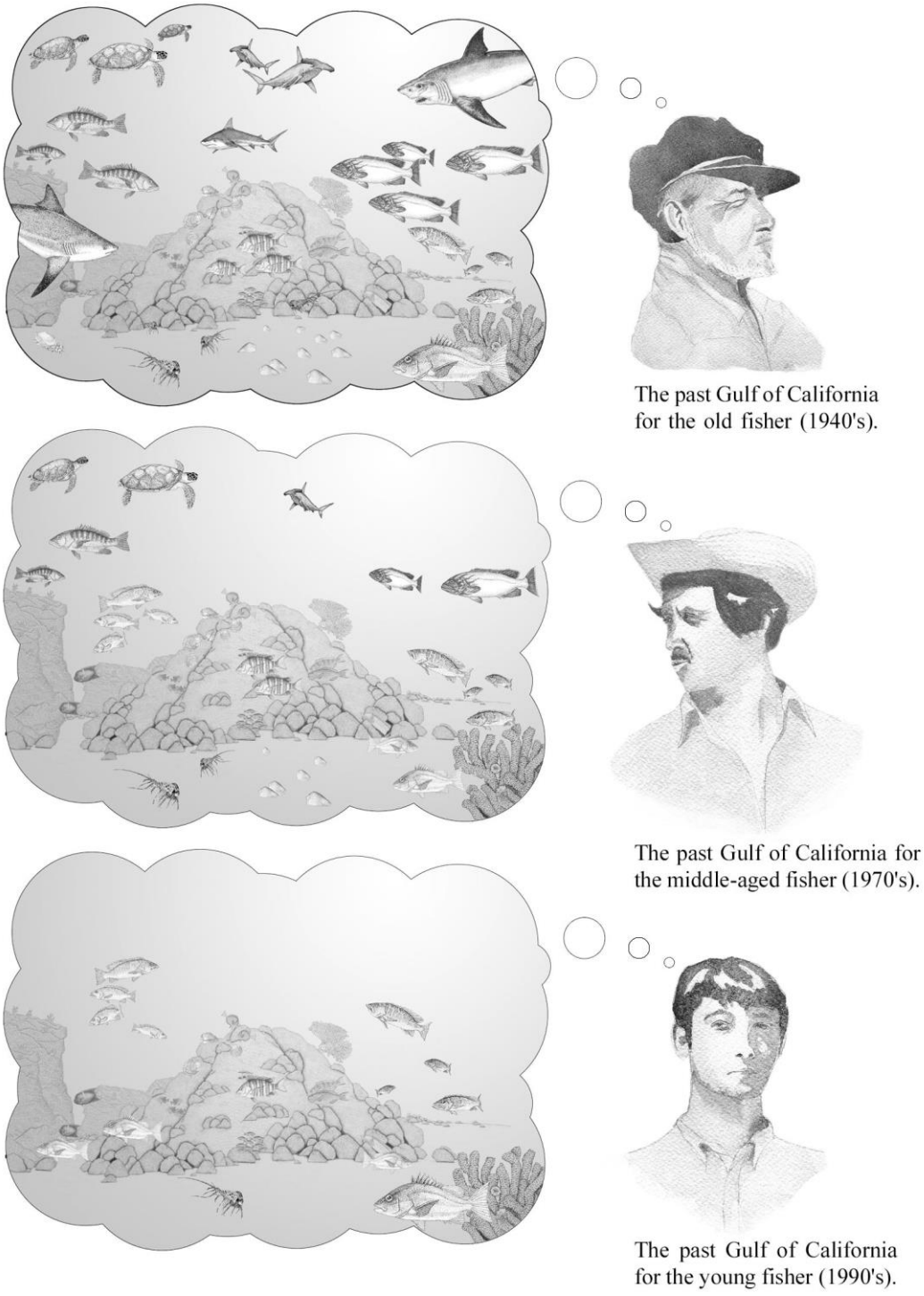

Figure 1. Sáenz-Arroyo et al. (2005) demonstrated shifting baselines among different generations of fishermen in the Gulf of California. Older fishermen consistently recalled past systems that had larger and more abundant populations of fish, while younger generations observed degraded systems as normal. Image by Anne Randall, Pier Thiret and Juan Jesus Lucero. Reproduced with permission of Andrea Sáenz-Arroyo.

To alleviate these problems, researchers have attempted to improve our understanding of past ecosystems by turning to historical data. Sources used include archaeological data, information from government and community archives (e.g., newspapers, books, pictures, early government surveys), local ecological knowledge and traditional ecological knowledge (Berkes et al. 2000; Coll et al. 2014; Sáenz-Arroyo et al. 2006). For example, archaeological remains have uncovered information on tens of thousands of years of coastal resource use in Australia, shedding insight into the species targeted by indigenous populations (McNiven 1984; Ulm 2006). Archival data have provided information on historical fishery abundance and early fishing activities, showing that coastal systems began to be significantly impacted by human activities much earlier than previously believed (i.e., a century or more, rather that just a few decades ago) (Edgar and Samson 2004; Klaer 2001; Pandolfi et al. 2003; Thurstan et al. *In press*). For example, a recent study by Alleway and Connell (2015) uncovered the past presence of native oyster (*Ostrea angasi*) reefs along large sections of the South Australian coast. Historical records also show that commercial fisheries existed for this species during the 19th and early 20th centuries, yet their presence has since largely been forgotten.

Historical data may thus provide novel information on the past structure and functioning of ecosystems. While we are unlikely to get back to these historical conditions (and indeed, we may not wish to), such insights provide us with information on the health of present-day ecosystems, and provide an evidence base upon which more informed decisions can be made.

Study objectives

This study aims to develop an understanding of historical fisheries productivity in the Noosa Estuary. It does not intend to prescribe targets for management; rather, it aims to inform the wider community about ecological changes that occurred prior to their lifetimes, to provide insights into the species that inhabited the Noosa River, and their changing abundance over time. It charts the evolution of the fisheries and places these into the context of the broader

environmental changes that have occurred within the river system in recent decades. To achieve this, archival materials were collated and local residents interviewed about historical fisheries in the Noosa Estuary and Lakes system. Data collation focused upon commercial and recreational fin fisheries, prawns and oysters.

Previous studies

This report is certainly not the first to focus upon the history of the Noosa region, or to mention its fisheries, although it may be the first to exclusively focus upon these within a historical context. A number of references sourced from local history collections, academic and government libraries have guided the context for this study and are referenced throughout. For additional information on the history of the Noosa River, the following references are suggested:

- Brown E (1996) Nineteenth Century Cooloola. MA Thesis, The University of Queensland.
- Monks C (2000) Noosa: the way it was, the way it is now. Noosa Library.
- Adams RJL (2004) Noosa Horizons: a history. Ultreya Publications.
- Adams RJL (2000) Noosa and Gubbi Gubbi. Ultreya Publications.
- Cato N (1979) The Noosa story. John Wiley and Sons.
- Wallace WAJ (1945) The mud crab collection. Noosa Library.

Methods

Data sources

Archival data sources were mined for information on the fisheries of the Noosa River and Estuary, in addition to broader environmental changes. Materials were sourced from the following locations: the Queensland State Archives, the State Library of Queensland, Department of Agriculture and Fisheries library, Department of Environment and Heritage Protection library, the Museum of Lands, Mapping and Surveying, Noosa library, Pomona Museum, Nambour library, Gympie library, and The University of Queensland library. In addition to material hard copies, digitised collections from The National Library of Australia (Trove: www.nla.gov.au) were also searched.

The major archival sources consulted were: Department of Harbours and Marine Annual Reports (1892-1970), Fish Board Annual Reports (1937-1981), Department of Agriculture and Fisheries commercial landings records (1990-2014), Fishery Inspectors' correspondence (1910-1965), Brisbane Courier (1884-1933), Courier Mail (1933-1954), Telegraph (1872-1947), Sunday Mail (1926-1954), Gympie Times and Mary River Mining Gazette (1863-1919), The Maryborough Chronicle (1860-1954), Nambour Chronicle and North Coast Advertiser (1903-1983), Noosa Advocate (1917-1933) and Noosa News (sub-sampled years 1968-2015).

At each location, or for each electronic source, a broad search of the available material was conducted using key words and combinations thereof, e.g., 'fisheries', 'fishing', 'oyster', 'snapper', 'mullet' 'Tewantin', 'Noosa river', 'Weyba', 'Cootharaba', 'Cooroibah' and 'competition'. Historical spellings of places and species were also searched to ensure earlier records were not missed, e.g., 'Nusa', 'Newsa', 'Neusa', 'Wybah', 'Whyba' and 'schnapper'. Newspaper records, pictorial sources and local heritage references were also searched at each of the locations visited.

Any information or observations/perceptions of Noosa Estuary fisheries e.g., abundance, species and number caught, locations fished, number of hours fished, were recorded and separated by method of fishing (line or net), species (oyster, prawn, finfish, megafauna e.g., sharks, groper, sawfish), and whether the record provided qualitative and/or quantitative information. Only catches or information relating to the Noosa Estuary, River or Lakes system were recorded. Catches outside of this area were not included, with the exception of fishing activities that took place at the North Shore near Tewantin, or at the local reefs within a few miles of the river mouth (e.g., Jew Shoal).

