

Assessment Authors and Year

Hall, K.C. 2023. NSW Stock Status Summary 2022/23 – Longfin Eel (*Anguilla reinhardtii*). NSW Department of Primary Industries, Fisheries NSW, Coffs Harbour, 9 pp.

Stock Status

Current stock status	On the basis of the evidence contained within this assessment, Longfin Eel is currently assessed as Sustainable for the NSW component of the stock.
----------------------	--

Stock structure & distribution

The Longfin Eel (*Anguilla reinhardtii*) has a wide species distribution that extends the entire eastern Australian coast from Cape York to Tasmania, and is also found at Lord Howe Island and Norfolk Island (Beumer & Sloane, 1990) and in northern New Zealand (Jellyman *et al.*, 1996). The stock structure was investigated via a microsatellite genetic study, and the results indicated a single panmictic biological stock along the east coast (Shen & Tzeng, 2007). However, there is currently no cross-jurisdictional stock assessment undertaken for the shared stock, so the assessment of the stock status is presented at the jurisdictional level.

The data presented in this summary relate to the New South Wales (NSW) part of the stock.

Biology

The Longfin Eel is a slow growing species that takes up to 22 years for males and 52 years for females to reach sexual maturity (Walsh *et al.*, 2004, 2006). The species is sexually dimorphic, with a larger size at sexual maturity for females (74–142 cm total length, TL) than males (44–62 cm TL) (Walsh *et al.*, 2003). In Australia, the species mainly inhabits the lower reaches and tidal areas of rivers east of the Great Dividing Range until reaching sexual maturity, and then migrates into the deep tropical ocean waters east of the Coral Sea to spawn once before dying (Jellyman, 1987; Pusey *et al.*, 2004). This semelparous life history strategy can make eels particularly vulnerable to recruitment overfishing (Hoyle & Jellyman, 2002). Furthermore, recruitment of juvenile Longfin Eel into NSW estuaries can be highly variable in response to environmental conditions (Silberschneider, 2005).

FISHERY STATISTICS

Catch information

Commercial

Commercial catches of Longfin Eel in New South Wales (NSW) rapidly increased in the early 1990s to supply a newly established live export market to China and peaked at 167 t in 2000/01 (Fig. 1). After a sharp decline in the early 2000s catches remained at around 80 t until 2014/15. Over the last six years the export market for live eels decreased and processing facilities closed in NSW. As a result the Longfin Eel catch decreased from 82.6 t in 2014/15 to a minimum of 8.2 t in 2018/19 and was 14.4 t in 2021/22 (Fig. 1).

The New South Wales commercial fishery targets the fully pigmented sub-adults or 'yellow eels' that return to estuaries on their migration back into freshwater systems; and does not permit any fishing above tidal waters. A minimum size limit of 300 mm total length (TL) was introduced for Longfin Eel in 1997, and subsequently increased to 580 mm TL in 2007. Most of the commercial catch is taken by eel trapping in the Estuary General Fishery (EGF), with seven main estuaries on average accounting for 73% of the catch. In particular, historical catches were largest in Regions 2 on the north coast and Region 4 on the central coast (Fig. 2).

The Longfin Eel is also harvested by trap fisheries in Queensland, Victoria and Tasmania, but NSW catches have historically accounted for the largest percentage of total harvests. Queensland commercial catches fluctuated widely during the 1990s, peaked at 50 t in 2002, then averaged 19.8 t per annum between 2009 and 2016, and have recently declined to just 1.6 t in 2022 (QDAF, unpublished data). Tasmanian and Victorian freshwater eel catches are dominated by Southern Shortfin Eel (*Anguilla australis*), with recent catches of around 5 t per annum of Longfin Eel in each jurisdiction .

