

Table S1. Summary of historical scientific surveys of fish assemblages at Ningaloo Reef (1987 – 2019) AIMS = Australian Institute Marine Science, CSIRO = Commonwealth Industrial and Scientific Research Organisation, RLS = Reef Life Survey, DBCA = Department Biodiversity, Conservation and Attractions, UWA = University Western Australia

Custodian	Year	Method	Reef region	Reef_Zone	Area/time surveyed	Reference
AIMS	1993	UVC-short	Cloates	Back reef	3000m2	Depczynski <i>et al.</i> , 2015
AIMS	1993	UVC-short	Maud	Back reef	2250m2	
AIMS	1993	UVC-short	Osprey	Back reef	3000m2	
AIMS	1993	UVC-short	Cloates	Reef slope	3000m2	
AIMS	1993	UVC-short	Osprey	Reef slope	3000m2	
AIMS	1998	UVC-short	Cloates	Back reef	2000m2	
AIMS	1998	UVC-short	Mandu	Back reef	2250m2	
AIMS	1998	UVC-short	Maud	Back reef	2250m2	
AIMS	1998	UVC-short	Osprey	Back reef	2250m2	
AIMS	2014	UVC-short	Cloates	Back reef	15000m2	
AIMS	2014	UVC-short	Maud	Back reef	7500m2	
AIMS	2014	UVC-short	Pelican	Back reef	7500m2	
AIMS	2014	UVC-short	Cloates	Lagoon	6000m2	
AIMS	2014	UVC-short	Mangrove	Lagoon	4500m2	
AIMS	2014	UVC-short	Maud	Lagoon	6000m2	
AIMS	2014	UVC-short	Pelican	Lagoon	7500m2	
AIMS	2014	UVC-short	Tantabiddi	Lagoon	3750m2	
Ayling	1987	UVC-long	Osprey	Back reef	35000m2	Ayling & Ayling, 1987
Ayling	1987	UVC-long	Osprey	Lagoon	25000m2	
Ben Fitzpatrick	2006	BRUV	Mandu	Back reef	1020min	Fitzpatrick <i>et al.</i> , 2015
Ben Fitzpatrick	2006	BRUV	Mandu	Back reef	1020min	
Ben Fitzpatrick	2006	BRUV	Osprey	Back reef	660min	
Ben Fitzpatrick	2006	BRUV	Osprey	Back reef	720min	
Ben Fitzpatrick	2006	BRUV	Osprey	Lagoon	720min	
Ben Fitzpatrick	2006	BRUV	Mandu	Reef Flat	1020min	
Ben Fitzpatrick	2006	BRUV	Mandu	Reef Flat	1080min	
Ben Fitzpatrick	2006	DOV	Mandu	Back reef	2500m2	
Ben Fitzpatrick	2006	DOV	Mandu	Back reef	2500m2	
Ben Fitzpatrick	2006	DOV	Osprey	Back reef	3750m2	
Ben Fitzpatrick	2006	DOV	Osprey	Back reef	3750m2	
Ben Fitzpatrick	2006	DOV	Osprey	Lagoon	2500m2	
Ben Fitzpatrick	2006	DOV	Osprey	Lagoon	2500m2	
Ben Fitzpatrick	2006	DOV	Mandu	Reef Flat	2500m2	
Ben Fitzpatrick	2006	DOV	Mandu	Reef Flat	2500m2	
Ben Fitzpatrick	2007	BRUV	Mandu	Back reef	1080min	
Ben Fitzpatrick	2007	BRUV	Mandu	Back reef	1080min	