State government fisheries records did not often report upon the Noosa River and Lakes system specifically, although the local oyster, prawn and mullet fisheries were occasionally mentioned in early reports. Commercial data were derived from three major sources: Department of Harbours and Marine Annual Reports, Fish Board Annual Reports, and Department of Agriculture and Fisheries commercial fisheries records (years as stated above). The method of recording quantities of fish landed differs throughout the time series, and after the dissolution of the Fish Board in 1982 annual landings were not recorded again until 1990, leaving an eight-year data gap.

Fish landings were extracted for the Tewantin Fish Board from 1946-1981. However, the few Fish Boards that existed along the coast meant that these records do not differentiate between catches sourced from within and outside the Noosa River. Other than Tewantin, the nearest Fish Board depots existed at Tin Can Bay and Mooloolaba, so many of the fish processed at Tewantin would have likely been sourced from locations such as the North Shore, possibly as far away as Double Island Point, in addition to the Noosa River. These records do not provide any indication of fishing effort (e.g., numbers of licenses or days fished), hence are restricted to reporting fish landings only.

The Queensland Department of Agriculture and Fisheries holds commercial landings and effort data for the years 1990-2014 (2015 catches are not yet complete and are not included in this report). From 1990, landings and fishing

effort reported by days and license were extracted. As for the Fish Board reports, landings records are not restricted to the Noosa River. Additionally, the reporting process differs from earlier records. Since 1990 fishers have reported their catch location as part of a Queensland-wide grid system. Each grid covers a 30nm by 30nm radius (55.6km by 55.6km). Landings were unable to be analysed at a finer spatial resolution (6nm by 6nm) (11km by 11km) due to data confidentiality and a lack of reporting at this scale. Grid W35 covers landings of species originating within the Noosa saltwater lakes system (e.g., Lake Cooroibah, Lake Weyba and part of Lake Cootharaba), and along the coast from just south of Double Island Point (north of the Noosa Estuary) to Peregian Beach (to the south of the Noosa Estuary). Grid V35 covers the remaining section of Lake Cootharaba. Hence, while the spatial reporting of contemporary fish landings differs from the Fish Board reports, the northern and southern boundaries of W35 are likely to be similar to the areas where commercial fish were landed for processing at the Tewantin Fish Board.

Local knowledge

Interviews were conducted with long-term local residents and fishers, in addition to meetings with historians, archaeologists and Traditional Owners. Fishers were asked about their historical and contemporary catch and effort, changes in targeting behaviour and locations fished. Fishers and residents were asked about their perceptions of changes in fish abundance within the river and estuary system, and observations of changes in the system more generally (e.g., changes in shellfish populations, changes in depth/location of the river and river mouth, mangrove coverage, impacts of development). Non-resident experts were asked specifically about their field of study and knowledge about the Noosa River.

Data analysis

Quantitative data on fish catch and effort could be sourced from archival materials for both recreational and commercial fisheries. Where available, catch rates were calculated. Catch rates from the recreational fishery were defined

using two measures: number of fish landed per angler per fishing session, and number of fish landed per angler per hour of fishing. Linear regression analysis was performed on each of these measures to determine if significant changes in catch rates occurred over time.

Catch rates were also compared to determine whether significant differences existed between a) data source and b) location fished. Catch rates sourced from newspaper reports of recreational fishing trips, competitions and a government survey were compared. As the government survey only spanned a period of two years (1961-62), only recreational catches reported between 1950 and 1970 were compared to the government data source, rather than the whole time series. The Mann-Whitney test was used to examine whether median catch rates from two different locations, or from two data sources, were statistically different. In cases where data were provided from more than two sources, a one-way Kruskal-Wallis test was performed, with post-hoc tests conducted using Dunn's multiple comparisons test.

Results

Data sources uncovered

Sources uncovered included annual government reports on the early fisheries in the Noosa River, Lakes and wider region, information on recreational fishing competitions, recreational and commercial catches, fishery inspector reports and correspondence concerning fishing licenses, oysters leases and complaints about net fishing, catches or sightings of megafauna within the Noosa River system, observations of indigenous fishing activities (although these were restricted to second-hand reports, i.e., observations by settlers rather than first hand accounts by indigenous people), archaeological studies of the Cooloola Coast (but not the Noosa River specifically), and previous academic and government reports on the fisheries and local history of the Noosa region.

In addition to searching through hard copies of local newspapers (Noosa Advocate, Noosa News), government reports, fisheries inspector correspondence and academic reports, approximately 10,000 individual digitised records were searched using Trove. From these popular sources nearly 900 records were extracted that provided either descriptive or quantitative information on the Noosa Estuary and its fisheries, spanning the years 1871-2014. Government records also provide commercial landings of finfish from 1946 to the present day, and prawns from 1959, although not for the Noosa River specifically. However, earlier records do provide insights into the Noosa River oyster fishery, which once exported oysters to Brisbane but which ceased to exist as a commercial fishery by the 1930s.

Thirty long-term residents including commercial, charter and recreational fishers, business owners, historians and Traditional Owners were spoken to about their observations of the Noosa River, its wildlife and people, with questions adapted according to their individual expertise and experience.

Fish frequently mentioned in the archival records for the Noosa Estuary include whiting, sea bream, flathead, jewfish, mullet, tailor and prawn. Many of these common names (e.g., bream, whiting, flathead, prawn) are used to refer to two or more closely related species, which were rarely distinguished in the historical records. Oysters (again, rarely distinguished to species but most likely to be rock oyster, *Saccostrea glomerata* (Smith 1981)) were mentioned in earlier documents, and occasional sightings or catches of megafauna (e.g., sharks, groper, sawfish) were also recorded. Locations mentioned with regards to fish catches included Lake Cootharaba, Lake Weyba, Munna Point, Tewantin, Gympie Terrace, Noosa Heads, the river mouth and North Shore. Catches of snapper and Spanish mackerel on the outside reefs were also occasionally reported.

Commercial fisheries

Prior to European settlement, archaeological evidence and traditional knowledge document the use of fish and shellfish resources by the indigenous population of the region, the Kabi Kabi Traditional Owners. Fish were caught by spearing and netting, and oysters by diving (Tewantin State School project 1957). Fishing seasons were linked to seasonal cycles, for example, the flowering of particular plant species (Kabi Kabi Traditional Owners, *pers. comm.*). Middens along the Cooloola coast contain shellfish remains, mainly pipi shells (*Donax deltoides*) (McNiven 1984), while earlier records hint at the existence of several significant middens along the Noosa River which contained large numbers of oyster shells (The Brisbane Courier, 5 Jul 1877; Monks 2000). When the settlers arrived in Queensland in the early 1800s, indigenous people used their knowledge of coastal fisheries to catch, trade and sell fish, crustaceans and shellfish to the growing population, making them the first commercial fishers (Kerkhove 2013).

Trading and selling of fish and oysters by indigenous inhabitants to the Noosa settlers certainly occurred, and by the 1870s settlers were also harvesting oysters to sell locally and further afield (Gympie Times, 25 Feb 1871) as they took advantage of the swelling population that had settled in the Gympie region as a result of the gold rush (Adams 2004). The timber trade of the 1870s provided regular and reliable transport to Brisbane for the first time, and it was

this mode of transport that facilitated the trade of oysters to Brisbane. In the early 1900s it was stated that approximately four parties of licensed fishermen supplied Gympie and other local towns with fish (The Brisbane Courier, 26 Sept 1908; Marine Department Report 1909), although the number of local fishing families was higher than this (Adams 2004). The net fishing industry remained largely localised to Gympie and the surrounding towns until the ice works was established at Tewantin, at which point fish could be more readily transported to the metropolitan market in Brisbane (see Adams 2004 and references therein).

Oyster fishing

Few records remain of the oysters and the oyster fishery that once existed in the Noosa River. However, occasional accounts exist in fishery inspector reports and popular articles, which, when pieced together provide insights into the past abundance of oysters and the commercial industry. In 1876 'Wybah Lake' was described as the '*oyster ground of the Tewantin people*' (The Telegraph, 12 Feb 1876). A visitor to the Noosa region the following year recorded that he came across large mounds of oyster shells within the Tewantin area, of such significance that they formed one of the '*Lions of Tewantin'*. By this date these mounds were already being dug into for road material and were subsequently destroyed. Stone tools were also found within them (The Brisbane Courier, 5 Jul 1877) although there is no record to say if these were preserved. A couple of articles published later that same decade state that large quantities of oyster shell remains existed at the location where the steamboat Culgoa (which transported timber, passengers and goods between Noosa and Brisbane from the 1870s) berthed (Maryborough Chronicle, 1 Nov 1877):

"Other settlements worthy of mention are Tewantin, a Government township on Noosa harbour, chiefly remarkable for the numerous aboriginal shell-mounds that are found in the vicinity, evident traces of a former very dense population. The face of one of these mounds, I may here parenthetically remark, forms a natural wharf of considerable extent, and is as such used by the small steamer that plies weekly to and from Brisbane." Australian Town and Country Journal, 23 Aug 1879.

The same source also mentioned the Tewantin oyster banks a few years later:

"Oysters are very plentiful, but are, I am told, gradually being killed by the pearl-bearing species, which here are of no commercial value. The banks of the river at Tewantin, for a depth of 12 or 13 feet, are entirely composed of oyster shells, which have no doubt been accumulated by the blacks, charcoal and stone tomahawks having been found 6ft below the surface." Australian Town and Country Journal, 29 Apr 1882.