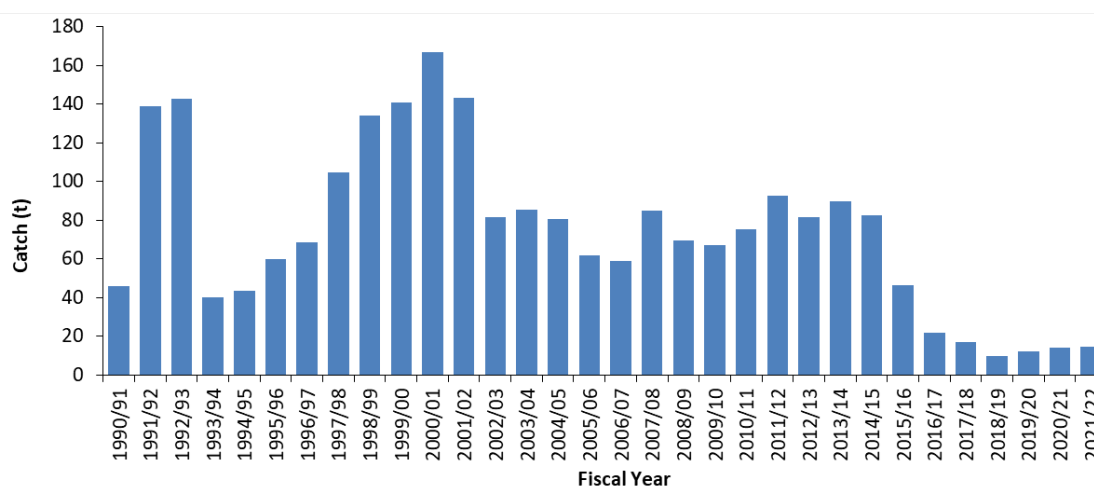


Figure 1. Annual commercial landings (tonnes) of Longfin Eel taken from NSW waters (1990/91–2021/22) for all fishing methods.

Stock Status Summary – 2022/23



NSW Stock Status Summary – Longfin Eel (*Anguilla reinhardtii*)

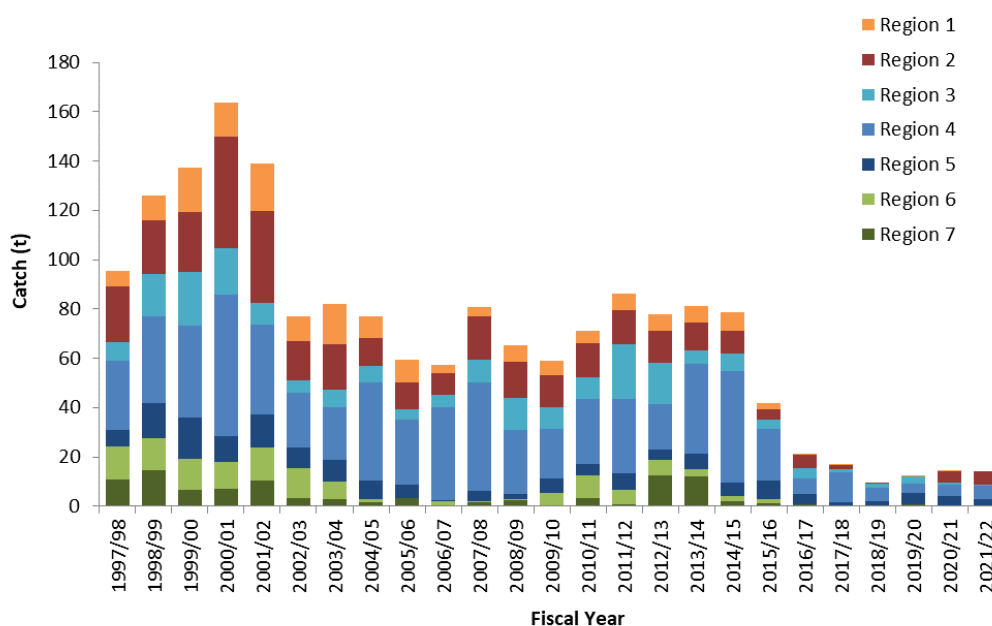


Figure 2. Annual commercial catches of Longfin Eel by the eel trapping sector in different regions of the NSW Estuary General Fishery from 1997/98 to 2021/22.

Recreational & Charter boat

Recreational catches of freshwater eels are not separated according to species. The most recent estimate of the recreational harvest of combined freshwater eels in NSW was approximately 2,605 eels during 2019/20 (Murphy *et al.*, 2022). A further 8,744 eels were estimated to be caught and released. These estimates were based on a survey of Recreational Fishing Licence (RFL) Households, comprised of at least one fisher possessing a long-term (1 or 3 years duration) fishing licence and any other fishers resident within their household. The equivalent estimates from previous surveys in 2017/18 and 2013/14 were around 2,955 and 1,024 eels harvested, with an additional 8,744 and 16,479 eels estimated to be caught and released, respectively (Murphy *et al.*, 2020). Historically, relative to the commercial catch, these recreational harvests are very small, comprising approximately 3.7% of the total harvest of freshwater eels from NSW waters in 2013/14.