Ben Fitzpatrick	2007	BRUV	Osprey	Back reef	660min	
Ben Fitzpatrick	2007	BRUV	Osprey	Back reef	720min	
Ben Fitzpatrick	2007	BRUV	Osprey	Lagoon	600min	
Ben Fitzpatrick	2007	BRUV	Osprey	Lagoon	720min	
Ben Fitzpatrick	2007	BRUV	Mandu	Reef Flat	900min	
Ben Fitzpatrick	2007	BRUV	Mandu	Reef Flat	960min	
Ben Fitzpatrick	2007	DOV	Mandu	Back reef	2500m2	
Ben Fitzpatrick	2007	DOV	Mandu	Back reef	2500m2	
Ben Fitzpatrick	2007	DOV	Osprey	Back reef	3750m2	
Ben Fitzpatrick	2007	DOV	Osprey	Back reef	3750m2	
Ben Fitzpatrick	2007	DOV	Osprey	Lagoon	2500m2	
Ben Fitzpatrick	2007	DOV	Osprey	Lagoon	2500m2	
Ben Fitzpatrick	2007	DOV	Mandu	Reef Flat	2500m2	
Ben Fitzpatrick	2007	DOV	Mandu	Reef Flat	2500m2	
CSIRO	2006	UVC-long	Cloates	Back reef	17000m2	Babcock <i>et al.</i> , 2008, 2018
CSIRO	2006	UVC-long	Mandu	Back reef	19000m2	
CSIRO	2006	UVC-long	Pelican	Back reef	13000m2	
CSIRO	2006	UVC-long	Cloates	Lagoon	19000m2	
CSIRO	2006	UVC-long	Mangrove	Lagoon	10000m2	
CSIRO	2006	UVC-long	Mangrove	Lagoon	4000m2	
CSIRO	2006	UVC-long	Mandu	Reef Flat	32000m2	
CSIRO	2006	UVC-long	Mangrove	Reef Flat	11000m2	
CSIRO	2006	UVC-long	Maud	Reef Flat	5000m2	
CSIRO	2006	UVC-long	Osprey	Reef Flat	27000m2	
CSIRO	2006	UVC-long	Pelican	Reef Flat	9000m2	
CSIRO	2006	UVC-long	Lighthouse	Reef slope	31000m2	
CSIRO	2006	UVC-long	Mandu	Reef slope	26000m2	
CSIRO	2006	UVC-long	Osprey	Reef slope	18000m2	
CSIRO	2006	UVC-long	Pelican	Reef slope	23000m2	
CSIRO	2007	UVC-long	Cloates	Back reef	15000m2	
CSIRO	2007	UVC-long	Mandu	Back reef	17000m2	
CSIRO	2007	UVC-long	Cloates	Lagoon	12000m2	
CSIRO	2007	UVC-long	Mangrove	Lagoon	8000m2	
CSIRO	2007	UVC-long	Mangrove	Lagoon	4000m2	
CSIRO	2007	UVC-long	Mandu	Reef Flat	37000m2	
CSIRO	2007	UVC-long	Mangrove	Reef Flat	9000m2	
CSIRO	2007	UVC-long	Maud	Reef Flat	10000m2	
CSIRO	2007	UVC-long	Osprey	Reef Flat	17000m2	
CSIRO	2007	UVC-long	Lighthouse	Reef slope	33000m2	
CSIRO	2007	UVC-long	Mandu	Reef slope	22000m2	
CSIRO	2007	UVC-long	Osprey	Reef slope	9000m2	
CSIRO	2007	UVC-short	Mandu	Reef flat	7200m2	
CSIRO	2007	UVC-short	Maud	Reef flat	7200m2	
CSIRO	2007	UVC-short	Osprey	Reef flat	7200m2	

