Saab Group Presentation

Analysis of South African Air Force combat losses due to Surface to Air Defences from the middle 1960s to the late 1980s. **Are the lessons learnt still valid for current and future Peace Operations in Africa?**

Gerrie Radloff

AOC Conference at CSIR, 12&13 November, 2008

This presentation covers the following

- Overview of the conflict.
- Discussion and Analysis of Losses due to Ground Fire.
- Discussion and Analysis of Missile Engagements:
  - Escalation of Air Defence Deployments.
  - IR Guided Missile Engagements.
  - Radar Guided Missile Engagements.
- Counter Measures:
  - Operational Procedures and Tactics.
  - EW and Aircrew Protection.
- Discussing Applicability of Lessons Learnt on current and future Peace Operations in Africa.

Although the analysis is mainly based on the conflict in Namibia and Angola after 1975, it should not be viewed in isolation.

The South African Air Force (SAAF) became involved in combat operations using helicopters and light aircraft ten years earlier (mid 1960's) in support of:

- Portugal's colonial wars against the Liberation Movements in Mozambique (FRELIMO) and in Angola (MPLA, FNLA and UNITA).
- The former Rhodesia's war against the Liberation Movements ZANU and ZAPU.

South Africa also became involved in the civil wars in Angola in support of the "anti Marxist" FNLA and UNITA against the MPLA and to a lesser degree in Mozambique when RENAMO started resisting FRELIMO when Portugal abandoned their colonies in 1975.

The overall experience and "learning curve" therefore started well before 1975. Fighter/strike aircraft however only became involved in Namibia/Angola from 1978 - resulting in escalation & sophistication of the Air Defence deployments.

Nature of War in Namibia/Angola

Continuous low intensity Counter Insurgency (COIN) war that peaked to full scale conventional operations at times. This happened about eight times.

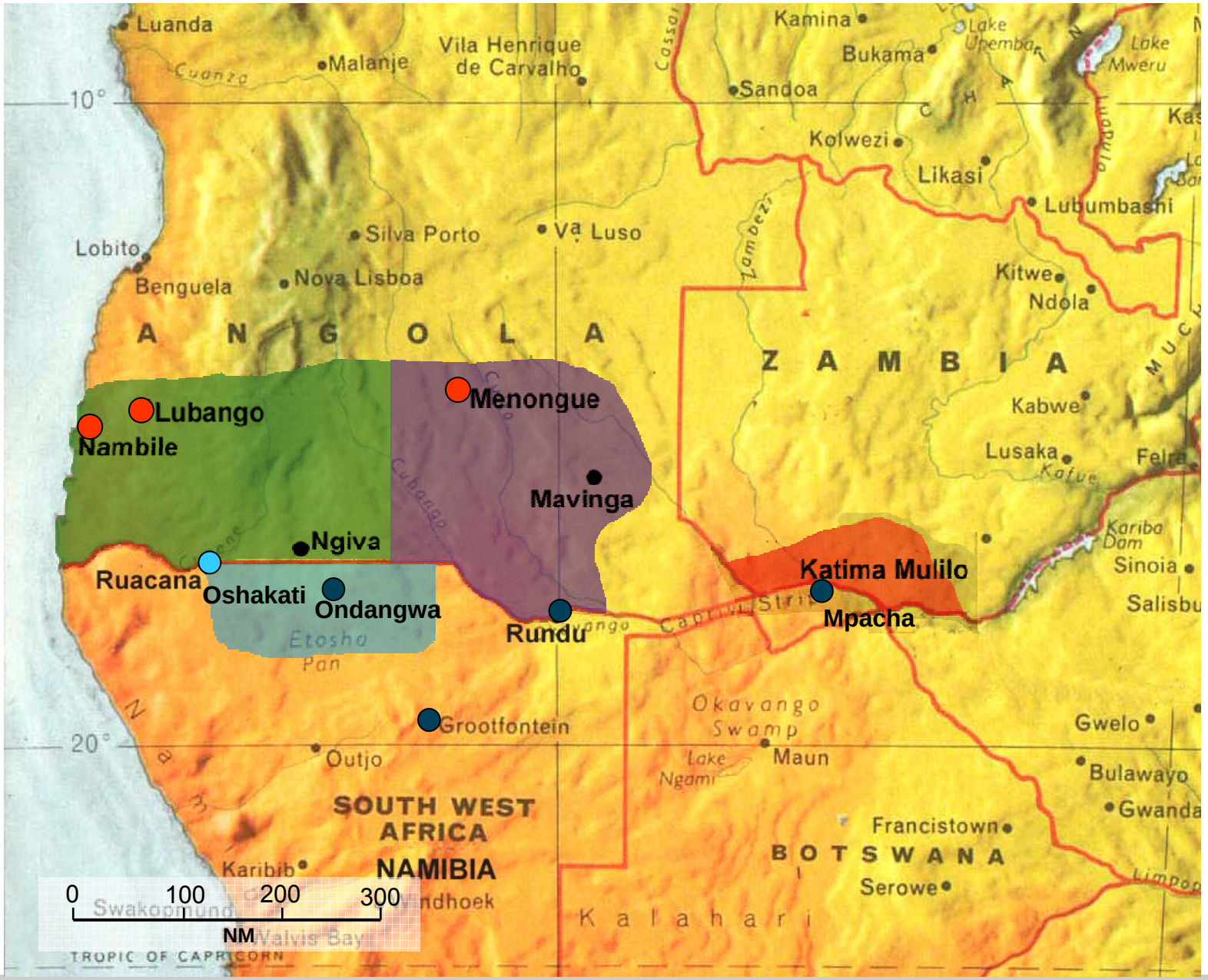
Opposition

- Angolan Defence Force
- Cubans (peaked to 60,000 in the later stages)
- East Block countries
- South West African Peoples Organisation (SWAPO)

War on three Fronts to counter offensive against South West Africa (Namibia) in the South-West and the Caprivi, as well as against UNITA in the South-East.

A fourth front (on occasion quite intense), also occurred inside Namibia when SWAPO infiltrated across the border. This was however largely restricted to the Ovamboland region where the Ovambo people (50% of Namibia's population), were the main victims and supporters of SWAPO.

The fourth front became less active after 1980/81 when territory across the border in Angola from where SWAPO operated, became dominated by South African forces.


Luanda
Malanje
Vila Henrique de Carvalho
Kamina
Bukama
Sandoa
Kolwezi
Likasi
Lubumbashi
Lake Mweru
Lobito
Benguela
Nova Lisboa
Silva Porto
Va Luso
Kitwe
Ndola
A N G O L A
Z A M B I A
Lubango
Nambile
Menongue
Mavinga
Ngiva
Ruacana
Oshakati
Ondangwa
Rundu
Katima Mulilo
Mpacha
Kabwe
Lusaka
Sinoia
Salisbu
Kariba Dam
Etosha Pan
Okavango Swamp
Lake Ngami
Maun
Grootfontein
Outjo
Gwelo
Bulawayo
Gwanda
Francistown
B O T S W A N A
SOUTH WEST AFRICA
NAMIBIA
Karibib
Swakopmund
Walvis Bay
Serowe
K a l a h a r i
0 100 200 300
NM
TROPIC OF CAPRICORN
10°
20°