This location is likely to be the same as the middens referred to by the visitor in 1877, and is along the banks of the river where the present day Council Chambers are located (*pers. comm.* George Pearce). The size of this midden, "*a depth of 12 or 13 feet"*, and the reported extent of this and other middens in the wider region; "*piles of oyster shells were formerly found for at least 80 miles along the range*" (Brisbane Courier, 14 Nov 1924), highlight the past abundance of oysters and the significance of this resource to the Kabi Kabi Traditional Owners. Given that these middens were being mined for road material by the 1870s, it is possible that these middens were once much larger. The extent of resource use is further highlighted by reports that a navigable channel had been formed at Tewantin due to oysters being frequently thrown up from the riverbed:

"This place happens to be where the blacks appear to have camped in large numbers at sometime or other; the place is stony, and there are large quantities of oysters on the stones or were at one time […] to get at the oysters the blacks from time to time have taken the stones and oysters out of the bed of the lake, and thrown some of them on the bank and some of them about 40 feet from this platform, and in the course of very many years by so shifting those stones and shells have caused a channel a few feet deep, and this is where […] the Culgoa goes alongside to discharge her freight." Maryborough Chronicle, 1 Nov 1877.

A local resident also highlighted the existence of a midden on Hay's Island during the 1960s, just prior to development of the area:

"The [midden] is at Hay's Island at Noosa Heads where a heap of oyster shells rising on a small piece of elevated ground amongst the mangroves bears testimony to the feeding habits of the former natives of the Noosa River estuary. An effort should be made to preserve this small piece of history when the development of Hay's Island eventually takes place, before it becomes buried or torn apart by the sand pumps and bulldozers..." Nambour Chronicle, 9 Feb 1967.

The remains of middens also occur within the Noosaville region, although many have not been documented in detail. For example, in 2014 a preliminary survey was undertaken on a midden located in central Noosaville (ARCHAEO 2014), within which oyster, cockle and mudwhelk shell remains were found. This midden had already been largely destroyed and its remains were at further risk from development. Archaeological studies and the archival evidence, although limited, clearly indicate the significance of the marine and estuarine resources to indigenous people prior to the arrival of Europeans (McNiven 1991).

The importance of oysters to the Kabi Kabi Traditional Owners within the Noosa region is also signalled by further references to oyster fishing, one of which refers to an observation of people diving for oysters from a boat (Nambour Chronicle, 17 Jun 1927), another which references the gift of a sturdy oyster boat provided to the Kabi Kabi of Tewantin after they had succeeded in capturing the outlaw Johnny Campbell:

"At Noosa wharf lies the recent addition to our fleet, vis., the oyster boat recently given to the black captors of the notorious Campbell. It is substantially built, of four oars, sets of sails, and two nets." The Week, 3 Jul 1880.

Another story, recounted retrospectively by E.G. Swan, told of an annual 'oyster feast' held at Tewantin during the 19th century:

"…from the lips of Tewantin's oldest pioneers, one may hear stories of the early days when the township was in the making […]. Once a year the bushways echoed to the blackfellows' well-feasted, careless laughter. Near to the inland end of the

township was held the annual corroboree of the oysters, when, from as far north as Maryborough and southward to Caloundra, the tribes foregathered to the feast." Sunday Mail, 30 Jan 1927.

The first recorded purchase of an oyster section within the Noosa River occurred in 1881 (The Queenslander, 17 Sept 1881). Oysters (in common with oyster fisheries throughout Queensland) were worked by the use of a heavy dredge that was hauled along the bottom of the river via a small boat, or along the bank if within wading depth. By the 1880s Noosa oysters were being transported to Brisbane:

"A small cutter that brings oysters to the Brisbane market was anchored on the bank, where a tent was pitched for the accommodation of the oyster-getters. The oysters are collected by means of a dredge, which brings up a hundredweight or two at a time, which must "pan out" pretty well at 1s. a plate. I was informed that a large quantity of the oysters are shipped to Brisbane every week, en route for Melbourne; and, speaking from personal experience, I can state that Noosa oysters are not to be despised, especially when you get them on "their native bank," and not after a two or three days' "preserving" in sultry Brisbane." The Queenslander, 17 Apr 1886.

Throughout the recorded history of the Noosa oyster fishery, flooding has resulted in the loss of oysters, although this loss was sometimes succeeded by large falls of spat (young oyster) if conditions were right. Even in its early years the industry was vulnerable to the sudden loss of oysters from disease or flooding, or slumps in the wider market (The Brisbane Courier, 25 Feb 1896; The Queenslander, 29 May 1897). Concern was also expressed about oyster declines:

"Not very long ago fat and luscious bivalves were to be found in plenty; now oysters are only to be obtained by laborious dredging or diving, and then they are of such insignificant size as to be scarcely worth opening." The Queenslander, 29 May 1897.

Despite these early concerns, oyster deposits were still being discovered, and by 1891 Noosa had two dredge sections for lease (The Telegraph, 4 Mar 1891). Dredge sections referred to oyster beds located in deep water, while bank sections referred to those which uncovered or had no more than 2 feet of water on them at low tide. While oysters occurred on the 'banks' of the river, the leased sections included areas of deeper water. In 1902 three Noosa river dredge sections were leased by the Moreton Bay Oyster Company, which dredged the young oysters and removed them to oyster banks in Moreton Bay and Southport, where they grew more rapidly for market. Over the next few years, large quantities of young oysters were removed from the Noosa river system:

"The Noosa River dredge sections have turned out supplies of young oysters quite up to expectation, each succeeding year showing marked improvement, the working of the dredge breaking up large clusters, thereby allowing the young oysters to develop healthily. During the year 2,000 bags of culture from this section were dredged up and transplanted to the southern beds in the Broadwater, at which place they thrive well." Marine Department Report, 1905.

"The dredge section in the Noosa River still continues to yield good supplies of cultivation, nearly 2,000 bags of which were removed by the lessees to the Bribie and Broadwater beds, at which places it thrives well. These sections have improved very much through being worked and thinned out, the samples obtainable being now of a very much better class than formerly." Marine Department Report, 1906.

It is uncertain quite how much a 'bag' held. Contemporary reports stated a bag held 1,000-1,500 oysters of market size (The Brisbane Courier, 3 Apr 1880; see also The Brisbane Courier, 19 Sept 1884) but estimates from government sources could not be found. Additionally the size of a 'bag' may have varied with time, so this value must be treated with caution. If we assume this quantity to be accurate, between 2 and 3 million oysters were removed from the Noosa River in each of these years. This number may have been greater if the oysters were smaller and more could be fitted into a bag. Another (later) source states that in the early years of the 20th century, 4,000 bags of oysters were transported by the

Moreton Bay Oyster Company every winter, presumably for relaying, and that the main Noosa lease was, *"where the barge goes over the river to the upper end of Wood's Reach going towards the lakes"* (Tewantin State School project 1957).

In 1920 the majority of the Noosa River sections were leased once again by the Moreton Bay Oyster Company (Fig. 2), who likely undertook a similar process of removing the Noosa River oysters for fattening in Moreton Bay. While this procedure benefited the industry in the short term by producing marketable oysters in large quantities over a short period of time, it is not reported how this removal affected the substrate and the remaining oyster populations of the Noosa River. Smith (1981) states that the big companies would acquire large numbers of banks or oyster sections, quickly strip these areas of their oysters to deposit upon their prime laying beds, and then forfeit the stripped beds, which would subsequently lose their value. It is highly likely that this occurred in the Noosa River.

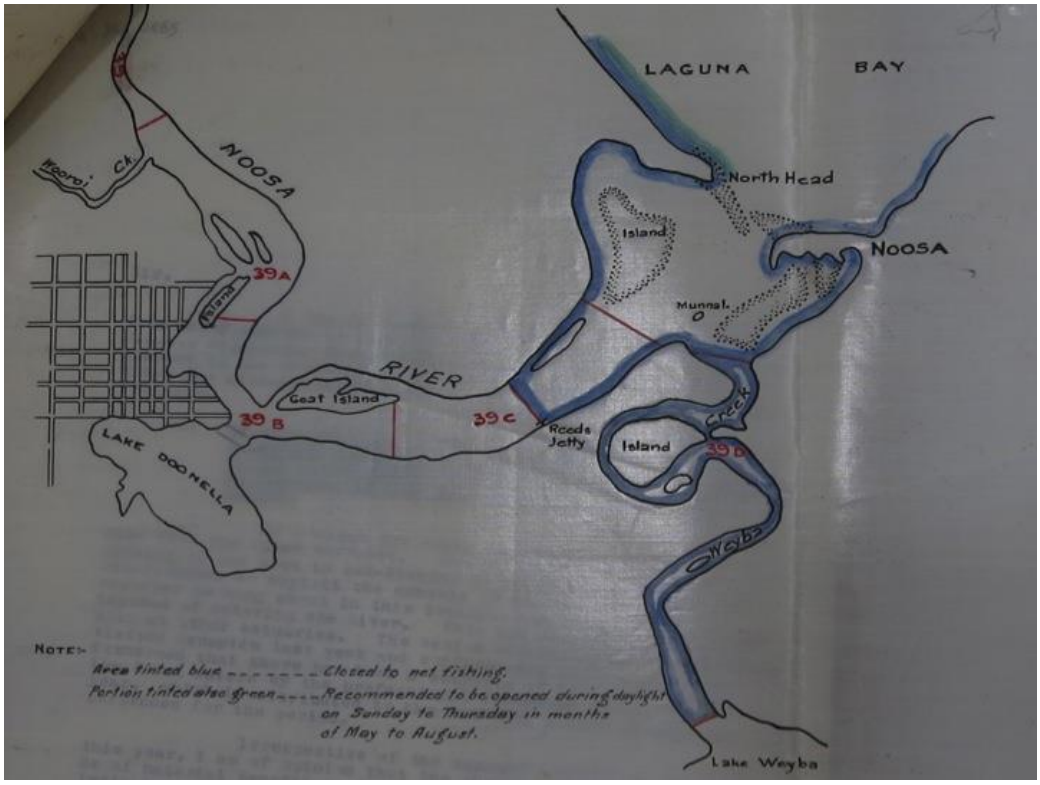

Figure 2. A hand-drawn sketch from 1934, drawn by the Fisheries Inspector to highlight the areas in the Noosa River closed to net fishing. The red numbers indicate the Noosa oyster sections. Source: Queensland State Archives.

