

## Wetland bird monitoring at the Avon-Heathcote Estuary and Bromley Oxidation Ponds, Christchurch: August 2009 to July 2010

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**Abstract** Monitoring of wetland birds was undertaken at the Avon-Heathcote Estuary and Bromley Oxidation Ponds between Aug 2009 and Jul 2010. Monthly totals exceeded 20,000 birds from Dec to Apr, with the highest count (36,637) recorded in Jan 2010. A total of 38 wetland bird species were recorded and 12 of these exceeded 1000+ individuals during at least 1 month of the study period. The 5 most abundant species were New Zealand shoveler (*Anas rhynchos*; maximum 7046), grey teal (*Anas gracilis*; 5881), New Zealand scaup (*Aythya novaeseelandiae*; 5739), red-billed gull (*Larus novaehollandiae*; 5000+) and South Island pied oystercatcher (*Haematopus finschii*; 4844). Ten species were recorded in numbers that met or exceeded the 1% Ramsar international significance criterion: pied cormorant (*Phalacrocorax varius varius*), paradise shelduck (*Tadorna variegata*), grey teal, New Zealand shoveler, New Zealand scaup, South Island pied oystercatcher, variable oystercatcher (*Haematopus unicolor*), eastern bar-tailed godwit (*Limosa lapponica baueri*), black-billed gull (*Larus bulleri*) and Caspian tern (*Hydroprogne caspia*).

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### INTRODUCTION

The Avon-Heathcote Estuary/Ihutai (43° 32'30" S, 172° 43'30" E) is located on the eastern fringes of Christchurch City, in central Canterbury, New Zealand. The site is separated from the Pacific Ocean by a 4.5 km long sand spit and comprises c. 880 ha of inter-tidal flats and peripheral salt marsh (Fig.1). The estuary is roughly triangular in shape and fed by 3 small rivers (Avon River, Heathcote River and Linwood Avenue Canal) which collectively drain a largely urbanised catchment of 188 km<sup>2</sup>. Tides are semi-diurnal with a range of 2.1 m for spring tides and 1.1 m for neap tides. The average water exchange per tide is 11 million m<sup>3</sup> with an average

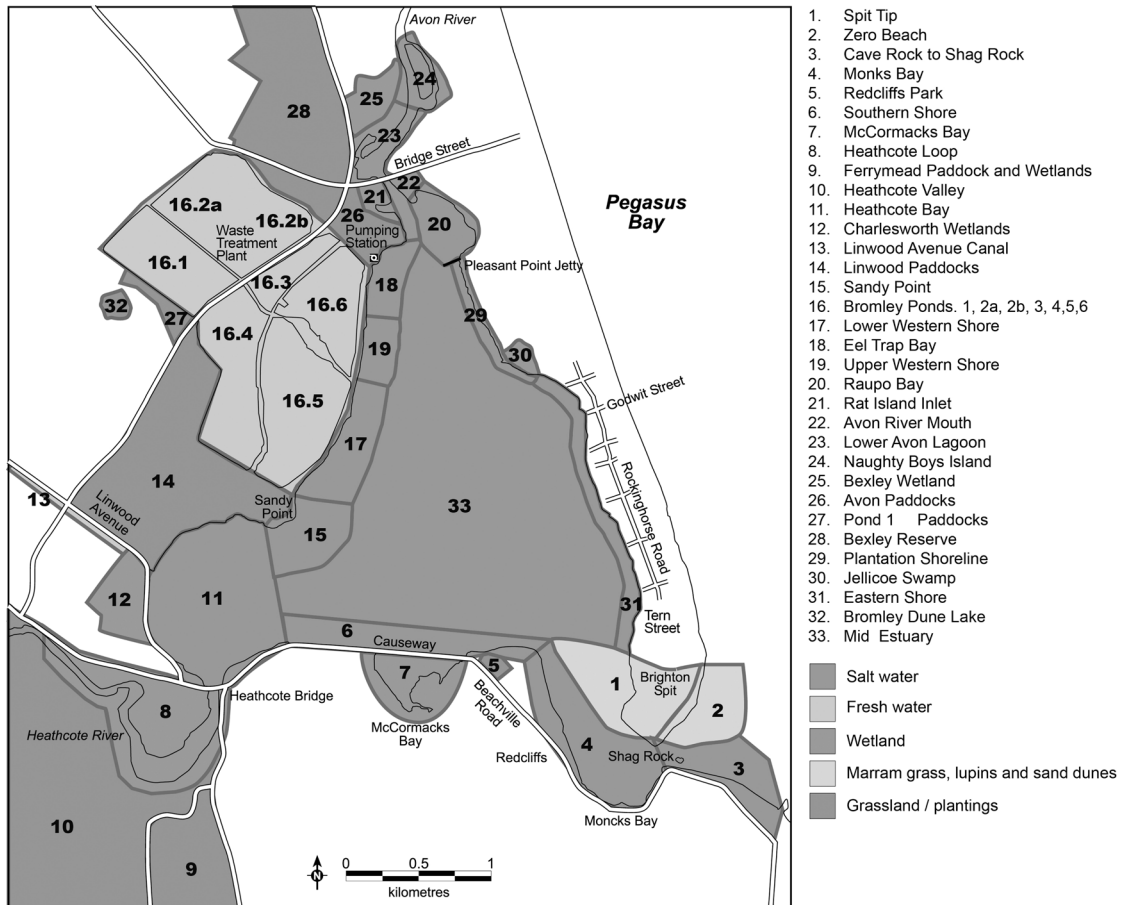
flooding depth of 1.4 m (Crossland 1993; Cromarty & Scott 1996).

