TROPICAL DEPRESSIONS AND CYCLONES IN THE NORTH WESTERN AUSTRALIAN REGION DURING THE 1959-60 SEASON

by the Forecasting Section,

Divisional Office, Perth

(Manuscript received March 1961)

Abstract: During the 1959-60 cyclone season in the North-western Australian region, there were a number of occasions initially favourable to cyclo-genesis, but only four cyclones were known to develop.

Of these, the first two operated in West Australian waters, the third over the Indian Ocean in the vicinity of Cocos Island, and the fourth passed from either the Banda Sea or the Arafura Sea into the Timor Sea.

The depressions are classified into three types according to the diameter of the area affected by winds of gale force. The depressions are listed and catalogued. The season is briefly discussed as a whole and finally each depression is discussed in detail under the headings of development, track, rainfall, winds, seas and damage.

1. INTRODUCTION

The tropical disturbances are classified as follows:

Class 1: Major cyclones with gale winds extending over 100 miles from the centre.

Class 2: Cyclones with gales not extending more than 100 miles from the centre.

Class 3: Tropical depressions with central winds of less than 34 kt.

Maps showing the tracks of the storms have been prepared, giving the positions at stated hours and the central pressure in millibars. The Greenwich date and hour are also shown in the form YYGG.
The catalogue identification code is as follows:

\[
\text{NNTY} \quad \text{YY} \quad \text{Y}_{1122} \quad \text{QLLLL} \quad \text{PPYYGG} \quad \text{QLLLL} \quad \text{PPYYGG} \quad \ldots
\]

where

- \( NN \) = identification number of disturbance
- \( T \) = class of disturbance
- \( Y \_Y \) = year (tens and units)
- \( Y \_Y \_1 \) = Greenwich date of first location
- \( Y \_Y \_2 \) = Greenwich date of last location
- \( Q \) = octant of the globe
- \( L \_L \_a \) = latitude (tens and units)
- \( L \_L \_o \) = longitude (tens and units)
- \( PP \) = central pressure (tens and units of mb)
- \( YY \) = Greenwich date
- \( GG \) = Greenwich hour

2. IDENTIFICATION LIST OF TROPICAL DISTURBANCES, 1959-60 SEASON

<table>
<thead>
<tr>
<th>No.</th>
<th>Class</th>
<th>Date</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>22nd to 29th January</td>
<td>Northwest coast of Western Australia</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>20th to 28th March</td>
<td>Across northern Australia to off west coast of Western Australia</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>4th to 8th April</td>
<td>Indian Ocean near Cocos Is.</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>21st to 27th April</td>
<td>Timor Sea</td>
</tr>
</tbody>
</table>

The catalogue identifications are given at the commencement of the detailed discussions of the individual depressions.
3. THE 1959-1960 CYCLONE SEASON

Although the four cyclones are listed as Class 1 associated with winds exceeding 33 knots extending over 100 miles from the centre, only the second cyclone assumed truly major proportions.

The first cyclone of the season operated off the northwest coast of Western Australia during the last week in January 1960.

The system was born at the expense of a number of circulations which existed in a vast area of low pressure, and was first identified on 22nd January some 200 miles to the north of Broome.

Initially it moved slowly to the northeast, but then recurved to the southwest, approaching closest to the coast in the vicinity of Cape Leveque, where the pressure fell to 989 mb and the wind increased to 55 knots during that day. The system then moved rapidly to the southwest along a preferred track almost parallel to the northwest coast until it became stationary to the north of Onslow on the 27th and commenced to fill.

When the cyclone lost its identity as such, a number of circulations became apparent again and these caused heavy rains and flooding over vast areas of the northern half of the State during the next fortnight. In the Gascoyne, large areas of country were submerged, rendering roads and airports unserviceable, and isolating homesteads and outcamps. When the torrential waters of the Gascoyne River reached Carnarvon at its mouth, half of the town was flooded and the remainder endangered, a youth was drowned and vehicles were swept out to sea.