After 1930 fewer references are made to the Noosa oyster fishery. A section was leased to a local fisher in the 1930s, but the wider oyster industry went into depression at this time (Smith 1981) and no references are made in government reports about the Noosa oyster fishery after this period, with the exception of 1960. During this year it is reported that an oyster grower "*transported approximately 400 sacks of culture from Weyba Lake to Weyba Creek, where it has been laid out in 650 trays*" (Marine Department Report 1960). However, discussions with a local resident who remembers the fisherman in question stated that this established bed was unsuccessful (although clearly large quantities of oysters existed in Weyba Lake). It is unclear why the Noosa oyster fishery ceased to exist, possible reasons could include: overexploitation, disease, removal of suitable substrate and/or declining water quality. According to Monks (2000) the decline was due to exploitation and a loss of substrate as the oysters and their shells were removed from the system, which young oysters require to settle successfully. Diggles (2013; 2015) provides evidence that the decline of oyster populations in Pumicestone Passage and Moreton Bay was due to declining water quality, which caused recruitment failure across multiple generations and facilitated the spread of disease.

While the Noosa oyster fishery no longer exists, an assessment recently conducted by The Nature Conservancy into oyster recruitment in the Noosa Estuary showed that oysters recruited in moderate numbers at nearly all sites where settlement tiles were deployed. These included the main channel around Tewantin and Weyba Creek, both sites of historical oyster production (see also Monks 2000). Although conditions in the river are likely different to a century ago, this study indicates that oyster restoration in the Noosa River may be feasible (The Nature Conservancy 2015).

Net fishing

During the early decades of the 20th century a steady trade in fishing existed within the Noosa River, with catches of 100-300 cases of mixed fish regularly sent each week to Gympie and other nearby centres (Noosa Advocate, 16 May 1919; Nambour Chronicle, 11 Dec 1925). However, prior to the Second World

War no central board existed to process and market commercial fishers' net catches. Fishers were therefore limited to marketing their fish at local distribution centres (e.g., Gympie) or occasionally the metropolitan market in Brisbane. A lack of swift and reliable transport meant that fish would sometimes be unsuitable for purchase upon reaching their destination, while a lack of freezing facilities meant that fish could not be kept longer than a few days, meaning that the market would either be starved of fish or glutted with produce. As a result, steady prices and a reliable income for commercial fishers did not exist, stifling the growth of the fishing industry. The Queensland Fish Board was established in 1936 in response to these issues, with its primary aim to improve the supply of fish to the populace (The Fish Board 1937). The fish distribution depot at Tewantin subsequently became a branch of the Fish Board (Fig. 3). All commercially caught fish were supposed to be processed through the Fish Board, and the commercial catch from the Noosa lakes and estuary would certainly have passed through the Tewantin depot (Fig. 4), in addition to fish caught from the ocean beaches and reefs.

Figure 3. Near the ice works at Tewantin; picture shows the trolleys that were used to unload fish from the commercial boats (date unknown). Source: Courtesy of George Pearce.

Figure 4. Fishing boats in the Noosa River ca. 1953, owned by the Massoud and Chaplin families. Source: Courtesy of Heritage Library, Sunshine Coast Council.

The records left by the Fish Board, in addition to contemporary logbook data collected since 1990, provide us with records of landings of commercial fish over a 70-year period (Fig. 5). Although landings of fish are reported in Fish Board records, fishing effort (e.g., how many days were fished, or how many fishers were working) is not. Government correspondence states that in 1944, 11 net crews (consisting of 1 to 4 men) actively worked the Noosa River and Lakes (Department of Harbours and Marine 1945). Some fishers also fished part time, so this number would have fluctuated throughout the year. This lack of information, alongside changes in management regulations over the years and the potential differences in areal coverage by the two datasets, means any long-term changes in recorded commercial catch must be interpreted with caution. What can be seen, however, is that landings of the major species were highly variable from year to year, and that mullet have dominated commercial catches within the Tewantin and wider region over the last 70 years (Fig. 5). These catches declined in the 1960s, partially due to a drop in consumer demand for mullet (the consequence of a 'kerosene' taste in the fish flesh, which was subsequently found to be harmless) but also the shifting of fishing effort to the prawn fishery, which increased rapidly throughout the 1950s before stabilising in the 1960s (Fig. 5).

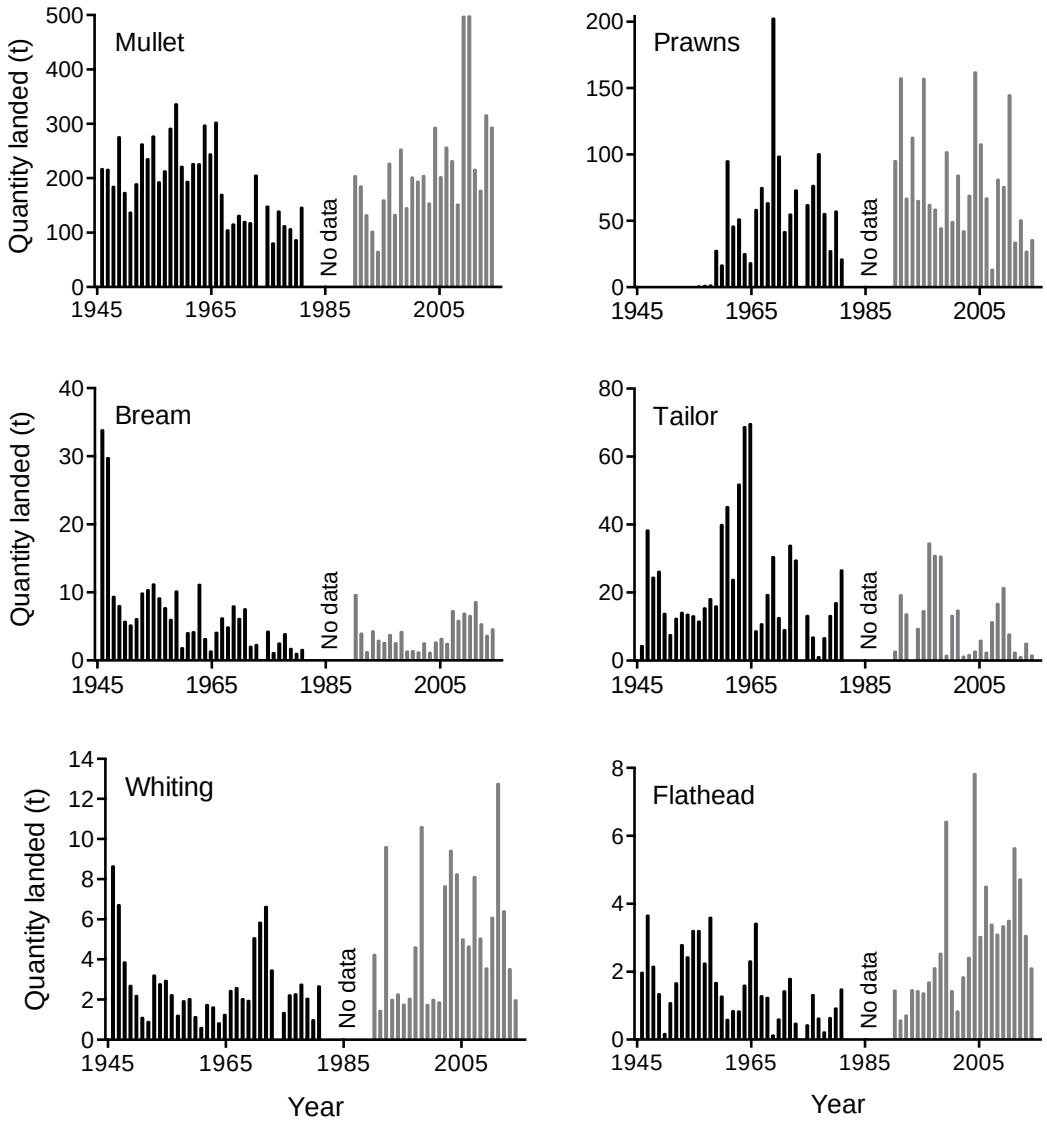

Figure 5. Quantity of selected fish species and prawns processed through the Tewantin Fish Board (1946-1981; black bars) and reported as caught within the Queensland Fisheries grids W35 and V35 (1990-2014; grey bars) by line, net and prawn trawls. Source: Queensland Department of Agriculture and Fisheries.