In addition to extensive areas of mudflat and peripheral salt marsh, the greater Avon-Heathcote area also includes the c. 275 ha Bromley Oxidation Ponds/Te Huingi Manu Wildlife Refuge, c.100 ha of lowland wet grassland (Linwood Paddocks), and a combined area of c. 40 ha of human-created tidal wetlands located around the margins of the estuary (Charlesworth, Bexley and Ferrymead wetland reserves, respectively). In total, c. 1300 ha of habitat is available for wetland birds and at peak times these combined habitats support upwards of 30,000 birds (Crossland 1992, 1993, 2010).

For more than 100 years treated effluent from the Bromley sewage works was discharged into the Avon-Heathcote Estuary (Owen 1992). In 2009-10

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**Fig. 1.** Map of Avon-Heathcote Estuary, Bromley Oxidation Ponds and environs showing survey sectors used in this study.

this discharge was at an average rate of 172,000,000 litres/day (M. Bourke, CCC, *pers. comm.*). Effluent inflow into the estuary ceased (with the exception of emergency overflows) on 1 Mar 2010 with the completion of an ocean-outfall pipeline which by-passes the estuary and conveys effluent to a discharge point 3 km offshore. To measure responses in the estuary ecosystem as it recovers from decades of high nutrient loadings, a range of environmental research programmes were commissioned by the Christchurch City Council (CCC), Environment Canterbury (ECAN), National Institute of Water and Atmospheric research (NIWA), the Avon-Heathcote Estuary Ihutai Trust and the University of Canterbury. This paper presents findings from a 12 month wetland bird census programme undertaken by the Regional Parks Team, Christchurch City Council.

Wetland bird populations on the Avon-Heathcote Estuary and Bromley Oxidation Ponds have been the focus of monitoring efforts since the

mid 1980s (Harris & Crossland 1990; Crossland 1993, 1999, 2005, 2009a, 2010). Population monitoring has included regular counts of waders, terns, spoonbills, rails and waterfowl, with irregular counts of gulls, herons, cormorants, kingfishers, swallows and birds of prey. Findings have been summarised in Crossland (1992, 1993, 1999, 2010). Prior to the cessation of effluent discharge, the only period when seasonal abundance data for all wetland bird guilds were gathered for a 12 month period was from Oct 1989 to Sep 1990 (Crossland 2010). By 2009 these data were 20 years old and local populations of some species, such as pied cormorant, royal spoonbill (*Platalea regia*), paradise shelduck, New Zealand scaup, grey teal, pukeko (*Porphyrio melanotus melanotus*), Australian coot (*Fulica atra australis*), variable oystercatcher (*Haematopus unicolor*) and Caspian tern were known to have changed to such a degree that the 1989-90 data could not be used as a baseline. As a consequence, a new set of monthly counts were commissioned. These were undertaken

between Aug 2009 and Jul 2010, and although they straddle the period when effluent discharge into the estuary ceased (Mar 2010), the lag period for ecological changes to take effect mean that these counts were considered a baseline record of bird population levels prior to the effluent discharge cessation.

