Aust. Met. Mag. 29 (1981) 41-53 551.515.23

The Australian tropical cyclone season 1979-80

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(Manuscript received March 1981)

Sixteen tropical cyclones occurred in the Australian region during the 1979-80 tropical cyclone season. The season had a very early start with a low latitude cyclone in the Indian Ocean in late August 1979. Thereafter, the remaining fifteen cyclones occurred between December 1979 and March 1980. While a few were quite intense at landfall and caused considerable monetary losses — mainly to large mining ventures — there were no major disasters.

Introduction

A rare low-latitude spring cyclone in the Indian Ocean gave a very early start to the 1979-80 tropical cyclone season in the Australian region. But then it was some three and a half months later before the occurrence of the second cyclone for the season, again in the Indian Ocean. In all the cyclone season ran from 27 August 1979 to 30 March 1980.

The 1979-80 tropical cyclone season was characterised by a high percentage of cyclones in the Western Region reaching severe intensity. Eight out of ten Indian Ocean cyclones in the Australian region reached severe cyclone (hurricane) intensity (mean winds above 120 km/h). However, it was equally significant that less than half of all the cyclones in the Australian region had any effect on Australia with less than one-third making landfall, although all of these were at cyclone intensity. Four were at severe cyclone intensity at landfall.

Seasonal statistics

The area over which the Australian Bureau of Meteorology has international tropical cyclone warning responsibilities is shown in Fig. 1. Reference in this report to the behaviour and tracks of cyclones outside this region is tentative only. A statistical summary of various aspects of the 1979-80 season is presented in Tables 1 and 2.

Tropical cyclone days

A tropical cyclone day is defined here as a day on which a tropical circulation of at least tropical cyclone intensity (mean winds of 63 km/h) existed in the Australian region for any part of the day commencing at 0000 GMT.

Initial location of tropical depressions

The locations where tropical depressions that later became tropical cyclones were first identified as closed rotational systems have been tabulated.

Tropical cyclone coastal crossings

During 1979-80 five tropical cyclones crossed the Australian coast from sea to land at cyclone intensity. No land to sea coastal crossings at cyclone intensity were recorded. Tropical cyclone **Simon** reached the Queensland coast then, with the eye of the cyclone half over land (see Fig. 8), it changed direction and moved out to sea again. This has been recorded once only as a sea to land crossing but not as a land to sea crossing.

Severe tropical cyclones

In the Australian region tropical cyclones (mean winds of at least 63 km/h) are upgraded to severe tropical cyclones when mean winds reach hurricane force (120 km/h). Nine cyclones reached this category in the Australian region during the 1979-80 season of which eight were in the Western Region. Another cyclone (**Sina**) reached severe cyclone intensity after moving into the Fiji area of responsibility.

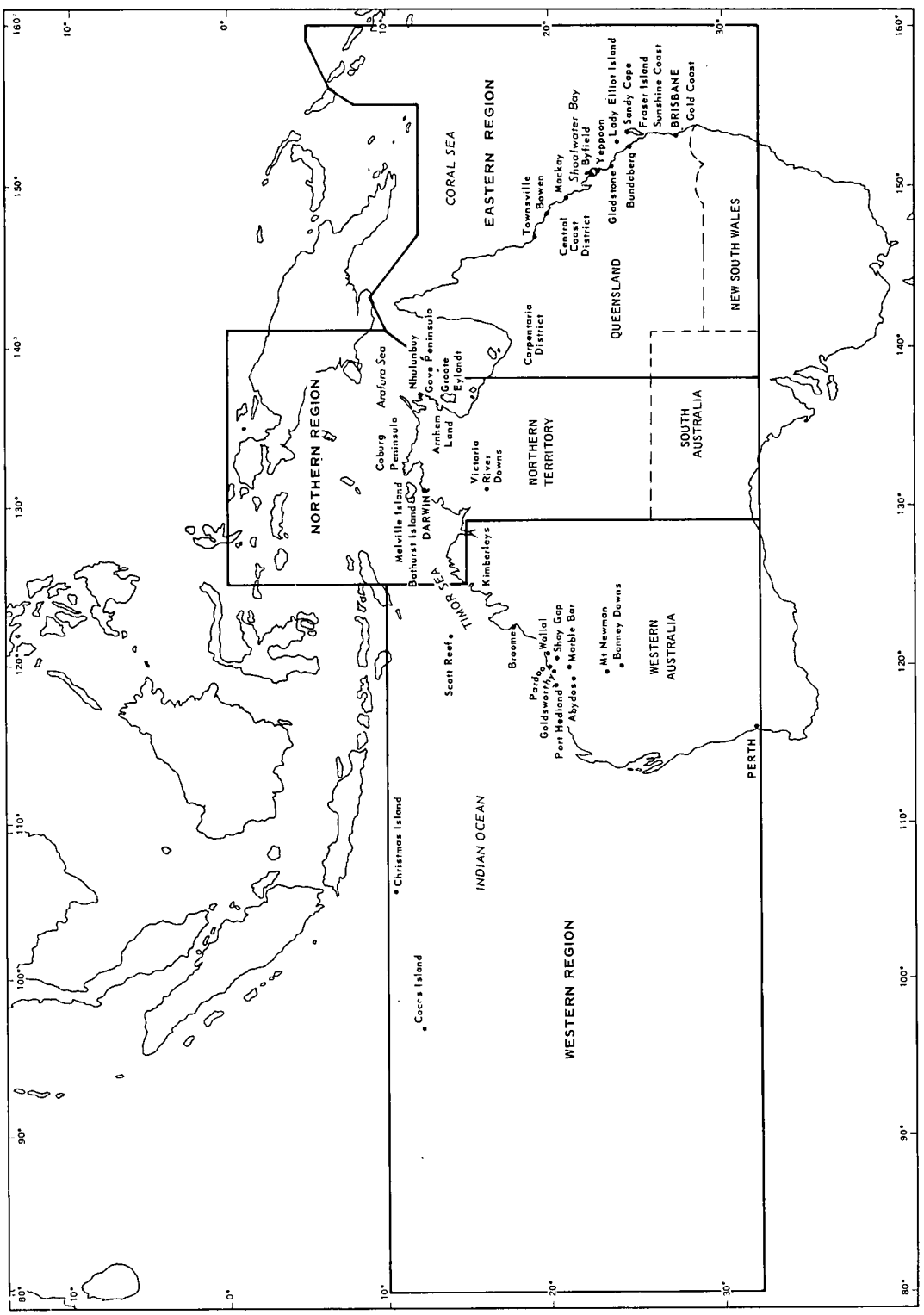


Fig. 1. Locality map showing the Western, Northern and Eastern Regions of the Australian area of tropical cyclone forecasting responsibility.