Aboriginal cultural fishery

A survey of Aboriginal cultural fishing in the Tweed River catchment identified river eels as one of the main components of freshwater catches (Schnierer & Egan, 2016). However, Longfin Eel only accounted for 0.8% of the total Aboriginal catch from the area (Schnierer, 2011). Total catches in the region were estimated to range between 117–350 Longfin Eel per annum (Schnierer, 2011). Statewide estimates of the annual Aboriginal harvest of Longfin Eel in NSW waters are unknown, but likely to be significant.

Illegal, Unregulated and Unreported

The amount of illegal, unregulated and unreported catches of Longfin Eels in New South Wales are unknown.

Fishing effort information

Commercial fishing effort for Longfin Eel was collected as number of days fished on monthly records prior to July 2009 and as numbers of traps fished per daily event after July 2009. To form a longer time series of effort, recent daily events were re-aggregated, with effort in days fished estimated from the number of fishing events entered for each fisher in each month where Longfin Eel was reported on at least one day.

Reported commercial fishing effort for Longfin Eel increased from below 5,000 days fished in 1997/98 to a peak of 6,721 days fished in 2001/02, before declining to 1,008 days fished in 2010/11 (Fig. 3). Fishing effort then increased steadily to around 1,880 days fished in 2014/15, but has been a small fraction (less than 3%) of past levels over the last five years with 169 days fished in 2021/22.

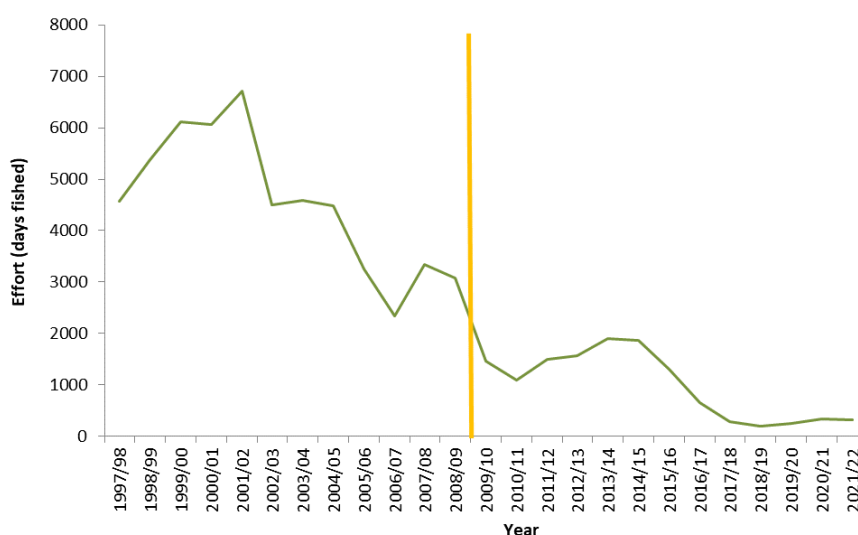


Figure 3. Annual effort (in days fished) for eel trapping fishers of the NSW Estuary General Fishery that reported landing Longfin Eel on at least one day in each month (1997/98 to 2021/22). The vertical gold line indicates the change from monthly to daily catch reporting.

Catch Rate information

Monthly catch rates (catch-per-unit-effort, CPUE in kg per day fished) for Longfin Eel taken by eel traps in the EGF were compiled from monthly records between 1991/92 and 2008/09 and were standardized for month, region and fishing business using the r-package 'rforcpue' (Haddon, 2023). Daily catch rates (CPUE in kg per eel trap) were also compiled from daily fishing event records from 2009/10 to 2021/22 and standardised for month, region and fishing business.

The historical mean standardised monthly catch rates of Longfin Eel steadily declined by over 50% during the 1990s and then increased back towards the long-term average (of 25 kg per days fished) during the 2000s (Fig. 4, left graph). Recent standardised daily catch rates suggest further declines occurred during the early 2010s, but over the last six years catch rates have fluctuated around the recent long-term average (of 4.8 kg per trap) and indicate a more stable trend (Fig. 4, right graph).