Although favourable periods of tropical activity followed this system, it was not until two months later that another cyclone was operating in the region.

On 18th March a low pressure circulation in the Coral Sea intensified and produced a small core of cyclonic proportions near the north coast of Queensland on the 20th. This moved rapidly over the northern parts of Australia and on the 23rd gained the Timor Sea where it commenced to deepen and accelerate to the southwest, again moving almost parallel to the Kimberley and northwest coasts of Western Australia. As the cyclone moved along this preferred track, winds along the coast increased to gale force and seas became rough to high. On the 26th the cyclone was in the vicinity of Northwest Cape, where it recurved to the south and assumed major proportions, deepening very rapidly as it accelerated southwards just off the coast. At midnight on the 26th the fully matured cyclone reached Carnarvon, where the full force of the cyclonic winds caused damage estimated at half a
million pounds. In the township, lightly built structures were
demolished and the more substantial buildings suffered extensive super-
ficial damage, while the surrounding banana plantations and bean farms
were completely destroyed.

The cyclone then commenced to weaken and accelerate further as
it moved southwards just off the coast, but gales and rough seas were
experienced in its vicinity until midnight on the 27th, when the system
was centred just south of Cape Leeuwin and the strong to gale force winds
had contracted to the ocean areas to the west. The system then recurved
to the southeast and as a rapidly deepening depression moved into the
Southern Ocean.

A week later, on 4th April, the third system became evident in
the Indian Ocean to the east of Cocos Island. Little is known of the
 genesis or development of this system, which was detected and classified
by reports from Cocos Island and from the ship "Tonan Maru".

The feature of this system was the heavy rains in the western
sectors. During the four days the cyclone was operating to the east,
Cocos Island recorded some 13 inches of rain, over 9 inches of this
being registered during 15 hours on the 15th, when the intensity exceeded
an inch per hour for three hours.

The movement and development of this system were probably
influenced by another cyclone operating at the time over the central
tropical Indian Ocean and moving to the southeast down a trough of low
pressure to become an intense extra-tropical depression to the north-
east of Amsterdam Island by the 7th.

A fortnight later, the fourth and last known cyclone was
operating in the Timor Sea.

This system was located by a report from the ship "Straat
Johore" in the Arafura Sea on the morning of 21st April. Apparently,
at the time, the cyclone had passed maturity and was weakening rapidly
as it passed southwestwards into the Timor Sea to lose identity on
27th April.

Although nothing is known of its genesis, or development
before the 21st April, its presence must have been recorded either
elsewhere in the Arafura Sea or in the Banda Sea, prior to this date.

Probably the last two cyclones of the season would have
escaped detection without the aid of reports from shipping and, once
again, it is believed that there are many more storms over the vast
and lonely expanses of tropical waters than are located and identified.
DEPRESSION NO. 1, CLASS 1
OFF THE NORTHWEST COAST OF WESTERN AUSTRALIA

01160  22291  71424  002201  71325  982301  71523  922401  71819  882501
71914  882601  71913  882701  71913  902801  72014  952901

Development:

A vast area of low pressure existed off the northwest coast of Western Australia on 19th January 1960, when two centres of circulation became evident, one to the southeast of Christmas Island, the other approximately 200 miles to the north of Broome. On the following day two further centres developed in the area, one in the vicinity of Onalow and the other north of Wyndham. However, during the day three of the centres lost identity and by the morning of 22nd January the only definite circulation was that to the north of Broome and this developed into a major cyclone, the first of the 1959-60 season.

The cyclone was centred over the ocean during its life of eight days, approaching closest to the coast on the 24th in the vicinity of Cape Leveque, where the pressure fell to 989 mb and the wind speed increased to 55 knots during that afternoon.

The cyclone then continued moving rapidly to the southwest, almost parallel to the northwest coast, for two days, when it became stationary and commenced to fill.