## METHODS

Counts ( $n = 12$ ) of all wetland birds (except New Zealand Kingfisher, *Halycon sancta*) were carried out at monthly intervals between Aug 2009 and Jul 2010. Counts generally took place between the 20th and 30th day of each month. Each "count" required 2-4 tidal cycles over 2-3 days to complete, with a different set of species targeted on each tidal cycle. This enabled a focus on each species group at the time of day or tide when the highest numbers of individuals were present and/or concentrated in a way that enabled the most accurate census. Species were counted in the following groups: waders and terns (over 1 high-tide); gulls (a mid-tide count of flocks assembling at night roosts made shortly before sunset); large waterfowl (a high-tide count); small waterfowl, coot and swallows (a high-tide count on a different tidal cycle to large waterfowl); herons and spoonbills (a mid-tide count); pukeko and harrier (a low-tide count) and cormorants (a dusk night roost count). All wetland bird species were counted in each of the 12 months, except cormorants (which were counted only during the post-breeding peak period of Jan-Mar) and gulls (counted only from Jan-Jul). This omission of year-round cormorant and gull counts was due to the logistical difficulty in counting these species groups at dusk. New Zealand kingfisher was excluded from the study due to the wide distribution of this species at all times of day and stages of tide.

All counts were made by the author, occasionally with the assistance of a second experienced observer. Equipment comprised 10 x 42 binoculars and 20-60 x 80 spotting scope. Census techniques followed those outlined in Howes & Bakewell (1989) in that scans were made of roosting, rafting or feeding congregations of birds and involved counting individuals wherever possible with block counting in multiples of 10 if large concentrations exceeded 2000 in size. Large totals in table 1 are derived from the sum of multiple "sector" counts (such as various parts of the oxidation ponds or the various high tide wader roosts around the estuary shoreline). The study area was divided into 33 sectors (with the oxidation ponds divided further into 7 sub-sectors) and each was counted as a discrete unit as shown in Fig. 1. The logistical challenge of undertaking an accurate census of the Avon-Heathcote's large bird population was made

easier by the ability of survey personnel to access all parts of the estuary shoreline, oxidation ponds, farm paddocks and adjacent habitats at any time of day or evening. In addition, this study followed 25 years of site monitoring, which had included more than 250 previous shorebird counts and over 100 previous waterfowl counts (AC/CCC, *unpubl. data*). All previous monitoring work had used the same 33 count sectors as used in the 2009-2010 study. Census methods and search effort were therefore comparable across months and years.

## RESULTS AND DISCUSSION

### Species richness and abundance

In total, 38 wetland bird species were recorded during the 2009-2010 study period, comprising 5 cormorants, 1 heron, 1 spoonbill, 1 ibis, 10 waterfowl, 2 rails, 9 waders, 1 skua, 3 gulls, 3 terns, 1 swallow and 1 raptor (Table 1). The highest counts were in late summer/autumn with *c.* 36,637 birds in Jan 2010, followed by 34,292 birds in Feb 2010 and 31,743 birds in Mar 2010. More than 20,000 wetland birds were present during each of the 5 months from Dec to Apr. This is the annual peak period when the area supports a considerable influx as part of the moulting, post-breeding flocking and migration strategies of many bird species (Crossland 1993, 2010). Lowest numbers occurred in Sep 2009 which coincides with many native species being away on inland breeding grounds and is immediately prior to the arrival of migratory bar-tailed godwits. The 7871 total recorded in Sep 2009 excludes cormorants and gulls. Based on counts in other years (*unpubl. data*), Sep estimates for gulls (3000+) and cormorants (400+) would give an estimated annual low population of *c.* 11,000 – 12,000 wetland birds.