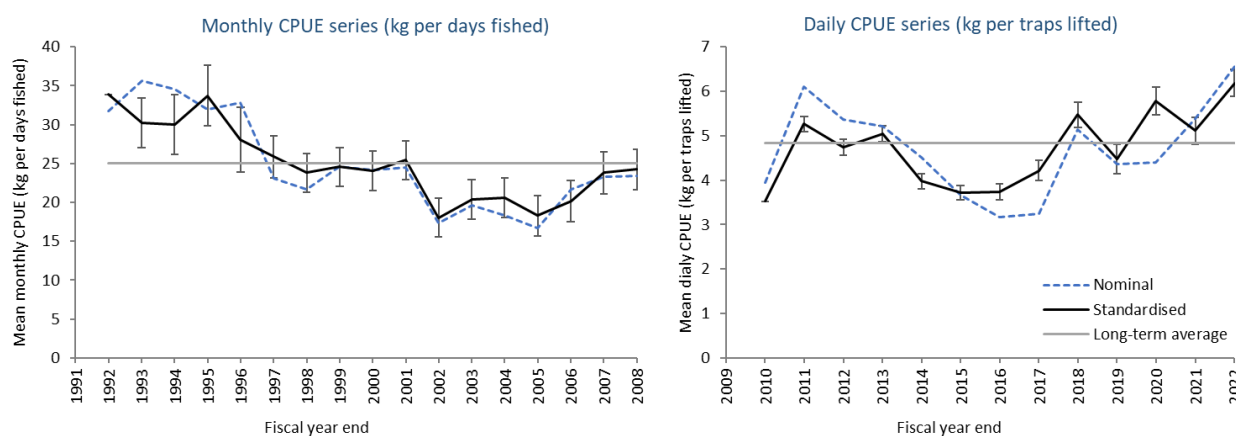


Figure 4. Mean standardised catch rates (catch-per-unit-effort, CPUE) of Longfin Eel for the eel trapping sector of the NSW Estuary General Fishery, estimated from monthly records (1992–2009) in kg per days fished (left graph) and from daily fishing event records (2010–2022) in kg per traps lifted (right graph). The dashed and solid lines indicate the nominal and standardised mean CPUE, respectively and the grey horizontal line indicates the long-term average for each series.

STOCK ASSESSMENT

Stock Assessment Methodology

Year of most recent assessment:

2023

No quantitative joint stock assessment of the entire biological stock is undertaken.

Assessment method:

A weight-of-evidence approach was used for this stock status assessment of Longfin Eel in NSW waters. It relies on analyses of standardised catch rates and total fishing effort for the eel trapping sector of the EGF.

Main data inputs:

Commercial catch and effort data – for all NSW commercial fisheries by fiscal years (1990/91–2021/22).

Recreational catches – estimated annual catches for combined freshwater eels from four periods – national recreational and indigenous fishing survey (2000/01) and NSW recreational fishing surveys (2013/14, 2017/18 and 2019/20).

Commercial catch rates historical – reported annual monthly CPUE data for the eel trapping sector of the EGF by calendar years in kg per days fished (1992–2009) – standardised.

Commercial catch rates recent – reported annual daily CPUE data for the eel trapping sector of the EGF by calendar years in kg per trap (2010–2022) – standardised.

Stock Status Summary – 2022/23



NSW Stock Status Summary – Longfin Eel (*Anguilla reinhardtii*)

Key model structure & assumptions:

The CPUE standardisations and analyses assume that the annual catch rates are a relative index of abundance and are not unduly influenced by other factors that are not accounted for through standardisation.

Catch rates were standardised for the influences of different months, estuary regions and fishing businesses.

Using fishing effort as an indicator of relative fishing pressure assumes that fish catchability and fishing power have not changed significantly over the monitoring period.

Sources of uncertainty evaluated:

None assessed.

Status Indicators - Limit & Target Reference Levels

There is no harvest strategy in place for Longfin Eel in NSW, so a weight-of-evidence approach has been applied in this stock assessment with nominated indicators and reference points in line with the current NSW Harvest Strategy Policy (NSW DPI, 2021).