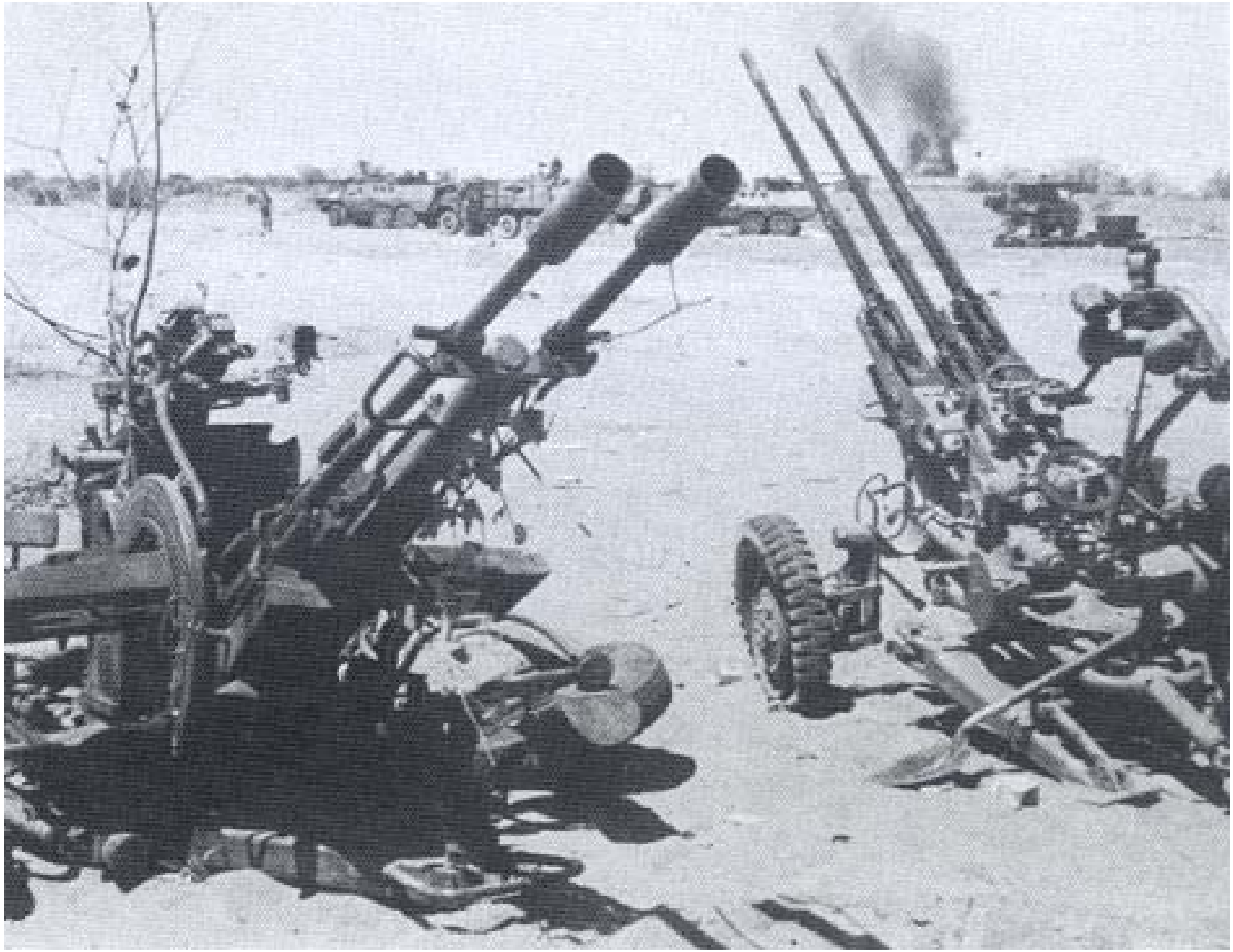
Air War - Continuously escalated from 1978 - 1989

1978

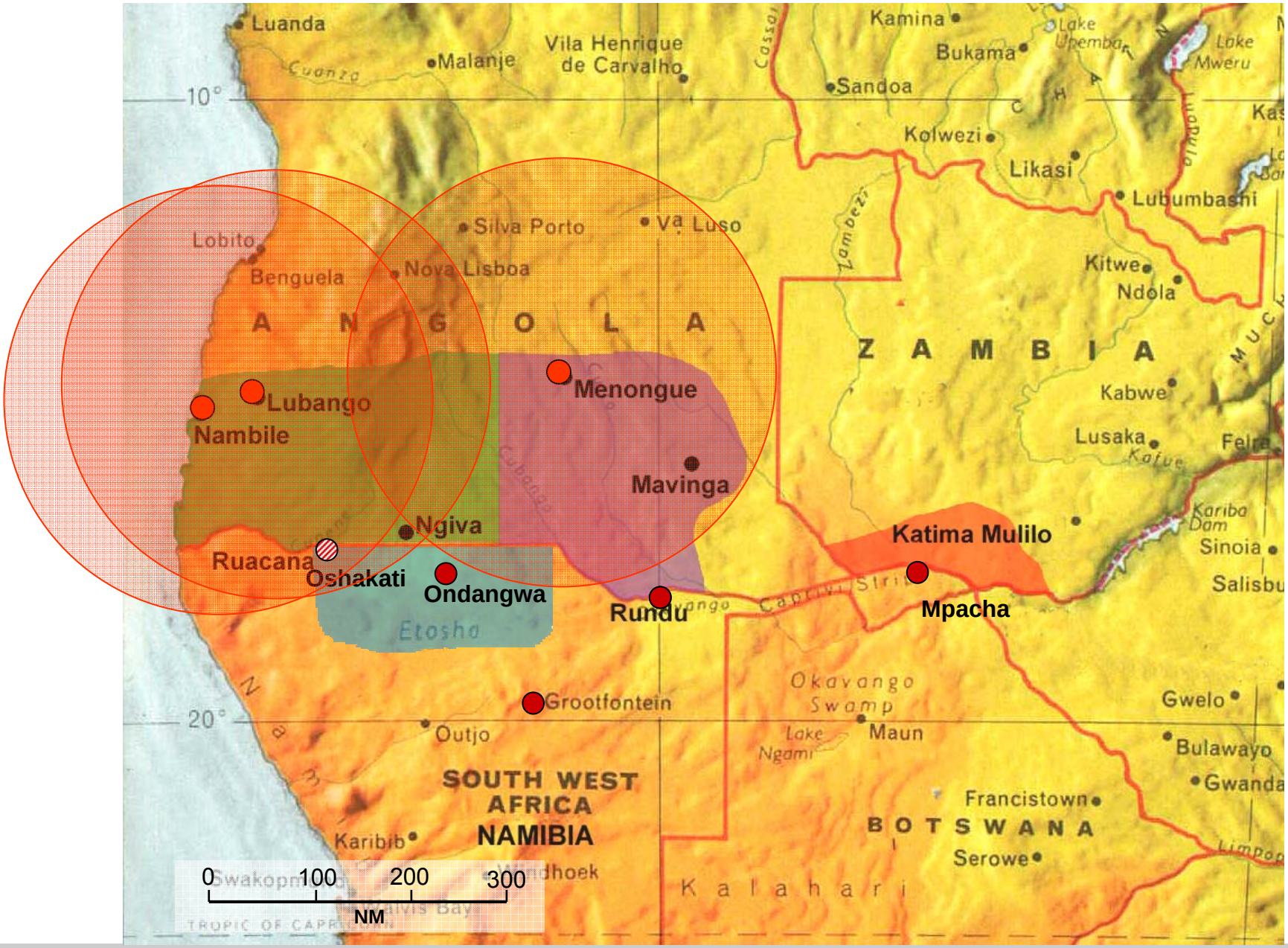
Optically aimed AAA (20mm, 23mm, 37mm, 57mm)