Tailor, bream, whiting and flathead have also traditionally formed a staple catch for commercial fishers, although catches again show high variability from year to year (Fig. 5); how much of this is due to changing fishing effort is uncertain. Large amounts of bream were processed through the Tewantin Fish Board in 1946 and 1947 in quantities not witnessed since (Fig. 5). Comparable records are not available prior to this, although the 1944 and 1945 reports record quantities of bream transported from Tewantin to the metropolitan market, and

suggest that the high post-war catches were limited to these two post-war years. Higher catches could have been due to increased demand, increased fishing effort, or large quantities of bream during these years, but it is difficult to know. Between 1946-1981 bream landings steadily decreased, but since 1990 landings of bream have been variable but stable. Quantities of tailor landed are also variable from year to year, but recent landings are lower than historical landings (Fig. 5). Whiting were also historically caught in significant numbers, together with flathead, although flathead were caught in smaller quantities compared to the other species. Again, catches were highly variable, but a decline was witnessed in flathead landings between 1946-1981. From 1990 landings of flathead increased to greater quantities than historical records (Fig. 5).

Since 1990, fishing effort has also been recorded to species, although this again must be interpreted with care given that a number of other factors can affect catch rates, particularly targeting behaviour of fishers as a result of changing regulations or market incentives. Trends in catch rates (quantity of fish landed per day fished) vary for the different species; increasing for mullet and prawn, declining for tailor, and remaining stable for bream, whiting and flathead.

In addition to the species highlighted above, historical records show that commercial fishers routinely caught other species in their nets, in particular, jewfish; these could be large fish weighing up to 9kg, although most were much smaller than this. A 'record consignment' of jewfish was recorded from Lake Cootharaba in 1929, when three crews combined and together caught 55 cases (approx. 1.1t) of jewfish weighing from 1.3-5.5kg each (The Brisbane Courier, 17 Jul 1929). The increase in minimum landing size of this species in recent years has, however, reduced commercial landings of this species within the river system (*pers. comm*., interview).

While it is unknown just how much of the landings recorded by the Fish Board were sourced from the Noosa River and Lakes, Grant and Kesteven (1965) suggest that of the quantities of mullet recorded by the Tewantin Fish Board prior to 1965, probably greater than 90% of the total catch was taken from the

Noosa Lakes. This percentage probably dropped in the later years of the Fish Board: Monks (2000) states that as a result of declining catch after development of the river mouth, many fishers turned to fishing the ocean beaches. However, fishing on the ocean beaches was certainly a feature of the Noosa net fishery prior to this, as reference to ocean beach hauls are recorded in Fisheries Inspectors' correspondence during the 1940s (Department of Harbours and Marine 1940).

Prawn trawling

Today prawns are targeted in the Noosa River and Lakes by small beam trawls, but this fishery did not develop until the late 1950s. Prior to this, prawns were principally targeted for fresh bait and were caught using scissor and scoop nets. In 1959 trials were conducted in which small beam trawlers were modified for use within the shallow lake system, and in 1961 a combination of the depressed market for mullet and a large run of school prawns (*Metapenaeus macleayi*) in the lakes resulted in reports of over 400,000kg of prawns being trawled from the Noosa system (Marine Department Report 1961). However, this number is not reported in the Fish Board report for that year, this may be due to the prawns being consigned to somewhere other than Tewantin.

While the numbers of boats working this fishery are not reported, Monks (2000) recalled around 25 small boats working in Weyba Lake during the 1960s, and by the 1980s around 20 prawn trawlers were reported to work seasonally in Lake Cootharaba (Coles and Greenwood 1986). A 1978-79 survey showed that the fishery consisted of multiple species, with the most abundant species being juvenile eastern king prawn (*Melicertus plebejus*), greasyback (*Metapenaeus bennettae*) and school prawns (Coles and Greenwood 1986). However, the prawn catch from year to year within the lakes was not consistent. After the large quantities of 1961, the 1962 catch dropped to just 45,000kg. This was reversed in 1969, when a large run of school prawns occurred within the lakes and trawlers (over 40 in number, Monks 2000) operating from Tewantin and Boreen Point landed over 200,000kg (Queensland Department of Primary Industries 1969).

Prawn species were not distinguished between in government records until 1990. Of the three prawn species recorded as caught within the Noosa River and Lakes during the 1978-79 survey (Coles and Greenwood 1986), only school prawn have been consistently recorded every year within the W35 and V35 grids from 1990-onwards, with eastern king prawns recorded from the year 2000 (Fig. 6). Landings records show highly variable fisheries, with no significant changes over time in either school of eastern king prawn landings (linear regression; p-value=0.619 and 0.614, respectively). It is unknown how much of this catch and fishing effort occurred in the Noosa River and Lakes. Fishing effort within this same region has declined over this period for school prawn; in 2014, seven licenses recorded catching school prawn (a total of 63 days fishing), down from a high of 26 in 1991 (a total of 1,103 days fishing). Fishing effort for eastern king has remained stable, if variable, over time.

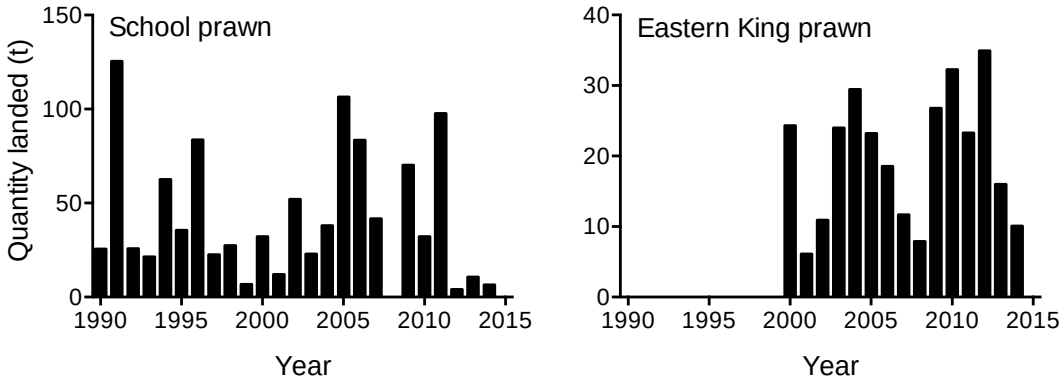

Figure 6. Quantity of school and eastern king prawns reported as caught within the Queensland Fisheries grids W35 and V35 (1990-2014). Source: Queensland Department of Agriculture and Fisheries.

Recreational fisheries

Estuary and beach fishing

During the 1920s and 1930s Noosa was advertised as a haven for recreational fishers and other visitors, lauded for its natural beauty and plentiful fish stocks:

"The Tewantin Lakes, Queensland's great fishing ground […]. Tewantin has some beautiful lakes, chiefly Lake Coroyba, in which abound jew, tailor, cod, bream, mullet, and whiting. Some enormous catches take place here, and it is generally acknowledged by visitors to be the leading Queensland ground. Besides the lake fishing, in Laguna Bay there are some of the best schnapper banks on the coast. The unlimited supply of oysters is one of its lesser attractions. Plying on the Tewantin Lakes is a fleet of motor boats. [Tewantin] is the rising watering-place of South Queensland and rapidly becoming the most popular." The Sydney Mail, 10 Mar 1909.

"…even the novice, with fine tackle, is assured of big catches." Daily Standard, 12 Mar 1920.

Throughout the early 20th century, numbers of visitors to Tewantin and the Noosa region swelled, and many of them were there to go fishing. Tourists would fish from either the riverbanks or from rowboats (and later, small motor boats):

"In 21 days [at Tewantin] [3 persons] caught about 3,000 fish, principally whiting (up to 22oz), flathead (up to 10lb), tailor, tarwhine, grunter, and bream. Worms were used the whole time except when fishing for flathead, for which the bait was whiting. Mrs R.W. Thurlow and her son Leu also had good sport, creeling over 1,500 fish in about three weeks." The Brisbane Courier, 6 Nov 1913.

Some were repeat visitors, with one couple of from Melbourne returning for many years to fish the river, even keeping a diary of their catches:

"Mr and Mrs J.H.J. Symon [...] have just returned to Melbourne [from Tewantin], leaving behind them a record of 3,299 fish of various varieties that they caught during the last half-year. Their total for the period spent at Tewantin during the past 13 years, however, is very formidable, 44,656 fish. As they fish every day except Sundays while at Tewantin the average per outing is approximately 22 fish." The Brisbane Courier, 12 Oct 1923.

Figure 7. Catch of fish at Boreen Point, Lake Cootharaba ca. 1925. Source: Courtesy of Picture Noosa/Noosa Library Service, Image No. M863036.

Recreational fishers caught many varieties of fish, but the most commonly mentioned included whiting, flathead, bream, tailor and jewfish. During the 1920s and 30s weekly columns appeared in many newspapers, reporting catches and fishing activities along the coast of southeast Queensland. In these early years it was common for recreational fishers to catch as many fish as they could:

"A party of residents, numbering nine, put in the day last Sunday fishing on the Noosa River in a motor boat […]. They were at it all day and only got 6 whiting, but just at dark, when they were well fed up, the jewfish seemed to come in droves, and up till 10 o'clock, when bait ran out, they landed 164 jewfish, one man bagging 38 jewies." The Richmond River Herald, 3 Aug 1923.