CSIRO	2009	UVC-short	Mandu	Reef flat	6000m2	
CSIRO	2010	UVC-short	Mandu	Reef flat	6000m2	
CSIRO	2012	UVC-short	Mandu	Reef flat	6000m2	
CSIRO	2013	UVC-long	Jurabi	Reef slope	14000m2	Vanderklift et al. 2020
CSIRO	2013	UVC-long	Mandu	Reef slope	35000m2	
CSIRO	2013	UVC-long	Osprey	Reef slope	30000m2	
CSIRO	2013	UVC-short	Mangrove	Back reef	2250m2	
CSIRO	2013	UVC-short	Maud	Back reef	2625m2	
CSIRO	2013	UVC-short	Cloates	Reef Flat	6000m2	
CSIRO	2013	UVC-short	Mandu	Reef Flat	6000m2	
CSIRO	2013	UVC-short	Mangrove	Reef Flat	2250m2	
CSIRO	2013	UVC-short	Maud	Reef Flat	3375m2	
CSIRO	2013	UVC-short	Osprey	Reef Flat	6000m2	
CSIRO	2014	UVC-short	Mandu	Reef Flat	6000m2	
CSIRO	2014	UVC-short	Mandu	Reef Flat	6000m2	
CSIRO	2014	UVC-short	Osprey	Reef Flat	6000m2	
CSIRO	2015	UVC-short	Mandu	Reef Flat	6000m2	
CSIRO	2015	UVC-short	Mandu	Reef Flat	5875m2	
CSIRO	2015	UVC-long	Jurabi	Lagoon	4000m2	
CSIRO	2015	UVC-long	Mangrove	Lagoon	8000m2	
CSIRO	2015	UVC-long	Osprey	Reef flat	4000m2	
CSIRO	2015	UVC-long	Jurabi	Reef slope	5000m2	
CSIRO	2015	UVC-long	Jurabi	Reef slope	4000m2	
CSIRO	2015	UVC-long	Osprey	Reef slope	13000m2	
CSIRO	2015	UVC-short	Jurabi	Lagoon	500m2	
CSIRO	2015	UVC-short	Mangrove	Lagoon	1000m2	
CSIRO	2015	UVC-short	Osprey	Reef flat	500m2	
CSIRO	2015	UVC-short	Jurabi	Reef slope	625m2	
CSIRO	2015	UVC-short	Jurabi	Reef slope	500m2	
CSIRO	2015	UVC-short	Osprey	Reef slope	1625m2	
CSIRO	2016	UVC-short	Mandu	Reef flat	5250m2	
CSIRO	2016	UVC-short	Mandu	Reef Flat	750m2	
CSIRO	2016	UVC-short	Mandu	Reef flat	1500m2	
CSIRO	2016	UVC-long	Mangrove	Lagoon	8000m2	
CSIRO	2016	UVC-long	Osprey	Reef flat	3000m2	
CSIRO	2016	UVC-long	Jurabi	Reef slope	5000m2	
CSIRO	2016	UVC-long	Jurabi	Reef slope	1000m2	
CSIRO	2016	UVC-long	Osprey	Reef slope	10000m2	
CSIRO	2016	UVC-short	Mangrove	Lagoon	1000m2	
CSIRO	2016	UVC-short	Osprey	Reef flat	375m2	
CSIRO	2016	UVC-short	Jurabi	Reef slope	625m2	
CSIRO	2016	UVC-short	Jurabi	Reef slope	125m2	
CSIRO	2016	UVC-short	Osprey	Reef slope	1250m2	
CSIRO	2017	UVC-short	Mandu	Reef flat	1375m2	

CSIRO	2017	UVC-short	Mandu	Reef Flat	375m2	
CSIRO	2017	UVC-long	Mangrove	Lagoon	8000m2	
CSIRO	2017	UVC-long	Osprey	Reef flat	4000m2	
CSIRO	2017	UVC-long	Jurabi	Reef slope	5000m2	
CSIRO	2017	UVC-long	Jurabi	Reef slope	2000m2	
CSIRO	2017	UVC-long	Osprey	Reef slope	13000m2	
CSIRO	2017	UVC-short	Mangrove	Lagoon	875m2	
CSIRO	2017	UVC-short	Osprey	Reef flat	500m2	
CSIRO	2017	UVC-short	Jurabi	Reef slope	625m2	
CSIRO	2017	UVC-short	Jurabi	Reef slope	250m2	
CSIRO	2017	UVC-short	Osprey	Reef slope	1625m2	
CSIRO	2018	UVC-long	Mangrove	Lagoon	8000m2	
CSIRO	2018	UVC-long	Osprey	Reef flat	4000m2	
CSIRO	2018	UVC-long	Jurabi	Reef slope	5000m2	
CSIRO	2018	UVC-long	Jurabi	Reef slope	2000m2	
CSIRO	2018	UVC-long	Osprey	Reef slope	13000m2	
CSIRO	2018	UVC-short	Mangrove	Lagoon	875m2	
CSIRO	2018	UVC-short	Osprey	Reef flat	500m2	
CSIRO	2018	UVC-short	Jurabi	Reef slope	625m2	
CSIRO	2018	UVC-short	Jurabi	Reef slope	250m2	
CSIRO	2018	UVC-short	Osprey	Reef slope	1625m2	
CSIRO	2019	UVC-long	Mangrove	Lagoon	8000m2	
CSIRO	2019	UVC-long	Osprey	Reef flat	4000m2	
CSIRO	2019	UVC-long	Jurabi	Reef slope	5000m2	
CSIRO	2019	UVC-long	Jurabi	Reef slope	2000m2	
CSIRO	2019	UVC-long	Osprey	Reef slope	13000m2	
CSIRO	2019	UVC-short	Mangrove	Lagoon	875m2	
CSIRO	2019	UVC-short	Osprey	Reef flat	500m2	
CSIRO	2019	UVC-short	Jurabi	Reef slope	625m2	
CSIRO	2019	UVC-short	Jurabi	Reef slope	250m2	
CSIRO	2019	UVC-short	Osprey	Reef slope	1625m2	
DBCA	2009	UVC-short	Mandu	Reef flat	5625m2	Wilson <i>et al.</i> , 2012; Holmes <i>et al.</i> , 2013; Wilson <i>et al.</i> , 2018
DBCA	2010	DOV	Maud	Lagoon	3000m2	
DBCA	2010	DOV	Tantabiddi	Lagoon	3000m2	
DBCA	2010	DOV	Lighthouse	Reef slope	1875m2	
DBCA	2010	UVC-long	Jurabi	Lagoon	3000m2	
DBCA	2010	UVC-long	Mandu	Lagoon	3000m2	
DBCA	2010	UVC-long	Mangrove	Lagoon	3000m2	
DBCA	2010	UVC-long	Jurabi	Lagoon	3000m2	
DBCA	2010	UVC-long	Mandu	Lagoon	3000m2	
DBCA	2010	UVC-long	Mangrove	Lagoon	3000m2	
DBCA	2011	DOV	Cloates	Back reef	3000m2	