Tropical cyclones of the 1979-80 season

1. Tropical cyclone Tony, 27 to 30 August 1979 (Fig. 2)

Tony was the first Australian cyclone of the 1979-80 season. It was one of the infrequent cyclones that occur in low latitudes of the Indian Ocean during winter and spring months. On 26 August 1979 a tropical low had developed on a shear line about 1300 km west-northwest of Cocos Island and by 1800 GMT 27 August 1979 it was estimated to have reached tropical cyclone intensity. **Tony** moved slowly west-southwest and attained peak intensity at about 1200 GMT 29 August 1979. The Dvorak satellite intensity analysis technique gave a central pressure of about 990 mb and a maximum ten minute mean wind speed at peak intensity of about 95 km/h.

A striking feature of the surface pressure pattern during the lifetime of the cyclone was an intense anticyclone of about 1040 mb some 2800 km to the south. On 26 and 27 August 1979 a mid-latitude cold outbreak on the eastern flank of the anticyclone (between longitudes 100°E and 110°E) produced a strong surge in the easterly trade winds to the south of the tropical low. This probably aided its development to tropical cyclone intensity. The steep pressure gradient between the tropical cyclone and the anticyclone to the south caused gale force winds to be experienced up to 1200 km from the storm centre. At 0000 GMT 28 August 1979 a ship about 150 km to the southwest reported a pressure of 1002.5 mb and a sustained wind speed near 74 km/h. There were no reports within 100 km of the cyclone centre. Early on 30 August 1979 **Tony** crossed longitude 80°E into the Mauritius Region.

2. Tropical cyclone Viola, 11 to 18 December 1979 (Fig. 3)

The active cloud cluster from which **Viola** developed formed about 600 km to the northwest of Cocos Island on 7 December 1979. It was part of a semi-continuous line of convection extending eastward across Indonesia. A tropical depression had developed by 9 December 1979 and moved slowly to the southwest. Using the Dvorak intensity analysis technique **Viola** reached tropical cyclone intensity at about 0300 GMT 11 December 1979. The cyclone then began to move westward under the influence of an easterly middle level flow north of the sub-tropical ridge.

Viola attained its maximum intensity late on 16 December 1979 when the central pressure was estimated to be near 930 mb giving a maximum mean wind speed of about 205 km/h. It maintained this intensity as it crossed into the Mauritius Region early on 18 December 1979. **Viola** was renamed **Claudette** and passed close to Mauritius late on 22 December 1979 causing the loss of six lives and injuring 21 people. It was reported that the sugar cane crop on Mauritius was devastated and that buildings suffered considerable damage.

Severe tropical cyclone **Viola** was notable for its small size and long lifetime. Satellite pictures showed that nearly all of the intense convective activity was within 200 km of the centre. Including the pre-cyclone and post-cyclone stages the storm lasted about 18 days from 9 December 1979.

3. Tropical cyclone Wilf, 25 December 1979 to 1 January 1980 (Fig. 2)

The pre-cyclone depression stage of **Wilf** developed about 300 km to the northwest of Cocos Island on 23 December 1979. As estimated from satellite photographs **Wilf** reached tropical cyclone intensity about 0600 GMT 25 December 1979. The cyclone continued to intensify rapidly and 18 hours later the central pressure was estimated to be near 980 mb. **Wilf** remained at this intensity with minor fluctuations until about 1800 GMT on 28 December 1979. Peak intensity occurred early on 28 December 1979 when the central pressure dropped to about 973 mb. Thereafter, **Wilf** weakened as strong northwesterlies at high levels began shearing the high cloud from the storm centre. After 29 December 1979 the cyclone exhibited marked short period (6 to 12 hour) fluctuations in convective activity as observed on satellite pictures, but was still of tropical cyclone intensity as it moved into the Mauritius Region at 0600 GMT 1 January 1980 and was renamed **Danitza.**

Features of the track were two major changes in the direction of movement on 26 and 28 December 1979. This suggests that a middle level trough (about 500 mb) moved across the storm during this time and caused a temporary break in the sub-tropical ridge. No ship reports were received within 100 km of the storm centre.

4. Tropical cyclone Amy, 5 to 11 January 1980 (Fig. 2)

The convective cloud cluster that developed into the severe cyclone **Amy** was first evident over the Timor Sea to the west of Scott Reef on 3 January 1980. The tropical depression drifted slowly west-southwest and winds reached gale force on 5 January 1980. Intensification continued as **Amy** accelerated southwards on 7 January 1980 towards Port Hedland. Early on 9 January 1980, when the cyclone was approaching its peak intensity, it changed direction towards the southeast then, as it approached the coast next morning, it again changed direction towards the southwest. A