MIG 21's (early models)

Limited radar coverage



AAA Guns (23mm ZPU - 2 and 20mm Triple Barrel from Czechoslovakia)


Luanda
Malanje
Vila Henrique de Carvalho
Kamina
Bukama
Sandoa
Kolwezi
Likasi
Lubumbashi
Lake Upemba
Lake Mweru
Silva Porto
Va Luso
Lobito
Benguela
Nova Lisboa
A N G O L A
Kitwe
Ndola
Z A M B I A
Menongue
Lubango
Nambile
Kabwe
Lusaka
Mavinga
Ngiva
Katima Mulilo
Ruacana
Oshakati
Ondangwa
Rundu
Mpacha
Sinoia
Kariba Dam
Etosha
Okavango Swamp
Grootfontein
Outjo
Maun
Lake Ngami
Gwelo
Bulawayo
Gwanda
SOUTH WEST AFRICA
NAMIBIA
Karibib
Francistown
B O T S W A N A
Serowe
K a l a h a r i
10°
20°
0 100 200 300
NM

Air War - Continuously escalated from 1978 - 1989

1978	Optically aimed AAA (23mm, 37mm, 57mm) MIG 21's (early models) Limited radar coverage
1979	SAM 7

SA 7/ Strela 2

Air War - Continuously escalated from 1978 - 1989

1978	Optically aimed AAA (23mm, 37mm, 57mm) MIG 21's (early models) Limited radar coverage
1979	SAM 7
1980	SAM 3, S-60 AAA (Flapwheel) MIG 21 J More radar coverage

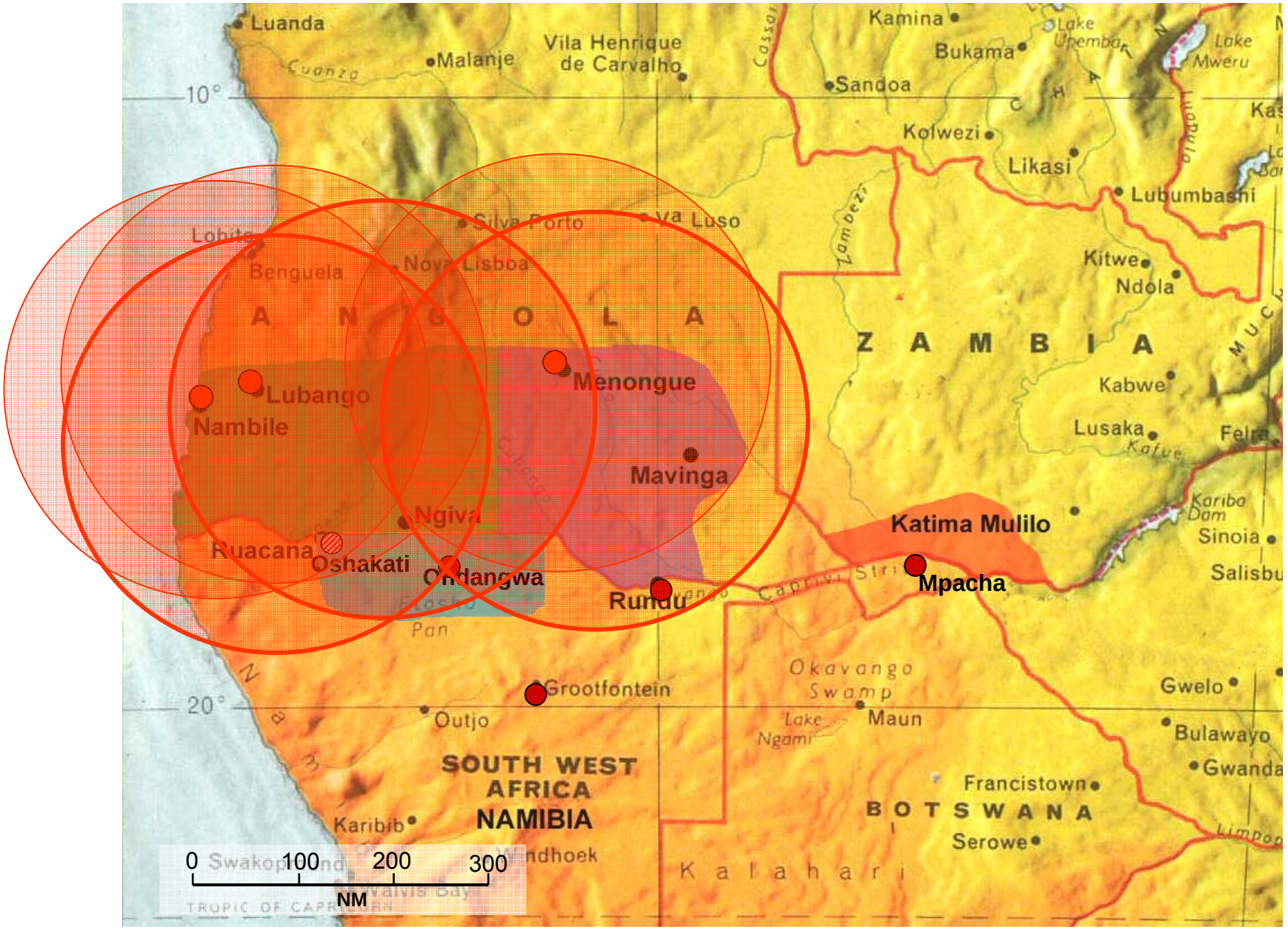
57mm AAA Fire Control Radar i.e. S – 60 “Flapwheel”

SAM 3 with“Low Blow” TWS Radar

Air War - Continuously escalated from 1978 - 1989

1978	Optically aimed AAA (23mm, 37mm, 57mm) MIG 21's (early models) Limited radar coverage
1979	SAM 7
1980	SAM 3, S-60 AAA (Flapwheel) MIG 21 J More radar coverage
1981 - 1982	ZSU 23-4 AAA, SAM 8, SAM 9 More radar coverage with a lot of redundancy involving P-12 "Spoonrest", P-15/19 "Flatface", P-35/37 "Barlock" early warning and "Thin-skin" and "Side-net" height finder radars at the same location.

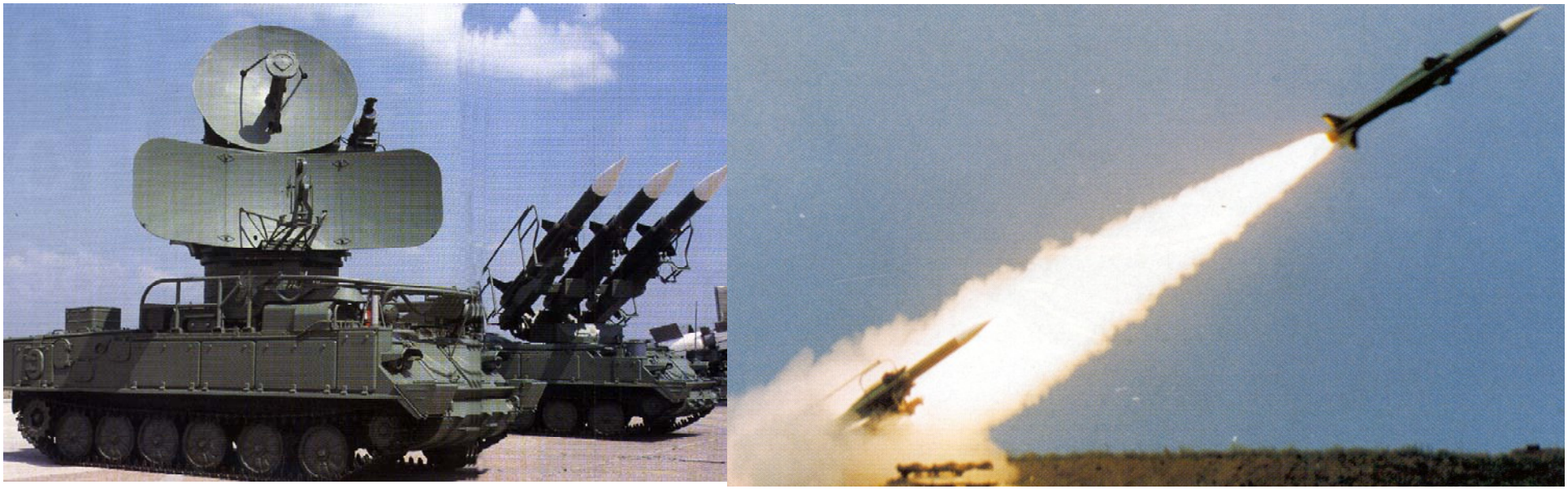
SAM 8 with Land Roll Acquisition & Tracking Radar