Biomass indicator or proxy	Trend in annual standardised catch rates of the eel trapping sector of the commercial EGF was used as an index of relative abundance.
Biomass Limit Reference Point	Current catch rates were compared to the long-term averages of each time series.
Biomass Target Reference Point	None specified.
Fishing mortality indicator or proxy	Trend in the total fishing effort of the eel trapping sector of the EGF was used as an indicator of relative fishing pressure.
Fishing mortality Limit Reference Point	Current effort levels were compared against historic levels.
Fishing Mortality Target Reference Point	None specified.

Stock Assessment Results

Stock Assessment Result Summary

Biomass status in relation to Limit	<p>Trends in historical catch rates from monthly records of commercial eel trapping suggest that some reduction in biomass may have occurred between 1990 and 2009. More recent standardised catch rates from daily event records show further declines between 2011 and 2015 but have fluctuated around an increasing trend since then and were above average over the last three years. An interim total commercial access level (ITCAL) of 137 t was introduced in 2017 and will transition to an adjustable TAC in 2024. Current harvests are well below the ITCAL and a more comprehensive stock assessment is required prior to the transition to support determination of an appropriate catch limit.</p> <p>The weight of evidence suggests that recent low harvest rates have permitted some biomass recovery following earlier declining catch rates and that the current stock biomass in NSW waters is unlikely to be recruitment overfished.</p>
Biomass status in relation to Target	Not assessed.
Fishing mortality in relation to Limit	Current fishing effort is very low (2.3%) relative to past levels. This is providing a temporary hiatus and the current low level of fishing mortality is unlikely to cause the stock to become recruitment impaired.
Fishing mortality in relation to Target	Not assessed.
Current SAFS stock status	On the basis of the evidence above, which includes extremely low levels of fishing effort over the last four years, the NSW part of the Longfin Eel stock is currently assessed as a sustainable stock .

Fishery interactions

The EGF eel trapping gears interact with other commercial and non-commercial by-catch species, a range of endangered, threatened and/or protected (ETP) species and freshwater habitats. However, the current regulations for eel trapping in the EGF, which include restricting eel fishing to tidal estuarine waters and some farm dams and artificial impoundments and using wingless baited traps are likely to be limit the amount of interactions with protected species such as platypus.

The use of traps with no wings reduces drowning of platypuses, and prevents mortality of small forage fish species, which might be captured by "gilling" in the wings of fyke nets (Grant, 1993). Furthermore, The EGF share management plan mandates that all eel traps must have a 100 mm rigid ring fit to funnel entrances to prevent air breathing animals (such as freshwater turtles and platypus) from entering the traps. Traps in freshwater dams and impoundments must also include an air pocket in the cod end. Mesh size and other gear restrictions are regulated to increase the target species selectivity of the traps and cod ends. Research results suggest that these measures significantly decrease the levels of by-catch associated with these fishing gears (Grant *et al.*, 2004).

Interactions with animals protected under the *Environment Protection and Biodiversity Conservation Act 1999* were subjected to a detailed risk assessment in an environmental impact statement (EIS) for the fishery undertaken during fisheries management strategy development (NSW Fisheries 2001). An updated threat and risk assessment for all components of the NSW marine estate was completed in 2017 (Fletcher and Fisk 2017). The EGF was considered a moderate threat to species and communities protected under the *NSW Fisheries Management Act 1994* and *Biodiversity Conservation Act 2016*. Compulsory logbook reporting of all interactions with ETP species was mandated in 2005 and these are reported annually to the Department of Environment and Energy (NSW DPI, 2017).

Qualifying Comments

- Current levels of fishing effort are extremely low and are likely to be permitting some recovery of biomass.
- The commercial EGF is permitted to operate in only a limited number of estuaries along the NSW coast, which provides some protection for a potentially large percentage of eel stock.
- The influence of catch reporting changes on commercial catch rates, especially during the transition from monthly to daily reporting in July 2009, limits their application as an index of relative abundance.
- Effort distributions changed significantly after July 2009 and indicate that a single, long-term series of monthly catch rates is not a reliable option for this species.
- Some species misidentification and/or misreporting of freshwater eels is likely and may cause increased uncertainty in stock status assessment results.
- Compliance activity suggests that some unreported, illegal fishing in freshwater systems closed to fishing may have occurred, which is not considered in this assessment.