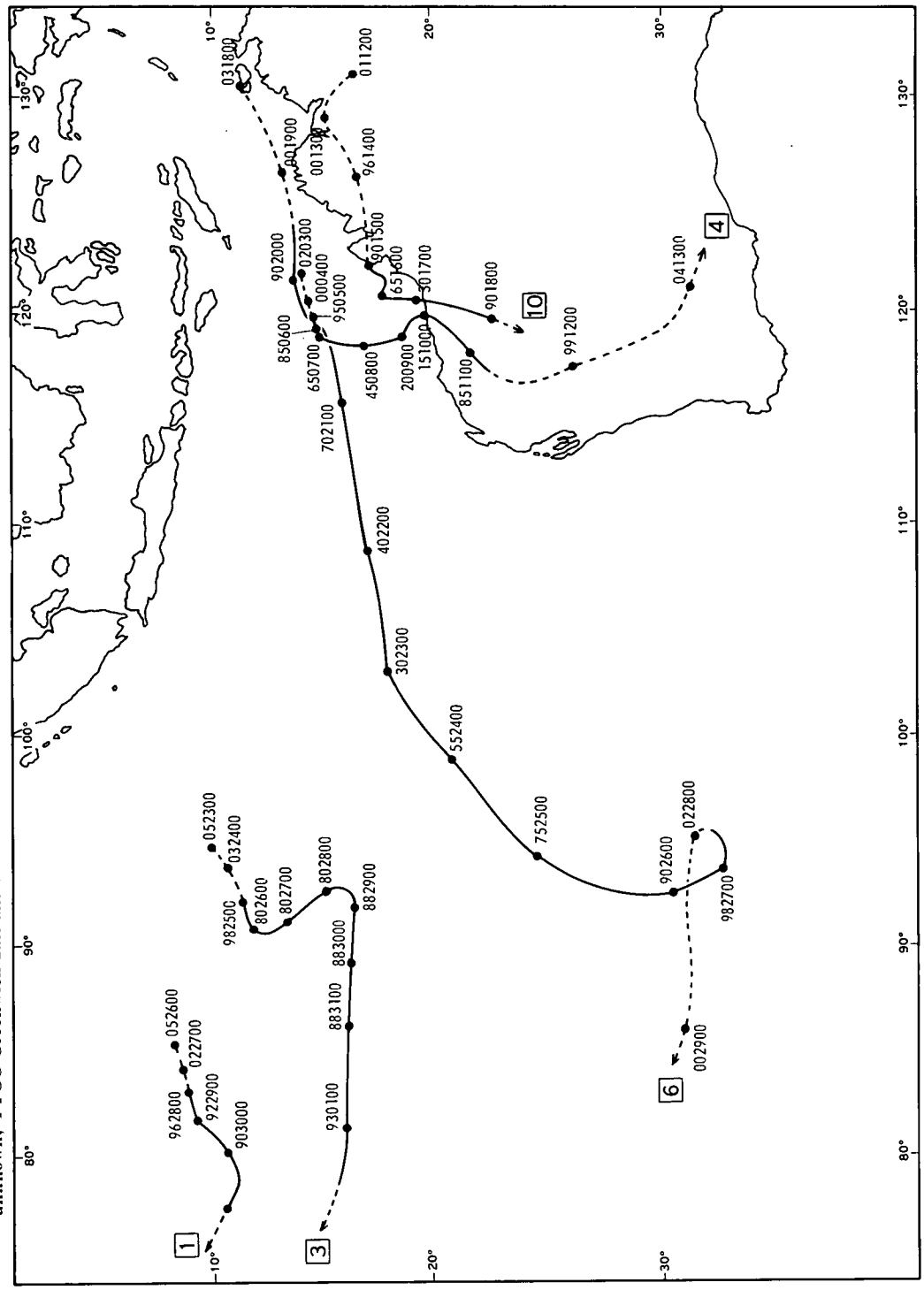


Fig. 2. Tracks of tropical cyclones during the 1979-80 season in the Western Region — cyclones 1, 3, 4, 6 and 10. Broken lines denote pre-or post-cyclone stage; full lines denote system at tropical cyclone intensity. Key to groups along track in code PPYYGG: PP central pressure (tens and units of millibars); XX pressure unknown; YYGG Greenwich date and time.

radar picture of **Amy** at 1824 GMT 9 January 1980 is shown at Fig. 4.

Amy crossed the coast near Pardoo Station about 110 km east of Port Hedland at 0200 GMT 10 January 1980 with a central pressure of 915 mb. Six hours later **Amy** passed very close to Goldsworthy where a mean sea level pressure of 932 mb was recorded. During the following 12 hours winds decreased markedly although they remained above gale force for about 30 hours after landfall. The maximum measured wind gust was 130 km/h at Port Hedland Meteorological

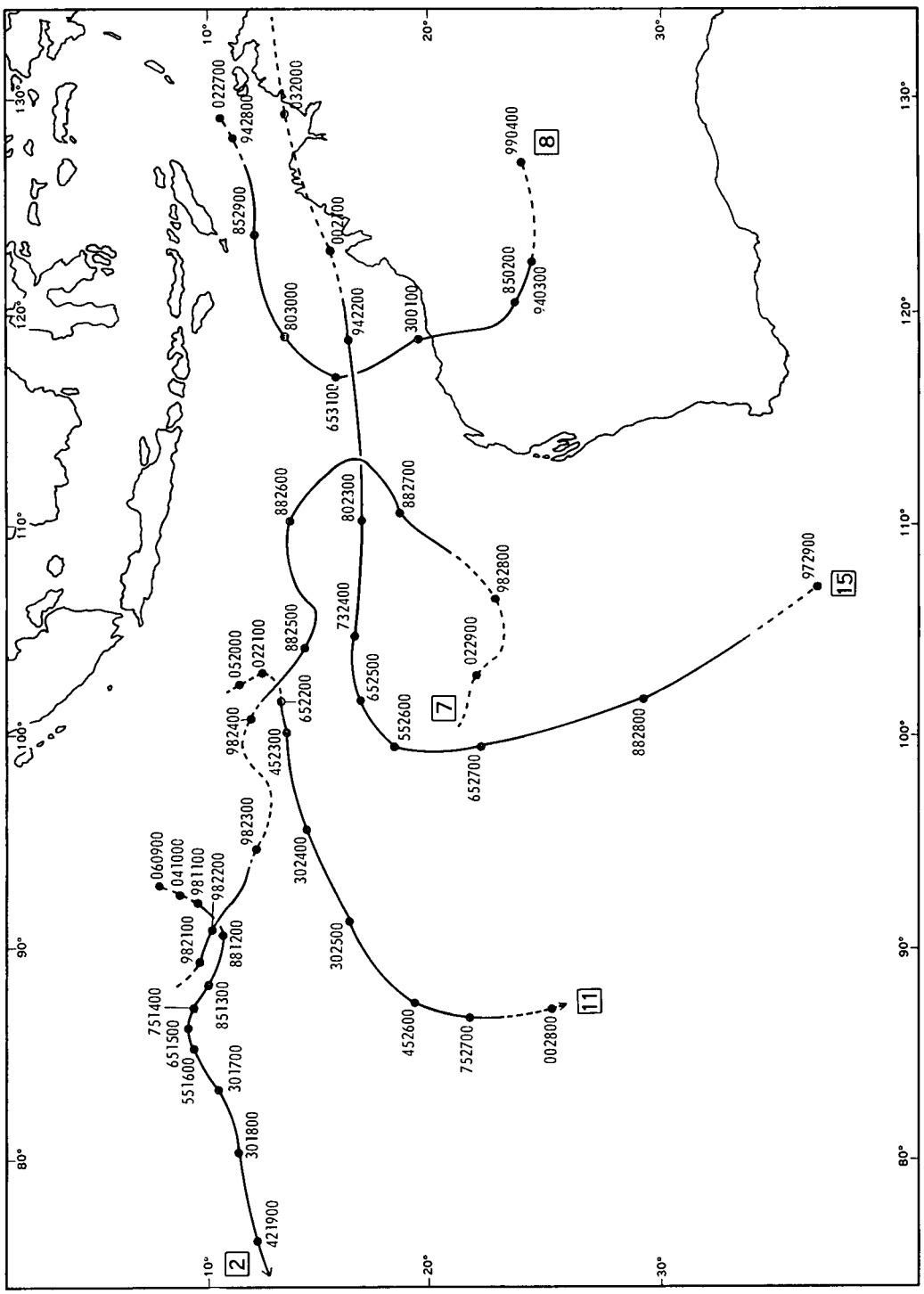


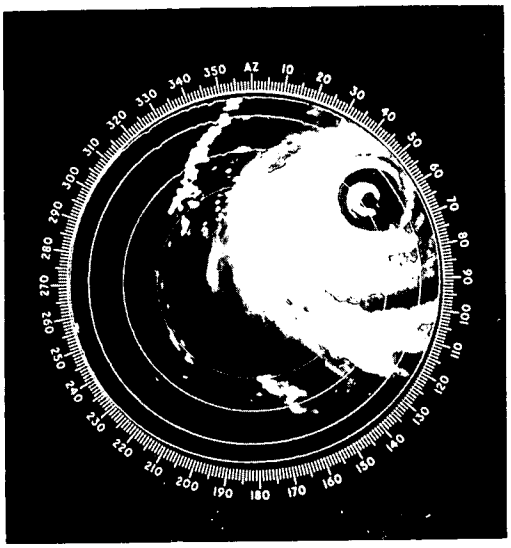
Fig. 3 Tracks of tropical cyclones during the 1979-80 season in the Western Region – cyclones 2, 7, 8, 11 and 15. Broken lines denote pre- or post-cyclone stage; full lines denote system at tropical cyclone intensity. Key to groups along track in code PPYYGG: PP central pressure (tens and units of millibars); XX pressure unknown; YYGG Greenwich date and time.