DBCA	2011	DOV	Mangrove	Back reef	3000m2	
DBCA	2011	DOV	Maud	Back reef	3000m2	
DBCA	2011	DOV	Osprey	Back reef	3000m2	
DBCA	2011	DOV	Pelican	Back reef	3000m2	
DBCA	2011	DOV	Mangrove	Lagoon	2750m2	
DBCA	2011	DOV	Maud	Lagoon	3000m2	
DBCA	2011	DOV	Tantabiddi	Lagoon	3000m2	
DBCA	2011	DOV	Lighthouse	Reef slope	3000m2	
DBCA	2013	DOV	Mangrove	Back reef	3000m2	
DBCA	2013	DOV	Tantabiddi	Lagoon	3000m2	
DBCA	2013	UVC-short	Cloates	Back reef	2700m2	Wilson et al., 2014
DBCA	2013	UVC-short	Mandu	Back reef	4050m2	
DBCA	2013	UVC-short	Mangrove	Back reef	2700m2	
DBCA	2013	UVC-short	Mangrove	Back reef	2700m2	
DBCA	2013	UVC-short	Maud	Back reef	5400m2	
DBCA	2013	UVC-short	Maud	Back reef	5400m2	
DBCA	2013	UVC-short	Pelican	Back reef	5400m2	
DBCA	2013	UVC-short	Pelican	Back reef	5400m2	
DBCA	2013	UVC-short	Cloates	Lagoon	6750m2	
DBCA	2013	UVC-short	Mangrove	Lagoon	5400m2	
DBCA	2013	UVC-short	Mangrove	Lagoon	5400m2	
DBCA	2013	UVC-short	Maud	Lagoon	6750m2	
DBCA	2013	UVC-short	Maud	Lagoon	6750m2	
DBCA	2013	UVC-short	Pelican	Lagoon	8100m2	
DBCA	2013	UVC-short	Pelican	Lagoon	8100m2	
DBCA	2014	DOV	Cloates	Back reef	10500m2	Wilson <i>et al.</i> , 2012; Holmes <i>et al.</i> , 2013; Wilson <i>et al.</i> , 2018
DBCA	2014	DOV	Mandu	Back reef	4500m2	
DBCA	2014	DOV	Mangrove	Back reef	4500m2	
DBCA	2014	DOV	Maud	Back reef	6000m2	
DBCA	2014	DOV	Osprey	Back reef	4500m2	
DBCA	2014	DOV	Pelican	Back reef	6000m2	
DBCA	2014	DOV	Winderabandi	Back reef	3000m2	
DBCA	2014	DOV	Mangrove	Lagoon	2750m2	
DBCA	2014	DOV	Tantabiddi	Lagoon	3000m2	
DBCA	2014	DOV	Lighthouse	Reef slope	3000m2	
DBCA	2014	UVC-short	Cloates	Back reef	2700m2	Wilson et al., 2014
DBCA	2014	UVC-short	Mandu	Back reef	4050m2	
DBCA	2014	UVC-short	Mangrove	Back reef	2700m2	
DBCA	2014	UVC-short	Mangrove	Back reef	2700m2	
DBCA	2014	UVC-short	Maud	Back reef	5400m2	