On the 29th of the month the system subsided, but once again a number of circulations became apparent as rain-bearing systems, causing heavy rains over vast areas of the northern half of Western Australia during the following fortnight. One of these rain-bearing depressions, probably the degenerate cyclone, moved down a trough of low pressure into the Gascoyne, bringing very heavy rains over the catchment areas of the Gascoyne and Lyons Rivers early in February 1960, causing one of the worst floods ever experienced in Carnarvon.

Track and its features:

As the system assumed identity on 22nd January 1960, it commenced to move very slowly to the northeast, but by the 23rd curvature had occurred, with the system then accelerating to the southwest almost parallel to the northwest coast of Western Australia. This continued until the 26th, when the system became stationary for several days and commenced to fill. On the 28th the system moved again, recurving to the
southeast as it gradually lost identity as a cyclone and assumed that of a rain-bearing depression, which then travelled slowly southwards into the Gascoyne districts of Western Australia.

A feature of the track was the initial movement to the north-east, a movement frequently observed in a system which is filling but seldom in one which is developing. The sparse surface reports and almost complete lack of upper air data made a definite analysis impossible. It can only be assumed that the initial movement was influenced by the circulation in the vicinity of Onslow providing a temporary westerly steering, which died rapidly after the surface circulation lost its identity.

The lack of data also made it impossible to determine why one particular circulation should develop at the expense of a number of other circulations in the area. This is most unfortunate, as this would probably provide some definite knowledge of the promotion of cyclogenesis in general.

Rain:

As the cyclone subsided into a number of rain-bearing depressions, heavy falls were experienced over vast areas of the northern half of the State during the following fortnight. During this period, Derby received nearly 22 inches of rain and places as widespread as Kalumburu, La Grange, Port Hedland, Roebourne, Whim Creek, Wittenoom Gorge, Mundiwindi, Meekatharra and Cue received from nearly 10 inches to 15 inches over the same period, with the intensity at Roebourne nearly 9 inches over a 24 hour period.

The heavy rains over the inland Gascoyne caused one of the severest floods ever experienced in Carnarvon.

Winds, seas and damage:

As the system remained centred over the ocean during its life as a cyclone, no damage from winds was reported. The highest velocity reported was 55 knots at Cape Leveque when the cyclone was at its closest point to the coast.

The most severe damage was caused by flood waters in the Gascoyne, where large areas of the country were submerged, isolating homesteads and outcamps, and rendering roads and airports unserviceable. When the swollen Gascoyne River reached Carnarvon, situated at its mouth, nearly half of the town was flooded and the remainder endangered, vehicles were swept out to sea and one youth was drowned in the swirling waters.
TROPICAL DEPRESSION NO. 2, CLASS 1

CAPE YORK, GULF OF CARPENTARIA, NORTHERN TERRITORY,

WESTERN AUSTRALIA

02160  20283  71244  042001  71240  072101  71334  032201  71229  012301
71523  862401  71718  862501  72114  852601  72513  602616
72914  802701  73215  902706  73515  002716  73820  022801

Development:

During the period after the first week in March 1960, a number of low pressure circulations were apparent over a wide area of tropical land and ocean areas, and although some heavy rains occurred, particularly in the North and East Kimberley districts of Western Australia with an intensity of over 11 inches in 24 hours at Turkey Creek and of over 5 inches in 24 hours at Kalumburu, there was no marked cyclonic development until the 18th of the month. On this day a low pressure circulation in the Coral Sea commenced to intensify, producing a small core of cyclonic proportions just off the north Queensland coast on the 20th. This system moved rapidly westwards over the Cape York Peninsula, passing just north of Iron Range into the Gulf of Carpentaria, where, contrary to accepted practice, it commenced to fill as it moved across the Gulf and into the Northern Territory. Over land once more, the movement accelerated and, again contrary to accepted practice, commenced to deepen a second time, passing south of Darwin and gaining the Timor Sea by the 23rd. Over the ocean again, the system accelerated to the southwest, deepening in its travel, and by the afternoon of the 23rd was in the vicinity of Troughton Island, where the pressure fell to 989 mb and the wind speed increased to 60 knots, with very rough seas.