References

- Beumer, J., & Sloane, R. (1990). Distribution and abundance of glass eels *Anguilla* spp. in east Australian waters. *Internationale Revue der gesamten Hydrobiologie und Hydrographie*, 75, 721–736.
- Grant, T. R. (1993). The past and present freshwater fishery in New South Wales and the distribution and status of the Platypus *Ornithorhynchus anatinus*. *Australian Zoologist*, 29, 105–113.
- Grant, T. R., Lowry, M. B., Pease, B., Walford, T. R., & Graham, K. (2004). Reducing the by-catch of platypuses (*Ornithorhynchus anatinus*) in commercial and recreational fishing gear in New South Wales. *Proceedings of the Linnean Society of New South Wales*, 125, 259–272.

Stock Status Summary – 2022/23



NSW Stock Status Summary – Longfin Eel (*Anguilla reinhardtii*)

- Haddon, M. (2023). *rforcpue: functions to assist with the analysis of CPUE data. R package version 0.0.0.3000.*
- Hoyle, S. D., & Jellyman, D. J. (2002). Longfin eels need reserves: modelling the effects of commercial harvest on stocks of New Zealand eels. *Marine and Freshwater Research*, 53, 887–895.
- Jellyman, D. J. (1987). Review of the marine life history of Australasian temperate species of *Anguilla*. *American Fisheries Society Symposium*, 1, 276–285.
- Jellyman, D. J., Chisnall, B. L., Dijkstra, L. H., & Boubee, J. A. T. (1996). First record of the Australian longfinned eel, *Anguilla reinhardtii*, in New Zealand. *Marine and Freshwater Research*, 47, 1037–1040.
- Murphy, J. J., Ochwada-Doyle, F. A., West, L. D., Stark, K. E., & Hughes, J. M. (2020). *The NSW Recreational Fisheries Monitoring Program - survey of recreational fishing, 2017/18. Fisheries Final Report Series No. 158.* p. Wollongong, NSW.
- Murphy, J. J., Ochwada-Doyle, F. A., West, L. D., Stark, K. E., Hughes, J. M., & Taylor, M. D. (2022). *Survey of recreational fishing in NSW, 2019/20 – Key Results. Fisheries Final Report Series No. 161.* Nelson Bay, NSW. p. 80.
- NSW DPI. (2017). *Assessment of the NSW Ocean Trawl Fishery. Prepared for the Department of Environment and Energy for the purpose of assessment under Part 13 and 13(A) of the Environment Protection and Biodiversity Act 1999.* Coffs Harbour, NSW: NSW Department of Primary Industries. p. 25 pp.
- Pusey, B. B., Kennard, M. M., & Arthington, A. A. (2004). *Freshwater Fishes of North-Eastern Australia.* Collingwood, Victoria: CSIRO Publishing.
- Schnierer, S. (2011). *Aboriginal fisheries in New South Wales: determining catch, cultural significance of species and traditional fishing knowledge needs. FRDC Final Report Project No. 2009/038.* 0960–3166. Fisheries Research and Development Corporation. pp. 693–709.
- Schnierer, S., & Egan, H. (2016). Composition of the Aboriginal harvest of fisheries resources in coastal New South Wales, Australia. *Reviews in Fish Biology and Fisheries*, 26, 693–709.
- Shen, K. N., & Tzeng, W. N. (2007). Population genetic structure of the year-round spawning tropical eel, *Anguilla reinhardtii*, in Australia. *Zoological Studies*, 46, 441–453.
- Silberschneider, V. (2005). *Recruitment and age dynamics of Anguilla australis and A. reinhardtii glass eels in the estuaries of New South Wales (PhD Thesis).* University of Technology, Sydney.
- Walsh, C. T., Pease, B. C., & Booth, D. J. (2003). Sexual dimorphism and gonadal development of the Australian longfinned river eel. *Journal of Fish Biology*, 63, 137–152.
- Walsh, C. T., Pease, B. C., & Booth, D. J. (2004). Variation in the sex ratio, size and age of longfinned eels within and among coastal catchments of southeastern Australia. *Journal of Fish Biology*, 64, 1297–1312.
- Walsh, C. T., Pease, B. C., Hoyle, S. D., & Booth, D. J. (2006). Variability in growth of longfinned eels among coastal catchments of south-eastern Australia. *Journal of Fish Biology*, 68, 1693–1706.