Office. However, gusts of 200 to 240 km/h are estimated to have occurred near the centre during the first 100 km of overland travel of the cyclone.

Extensive damage to buildings and windmills, together with some loss of stock due to drowning, was reported by pastoral properties up to 200 km to the east and south of Port Hedland. Severe damage to company housing, buildings and mining equipment occurred at Goldsworthy. Damage to Goldsworthy Mining Co. property was estimated to be about $8.0 million.

Total losses, including property damage and

Fig. 4 Photograph of radar display of cyclone Amy taken at the Port Hedland Meteorological Office at 1824 GMT 9 January 1980. Range rings are at 20 nautical mile intervals.



industrial disruption, are estimated at around $25 million. No lives were lost, nor injury sustained, despite destruction of houses at Goldsworthy. Some of this damage is shown in Fig. 5.

5. Tropical cyclone Paul, 7 to 8 January 1980 (Fig. 6)

Paul developed out of a tropical depression that first became evident in the southwest Gulf of Carpentaria on 2 January 1980. By 3 January 1980 this tropical depression had developed early signs of a cyclonic circulation and had deepened to 997 mb, but it had been drifting slowly southeast and made landfall before reaching cyclone intensity.

The low moved in a general east-southeast direction across the Carpentaria and Central Coast districts of Queensland during the next few days, with the central pressure falling slightly. It then moved out over the Coral Sea just south of Sarina early on 7 January 1980 with a central pressure of 995 mb.

While moving overland the low forced strong convergence in the moist northeast airstream onto the Queensland tropical coast. Resultant

Fig. 5 Damage to housing at Mt Goldsworthy caused by cyclone Amy (courtesy West Australian Newspapers Ltd).

very heavy rain caused one of the highest floods this century down the Don River through Bowen. The river changed its course in its lower reaches, washing away two homes and causing damage estimated at several million dollars to the market garden industry. Major flooding also occurred in other Central Coast rivers.

The tropical depression was moving east-southeast at 40 km/h as it crossed Shoalwater Bay. By 0600 GMT 7 January 1980 its central pressure had fallen to 992 mb, gales had developed and it was named tropical cyclone **Paul** while just northeast of Yeppoon. This movement continued until 1500 GMT 7 January 1980 when **Paul** turned southeast and three hours later had deepened to 989 mb, its lowest central pressure as a tropical cyclone. This rapid southeast then south-southeast movement continued until by 1200 GMT 8 January 1980 it had passed latitude 30°S, slowed to 25 km/h and became cold cored. At that time it was downgraded from a tropical cyclone.

Throughout its life as a tropical cyclone **Paul** did not affect the Australian mainland. It did not develop a deep convective warm cored structure and winds did not reach much above gale force. Much stronger winds and a lower central pressure were eventually achieved as a cold cored extratropical circulation.

6. Tropical cyclone Brian, 19 to 27 January 1980 (Fig. 2)

A surface depression was located just east of Bathurst Island early on 18 January 1980. Under the influence of an easterly mid-tropospheric flow to the north of the subtropic ridge, the system moved west-southwest for five days at an average speed of 26 km/h. **Brian** intensified very rapidly during 19 Jauary 1980 and at 2100 GMT a drilling ship and two smaller ships within 50 km of the centre reported sustained winds of 110 km/h. Three hours later Scott Reef Automatic Weather Station recorded a pressure of 988.5 mb only 20 km from the storm centre. **Brian** continued to intensify rapidly to a peak intensity at 1800 GMT 22 January 1980, the central pressure then being 930 mb, with a maximum sustained wind speed of 205 km/h. This intensity was maintained for about 24 hours before the storm commenced weakening. The cyclone moved southwest for over two days then south and became an extratropical depression with below gale force winds late on 27 January 1980.

After 20 January 1980 no ship reports were received from near the storm centre. However, at 1200 GMT on 22 January 1980 a drifting buoy within 60 km of the centre recorded a pressure of 970.6 mb when the estimated minimum pressure was about 940 mb.

Brian did not cause any damage to the mainland, although production losses to oil companies due to shut-down of operations amounted to $1.74 million.

7. Tropical cyclone Clara, 21 to 27 January 1980 (Fig. 3)

A surface depression formed on 20 January 1980 about 1000 km west-northwest of Cocos Island in an elongated monsoonal trough which extended from near the east coast of Africa to northern Australia. The system moved slowly southeast and late on 21 January 1980 was estimated to have reached tropical cyclone intensity. At 1200 GMT on 22 January 1980 a ship about 200 km to the northwest of **Clara** reported a mean wind of 55 km/h. However, at about this same time **Clara** was entering the periphery of the circulation around the severe tropical cyclone **Brian** and the system rapidly weakened to a tropical depression as the low-level circulation was moved eastward at about 30 km/h and became completely separated from the high-level outflow. This type of sheared flow pattern was evident in satellite photographs throughout **Clara's** lifetime.

Satellite imagery indicated that **Clara** regained tropical cyclone strength on 24 January 1980 but was only ever a weak to moderate storm. Peak intensity occurred at about 1200 GMT on 26 January 1980 with a minimum central pressure of about 980 mb and a maximum sustained wind of about 100 km/h. At 0000 GMT on 27 January 1980 a drill ship about 200 km southeast of the centre reported a sustained wind of about 75 km/h. On 27 January 1980 strong northwest winds in high levels of the troposphere sheared away the outflow region of the cyclone and as a weakening depression **Clara** was carried westward until it dissipated late on 29 January 1980.

The most interesting meteorological features of **Clara** were its interaction with the intense tropical cyclone **Brian** and the shear type cloud patterns displayed by the storm over most of its life cycle. This frequently made location of the centre by satellite imagery difficult.

8. Tropical cyclone Dean, 28 January to 3 February 1980 (Fig. 3)

Dean was the third Australian region tropical cyclone to develop between 19 and 28 January 1980 in a persistent monsoonal low pressure trough that extended from northern Australia westward across the Indian Ocean to about longitude 50°E. A fourth tropical cyclone (**Hyacinthe**) formed in the Mauritius Region at the western end of this very extensive trough on 23 January 1980. The pre-cyclone cloud cluster and associated surface low formed near Bathurst Island late on 26 January 1980 and moved slowly westward. The tropical depression intensified rapidly and was estimated to have reached tropical cyclone intensity early on

28 January 1980. The rate of intensification slowed during the next 36 hours as **Dean** moved west-southwestward at about 20 km/h. Late on 30 January 1980 the speed of movement decreased markedly as the system turned towards the south in response to a northerly flow ahead of a mid-tropospheric trough approaching from the west. **Dean** continued to strengthen as it accelerated towards the coast and reached peak intensity at about 2100 GMT 31 January 1980 when the central pressure was estimated to be near 930 mb with maximum sustained winds of about 200 km/h.