Luanda
Malanje
Vila Henrique de Carvalho
Kamina
Bukama
Sandoa
Kolwezi
Likasi
Lubumbashi
Kitwe
Ndola
Kabwe
Lusaka
Menongue
Lubango
Nambile
Mavinga
Ruacana
Oshakati
Ondangwa
Rundu
Katima Mulilo
Mpacha
Sinoia
Grootfontein
Outjo
Maun
Gwelo
Bulawayo
Francistown
Gwanda
Serowe
Karibib
Windhoek
Walvis Bay
Kalahari
ANGOLA
ZAMBIA
BOTSWANA
SOUTH WEST AFRICA
NAMIBIA
10°
20°
0 100 200 300
NM

1983 - 1984

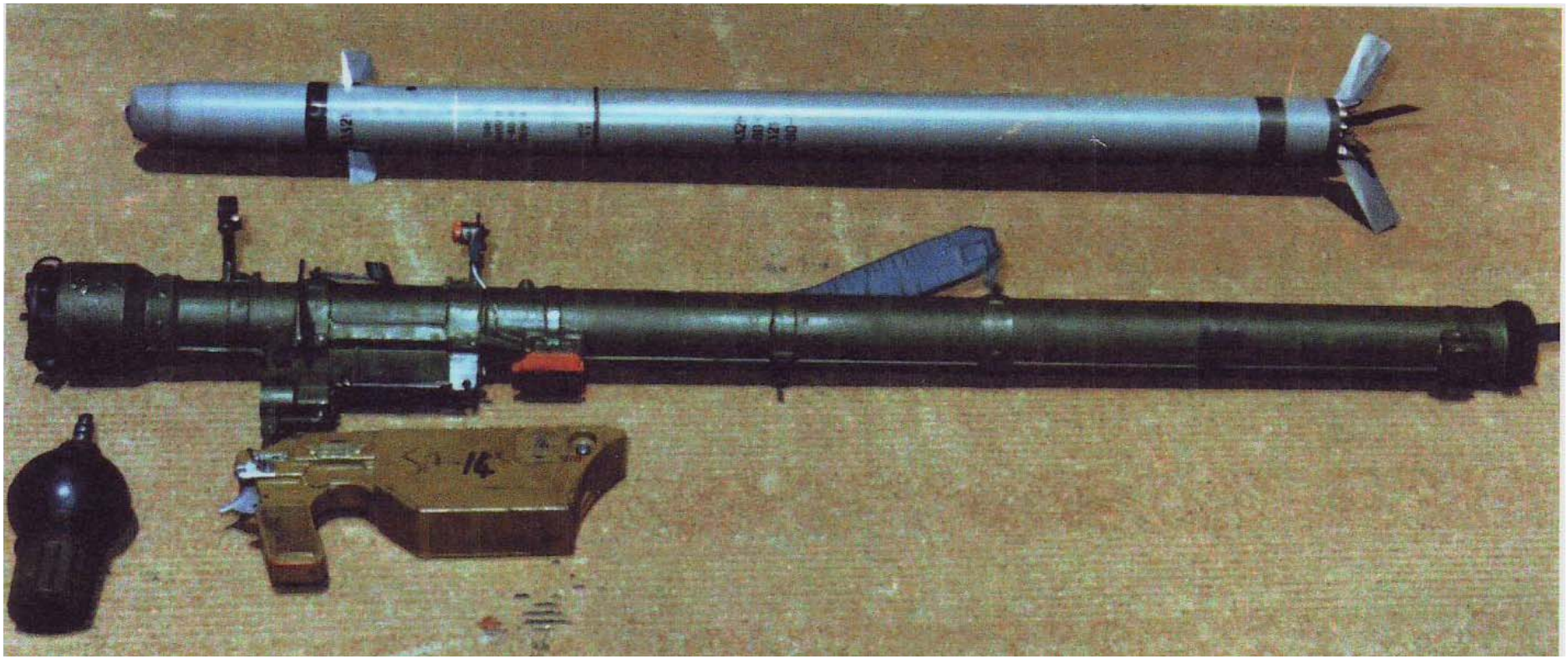
SAM 6, SAM 2
SU 22, MIG 21 Bis, MIG 23
MI 25

SAM 2 with “Fansong” TWS Radar



SAM 6 with “Straight Flush” Tracking & Target illumination Radar

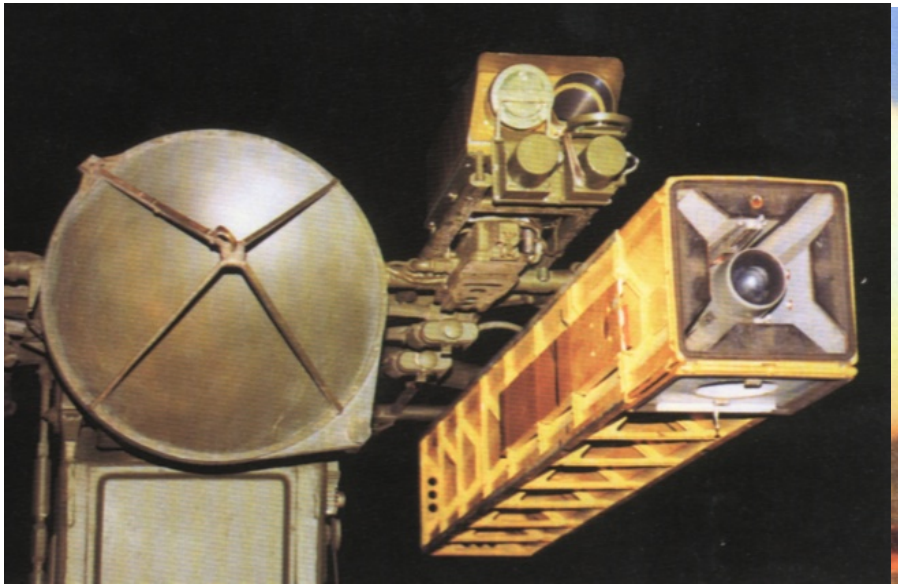
1983 - 1984	SAM 6, SAM 2 SU 22, MIG 21 Bis, MIG 23 MI 25
1985 - 1986	SAM 14 SU 25, MI 35 More radar coverage