During the 24th and 25th, the cyclone continued moving to the southwest along a preferred track almost parallel to the coast, where wind speeds were increasing to gale force, accompanied by rough to high seas. By the 26th the cyclone was off Northwest Cape, where the pressure had fallen to 995 mb, with easterly winds increasing to 60 knots, accompanied by high seas and heavy northerly swell.

At this stage the cyclone curved to the south and assumed major proportions, deepening very rapidly with gale force winds expanding over a wider area as it accelerated southwards just off the coast. By midnight on the 26th the cyclone was off Carnarvon, where the pressure fell to 966 mb and winds from the eastnortheast were gusting to 96 knots. As the centre passed just west of the town, winds decreased
very rapidly, but in less than an hour had strengthened from the north-west to gusts of 65 knots. The cyclone then commenced to weaken as it accelerated to over 30 knots in its movement southwards and was just off the coast at Geraldton by 9 a.m. on the 27th, with a central pressure of 980 mb and a maximum wind gust at Geraldton of 53 knots from the north-west. Still weakening, and accelerating to over 60 knots, the cyclone continued its path off the coast and by 2 p.m. was in the vicinity of Perth, with a central pressure of 990 mb and a maximum wind gust at Perth of 62 knots from the north. By midnight on the 27th, the system was centred just south of Cape Leeuwin and the central pressure had weakened to 1000 mb, while strong to gale force winds had contracted to ocean areas to the west. The system then recurved to the southeast and as a rapidly deepening extra-tropical depression moved into the Southern Ocean, arriving in the Macquarie Island region by the end of the month.

It is difficult to account for the major development off Northwest Cape and with the sparse upper air network in the region it can only be assumed that a strong positive divergence developed in the upper levels and then rapidly diminished as the cyclone accelerated down the lower west coast.

Track and its features:

The track of this system was remarkable in that it passed over alternate water and land areas in a westerly direction for approximately 1000 miles, then travelled south-westwards and later southwards over some 2000 miles of ocean into temperate latitudes before losing its tropical identity.

The system moved from the Coral Sea over 100 miles of land and then over 350 miles of Gulf waters into the Northern Territory. After some 350 miles of travel over land it gained the Timor Sea and curved to the southwest along a preferred track almost parallel to the northwest coast of Western Australia to Northwest Cape, where it recurved to the south and accelerated down the west coast of Western Australia, the centre remaining just off the coast. Off Cape Leeuwin the system had lost its identity as a cyclone, but after recurving to the southeast quickly regained intensity, reaching the Macquarie Island region as a very deep depression.

The long travel off the entire coastline of Western Australia was remarkable, as recurvature inland usually occurs either along the northwest coast or along the upper west coast. On the few occasions on which a cyclone has travelled to off the lower west coast, passage inland has occurred not far south of Perth, and this is the only recorded occasion on which such a system has passed around the southwest corner of Western Australia.
Once again, the sparse upper air network makes it difficult to account for this track. On the 24th and 25th, a surface trough extended from the northwest coast southwards, moving rapidly westwards over the southern parts of the State, but the new ridge of high pressure extending across the west coast in its wake was very shallow and a new trough rapidly developed off the upper west coast on the 25th and extended to off the lower west coast by the 26th. From the 23rd to the 27th, temperatures in Perth in the upper air to beyond the 300 mb level were above normal, with a very marked rise of 6°C at the 300 mb level during the 24 hours ended on the morning of the 27th. This warm tongue apparently extended southwards to off Cape Leeuwin and it is assumed that this was the prime steering factor.

Rain:

Although some falls of 1 to 2 inches occurred in the Northern Territory and along the Kimberley coasts, rainfall was not particularly heavy or general as the system travelled on its westerly course. As the system approached the lower northwest coast of Western Australia, good falls of 2 to 3 inches, with isolated falls of up to 6 inches, were recorded in the Fortescue Division. As the system passed down the west coast, stations in the West Gascoyne recorded from 1 to 3 inches, with the rain band then expanding over the agricultural divisions of the State, where good "opening of the season" rains were experienced.