Dean was near peak intensity when it crossed the coast about 48 km east of Port Hedland at about 0120 GMT on 1 February 1980. The anemograph record from Port Hedland Meteorological Office indicates that a maximum ten-minute mean wind speed of 130 km/h with gusts reaching 195 km/h occurred shortly after the cyclone made landfall. Extensive damage resulted at Port Hedland. The minimum MSL (mean sea level) pressure recorded there was 963 mb at 0200 GMT 1 February 1980. **Dean** moved to the south-southeast at an average speed of 25 km/h for 12 hours after crossing the coast before slowing down to about half that speed and tracking towards the southeast. A feature of the storm was its slow rate of decay over land. Wind speed recordings near Mt Newman indicated maximum sustained wind speeds near 110 km/h at 1900 GMT on 1 February 1980. The towns of Goldsworthy, Marble Bar and Mt Newman all suffered wind damage but not to the same extent as Port Hedland. Many of the pastoral stations up to 500 km from the coast were considerably damaged. Non-industrial insurance claims for damage were estimated to total $2.2 million.

Two men were lost overboard from a Taiwanese fishing boat (*Hsin Ho Chung 101*) about 330 km west of Broome early on 1 February 1980. Wave action caused damage to solar salt manufacturing ponds near Port Hedland, with estimated losses of $12 million. A prawn fishing boat was sunk in Port Hedland harbour.

Flooding between Port Hedland and Mt Newman caused damage to the roads and the railway line. Damage estimates at Mt Newman and along the railway line were of the order of $1.6 million. Total damage and industrial losses due to **Dean** were estimated to be about $20 million.

9. Tropical cyclone Ruth, 12 to 14 February 1980 (Fig. 6)

Ruth formed in the monsoon trough east of Townsville and after meandering slowly around the central Coral Sea for several days gradually decayed again without ever affecting any land areas. Using the criterion that tropical cyclones have a belt of maximum winds of at least gale force near the centre, then **Ruth** existed as a cyclone from 0900 GMT 12 February 1980 until 1800 GMT 14 February 1980. However, for a period of almost a week before, during, and after the existence of **Ruth** there was an extensive area of gale force winds over ocean areas from northern New South Wales to central Queensland.

On 8 February 1980 a broad monsoonal trough was lying from the southern Gulf of Carpentaria across the Coral Sea at about latitude 16°S. A cold front, which lost its identity just north of Brisbane by about midday on 9 February 1980, was advancing up the Australian east coast. A strong ridge behind this change caused pressures to rise rapidly. The ridge extended north to about Bundaberg and the resultant strong pressure gradient between the ridge and the monsoon trough caused winds to exceed gale force off northern New South Wales by 1200 GMT 9 February 1980, extending to Fraser Island by 1800 GMT 9 February 1980. The developing tropical depression caused winds further north to strengthen over the next three days. By 0900 GMT 12 February 1980 the broad area of gales had extended to 20°S and the depression had deepened to 996 mb. Winds around the depression reached gale force and it was named tropical cyclone **Ruth.**

The cyclone developed steadily until strong upper level northwest winds intruded into the circulation from 0000 GMT 13 February 1980. By 0900 GMT 13 February 1980 the central pressure had fallen to 978 mb but by that time the entire upper structure including all convective cloud had been sheared off the cyclone. Thereafter, the central pressure gradually rose until by 1800 GMT 14 February 1980 the winds around the centre had decreased to below gale force and the cyclone was downgraded. The extensive southeast gales over the western Coral Sea persisted for most of another day, finally abating by 1500 GMT 15 February 1980.

Tropical cyclone **Ruth** caused no significant flooding or structural damage. However, the occurrence of the highest astronomical tides for ten years resulted in the rough seas and very heavy swell causing extensive foreshore erosion along Gold Coast and Sunshine Coast beaches in southeast Queensland on 14, 15 and 16 February 1980.

10. Tropical cyclone Enid, 15 to 18 February 1980 (Fig. 2)

Enid developed from a weak surface low that was first evident near Victoria River Downs in the Northern Territory on 12 February 1980. As the low moved generally westward across the Kimberleys it gradually deepened so that when it moved offshore about 70 km north of Broome on 15 February 1980 it already had a central pressure of 990 mb. Once over warm water **Enid** intensified

rapidly. After moving slowly and somewhat erratically for 15 hours after 1000 GMT 15 January 1980, the cyclone began to move steadily towards the south and crossed the coast at 0200 GMT 17 January 1980 some 25 km west of Wallal with its central pressure estimated to be 930 mb. At about 0700 GMT 17 January 1980 **Enid** passed within 30 km of Shay Gap.

Heavy rain accompanied **Enid** along the full length of its overland track. The highest 24-hour falls reported were 115 mm at Bonney Downs, 113 mm at Marble Bar and 99 mm at Newman. Although wind gusts exceeding 200 km/h are estimated to have occurred near Wallal no measured wind speeds are available.

Severe damage to buildings and windmills occurrred at Wallal and cattle valued at $200 000 were drowned in the ocean. At Shay Gap severe damage was sustained to blocks of flats and houses which were unroofed. Fortunately no lives were lost and only minor injuries were sustained. The total damage loss due to **Enid** was estimated to be of the order of several million dollars.

11. Tropical cyclone Fred, 21 to 27 February 1980 (Fig. 3)

Fred developed from an active area of convection associated with the monsoon shear line about midway between Cocos and Christmas Islands late on 19 February 1980. It reached tropical cyclone strength early on 21 February 1980 and attained its maximum intensity on the afternoon of 24 February 1980 when the central pressure was estimated to be near 930 mb. Despite the small size of the cyclone it maintained this intensity with minor fluctuations until about 1200 GMT 25 February 1980. Early on 26 February the direction of movement changed from southwestward to southward as **Fred** came under the influence of a northwesterly upper-level flow. It weakened rapidly as it moved into a strong ridge of high pressure located at about latitude 33°S. No ship reports were received within 200 km of the cyclone centre.

Fig. 6 Tracks of tropical cyclones during the 1979-80 season in the Northern and Easten Regions — cyclones 5, 9 and 14.
Broken lines denote pre- or post-cyclone stage; full lines denote system at tropical cyclone intensity. Key to groups along track in code PPYYGG: PP centrl pressure (tens and units of millibars); XX pressure unknown; YYGG Greenwich date and time.