Twelve species were recorded with populations exceeding 1000 individuals in at least 1 month of the survey period. These included New Zealand shoveler (7046), grey teal (5881), New Zealand scaup (5739), South Island pied oystercatcher (4844), paradise shelduck (3092), Canada goose (*Branta canadensis*; 2871), mallard/grey duck hybrid (*Anas platyrhynchos x A. superciliosa*; 2617), black-backed gull (*Larus dominicanus*; 2344), bar-tailed godwit (2110) and black swan (*Cygnus atratus*; 1104). In addition, both red-billed gull and black-billed gull (with a combined peak count of 6214) had peak populations estimated at 5000+ and 1000+, respectively. Another 8 species were recorded with numbers exceeding 100 individuals in at least 1 month: pukeko (881), pied cormorant (427), white-fronted tern (*Sterna striata*; 319), pied stilt (*Himantopus h. leucocephalus*; 312), little cormorant (*Phalacrocorax melanoleucus brevirostris*; 142), spur-winged plover (*Vanellus miles novaehollandiae*; 116), variable oystercatcher (109) and

**Table 1.** Monthly counts of wetland birds at the Avon-Heathcote Estuary, Bromley Oxidation Ponds and environs, Christchurch, Aug 2009 – Jul 2010. Totals for Jan-Feb cover all species: totals for other months exclude cormorants and gulls.

Species	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Black cormorant						93	76	65				
Pied cormorant						427	385	366				
Little cormorant						142	78	81				
Little black cormorant						10	10	10				
Spotted shag						16	5	12				
White-faced heron	42	34	42	50	51	72	85	73	71	77	47	49
Royal spoonbill	21	20	91	17	18	15	63	102	70	29	16	24
Glossy ibis	0	0	0	0	0	0	1	0	0	0	0	0
Black swan	983	818	464	642	612	807	932	1104	810	676	475	785
Canada goose	2540	989	332	815	2871	1623	1826	836	1365	1326	2022	1589
Greylag (feral) goose	14	7	12	13	6	8	13	11	14	7	12	14
Paradise shelduck	264	128	139	301	1305	3092	1498	709	447	332	591	432
Mallard/grey/hybrid	560	350	338	503	1221	2617	1289	1262	894	732	651	650
New Zealand shoveler	83	96	424	4601	5347	7046	3337	2215	1743	1205	264	378
Chestnut teal	0	0	0	0	0	0	0	1	0	0	0	0
Grey teal	921	1126	1896	2581	3340	4420	5881	5662	4450	528	324	301
New Zealand scaup	3770	2594	5739	4335	4734	4718	4062	4763	3020	2844	3928	4105
Pukeko	693	368	245	225	161	264	234	414	546	821	804	881
Australian coot	23	18	14	5	10	4	11	10	8	5	13	16
Variable oystercatcher	98	62	73	51	63	49	55	96	102	109	99	99
S.I. pied oystercatcher	675	758	701	944	1927	4022	4844	4128	3706	3074	2034	1194
Pied stilt	124	95	77	88	199	225	312	256	80	69	98	66
Spur-winged plover	75	58	34	74	93	76	116	110	60	68	92	73
Banded dotterel	10	3	0	0	10	57	66	81	85	86	55	23
Asiatic whimbrel	0	1	0	0	0	0	0	0	0	0	0	0
Bar-tailed godwit	268	190	1937	2078	2110	1826	2080	558	309	362	410	380
Ruddy turnstone	0	0	0	1	0	1	0	0	0	0	0	0
Red knot	0	2	0	0	0	0	0	1	0	0	0	0
Arctic skua	0	0	0	2	1	0	2	1	1	0	0	0
Black-backed gull						1070	1720	2094	2344	163	1392	1085
Red/black-billed gulls						3670	4768	6214	4641	1468	2793	3172
Caspian tern	6	5	11	13	12	40	62	54	43	8	9	3
White-fronted tern	4	127	42	12	15	202	319	228	295	0	8	2
Black-fronted tern	0	0	0	0	1	1	1	21	21	1	1	0
Welcome swallow	12	15	6	2	2	12	150	191	260	335	180	322
Australasian harrier	6	7	6	7	7	12	11	14	12	9	6	8
<b>Total</b>	<b>11,192</b>	<b>7871</b>	<b>12,623</b>	<b>17,360</b>	<b>24,116</b>	<b>36,637</b>	<b>34,292</b>	<b>31,743</b>	<b>25,397</b>	<b>14,334</b>	<b>16,324</b>	<b>15,651</b>

royal spoonbill (*Platalea regia*; 102). Three additional species had peak counts slightly under 100 during the 2009-2010 study but in other years each of these has regularly exceeded 100 in number: black cormorant (*Phalacrocorax carbo novaehollandiae*; 93), banded dotterel (*Charadrius b. bicinctus*; 86), and white-faced heron (*Egretta novaehollandiae*; 85)(Crossland 1993, 2009a).