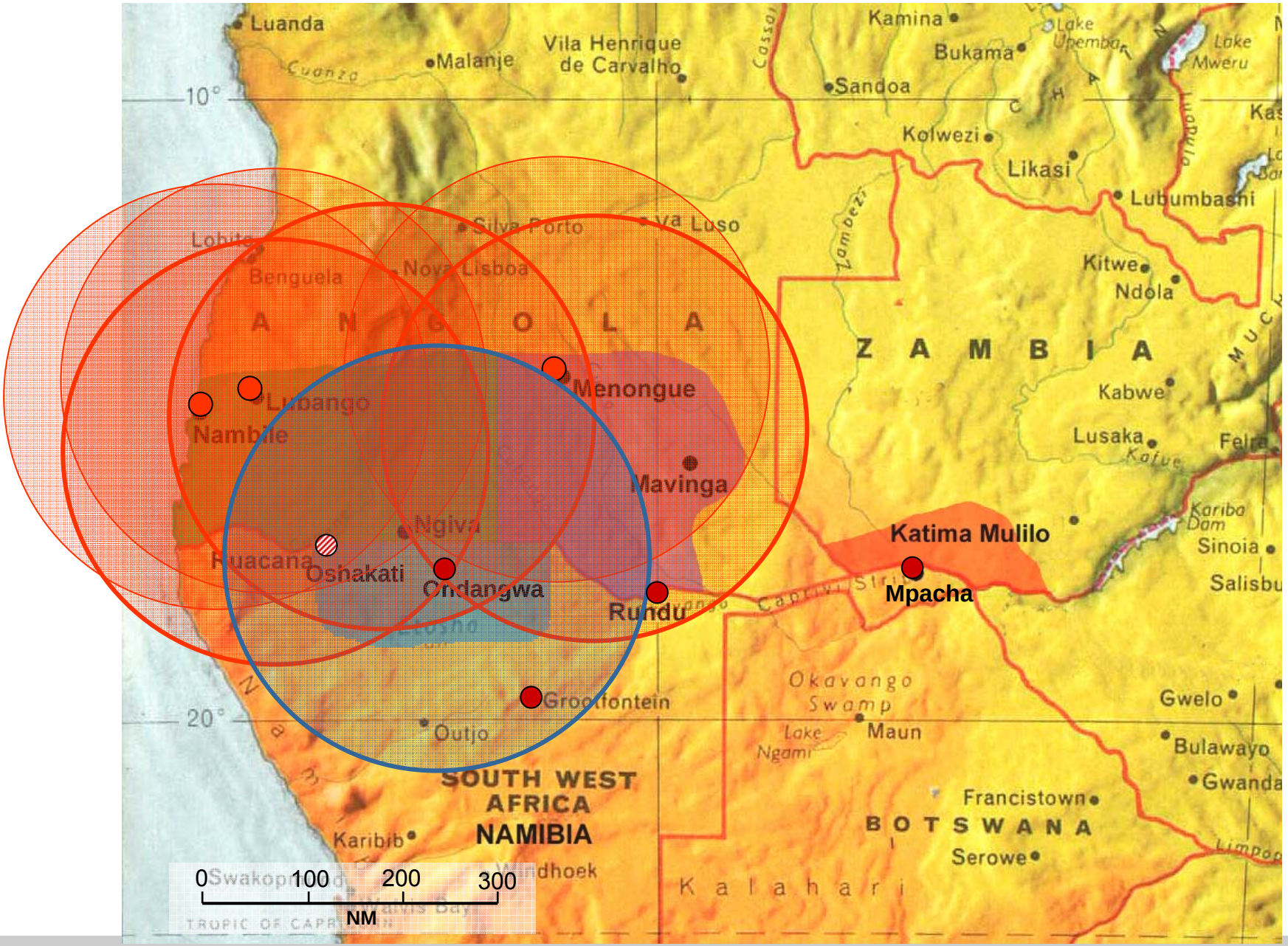
SA 14/ Strela 3

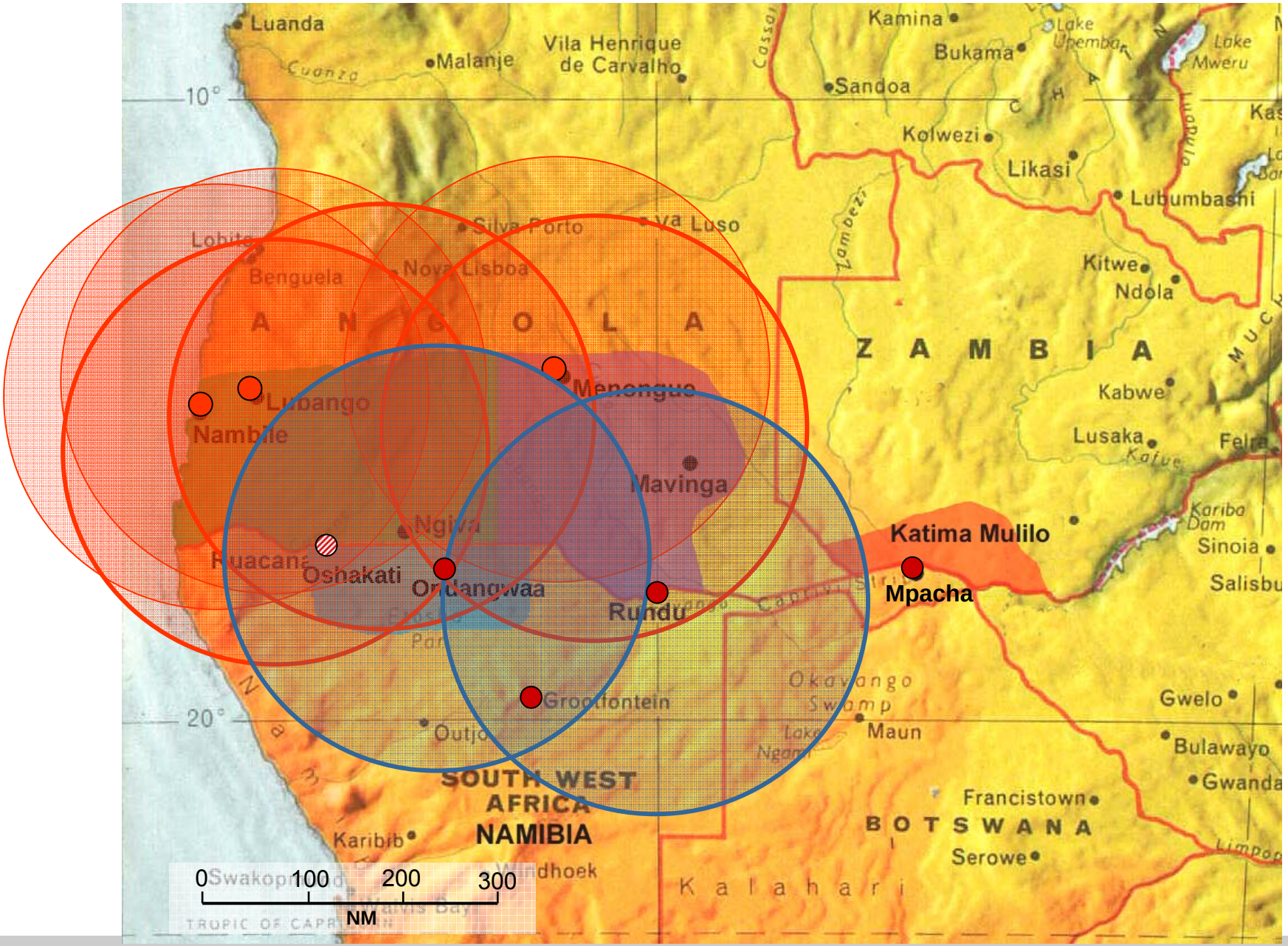
1983 - 1984	SAM 6, SAM 2 SU 22, MIG 21 Bis, MIG 23 MI 25
1985 - 1986	SAM 14 SU 25, MI 35 More radar coverage
1987 - 1989	SAM 13, SAM 16 MIG 23 K