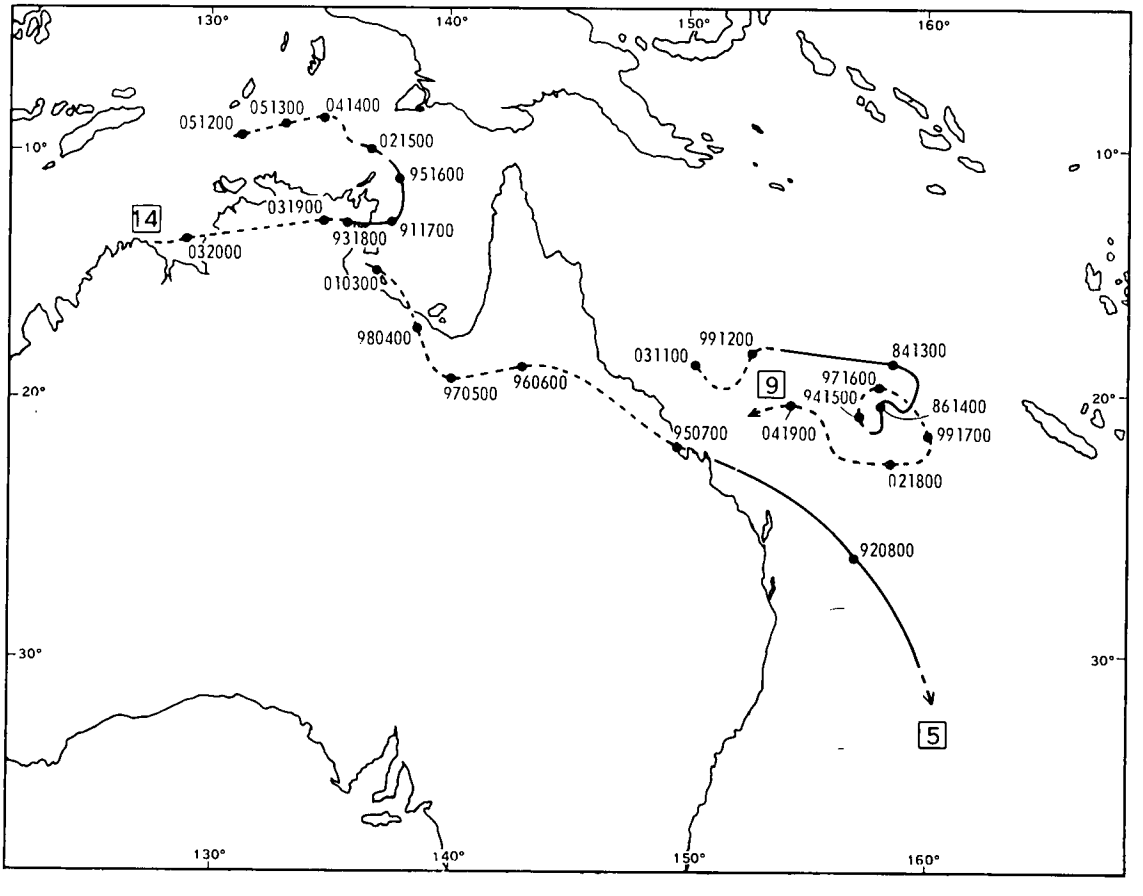
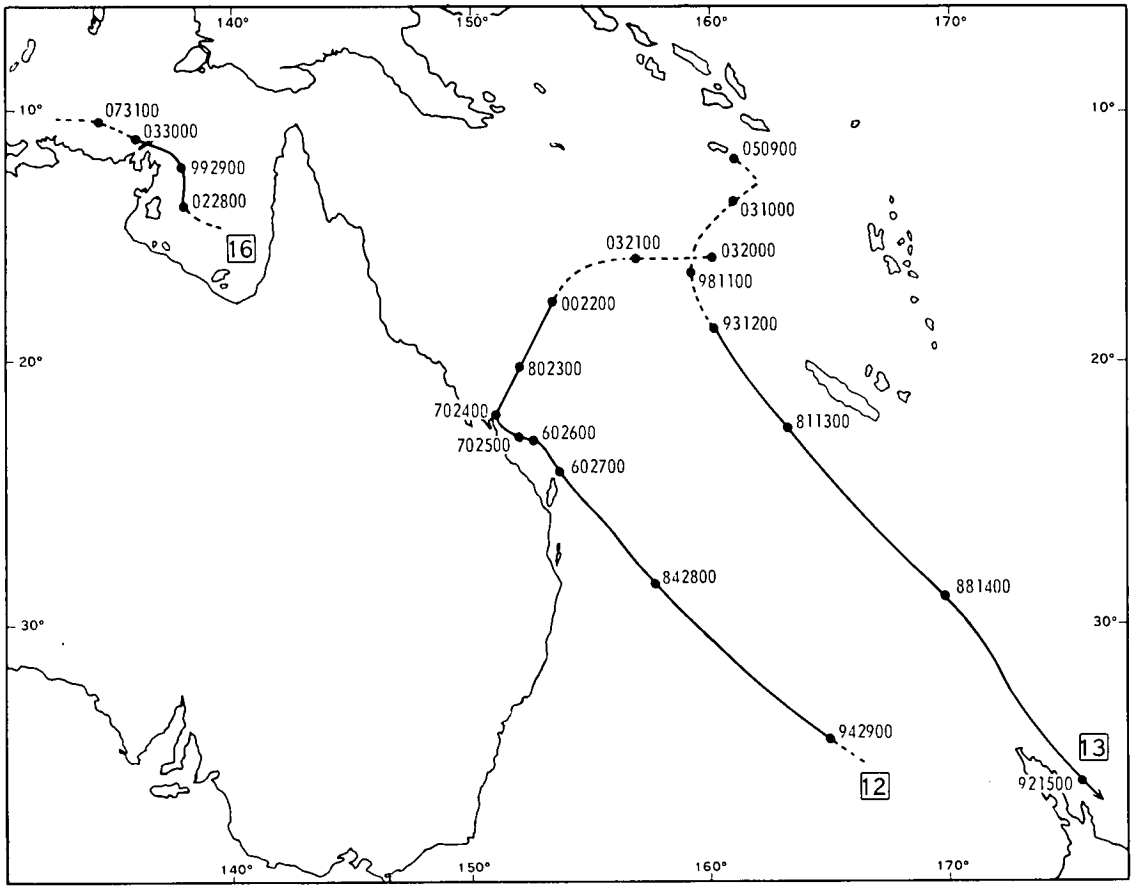


Fig. 7 Tracks of tropical cyclones during the 1979-80 season in the Northern and Eastern Regions — cyclones 12, 13 and 16.
Broken lines denote pre- or post-cyclone stage; full lines denote system at tropical cyclone intensity. Key to groups along track in code PPYYGG: PP central pressure (tens and units of millibars); XX pressure unknown; YYGG Greenwich date and time.



12. Tropical cyclone Simon, 21 to 28 February 1980 (Fig. 7)

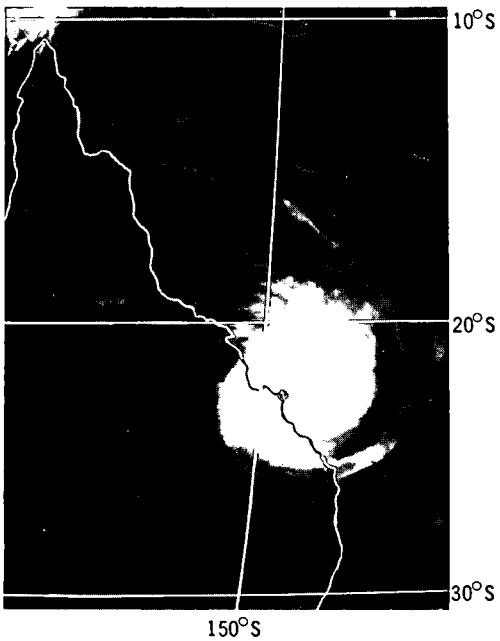
Following the demise of tropical cyclone **Ruth** off the central Queensland coast on 19 February 1980, the monsoon trough reformed with a weak low pressure system in the central Coral Sea on 20 February 1980. The low drifted west then turned southwest as it began deepening to reach cyclone intensity by 1800 GMT 21 February 1980.