DBCA	2014	UVC-short	Maud	Back reef	5400m2	
DBCA	2014	UVC-short	Pelican	Back reef	5400m2	
DBCA	2014	UVC-short	Pelican	Back reef	5400m2	
DBCA	2014	UVC-short	Cloates	Lagoon	6750m2	
DBCA	2014	UVC-short	Mangrove	Lagoon	5400m2	
DBCA	2014	UVC-short	Mangrove	Lagoon	5400m2	
DBCA	2014	UVC-short	Maud	Lagoon	6750m2	
DBCA	2014	UVC-short	Maud	Lagoon	6750m2	
DBCA	2014	UVC-short	Pelican	Lagoon	8100m2	
DBCA	2014	UVC-short	Pelican	Lagoon	8100m2	
DBCA	2015	DOV	Mandu	Back reef	3000m2	Wilson <i>et al.</i> , 2012; Holmes <i>et al.</i> , 2013; Wilson <i>et al.</i> , 2018
DBCA	2015	DOV	Maud	Back reef	4500m2	
DBCA	2015	DOV	Osprey	Back reef	3000m2	
DBCA	2015	DOV	Tantabiddi	Lagoon	3000m2	
DBCA	2015	DOV	Lighthouse	Reef slope	3000m2	
DBCA	2015	UVC-short	Cloates	Back reef	2700m2	Wilson <i>et al.</i> , 2014)
DBCA	2015	UVC-short	Mandu	Back reef	4050m2	
DBCA	2015	UVC-short	Mangrove	Back reef	2700m2	
DBCA	2015	UVC-short	Mangrove	Back reef	2700m2	
DBCA	2015	UVC-short	Maud	Back reef	5400m2	
DBCA	2015	UVC-short	Maud	Back reef	5400m2	
DBCA	2015	UVC-short	Pelican	Back reef	5400m2	
DBCA	2015	UVC-short	Pelican	Back reef	5400m2	
DBCA	2015	UVC-short	Cloates	Lagoon	6750m2	
DBCA	2015	UVC-short	Mangrove	Lagoon	5400m2	
DBCA	2015	UVC-short	Mangrove	Lagoon	5400m2	
DBCA	2015	UVC-short	Maud	Lagoon	6750m2	
DBCA	2015	UVC-short	Maud	Lagoon	6750m2	
DBCA	2015	UVC-short	Pelican	Lagoon	8100m2	
DBCA	2015	UVC-short	Pelican	Lagoon	8100m2	
DBCA	2016	DOV	Mandu	Back reef	3000m2	Wilson <i>et al.</i> , 2012; Holmes <i>et al.</i> , 2013; Wilson <i>et al.</i> , 2018
DBCA	2016	DOV	Mandu	Back reef	3000m2	
DBCA	2016	DOV	Mangrove	Back reef	3000m2	
DBCA	2016	DOV	Maud	Back reef	4500m2	
DBCA	2016	DOV	Osprey	Back reef	3000m2	
DBCA	2016	DOV	Osprey	Back reef	3000m2	
DBCA	2016	DOV	Tantabiddi	Back reef	3000m2	
DBCA	2016	DOV	Tantabiddi	Lagoon	3000m2	