"The fishing for the past few months has been splendid. Mr B Newman and his three children caught 440 flathead in two days, a little over a week ago, and flathead, tailor and whiting are still being caught in large numbers." The Brisbane Courier, 30 Nov 1923.

Colin Monks (2000), a local resident of Noosa, described his personal experiences of catching large numbers of fish when he was young, primarily

within the Noosa Lakes, but also the river. The numbers he recounts are backed up by many reports from the local newspapers of the time:

"It was common to catch 2lb whiting and to catch 30 of a catch in half an hour." Monks 2000.

"…whiting are now in the [Noosa] river in immense quantities, as well as many of the larger denizens of the deep. Mr Acting-Judge Byrne, and Mr Benson, fruit expert, left today after enjoying exceptionally good sport, several times bringing home 60 and 70, and once or twice well over the century." Gympie Times, 14 Sept 1901.

"The silver bream were so thick in the water, schools of several hundred were seen anywhere at all on the Weyba Creek and lake bottom together. It was not unusual to catch bream of average 3lb in weight and 30 to 40 in an hour…" Monks 2000.

"Fishing for about five hours in the Noosa River at Tewantin last Saturday, PJ Preston, V Cort and W Sallaway, well known residents of Cooran, landed 87 sea bream, all of good size." Sunday Mail, 11 Aug 1929.

"Flathead were so numerous, so much so that early morning fishermen could fish at daylight with prawn or fish bait and come home before 7am for breakfast with an average of 14 flathead each person to the weight of between 8 to 12lb." Monks 2000.

"[4 persons] went line fishing at Tewantin during the holidays, caught 35 large flathead and 12 taylor [sic] in less than two hours." Nambour Chronicle, 9 Jan 1925.

However, fish catches were not always good, and it is likely that the poorer catches were simply not reported in the newspaper columns:

"Lake Cootharaba: Fishing. — Usually at this time of the year prawns for baiting purposes line the western shores of the Lake, and line fishing is just OK. This year

both are virtually nil, although some good hauls of mullet have been made and crabs are plentiful. The rush of rain water from the Kin Kin and Upper Noosa River is keeping the Lake waters in flood and almost fresh." Gympie Times, 2 Feb 1918.

And even in those early days, the occasional voice could be heard stating that the fishing was not as good as before:

"Fishing very brisk. A party from Martin's Hotel caught 85 fish on Thursday, and 97 on Friday - only fishing a few hours. Although the fishing is not as good as it was 20 years ago, the anglers still get a few good days now and again." The Brisbane Courier, 15 Jul 1928.

During the 1920s and 30s, regular reporting of fish catches and the number of people fishing allows the number of fish caught per angler per fishing session to be calculated (Fig. 8a). The majority of catches comprised mixed fish, most commonly whiting, bream and flathead. While the majority of catches comprised less than 50 fish per angler per fishing session, some catches were considerably higher. In some cases the number of hours fished was also described, providing number of fish per angler per hour (Fig. 8b). While variable, catch rates could reach 20 or more fish caught per angler per hour at times.

This habit of describing the number of fish caught seems to have declined in later years, hence only a snapshot of catches and catch rates can be extracted from these sources, with most catches reported between 1920 and 1940. Furthermore, it is likely (see later section on 'bias') that newspapers only reported the best catches. Hence, these figures should be assumed to be the highest catches and catch rates for that period. Figure 8 includes catches both in the river and North Shore near Tewantin, although the numbers of trips recorded on the North Shore were considerably fewer. No significant differences in catch rates between the river and North Shore were observed (median catch rate river=26.67 fish per angler per fishing session, median North Shore=19.88, Mann-Whitney U=1,952, p=0.186).

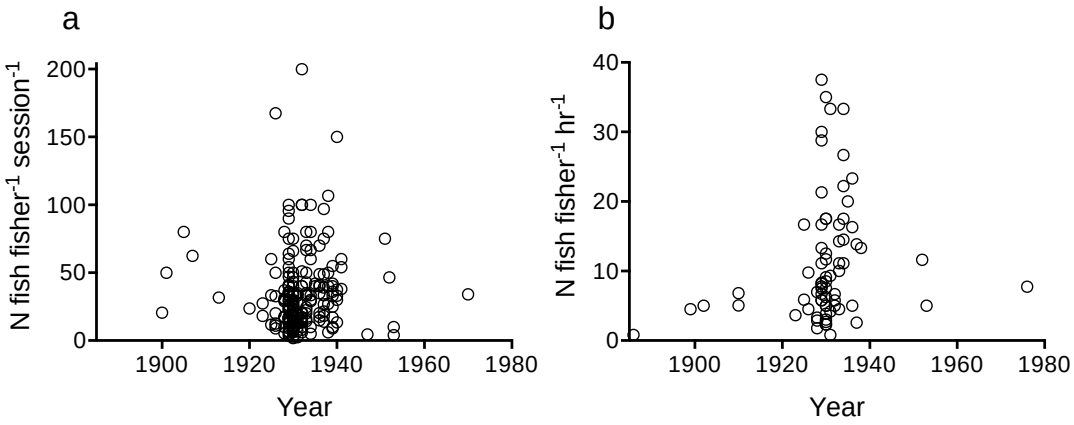

Figure 8. Catch rates of mixed fish caught within the Noosa River and on the North Shore near Tewantin by recreational anglers and recorded in newspapers. A) Number of fish caught per fisher per fishing session (n=219). B) Number of fish caught per fisher per hour (n=72).

Fishing competitions

As recreational fishing increased in popularity, so did fishing competitions. While many recreational competitions today highlight the importance of catch and release (including tag and release), or emphasise the targeting of particular species or sizes over number of fish, this was not always the case and in the past the winner was judged to be the person with either the greatest number of fish, greatest weight or a combination thereof. As was the case with recreational fishing, fishing competitions were also regularly reported in popular media.

One of the earliest reported fishing competitions to take place at Tewantin was organised through the Queensland Amateur Fishermen's Association, when 23 members caught 981 fish weighing 646lb (The Referee, 13 Aug 1913). During the 1920s and 1930s, several fishing clubs formed in Noosa and surrounding areas, and clubs from other regions would also visit to hold fishing competitions in the river or on the North Shore. Clubs regularly mentioned as fishing in the Noosa River included, Cooroy Amateur Fishermen's Association, Cooroora Amateur Fishing Club, Pomona Amateur Fishing Club, Eumundi Amateur Fishing Club and the Tewantin-Noosa Amateur Fishing Club. Popular locations fished included Munna Point, Noosa River at Tewantin, near the mouth, and the North Shore near Tewantin.

As with recreational fishing, a variety of fish species were caught by competitors, including bream, whiting, flathead and tailor, with mixed species bags being the norm. However, reporting of fishing competitions was not always consistent. In many cases only the greatest, or principal catches were reported. Sometimes the total number of fishers competing and total catch was reported, providing us with an average number of fish caught per competitor:

"The second competition for the year of the Tewantin Fishing Club took place on January 31, 13 competitors taking part. The fishing took place at the Heads, where fish were plentiful. Following the rule the competitors away from the town should only last two hours, the fishing commenced at 8pm and ended at 10pm. All members used mullet bait […]. A total of 225 fish were caught..." The Brisbane Courier, 3 Feb 1926.

"The fishing competition for the McFie trophy was held in the Tewantin reach of the Noosa River on Tuesday night, April 27, when 18 competitors took part. The winner was W. Hooper, with 21 fish…" The Telegraph, 7 May 1926.

When split into 'best' catch (i.e., the top catch reported per competition) and 'average' catch (i.e., the total number of fish divided by the number of competitors), quantitative records span a period of 67 years, from 1913-1980. The majority of competitions were recorded in the late 1920s/early 1930s, and again in the 1950s and 1960s/70s (Fig. 9). Statistically significant declines were witnessed over time in both best and average catch rates (best: r^2=0.13, p=0.001; average: r^2=0.06, p=0.021).

Records of the numbers of hours fished rarely occurred for competitions. From the descriptive data, it appears that the allocated fishing time was variable, however, the lack of data means that catches must be reported per 'fishing session', rather than per hour.

While we cannot be certain about why these declines occurred, interviews with long-term fishers suggest it is unlikely due to changes in attitudes towards conserving fish stocks (at which point, catch rates would have fallen because fishers would have targeted stocks differently). This certainly occurred, but such shifts occurred several years after the conclusion of this time series with the introduction of bag limits and the increasing popularity of catch and release fishing (*pers. comm.*, interviews).