SA 16/ Igla -1

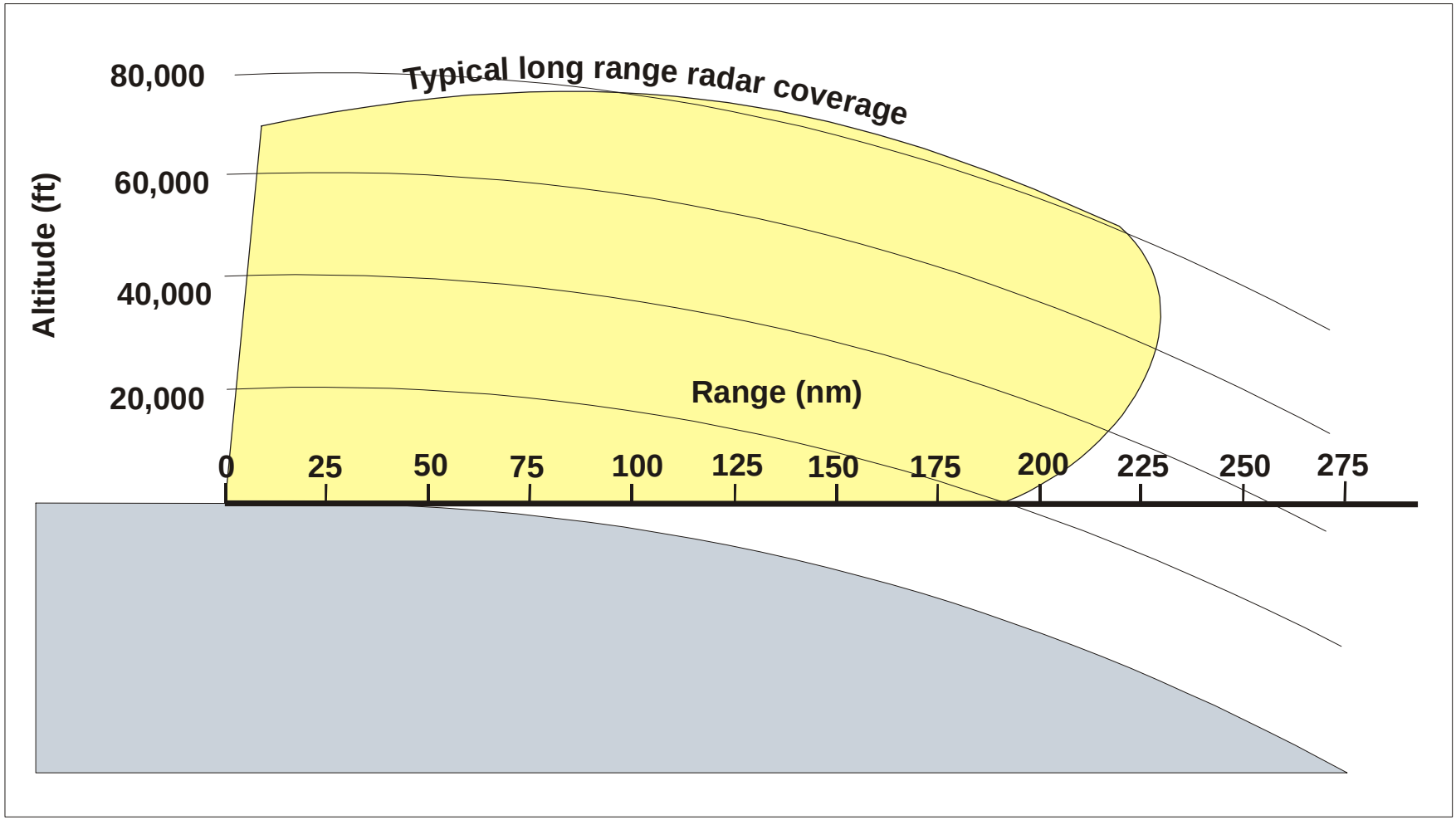


SA 13 / Strela 10


Luanda
Malanje
Vila Henrique de Carvalho
Kamina
Bukama
Sandoa
Kolwezi
Likasi
Lubumbashi
Kitwe
Ndola
ZAMBIA
Kabwe
Lusaka
Katima Mulilo
Mpacha
Sinoia
Menongue
Lubango
Namibe
Benguela
Mavinga
Ngiva
Ruacana
Oshakati
Ondangwa
Rundu
Grootfontein
Outjo
SOUTH WEST AFRICA
NAMIBIA
Karibib
Okavango Swamp
Lake Ngami
Maun
Gwelo
Bulawayo
Francistown
BOTSWANA
Serowe
Kalahari
10°
20°
0 100 200 300
NM


Luanda
Malanje
Vila Henrique de Carvalho
Kamina
Bukama
Sandoa
Kolwezi
Likasi
Lubumbashi
Kitwe
Ndola
ZAMBIA
Kabwe
Lusaka
Katima Mulilo
Mpacha
Sinoia
Mavinga
Menongue
Lubango
Namibe
Benguela
Nova Lisboa
Silva Porto
Oshakati
Ondangwaa
Rundu
Grootfontein
Outjo
Maun
Gwelo
Bulawayo
Gwanda
Francistown
BOTSWANA
Serowe
SOUTH WEST AFRICA
NAMIBIA
Karibib
Windhoek
Kalahari
Okavango Swamp
Lake Ngami
Kariba Dam
Zambezi
10°
20°
0
100
200
300
NM

Effect of Earth's Curvature on Radar coverage



The statistics in this presentation may contain some errors although reasonable effort was taken to verify the numbers.

If errors do occur, they were not intentional but made in good faith. It will however be surprising if the accuracy of the statistics vary more than 10%.

Discussion and Analysis of Losses due to Enemy Ground Fire – 17 Aircraft of which 13 were in Angola :

Small arms fire – Nine aircraft.

- Three Alouette III helicopters (two in Rhodesia)
- Two Puma helicopters
- Two Impala Mk II
- One Canberra
- One Mirage III RZ

AAA – Six aircraft.

- Two Alouette III helicopters
- Two Puma helicopters (one in Mozambique)
- Two Impala Mk II

RPG 7 – Two aircraft.