Winds:

At its inception off the north Queensland coast, wind speeds of 50 knots were reported in the vicinity of the centre, but in its travel across the Gulf and the Northern Territory wind force diminished, although strong winds were still evident within 50 miles of the centre. After gaining the Timor Sea, however, wind force increased to 60 knots within 50 miles of the centre, and as it passed southwestwards parallel to the northwest coast the area of gale force winds expanded to more than 200 miles from the centre and winds near the centre were probably of the order of 80 knots. When the system assumed major proportions, central winds increased to over 100 knots and the area of strong to gale force winds increased still further. The maximum recorded gust was 96 knots at Carnarvon, when the cyclone was in the vicinity of the township. As the system travelled southwards off the west coast, gale force winds were maintained over a wide area of sea and land, although the wind force near the centre was diminishing as the system weakened. When the system was centred close to Geraldton the maximum wind gust at that town was 53 knots and as it passed to seawards at Perth the maximum wind gust there was 62 knots. After passing southwards from Perth wind force abated rapidly and winds near the centre at Cape Leeuwin were only of the order of 10 knots, although strong to gale force winds were still
evident some 300 miles seawards to the west. As the cyclone commenced to fill, a secondary wind surge became apparent after the centre had passed, reaching a velocity of 40 knots from Geraldton to Perth.

Seas:

After the system gained the Timor Sea very rough to high seas were reported, and as the system moved parallel to the northwest coast of Western Australia high seas were reported some 200 miles from the centre and rough seas over 400 miles from the centre, with a heavy swell from the northeast to north along the whole of the northwest coast.

Damage:

Although high seas pounded the northwest coast and some intense rain was reported, little damage occurred from these factors, but once the cyclone assumed major proportions, wind damage became widespread. During the 26th, windmills and outbuildings at West Gascoyne stations suffered heavy damage or demolition. When the centre reached the more populated area at Carnarvon, damage became more heavy and widespread. Lightly built structures, including residences and storehouses, were demolished or extensively damaged, while the more substantial structures sustained considerable superficial damage, mainly the loss of roofs. At the same time surrounding banana plantations and bean farms were completely destroyed, the damage here alone being estimated as equivalent to that in the township, some quarter of a million pounds.

Little damage to small boats was reported from Carnarvon and although one motor launch was blown half a mile inland many small craft were exposed to the storm with little effect. As the centre passed southwards, the crayfishing fleet at the Abrohlos Island sheltered safely in the lee of the islands, but many pleasure craft along the coast from Geraldton to south of Perth were washed or blown ashore and damaged, while many towns in the wheatbelt reported damage to outbuildings, wheat silos, and homestead roofs.
TROPICAL DEPRESSION NO. 3, CLASS 1
OVER INDIAN OCEAN IN COCOS ISLAND REGION
03160 04084, Track and Development Unknown

Development:

Little is known of the development of the next tropical depression which appeared on 4th April 1960 over the ocean some 150 miles to the northeast of the Cocos Islands. Winds of 30 knots were reported over 200 miles from the centre and gusts to 45 knots were recorded at Cocos Island when the centre was over 100 miles distant, so that the system has been classified as Class 1.

From the 1st to the 4th April 1960, the upper air temperatures at Cocos Island increased by 3 to 4°C generally and by as much as 8°C at the 350 mb and 250 mb levels, and, although the sounding on the morning of the 5th was suspect due to the prevailing weather, a further warming of 2 to 3°C on the lower levels was evident by this time.

During the 4th, winds at Cocos Island gradually veered from southeast to southwest and winds at the ship "Tonan Maru", some 200 miles to the southeast of the centre, gradually backed from northeast 30 knots at 0600Z to north 20 knots at 1800Z, while the direction of the swell experienced by the ship changed similarly and moderated from 9 ft to 5 ft during the period and the sea surface temperature rose by 3°F to 80°F as the centre moved southwards.