Notable uncommon species recorded on the survey were glossy ibis (1 in Feb 2010), chestnut teal (*Anas castanea*; 1 in Mar 2010), Asiatic whimbrel (*Numenius phaeopus variegatus*; 1 in Sep 2009) and Arctic skua (*Stercorarius parasiticus*; 1-2 in most months from Nov 2009 – Apr 2010). Unusual bird reports submitted for the glossy ibis and chestnut teal were accepted by the OSNZ Records Appraisal Committee (Miskelly *et al.* 2011; Miskelly, *in press*).

### Seasonality

The 2009-2010 baseline data provide insight into the patterns of seasonal abundance of wetland bird species using the Avon-Heathcote Estuary and Bromley Oxidation Ponds. The main species groups, other than gulls and cormorants (for which insufficient monthly data are available) are discussed below.

#### Waterfowl

Waterfowl were abundant on the Avon-Heathcote Estuary and Bromley Oxidation Ponds during this survey. The core populations of all waterfowl species were located on the permanent waterbodies of the oxidation ponds but movement was frequently observed between these ponds and the estuarine mudflats, coastal fields, tidal wetlands and nearby freshwater habitats. The abundance of all species other than black swan was highly seasonal, with peak numbers occurring mainly during the post-breeding flocking/moulting period (Dec – Apr). New Zealand scaup were the only waterfowl species to breed in large numbers at the Bromley Oxidation Ponds (300+ pairs) and numbers remain elevated through their long breeding season (Sep – Mar). Black swan numbers were not seasonal and instead fluctuated as birds responded to water levels at Lake Ellesmere, 24 km SSW of the Avon-Heathcote Estuary (Crossland 1993). If water levels at Ellesmere are either excessively high, or excessively low, feeding conditions deteriorate and large numbers of black swan shift to the more stable feeding environment of the Avon-Heathcote (Crossland 1993).

The 2009-2010 data confirm 25+ years of observations that the duck-shooting season (May-June) does not trigger an influx of waterfowl to the estuary and oxidation ponds (Crossland 1993, 2005). Numbers of all species other than Canada goose declined through late autumn and winter

as post-breeding flocks break up and by Jul, many “wintering” birds were probably dispersing back to their breeding areas. Canada geese remain in flocks longer than most species, breaking up in late Aug when breeders move inland. There are 2 influxes of Canada geese at the Avon-Heathcote – the first occurs in Nov-Dec when immatures and non-breeders arrive to moult; the second starts in Apr when adults and young-of-the-year migrate to coastal wetlands from their high country breeding grounds (Crossland 1993). The dips recorded in Mar and Jul 2010 can be attributed to goose population control operations conducted on farmland adjacent to the Avon-Heathcote Estuary (*pers. obs.*).

#### Pukeko and coot

Pukeko abundance is highly seasonal, with lowest numbers recorded during the local breeding season (Sep – Feb), followed by a substantial influx and large autumn-winter flocks. Australasian coot numbers fluctuate from month to month with highest numbers recorded in winter and spring (Jun – Oct).

#### Waders

All native waders have a similar pattern of seasonal abundance with lowest numbers present during the breeding season (Aug – Nov) and peak numbers recorded during the post-breeding flocking and northward migration periods (Dec – May). South Island pied oystercatcher, pied stilt and spur-winged plover all reached highest numbers in Feb which coincides with the period when most inland-breeding waders have moved to coastal habitats and many species are transiting through the Avon-Heathcote on migration to regions further north (Crossland 1993; Dowding & Moore 2006). Banded dotterels form a post-breeding flock on the estuary which peaked in May during the study period. Variable oystercatchers do not breed on the estuary but a large proportion of the Canterbury regional population congregates there in autumn/winter, usually peaking in May or Jun (Crossland 2001). Wrybill were not recorded during 2009-2010 but most years small numbers of this species over-winter. Migratory bar-tailed godwits arrive on the Avon-Heathcote Estuary from late Sep and depart during Mar (Crossland 2009b). Numbers in 2009 – 2010 peaked in Dec. Other migratory waders recorded were Asiatic whimbrel, ruddy turnstone (*Arenaria interpres*) and red knot (*Calidris canutus rogersi*), but all of these species were observed in very low numbers.