- Two Alouette III helicopters (one in Rhodesia)

Alo III shot down by ground fire recovered by Puma

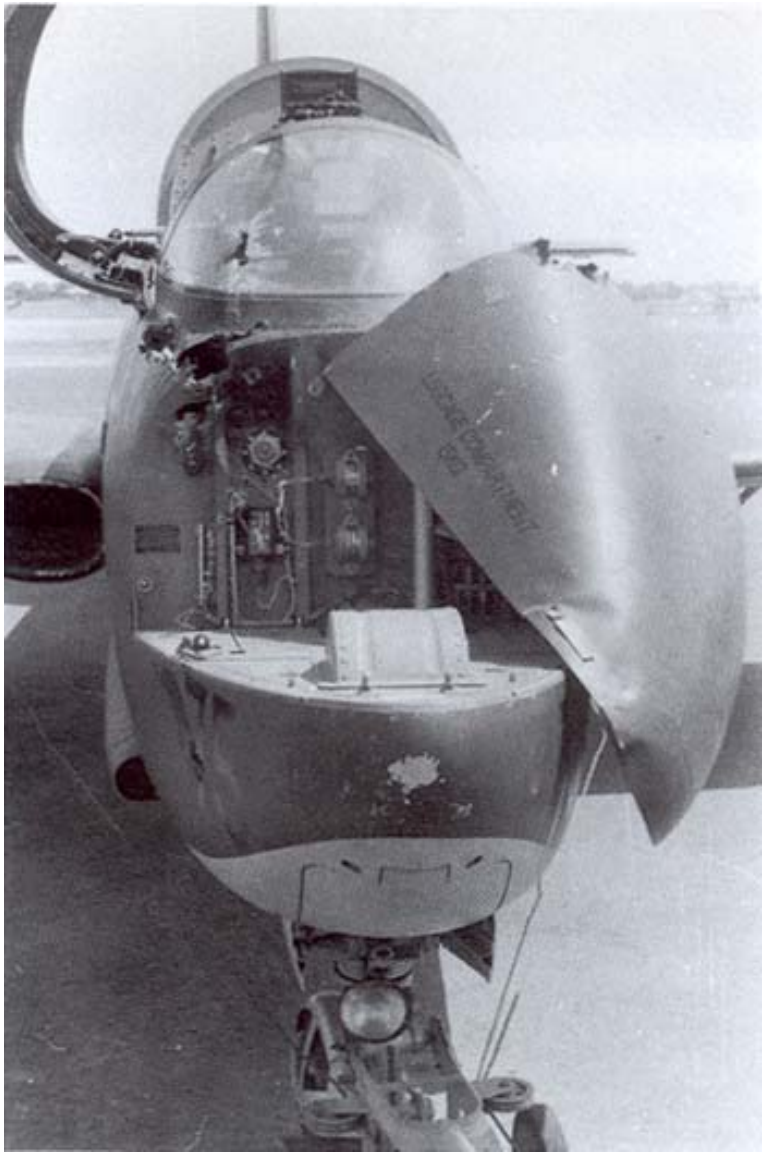
Wreckage of Impala Mk II shot down by ground fire

Shot down Puma recovered by another Puma

Most of the losses occurred prior to 1980 when tactics and the corresponding skills of aircrew was found wanting. Lessons were however being learned (fast) and applied which subsequently improved the situation markedly and will be discussed later.

As an example, when the Impala Mk II were deployed on a permanent basis in the “Operational” area towards the end of 1978, one Impala per month was lost or suffered substantial damaged for the first six months. (Not all the losses were however attributed to enemy action).

Many small arms fire, AAA and even RPG 7 hits causing only minor damage were also suffered. In a number of cases aircrew were wounded as well.



Extremely lucky Impala Mk II pilot survived direct 23mm hit that entered the cockpit

Missile engagements experienced (IR and Radar guided)

Total missile launches:

- Conservative estimate based on confirmed visual sightings **> 400.**

- Twelve missile hits involving 10 aircraft were experienced which resulted in four losses. Two UAVs were also shot down.

- IR guided missiles of which Man Portable Air Defence Systems (MANPADS) were the majority by far, were responsible for more than 80% of all missile launches. The reasons are well known :
  - Provided in large quantities by East Block countries during the Cold War.
  - Easily transportable.
  - Relative unsophisticated, robust, reliable and easy to operate.
  - Passive i.e. no warning prior to or after missile launch.
  - Near impossible to predict where to expect launches from.

} Very difficult to avoid launches

Breakdown and analysis of missile launches

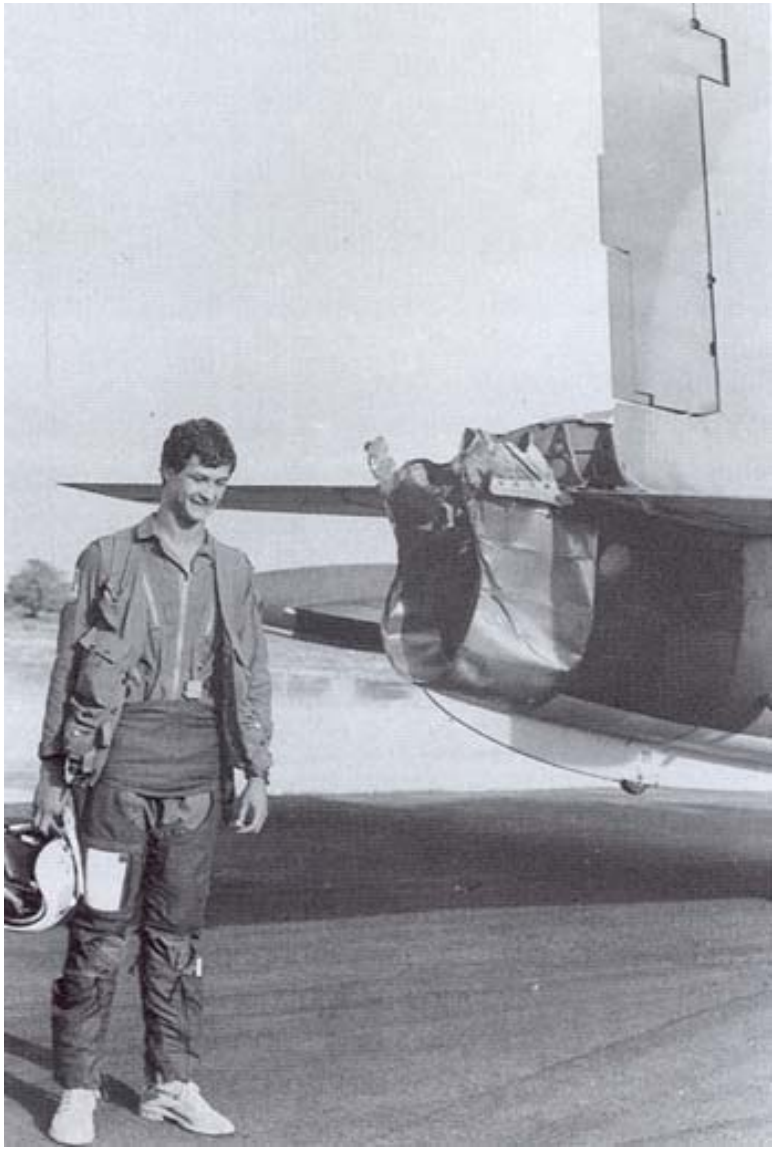
IR Guided Missiles

- **MANPADS** (Vast majority SA-7)    
  - **Allouette III:** >100 launches with no hits.
    - Good tactics i.e. nap of the earth (NOE)
    - Good EW (IR signature suppression) when conducting “gunship” operations at the very vulnerable height of 800ft above ground level.
  - **Puma:** 6 launches with no hits.
    - Good tactics i.e. NOE.
  - **Transport and Light aircraft:** 12 launches.
    - One C47 hit as a result of modification to strengthen control surfaces against hail, which negated IR signature suppression modifications.
    - Good tactics and IR suppression on light aircraft, C 47 (Dakota) and C 54 (Skymaster) prevented more hits.

Damaged rudder and elevators of C 47 after hit by SA – 7

(Landscape typical of Ovamboland – notice the total absence of high ground. Southern Angola is as flat but has much less human activity and therefore more trees).

- **Impala Mk II** > 100 launches. Four hits on three Impalas. Two lost and one landed.