Tropical cyclone **Simon** had a well organised spiralling inflow pattern on both Mackay and Gladstone weather radars as it approached the coast. There was a large well defined eye and the central pressure was estimated at 970 mb as it made landfall about 50 km north of Yeppoon on the afternoon of 24 February 1980 (Fig. 8). However, with the eye half over land the cyclone altered direction through a right angle and moved back out to sea. For the next two and a half days the cyclone meandered southeast about 100 km off the Queensland coast while slowly intensifying further to achieve a central pressure of 960 mb at 0600 GMT 26 February 1980.

Simon retained near-peak intensity for almost a day and at about 2200 GMT 26 February 1980 passed within 30 km of Sandy Cape which reported mean winds of 140 km/h and gusts to 170 km/h. Soon after, however, the cyclone accelerated away to the southeast and weakened steadily. It moved into the New Zealand area of responsibility at 1000 GMT 28 February 1980.

Simon caused shoreline erosion from Yeppoon to Bundaberg and some minor property damage from Byfield to Gladstone. The yacht *Thisbe* was blown ashore on Lady Elliot Island and a RAAF helicopter crashed on Fraser Island. No lives were lost.

Fig. 8 GMS infrared photograph of cyclone Simon making landfall at Port Clinton at 0000 GMT 24 February 1980. Central pressure at landfall was 970 mb, eye diameter 50 km.



13. Tropical cyclone Sina, 11 March 1980 (Fig. 7)

A broad doldrum trough had been lying across the Coral Sea from Vanuatu to north Queensland for several days when a weak circulation became evident south of the Solomon Islands on 9 March 1980. The tropical depression drifted southeast then southwest slowly deepening for almost three days before reaching tropical cyclone intensity at 1800 GMT 11 March 1980.

Just four hours after becoming a cyclone **Sina** moved from the eastern Australian to the Fiji area of responsibility on a southeast track. It moved slowly at first and continued to intensify. **Sina** was a severe cyclone as it passed some 200 km to the southwest of New Caledonia.

After reaching peak intensity at 0200 GMT 13 March 1980, when the central pressure was 980 mb, tropical cyclone **Sina** accelerated to over 30 km/h while maintaining a southeasterly track. It only very gradually weakened and was still generating storm force winds when it reached the north of New Zealand as an extratropical cold-cored depression on 15 March 1980.

14. Tropical cyclone Doris, 15 to 17 March 1980 (Fig. 6)

Doris began as a tropical depression in the Arafura Sea north of Melville Island on 12 March 1980. The low drifted slowly east with little development for about three days then became better organised on 15 March 1980. By 1200 GMT 15 March the central pressure had fallen to 999 mb, winds near the centre reached gale force, and the depression was named tropical cyclone **Doris.**

The cyclone moved slowly south during 16 March 1980 while continuing to intensify. By 1800 GMT16 March 1980 the central pressure had fallen to 989 mb but then strengthening upper easterlies both turned the cyclone to the west and disturbed its symmetry. The central pressure rose slowly to about 993 mb by 0800 GMT 17 March 1980 when tropical cyclone **Doris** made landfall on the Arnhem Land coast between Nhulunbuy and Groote Eylandt.

Although the intense low-level structure of **Doris** was destroyed on landfall its well developed upper circulation retained its identity as the system moved west across the Top End of Northern Territory during 18 and 19 March 1980. After reaching the Joseph Bonaparte Gulf the depression moved quite rapidly west-southwest, later to become tropical cyclone **Gloria** in the Indian Ocean.

Tropical cyclone **Doris** produced heavy rain over Arnhem Land, without significant flooding. Extensive but minor damage occurred on Groote Eylandt and the Gove Peninsula although no lives were lost. The mining companies of Nabalco and Gemco incurred direct cost damages of about $150 000 while total community damage has been estimated at $500 000.

15. Tropical cyclone Gloria, 21 to 28 March 1980 (Fig. 3)

Gloria was a regeneration of tropical cyclone **Doris.** The westward moving tropical depression started to intensify as it moved across the Joseph Bonaparte Gulf early on 20 March 1980. The rate of development increased markedly as the depression moved from land to the Indian Ocean. **Gloria** reached tropical cyclone intensity by about 1400 GMT 21 March 1980 as estimated using GMS (Geostationary Meteorological Satellite) enhanced infrared imagery (i.e. about 24 hours after it moved from land to ocean). The cyclone accelerated westward and continued to strengthen, attaining peak intensity about 0900 GMT 25 March 1980 when the central pressure was estimated to be near 955 mb. This intensity was maintained for about 30 hours during which the cyclone came under the influence of a strong northerly flow ahead of a middle-level trough. It commenced weakening late on 26 March 1980 as it accelerated to the south-southeast. **Gloria** became extratropical on 28 March 1980 and was captured by a cold front on 29 March 1980.

The track of **Gloria** is fairly typical of March tropical cyclones in the Western Region; an initial move westward and then recurvature in a southeasterly direction at about latitude 20°S. At 1200 GMT on 23 March 1980 a ship about 100 km from the storm centre reported a pressure of 997 mb and a mean wind speed of 80 km/h. At that time the maximum mean wind speed near the centre was estimated to be approximately 100 km/h. No reports of damage were received.

16. Unnamed tropical cyclone, 28 to 30 March 1980 (Fig. 7)

A tropical depression in the Gulf of Carpentaria intensified to produce localised and intermittent gales over the northeast Arnhem Land coast as it moved into the Arafura Sea. The system did not develop a deep convective warm cored structure, winds barely reached cyclonic intensity and at the time it was not classified as a tropical cyclone.

A tropical depression first appeared in the central Gulf of Carpentaria on 27 March 1980. The circulation intensified and reached tropical cyclone intensity by 0000 GMT 28 March 1980. Winds of around gale force were reported for the next two days as the cyclone moved northwest off the Arnhem Land coast. The system deepened a little and reached its lowest central pressure of 998 mb at 0600 GMT 29 March 1980.

By 1200 GMT 29 March 1980, as the cyclone moved into the Arafura sea, very strong wind shear and an intrusion of dry air caused a rapid weakening of the system. The central pressure had risen to 1003 mb by 0000 GMT 30 March 1980 and winds had moderated to below cyclonic intensity. The residual tropical depression then moved west towards the Timor Sea, finally disappearing north of the Cobourg Peninsula on 31 March 1980. The cyclone had taken no lives and caused only minor damage.

Acknowledgment

Material used in this report was provided by the staffs of the Tropical Cyclone Warning Centres of the Bureau of Meteorology in Brisbane, Darwin and Perth.