DBCA	2016	DOV	Lighthouse Bay	Reef slope	3000m2	
DBCA	2016	UVC-long	Mandu	Back reef	3000m2	
DBCA	2016	UVC-long	Mangrove	Back reef	3000m2	
DBCA	2016	UVC-long	Osprey	Back reef	3000m2	
DBCA	2016	UVC-long	Tantabiddi	Back reef	3000m2	
Kathy Cure	2013	DOV	Maud	Back reef	13500m2	na
Kathy Cure	2013	DOV	Pelican	Back reef	7500m2	na
Kathy Cure	2013	DOV	Maud	Reef slope	9000m2	na
Kathy Cure	2013	DOV	Pelican	Reef slope	7500m2	na
Mark Westera	1999	UVC-short	Mandu	Back reef	4000m2	Westera 2003
Mark Westera	1999	UVC-short	Maud	Back reef	4000m2	
Mark Westera	1999	UVC-short	Osprey	Back reef	4250m2	
Mark Westera	2000	BRUV	Mandu	Back reef	750min	
Mark Westera	2000	BRUV	Maud	Back reef	690min	
Mark Westera	2000	BRUV	Maud	Back reef	570min	
Mark Westera	2000	UVC-long	Mandu	Back reef	20000m2	
Mark Westera	2000	UVC-long	Mandu	Back reef	20000m2	
Mark Westera	2000	UVC-long	Maud	Back reef	20000m2	
Mark Westera	2000	UVC-long	Maud	Back reef	25000m2	
Mark Westera	2000	UVC-long	Osprey	Back reef	20000m2	
Mark Westera	2000	UVC-long	Osprey	Back reef	20000m2	
Mark Westera	2000	UVC-short	Mandu	Back reef	3750m2	
Mark Westera	2000	UVC-short	Mandu	Back reef	4000m2	
Mark Westera	2000	UVC-short	Maud	Back reef	4000m2	
Mark Westera	2000	UVC-short	Maud	Back reef	3500m2	
Mark Westera	2000	UVC-short	Osprey	Back reef	4000m2	
Mark Westera	2000	UVC-short	Osprey	Back reef	4000m2	
Reef Life Survey	2010	UVC-short	Cloates	Back reef	1000m2	Edgar GJ, and Stuart-Smith, RD 2014
Reef Life Survey	2010	UVC-short	Maud	Back reef	4250m2	
Reef Life Survey	2010	UVC-short	Pelican	Back reef	1750m2	
Reef Life Survey	2012	UVC-short	Cloates	Back reef	1500m2	
Reef Life Survey	2012	UVC-short	Maud	Back reef	7750m2	
Reef Life Survey	2012	UVC-short	Pelican	Back reef	3000m2	
Reef Life Survey	2015	UVC-short	Cloates	Back reef	1500m2	
Reef Life Survey	2015	UVC-short	Maud	Back reef	11500m2	
Reef Life Survey	2015	UVC-short	Pelican	Back reef	4000m2	
Reef Life Survey	2016	UVC-short	Cloates	Back reef	1500m2	
Reef Life Survey	2016	UVC-short	Maud	Back reef	7500m2	
Reef Life Survey	2016	UVC-short	Pelican	Back reef	1500m2	
Reef Life Survey	2017	UVC-short	Cloates	Back reef	1500m2	
Reef Life Survey	2017	UVC-short	Maud	Back reef	8000m2	
Reef Life Survey	2017	UVC-short	Pelican	Back reef	1500m2	

UWA	2014	BRUV	Cloates	Reef slope	1500min	McLean <i>et al.</i> , 2016
UWA	2014	BRUV	Cloates	Reef slope	1500min	
UWA	2014	BRUV	Lighthouse	Reef slope	1200min	
UWA	2014	BRUV	Lighthouse	Reef slope	1200min	
UWA	2014	BRUV	Mandu	Reef slope	960min	
UWA	2014	BRUV	Mandu	Reef slope	960min	
UWA	2014	BRUV	Osprey	Reef slope	900min	
UWA	2014	BRUV	Osprey	Reef slope	900min	
UWA	2014	BRUV	Pelican	Reef slope	1140min	
UWA	2014	BRUV	Pelican	Reef slope	1140min	
UWA	2014	BRUV	Winderabandi	Reef slope	1140min	
UWA	2014	BRUV	Winderabandi	Reef slope	1140min	
UWA	2015	BRUV	Cloates	Back reef	2400min	
UWA	2015	BRUV	Cloates	Back reef	2400min	
UWA	2015	BRUV	Mandu	Back reef	720min	
UWA	2015	BRUV	Mandu	Back reef	720min	
UWA	2015	BRUV	Mangrove	Back reef	720min	
UWA	2015	BRUV	Mangrove	Back reef	720min	
UWA	2015	BRUV	Osprey	Back reef	900min	
UWA	2015	BRUV	Osprey	Back reef	900min	
UWA	2015	BRUV	Pelican	Back reef	600min	
UWA	2015	BRUV	Pelican	Back reef	600min	
UWA	2015	BRUV	Winderabandi	Back reef	720min	
UWA	2015	BRUV	Winderabandi	Back reef	720min	
UWA	2015	BRUV	Cloates	Reef slope	1800min	
UWA	2015	BRUV	Cloates	Reef slope	1800min	
UWA	2015	BRUV	Mandu	Reef slope	1440min	
UWA	2015	BRUV	Mandu	Reef slope	1440min	
UWA	2015	BRUV	Osprey	Reef slope	840min	
UWA	2015	BRUV	Osprey	Reef slope	840min	
UWA	2015	BRUV	Pelican	Reef slope	1200min	
UWA	2015	BRUV	Pelican	Reef slope	1200min	
UWA	2015	BRUV	Winderabandi	Reef slope	660min	
UWA	2015	BRUV	Winderabandi	Reef slope	660min	