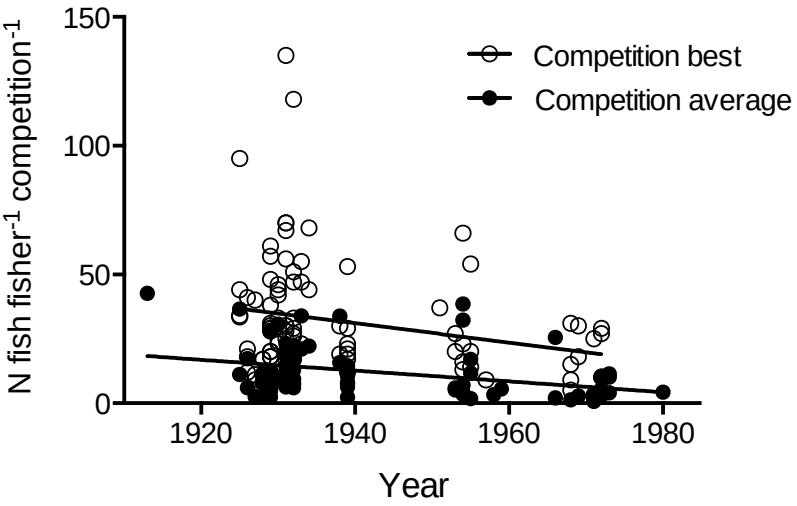

Figure 9. Catch rates of fish caught during recreational fishing competitions. Best equals the highest number of fish caught by a competitor, average equals the total number of fish caught divided by the number of people recorded as taking part in the competition.

'Outside' fishing

Figure 10. Catch of snapper brought ashore at Tewantin jetty ca. 1935. Source: Courtesy of Heritage Library, Sunshine Coast Council.

During the late 19th and early 20th centuries, the sport of 'outside' fishing, fishing on the open ocean on the local reefs, greatly increased in popularity. Snapper (*Pagrus auratus*) or 'schnapper' as it was referred to then, was one of the principal fish caught during these excursions (Welsby 1905). While the majority of charter fishing excursions took place out of Brisbane, 'schnappering' was popular along the coast, and trips across the mouth of the Noosa River to fish for snapper are recorded prior to the turn of the century:

"The second schnapper excursion of the season (writes a Tewantin correspondent) took place on Wednesday outside Noosa Heads, when a party of three, including a Brisbane gentleman had excellent sport, bagging between 130 and 140 splendid fish in a few hours. The pleasure of the excursion was enhanced owing to the party being able to leave Tewantin about daylight and return before 5 o'clock in the afternoon. As a matter of fact, they were only absent under eleven hours." The Brisbane Courier, 9 Jun 1899.

Similar occasions are also recorded, with parties from Brisbane sometimes travelling to Noosa by boat to fish the local reefs, before travelling back again. Schnappering also remained a popular sport in Noosa:

"On Wednesday, 9th instant, a party of six went out from Tewantin on a schnappering excursion in the Waterwitch. Mr. C. Martin, owner of the boat, was in charge. They returned in the afternoon with 483 fish, mostly schnapper. Comprised in the total were one red groper, some parrot fish and kelpie. It is the record catch for this season. The average weight of the catch would be over 4 lbs. Individual catches are 56, 60, 63, 103, 107, and 94." Worker, 17 Jun 1915.

Again, it is possible that only the higher catches were recorded within popular media, but evidence from government reports and the occasional government survey suggest that the local reefs were highly productive:

"Later on line fishing was tried at the Jew Shoal, off Noosa, and 184 fish, averaging a little over 3lb were caught during 2.25 hours, including 89 schnapper, weighing 398lb […]. There were in all 12 lines out, the average being something over 21 fish per line […]. The next day (17th) was spent drifting over the same shoal, and 405 fish weighing 999lb were decked, including a 55lb groper, 6 emperor weighing 32lb, 11 king schnapper (50lb), 39 parrot fish (83 lb), and 223 schnapper (485lb)." Marine Department, reported in The Queenslander, 6 Aug 1910.

Other fish were also targeted on the outside reefs: mackerel by commercial fishers and later recreational fishers, in addition to mixed bags comprised of species such as those described in the previous paragraph. By 1944 eleven launches targeted snapper on the local reefs off Noosa (Department of Harbours and Marine 1945).

Recreational records and potential bias

As stated in the previous sections, it is possible that references to recreational catches published in the newspapers only referred to the best catches, in which

case, a reporting bias exists. The existence and extent of reporting bias was evaluated by comparing catch rates from different sources: government records, recreational catch rates reported in newspapers, and fishing competitions (best and average catch rates). Government records of recreational fish catches exist for the years 1961-2, when fishery inspectors at Tewantin inspected recreational fishers' catches to determine whether undersized fish were being illegally retained. In so doing, they provided information on the species and number of fish caught, locations fished, number of people fishing, and in some instances, number of hours fished. Catch rates from this data set are thus assumed to be reliable and representative of the size of catches that occurred at this time.

Catch rates between the four sources (recreational records, best competition catch, average competition catch, government survey records) were compared. Significant differences occurred between the four datasets (Kruskal-Wallis=301.6, p=<0.001). Post-hoc tests revealed that average competition results (1950-1970) showed no significant differences to government survey data, while records of best competition catch rates were comparable to recreational records. This information suggests that records of recreational catches are indeed biased towards the best catch rates, but that reports of average competition catches are likely to provide a more accurate depiction of historical catch rates and trends over time.

Early controversy: net versus line

The controversy between net and line fishers is not new. Maintaining the attraction of Tewantin as a recreational fishing centre was a factor in the prohibition of net fishing in certain parts of the Noosa River and Lakes from the early decades of the 20th century (Department of Harbours and Marine 1934). In 1914 net fishing was prohibited in parts of the Noosa River and Lake Cootharaba, with further limits applied in 1919. From 1925 further portions of the Noosa River were closed to net fishing (Department of Harbours and Marine 1934). In 1933 a number of commercial fishers formally requested that Weyba Creek be closed to net fishing for two years, to enable the fish to travel into the

Lake where they could be targeted. Portions of the lower river, as well as Weyba Creek, were subsequently closed to net fishing (Fig. 2). Despite these closures, it was widely believed that line fishing was becoming poorer as a result of extensive net fishing and consequent destruction of young fish (e.g., Courier Mail, 6 Oct 1936; Department of Harbours and Marine 1937). However, subsequent enquires by the fisheries inspector led him to report that line fishing had not decreased:

"Every one I spoke to [about fishing] gave the same reply, "very good, could not be better". This is the outcome of the recent rains, which goes to show that when poor results are obtained by the anglers, natural conditions such as prolonged spells of dry weather are primarily the cause, and not net-fishing. As a general rule, when line-fishing is poor, net-fishing is also poor. Another factor which could be taken into consideration is the shallow nature of the river, and the number of small motor-boats cruising about; this tends to frighten the fish, and does not allow them to settle down." Department of Harbours and Marine 1937.

In 1939 three separate petitions were presented to the Fisheries Department. The first, from the local net fishers, requested that the closed area at the mouth of the Noosa River and the South Shore be opened to net fishing for several nights a week during July and August. The second and third came from local residents, both objecting to the proposed reopening of the closed area, with one requesting that further closures occur. These residents, however, distinguished between net fishing and bait nets, which many recreational fishers used at the time, stating that bait nets should continue to be allowed within the closed area. The fisheries inspector of the time noted that:

"I do not think the request a reasonable one, if bait-nets were allowed, it would be more detrimental to the young fish life than the ordinary fishing nets. I do not consider that the closing of further waters would be of any benefit to line fishing, not to the general advancement and progress of Tewantin, or the professional fishermen." Department of Harbours and Marine 1939.

From this period onwards two opposed camps emerged, one wishing to uphold the popularity of the Noosa River as an angler's paradise, and the other keen to exploit the available commercial opportunities.

Figure 11. Hauling mullet at North Shore ca. 1958. Source: Courtesy of Heritage Library, Sunshine Coast Council.

Megafauna

Large fish have occasionally been sighted and landed within the Noosa River system. Sharks are still a common feature of the river and lakes, although it is likely that species such as large gropers were much more abundant in the past compared to today (Monks 2000).

While catches of large fish were not reported regularly enough to provide us with an indication of abundance or relative change, archival reports do provide insights into which species did occur within the river system. One of the earliest reports found dated from 1872, and concerned the catch of a large groper:

"Newsa River is said to be alive with fish. On Tuesday last some men hooked a gigantic rock cod (which seems to be identical with the Sydney groper, judging

from the description given). It dragged the boat about for some time, but was at last landed with difficulty. It measured, we are told, 8 feet 4 inches in length, 6 feet 2 inches in girth [...]. Its rotundity is partly accounted for, however, by the contents of its stomach, viz, 2 young sharks, one over three feet long, likewise 8 or 9 crabs whole. The weight was estimated at 5 cwt [...]. As these monsters seem to prefer a shark diet we feel inclined to enter a protest against their destruction..." Gympie Times, 13 April 1872.

Figure 12. Groper caught in the Noosa River, 1935. Source: Courtesy of Picture Noosa/Noosa Library Service, Image No. M856806.

While the recorded size of the groper (approx. 250 kg) caught in 1872 appears almost fantastical, the occurrence and capture of large gropers occur throughout the recorded history of the Noosa River. This includes the capture of a 90 kg groper by Howard Parkyn in 1935 (Fig. 12), and a 206 kg groper the year before, which was reported to be over 7 feet long (Nambour Chronicle, 30 Nov 1934). Stingarees and shovelnose sharks were sometimes reported as 'troublesome', usually as a result of their breaking anglers lines, although they also provided sport for tourists who enjoyed chasing them in the shallow waters of Lake Weyba. Occasionally jewfish up to 20 kg were caught in the lakes and the river

(e.g., The Brisbane Courier, 10 Sept 1927). On at least two occasions, sawfish were caught in fishers' nets:

"The Noosa River at Tewantin last week gave up an unusual specimen - a sawfish four feet seven inches long with a 17in saw. The fish which weighed 262 lbs, was caught in a net by Tewantin professional fishemen […] 250 yards from the museum above Tewantin." Maryborough Chronicle, 15 Sept 1954.