Reference

Dvorak, V. F. 1975. Tropical cyclone intensity analysis and forecasting from satellite imagery. *Mon. Weath. Rev., 103*, 420–30 (plus revised training notes for enchanced infrared or visible imagery, June 1979, November 1979, September 1980).

Table 1. Summary of the 1979-80 tropical cyclone season in the Australian region.

	Tropical cyclone days					
	One cyclone active	*Two cyclones active*	*Initial location of tropical depression*	*Coastal crossings at cyclone intensity (sea to land)*		*Severe cyclones (mean winds of at least 120 km/h)*
Australian area	70	16	10*	5		9†
Western Region	60	6	2	3	**Amy** **Dean** **Enid**	8
Northern Region	6		5	1	**Doris**	
Eastern Region	14		3	1	**Simon**	1†

* (a) Four cyclones developed from depressions initially located in Indonesia, and one in the Fiji area of responsibility.
(b) One cyclone (**Gloria**) was a re-development of another (**Doris**).
† One cyclone (**Sina**) reached severe intensity after it moved out of the Eastern Region.

Table 2. Tropical cyclones in the Australian region during the 1979-80 tropical cyclone season.

No.	*Name and lifespan*	*Initial location of tropical depression*	*First reached cyclone classification*	*Weakened below cyclone classification*	*Lowest central pressure*
1	**Tony** 27.8.79 to 30.8.79	8.1°S 85.2°E 00 GMT 26.8.79	998 mb 8.6°S 83.6°E 18 GMT 27.8.79	990 mb 10.7°S 80.0°E* 00 GMT 30.8.79	about 990 mb 9.9°S 80.9°E 12 GMT 29.8.79
2	**Viola** 11.12.79 to 18.12.79	8.0°S 93.0°E 00 GMT 9.12.79	997 mb 10.0°S 92.2°E 03 GMT 11.12.79	932 mb 11.6°S 80.0°E* 03 GMT 18.12.79	930 mb 10.5°S 84.0°E 21 GMT 16.12.79
3	**Wilf** 25.12.79 to 1.1.80	9.7°S 94.8°E 00 GMT 23.12.79	993 mb 11.5°S 91.8°E 06 GMT 25.12.79	994 mb 16.0°S 80.0°E* 06 GMT 1.1.80	973 mb 15.5°S 92.8°E 03 GMT 28.12.79
4	**Amy** 5.1.80 to 11.1.80	14.0°S 121.7°E 00 GMT 3.1.80	995 mb 14.7°S 119.7°E 00 GMT 5.1.80	990 mb 23.0°S 117.0°E 08 GMT 11.1.80	915 mb 19.9°S 119.7°E 02 GMT 10.1.80
5	**Paul** 7.1.80 to 8.1.80	14.9°S 136.6°E 18 GMT 2.1.80	992 mb 22.6°S 151.2°E 06 GMT 7.1.80	990 mb 30.3°S 159.7°E 12 GMT 8.1.80	989 mb 24.7°S 155.6°E 18 GMT 7.1.80
6	**Brian** 19.1.80 to 27.1.80	11.5°S 130.5°E 00 GMT 18.1.80	995 mb 13.8°S 123.7°E 15 GMT 19.1.80	1000 mb 32.0°S 95.6°E 18 GMT 27.1.80	930 mb 17.5°S 104.6°E 18 GMT 22.1.80
7	**Clara** 21.1.80 to 22.1.80	8.5°S 88.5°E 12 GMT 20.1.80	998 mb 10.0°S 90.5°E 18 GMT 21.1.80	998 mb 11.9°S 94.0°E 18 GMT 22.1.80	about 995 mb 11.5°S 93.0°E 12 GMT 22.1.80
7	**Clara** 24.1.80 to 27.1.80	"	996 mb 12.9°S 101.8°E 06 GMT 24.1.80	994 mb 21.5°S 108.8°E 12 GMT 27.1.80	980 mb 17.0°S 113.3°E 12 GMT 26.1.80
8	**Dean** 28.1.80 to 3.2.80	10.0°S 130.0°E 12 GMT 26.1.80	990 mb 11.6°S 127.0°E 06 GMT 28.1.80	994 mb 24.5°S 122.5°E 00 GMT 3.2.80	about 930 mb 19.0°S 118.7°E 21 GMT 31.1.80
9	**Ruth** 12.2.80 to 14.2.80	18.8.°S 150.3°E 00 GMT 11.2.80	994 mb 18.2°S 154.6°E 09 GMT 12.2.80	992 mb 21.3°S 157.8°E 18 GMT 14.2.80	978 mb 20.1°S 158.8°E 09 GMT 13.2.80
10	**Enid** 15.2.80 to 12.2.80	16.5°S 131.0°E 00 GMT 12.2.80	990 mb 17.4°S 122.0°E 00 GMT 15.2.80	990 mb 22.8°S 119.6°E 00 GMT 18.2.80	930 mb 19.8°S 120.3°E 02 GMT 17.2.80
11	**Fred** 21.2.80 to 27.2.80	11.2°S 102.0°E 18 GMT 19.2.80	995 mb 13.0°S 102.8°E 06 GMT 21.2.80	990 mb 23.8°S 87.0°E 12 GMT 27.2.80	about 930 mb 15.2°S 94.2°E 06 GMT 24.2.80
12	**Simon** 21.2.80 to 28.2.80	16.0°S 160.0°E 00 GMT 20.2.80	1002 mb 17.0°S 153.8°E 18 GMT 21.2.80	990 mb 30.2°S 160.0°S† 10 GMT 28.2.80	960 mb 23.2°S 152.6°E 06 GMT 26.2.80
13	**Sina** 11.3.80	12.0°S 161.0°E 00 GMT 9.3.80	994 mb 18.29°S 159.7°E 18 GMT 11.3.80	993 mb 18.5°S 160.0°E†† 22 GMT 11.3.80	980 mb 23.5°S 164.0°E 02 GMT 13.3.80
14	**Doris** 15.3.80 to 17.3.80	9.5°S 131.3°E 00 GMT 12.3.80	999 mb 10.2°S 137.3°E 12 GMT 15.3.80	999 mb 12.7°S 136.4°E 12 GMT 17.3.80	989 mb 12.9°S 137.5°E 18 GMT 16.3.80
15	**Ex Doris** **Gloria** 21.3.80 to 28.3.80	9.5°S 131.3°E 00 GMT 12.3.80	996 mb 16.4°S 120.5°E 14 GMT 21.3.80	993 mb 33.7°S 104.7°E 12 GMT 28.3.80	about 955 mb 17.3°S 101.0°E 09 GMT 25.3.80
16	Unnamed 28.3.80 to 30.3.80	14.5°S 139.7°E 12 GMT 27.3.80	1002 mb 13.8°S 137.8°E 00 GMT 28.3.80	1003 mb 11.1°S 135.9°E 00 GMT 30.3.80	998 mb 11.7°S 136.9°E 06 GMT 29.3.80

* Entered Mauritius area of responsibility
† Entered New Zealand area of responsibility
†† Entered Fiji area of responsibility