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Table S2. Summary data from 2021 timed-swim surveys

Month	Latitude	Longitude	Transect length (m)	Surveyed area (ha)	Number fish	Density (ind/ha)
February	-21.8578	113.981	903	1.8	0	0.0
February	-22.218	113.8331	789	1.6	0	0.0
February	-22.0093	113.9007	603	1.2	0	0.0
February	-22.0062	113.9017	598	1.2	1	0.8
February	-22.0031	113.9037	439	0.9	0	0.0
February	-21.9968	113.9063	545	1.1	2	1.8
February	-21.9732	113.9118	561	1.1	0	0.0
February	-21.9644	113.9126	660	1.3	0	0.0
February	-21.9588	113.9131	511	1.0	0	0.0
February	-21.9529	113.9144	388	0.8	0	0.0
February	-21.9465	113.9159	902	1.8	7	3.9
February	-21.8578	113.981	764	1.5	0	0.0
February	-21.8695	113.9718	818	1.6	0	0.0
February	-22.2478	113.8208	695	1.4	0	0.0
February	-22.2612	113.816	688	1.4	0	0.0
February	-22.2549	113.8182	627	1.3	0	0.0
February	-22.2283	113.827	838	1.7	0	0.0
February	-22.2104	113.8358	707	1.4	0	0.0
February	-22.0181	113.8976	609	1.2	0	0.0
February	-22.0263	113.8965	342	0.7	0	0.0
February	-22.037	113.8965	616	1.2	0	0.0
February	-21.9351	113.9187	848	1.7	35	20.6
February	-21.9247	113.9228	874	1.7	11	6.3
February	-21.9126	113.9284	839	1.7	43	25.6
February	-21.9052	113.9329	702	1.4	0	0.0
February	-22.0797	113.8829	810	1.6	0	0.0
February	-22.0696	113.8866	903	1.8	0	0.0
February	-22.0583	113.8886	744	1.5	0	0.0
February	-22.0515	113.8891	776	1.6	0	0.0
February	-21.9655	113.9176	660	1.3	0	0.0
February	-21.974	113.9184	582	1.2	0	0.0
May	-21.9151	113.9278	912	1.8	0	0.0
May	-22.1852	113.8455	618	1.2	0	0.0
May	-22.1751	113.8502	563	1.1	0	0.0
May	-22.1684	113.8528	685	1.4	0	0.0
May	-22.1486	113.8605	606	1.2	0	0.0
May	-21.9151	113.9278	743	1.5	0	0.0
May	-21.9222	113.9243	594	1.2	0	0.0
May	-21.9285	113.9217	912	1.8	1	0.5
May	-22.1051	113.873	668	1.3	0	0.0
May	-22.0948	113.8769	740	1.5	0	0.0

May	-22.082	113.8824	592	1.2	0	0.0
May	-22.0709	113.8871	724	1.4	0	0.0
May	-22.056	113.8895	614	1.2	0	0.0
May	-22.0404	113.8954	530	1.1	0	0.0
May	-22.0352	113.8966	466	0.9	0	0.0
May	-22.0276	113.8954	643	1.3	55	42.8
May	-22.0217	113.8979	545	1.1	0	0.0
TOTAL			31593	63.2	155	

Table S3. Reported sightings of *Bolbometapon muricatum* by expert witnesses between 2007 and 2020 at Ningaloo.