#### Terns

No tern species breed at the Avon-Heathcote Estuary but white-fronted terns nest colonially at Sumner Head and Godley Head, 2.3 km and 4.5 km east of the Avon-Heathcote Estuary mouth, respectively. Consequently, white-fronted terns have a period of increased abundance during the breeding season

**Table 2.** Species or sub-species of waterbird for which the Avon-Heathcote Estuary and Bromley Oxidation Ponds meet the current Wetlands International/Ramsar 1% population threshold in 2009-2010.

Species	Population	1% threshold 2009-10 maximum	Avon-Heathcote Estuary	Percent of population
Pied cormorant	New Zealand	250	427	1.7
Paradise shelduck	New Zealand	1700	3092	1.8
Grey teal	New Zealand	1000	5881	3.0
New Zealand shoveler	New Zealand	1000	7046	5.8
New Zealand scaup	New Zealand	200*	5749	28.7
S.I. pied oystercatcher	New Zealand	1100	4844	4.4
Variable oystercatcher	Australia/NZ/Alaska	40	109	2.7
Eastern bar-tailed godwit	New Zealand	1600	2110	1.3
Black-billed gull	New Zealand	960	1000+	1.0
Caspian tern	New Zealand	50	62	1.2

\* The New Zealand scaup population estimate of 20,000 given by Heather & Robertson (1996) is followed here as it is more realistic than the estimate of 5000-10,000 proposed by Delaney & Scott (2006).

(Sep – Oct) as they visit from the breeding colonies, followed by a peak during the post-breeding flocking period (Jan – Apr). Black-fronted tern (*Chlidonias albobriatus*) is a non-breeding visitor to the estuary and oxidation ponds with peak numbers in autumn (Mar – Apr). Most Caspian terns occurring on the Avon-Heathcote Estuary come from the Southland breeding population and the estuary is an important wintering site for these birds (Crossland 1992; Barlow 1998). Although non-breeding birds are present during spring and early summer, the main post-breeding influx starts in Jan with peak numbers through until Apr.

#### Welcome swallow

Welcome swallow numbers are highly seasonal with large flocks present during the post-breeding period and winter (Feb – Jul). A northward migratory movement is evident during autumn (Crossland 1992).

#### Australasian harrier

Although resident on farmland, the oxidation ponds and wetland fringes of the estuary, a marked influx of Australasian harrier, particularly juveniles, occurs in late summer-autumn (Jan – Apr).

### National and International significance of waterbird populations

Data from this study indicate that during 2009-2010 the Avon-Heathcote Estuary area supported concentrations of at least 10 wetland bird species that met 1% international importance thresholds as determined by Wetlands International (Delaney & Scott 2006; Li *et al.* (2009). These species comprise pied cormorant, paradise shelduck, grey teal, New Zealand shoveler, New Zealand scaup, South Island

pied oystercatcher, variable oystercatcher, bar-tailed godwit, black-billed gull and Caspian tern (Table 2). In addition, in other years at least 3 other species (black cormorant, white heron and black-fronted tern) have met 1% international importance thresholds (Crossland 2009a, 2010).

The Avon-Heathcote area has been identified as a nationally significant site for 1 or more species of wetland bird by Crossland (1993; 2009a; 2010); Cromarty & Scott (1996); Sagar *et al.* (1999); Dowding & Moore (2006); Melville & Battley (2006); Southey (2009) and Li *et al.* (2009). As yet, no formal recognition of the area's national and international importance to birdlife has occurred, but local level recognition has included the gazetting of wildlife refuge status over the Bromley Oxidation Ponds, the establishment of local nature reserves at high tide roost sites and salt marshes, and identification of the estuary and oxidation ponds as an important biodiversity site in the Christchurch City Council Biodiversity Strategy (Anon 2008).

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