Physical changes to the Noosa River

The shifting sands and changing nature of the river mouth were recorded in the earliest surveys of the Noosa River. The development of the lower river and its surrounds have been detailed elsewhere (e.g., Cato 1979; Gloster 1997) and will not be repeated here, but 19th century surveys show that the entrance to the river was located where Noosa Woods stands today, with large dune systems existing along the Noosa spit (Chamberlain and Tomlinson 2006). The developments of the lower reaches and Hay's Island during the 1960s are still remembered by long-term residents. In contrast, many of the middens that existed along the riverbank were destroyed by the turn of the 20th century.

A common theme among long-term residents interviewed for this project was the concern expressed at the development of the river mouth (Fig. 13), in particular, Hay's Island and nearby areas. Fishers' (commercial and recreational) expressed the view that these areas had previously been important nursery habitat, providing food and shelter for many of the species targeted within the river system. This view was also expressed by Monks (2000):

"In the early 1970's the decline in fishing in the whole area became apparent over many years with the man made alterations to the river mouth because of erosion and shifting sands […]. With less water from the tides entering so the water levels dropped in all the lake systems […]. Not only that the marine life and the fish knew about it too and did not enter the River from the sea as usual – many of the area's net fishermen became irate as their catches dropped by at least two thirds of their

usual catch. There was worse to come with the starting of Hay's Island development [...]. What was definitely the fish breeding area of the whole of the Noosa estuary system, with a teeming mass of mudcrabs, periwinkles, oysters by the thousands [...] and juvenile fish in their thousands – so much so the water boiled with their presence [...] were all destroyed." Monks 2000.

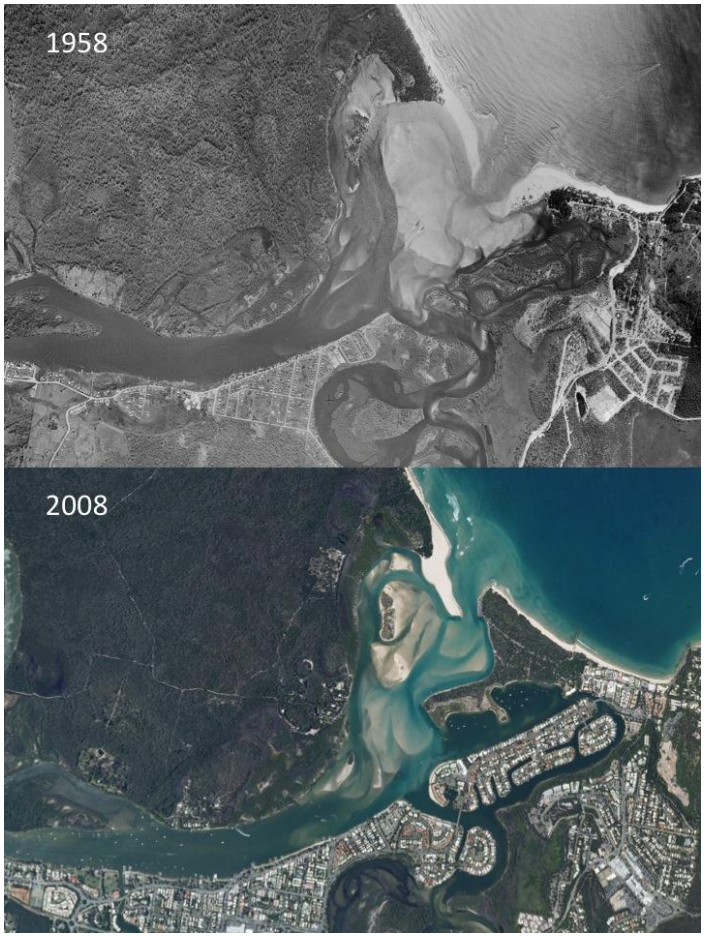

Figure 13. Aerial photographs of the Noosa River mouth, taken in 1958 and 2008 and showing the development of the Noosa Bar and Sound between the two periods. Reproduced with permission of the Department of Natural Resources and Mines.

Contemporary perceptions

Many of the long-term residents interviewed believed that the abundance of fish in the river had declined in their lifetimes, although it was commonly stated that, despite declines, a good catch could still be achieved. Fishers stated that they

used to observe large schools of fish in the waterways, but that the volume of fish observed was now less. Some raised concerns about water quality, but many interviewees compared the Noosa River favourably to other coastal rivers in the region. Concerns were more commonly expressed for fish spawning and nursery habitat lost as a result of development, or the detrimental effects of wash on the banks and mangrove habitat from fast moving boats.

Commercial fishers spoke of natural cycles and seasons, emphasising that fish varied in abundance from year to year. Generally they did not perceive any major changes in the abundance of mullet, in common with the commercial landings records. Two commercial fishers stated that stocks of some other species (flathead and bream) were less in the river, but that they were not at dangerously low levels. All recreational fishers stated that they had observed declines in fish abundance.

All fishers (recreational and commercial) attributed declines in fish (at least in part) to development of the river mouth and altering of the channel. Some recreational fishers perceived the net fishery to be detrimental to fish stocks in the river. Others mentioned the lack of prawns in recent years (which they related to a lack of rainfall) and stated that a declining food base affects the abundance of fin fisheries. All commercial and recreational fishers interviewed had observed an increase in the numbers of recreational fishers in the river throughout their lifetimes, with many stating that overpopulation affected fish abundance, both directly (from fishing) and indirectly (a loss of habitat and declining water quality as a result of development).

Summary

The Noosa Estuary and Lakes have been exploited for centuries, with early accounts suggesting abundant fish and shellfish stocks. Oysters, other shellfish and finfish were an important resource for the Kabi Kabi Traditional Owners, and they traded and sold fish to the early settlers. The earliest available fishery records show that Noosa oysters were being transported to Brisbane and beyond by the late 19th century. By the turn of the 20th century the net fisheries were providing significant quantities of fish to the Gympie and Brisbane markets. Many of these fisheries, with the exception of oyster, continue today. The recreational fishery also commenced early on in the written history of the region, with the Tewantin region lauded as far away as Sydney for its abundant fish stocks and scenic beauty. These factors led to rapid increases in population and tensions between commercial and recreational fishers as early as the 1920s. As the commercial and recreational fisheries increased, the Noosa oyster fishery was in quiet decline, becoming commercially extinct by the 1930s.

While oysters have greatly declined from historical levels, data on other commercial fisheries suggest that landings were highly variable from year to year, a feature that remains in the contemporary fisheries. The lack of information on historical fishing effort, and in some cases a lack of data to the species level, makes it almost impossible to draw any conclusions about changes in population size from the historical record. Moreover, some of the commercial stocks exploited within the Noosa region are migratory; species such as mullet are exploited along the coast from New South Wales and north. However, time series data are also available for recreational fishing activities within the Noosa Estuary, and suggest a decline in catch rates for the most popular estuarine species throughout the 20th century. These data depict a gradual decline rather than any sudden change. This could be related to a number of factors including urban development, loss of fish habitat (including oyster beds) and increasing fishing pressure (recreational and commercial). Given that the time series ends in 1980, it is unlikely to be due to changes in targeting behaviour of fishers,

which largely occurred a decade or so later with the introduction of bag limits and the increasing popularity of catch and release fishing.

The historical data collated present a picture of a highly productive estuarine environment. Despite fundamental changes to the mouth of the river and much greater population pressure today, the Noosa Estuary still supports a popular recreational fishery and commercial quantities of many of the species it historically supported. The exception to this is the oyster fishery. It is difficult to say with certainty how the loss of oyster beds from the Noosa River affected the wider food chain, but studies from other locations suggest that oysters play an important role in the provision of food and shelter for fish and other invertebrates, and contribute to improved water quality (Diggles 2013).

Key Lessons

This section provides key lessens relevant for considering similar analyses of historical fisheries productivity for other estuaries in Australia.

Coastal populations of fish and shellfish have been exploited for centuries. In order to provide a more complete view of changes to these ecosystems, interdisciplinary research spanning the archaeological, anthropological, social, historical and ecological disciplines is necessary. Without such interdisciplinary efforts we risk missing vital data sources, or misinterpreting the historical record.

A large amount of information exists within local and state archives and with resident experts. Archival data should be explored using multiple channels, including popular media, government records, universities, local libraries and local historical societies. Local and traditional ecological knowledge are important sources of data that should not be discounted, as they provide information on historical observations of species or periods of time that may not be well described within the archival literature, in addition to placing acquired data into context (e.g., any legislative, environmental or societal changes).

Researchers should approach knowledge holders at an early stage of the study, preferably during the planning stage, and ensure that they undertake their research with cultural sensitivity and using the appropriate channels (e.g., approaching Traditional Owners of the region for an understanding of indigenous history and resource use).

The amount of time required to fully explore the various different data sources should not be underestimated. Expect to have to reject large quantities of historical material for every piece of data found.

Both qualitative and quantitative data are equally important for understanding and communicating historical change, and both should be prioritised.

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