By the early morning of the 5th rain commenced at Cocos Island and gradually increased in intensity until the late afternoon when it abated. Although the surface wind velocity at Cocos Island remained in the vicinity of 20 knots during the 5th, gusts to 37 knots were recorded, while the upper winds strengthened and the seas became rough and confused. The pressure at the Island remained fairly steady between 1008 and 1010 mb, but the surface winds were alternately backing and veering during the day and the centre was apparently oscillating in an east-west movement.

By the morning of the 6th, although the upper winds at the Island had abated, the surface velocity had increased to 25 knots with gusts to 45 knots and the seas remained rough and confused. During the day the wind velocity increased to 30 knots and further heavy rain commenced, and the system then appeared to move northwards as the surface wind backed from southwest to south, this trend being followed by the
upper winds, which strengthened to 30 knots, while the seas remained rough and confused.

By the morning of the 7th winds at Cocos Island had abated to 10 knots and the seas had become slight. However, during the day the wind veered west again and further heavy rain was experienced.

By the morning of the 8th the winds at and over Cocos Island were northerly, while the seas were moderate and confused, but by the 9th conditions in the area had returned to normal.

Track and features:

Little is known of the track of this system. It apparently moved due south during the 4th, assumed an erratic movement on the 5th, moved northwards on the 6th, then either filled or moved rapidly to the west of Cocos Island and finally filled on the 8th.

The movement and development of this system was probably influenced by another system operating during the period over the central tropical Indian Ocean. This other system moved southeastwards down a trough of low pressure to become an intense extratropical depression to the northeast of Amsterdam Island by the 7th.

Rain:

Cocos Island experienced very heavy rain during the 5th, with the intensity increasing to over an inch an hour for three hours during the afternoon. During the 15 hours from 3 a.m. on the 5th, over 9 inches of rain were registered, 355 points being recorded between noon and 3 p.m. During the 4 days ended 9 a.m. on the 8th, over 13 inches of rain were registered at the Island.

The rain occurred in the southwest quadrant of the system, an unusual feature in this area. Here again, the cyclone further to the west may have contributed to this feature.

Winds, seas and damage:

Winds of 30 knots were experienced over 200 miles from the centre and gusts to 45 knots were recorded over 100 miles from the centre. Although no information was available from regions near the centre, wind velocities were probably of the order of 50 knots. Seas over 100 miles from the centre were rough and confused, and were probably high near the centre.

No damage was reported.
TROPICAL DEPRESSION NO. 4, CLASS 1

TIMOR SEA

04160  21274  70929  802101  71127  902201  71226  002301  71324  002401
71323  022501  71323  022601  71323  052701

Development:

No information is available concerning the development, track or effects of this system before its location by a report from the ship "Straits Johore" on the morning of 21st April 1960. The ship was in the vicinity of Sermattan Island, to the east of Timor, and was hove to in phenomenal seas with northerly winds exceeding 50 knots, while the pressure fell to 980.6 mb.

Doubtless, prior to this date the cyclone was very intense and its presence must have been recorded either elsewhere in the Arafura Sea or in the Banda Sea, but at the time of location, apparently it had passed maturity and was weakening as it moved southwestwards over the Timor Sea to lose its identity on 27th April 1960.

Track and features:

From the vicinity of Sermattan Island the cyclone moved approximately 500 miles southwestwards over the Timor Sea as it filled during the next four days and then remained stationary as it lost identity during the next two days.

Rain:

Several inches of rain were reported from stations along the North Kimberley coast, but no rain of any consequence was reported from other Australian stations in the vicinity of the system.

Winds, seas, and damage:

At the time the system was located, winds exceeding 50 knots and phenomenal seas were reported within 50 miles of the centre and gale force winds and rough seas over 100 miles from the centre, but both winds and seas rapidly abated as the cyclone moved into the Timor Sea. There were no gales or rough seas reported from Australian stations to the south and there was no damage in these areas.
Fig. 2  The 1959-60 Cyclone Season in the Northwestern Australian Region  Depression No. 2 and No. 4