Year	Month	Day	Latitude	Longitude	Number_fish	Length (cm)	Depth (m)	Habitat
2020	-	-	-23.1654	113.7493	15	na	-	Reef slope
2020	-	-	-22.0255	113.8969	15	na	-	Reef slope
2020	10	8	-23.1358	113.7448	15	75	-	Reef slope
2020	9	20	-22.4992	113.6932	10	na	-	Reef flat
2020	10	5	-23.0445	113.7721	1	70	3	Reef flat
2020	9	-	-23.6395	113.6017	15	100	3	Reef slope
2020	2	-	-21.9519	113.9266	20	na	1	Reef flat
2020	9	8	-21.9968	113.9063	60	120	5	Reef slope
2020	5		-23.1729	113.9757	1	6 to 10	5	Lagoon
2020	5		-23.1729	113.9757	1	6 to 10	5	Lagoon
2019	11	-	-21.9519	113.9266	20	na	1	Reef flat
2019	5	-	-21.9974	113.9113	5	70	5	Reef slope
2018	-	-	-21.9778	113.9201	1	na	1	Reef flat
2018	8		-23.1729	113.9757	1	15	5	Lagoon
2017	-	-	-22.4992	113.6932	25	100	5	Reef slope
2016	-	-	-22.4992	113.6932	25	100	5	Reef slope
2016	5	-	-21.9678	113.9131	30	80	1	Reef slope
2015	-	-	-22.4992	113.6932	25	100	5	Reef slope
2015	2	-	-21.9519	113.9266	20	na	1	Reef flat
2014	-	-	-21.9628	113.9157	50	100	1	Reef flat
2011	6		-21.9105	113.9644	1	6	4	Lagoon
2008	-	-	-22.2394	113.8245	30	100	6	Reef slope
2008	2	-	-21.9974	113.9113	5	na	5	Reef slope
2007	11	-	-21.9678	113.9131	30	100	1	Reef slope
2007	11	-	-21.9628	113.9157	30	80	1	Reef slope
2007	-	-	-21.9105	113.9644	1	10	4	Lagoon
2007	-	-	-21.9519	113.9266	1	10	4	Lagoon

Table S4. Assessment of limiting factors on the distribution and abundance of *B. muricatum* at northern Ningaloo (Table adapted from Kobayashi et al. 2011)

Factor considered	Discussion	Plausible limiting factor
Settlement/recruitment	It remains unclear whether any shortages of juveniles at Ningaloo reflect shortages of egg/larval supply or is indicative of bottlenecks in older life history stages. Since recruitment limitation is commonly documented in other reef fish species, this is a plausible limiting factor for this species at northern Ningaloo	Plausible
Juvenile habitat	The juveniles of this species settle/recruit to shallow, low-energy, lagoonal areas within either seagrass, mangroves, or high relief coral formations. This specific habitat requirement is considered to be a plausible limiting factor to their distribution at northern Ningaloo	Plausible
Physical environmental constraints (temperature, salinity, oxygen, light, water clarity)	This species has a wide range and is found throughout the Indo-Pacific from the Red Sea and East Africa as far eastward as the Line Islands and Samoa. The southern extremity of its range in both the Indian and Pacific oceans is approximately 21 degrees south, approximately the same latitude of northern Ningaloo Reef. Extreme environmental conditions are therefore considered a plausible limiting factor for this species at northern Ningaloo	Plausible
Conspecifics	The species displays a relatively complex social behavior. It is possible that density-dependent effects could hinder initial population growth as has been shown in some reef fishes preferentially recruiting to areas with conspecifics.	Possible
Predators	The species is gregarious, grows to a large size, can maneuver adeptly around the benthos, and is likely difficult to prey upon once adult size and behavior are attained. The primary predators of adults would be large sharks, which occur in moderate to high abundance at northern Ningaloo.	Possible
Adult daytime habitat	The species has been shown to have a large home range or territory in the high-energy environment of the forereef and adjacent areas. Space on the reef crest does not seem to be a limiting factor at northern Ningaloo.	Unlikely
Adult sleeping habitat	This species sleeps at night in sheltered areas of the reef, either in caves or in some instances in deeper reef passages. Adequate passages and spur/groove habitat in deeper water is likely necessary for optimal survival while sleeping, all of which are present in habitats adjacent mangrove Bay at Ningaloo.	Unlikely
Adult food	The species is a facultative corallivore and has been observed feeding on algae, sponges, and other benthic organisms. It is unlikely that food is a limiting factor.	Unlikely