Damaged Impala Mk II jet pipe
as a result of direct SA -7/14 hit

- **Impala Mk II** > 100 launches. Four hits on three Impalas. Two lost and one landed.

  - Steep learning curve rectified initial bad tactics and profiles.
  - No EW protection until last four years of conflict (RWS + CMDS)
  - The Impala hit by two missiles made the fatal error by climbing in area where they have been operating for some time which allowed enemy time to react. Standard operating procedure were then changed to prevent this from happening again.

Fighter/Strike Aircraft ~ 100 launches

- **Mirage III:** One SA - 7 hit.

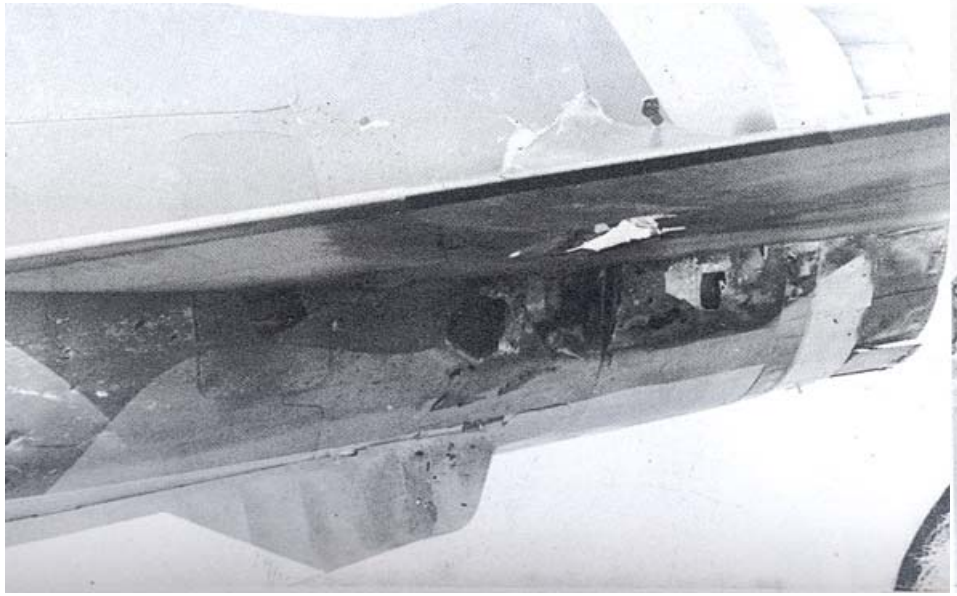
  - Bad tactics used in early stage of conflict during rocket attack and aircraft had no EW protection.

Damaged Mirage III CZ tail as a result of a direct SA – 7 hit

- **Impala Mk II** > 100 launches. Four hits on three Impalas. Two lost and one landed.
  - Steep learning curve rectified initial bad tactics and profiles.
  - No EW protection until last four years of conflict (RWS + CMDS)
  - The Impala hit by two missiles made the fatal error by climbing in area where they have been operating for some time which allowed enemy time to react Standard operating procedure were changed afterwards to prevent this from happening again.

Fighter/Strike Aircraft ~ 100 launches

- **Mirage III:** One SA - 7 hit. Aircraft landed back at base.
  - Bad tactics use in early stage of conflict during rocket attack and aircraft had no EW protection.
- **Mirage F1:** One SA - 7 hit. Aircraft landed at forward base.
  - Bad planning and tactics during early phase of conflict and no Counter Measures Dispensing capability.



Damaged caused by direct SA – 7 hit on Mir F1 AZ left hand tail plane and secondary fire damage. Same aircraft was also hit by SA -3 (proximity fuse fortunately detonated at some distance) which “only” resulted in hydraulic and partial electrical failure.

- **Vehicle Launched IR missiles: ~ 30** (SA - 9 and SA - 13)

  - **Impala Mk II:** One SA - 9 hit. Aircraft landed at forward airfield.
    - Pilot warned his wingman of a missile launch as they recovered out of an attack. He was distracted by this and did not manoeuvre optimally.
    - Mutual support was not yet re-established after attack. Wingman also broke hard to avoid the missile and therefore could not cover and warn his leader of the second missile.
    - Also had no counter measures dispensing capability.

- **Mirage F1:** One SA – 13 hit. Aircraft and pilot lost.
  - Bad planning which deviated from standard operating procedures i.e. using the same run in for repeated attacks on the same day - became very predictable!!
  - Pilot again distracted after warning his wingman of a missile as they recovered out of an attack. Did not manoeuvre optimally as a result.
  - Mutual support was also not yet re-established after the attack. He was still in the wingman's blind zone up to the last moment when the wingman tried to warn him a split second before a second missile impacted into his F1.
  - Also had no Counter Measures Dispensing capability.

UAV: One SA – 13 hit (some uncertainty whether it was not SA - 8). UAV lost.

Seeker UAV

Many potential IR guided missile launches were prevented by:

- Thorough knowledge about threats obtained from the exploitation of captured missile systems and other intelligence.

Captured SA - 9 (1983) being recovered under guidance of Air Force experts

Many potential IR guided missile launches were prevented by:

- Thorough knowledge about threats obtained from the exploitation of captured missile systems and other intelligence.

- This allowed:

  - Tactics and flight profiles designed to stay either inside the minimum or beyond the maximum engagement ranges and altitudes and within the minimum reaction time of the missiles as far as possible. This was not always successful mainly due to chance factors and mistakes made.

  - IR suppression designs were quite successful in reducing lock-on ranges and even preventing lock-on (especially SA - 7), for piston engine aircraft and Alouette III helicopters.

Radar Guided Missile Launches ~ 30:

SA – 2:

- **Impala Mk II:** Two launches.

  - Inadequate intelligence (good enemy emission control).

  - RWS and Chaff plus good tactics and training prevented any hits.

SA – 3:

- **Mirage F 1:** Seventeen launches against last eight of sixteen F1s participating in a strike. Two aircraft hit. One landed back at base and one at forward air field.

  - Real bad planning plus bad tactics during early phase of conflict.
  - Obsolete RWS with no Counter Measures Dispensing capability.

- **UAV:** Two or three launches with loss of a UAV (not in Angola but in Mozambique).

SA – 6:

- **Impala Mk II:** Two launches.
  - Inadequate intelligence (good enemy emission control).
  - RWS and Chaff plus good tactics and training prevented any hits.
- **Canberra:** Launch after radar lock-on prevented.
  - Active radar jamming during a reconnaissance mission.

SA – 8:

- **AMC – 3:** Three launches and aircraft lost.
  - Lack of intelligence (good emission control by the enemy).
- **UAV:** Four launches
  - Only explanation that UAV survived is that proximity fuses did not detonate, maybe RCS of UAV too small ?

- **Buccaneer:** Launch after radar lock-on prevented.
  - Active radar jamming and Chaff.

Many potential radar guided missile launches were prevented as good tactics were developed which was based on :

- Sigint providing intelligence of location of missiles sites. Good planning therefore restricted unexpected missile launches to a large extent. (Very good emission control by enemy were applied towards the latter phases of the conflict and as seen, surprises did occur!)
- ESM provided real time situational awareness of radar activity before aircraft entered engagement zones of missile air defences. Attacks could therefore be aborted if surprise was considered vital but not achieved.
- RWS with good threat libraries also allowed pilots to avoid engagement zones or fly for survival if already within engagement zones of missile defences.
- Thorough knowledge about the threats obtained through Elint, exploitation of captured threat systems and other intelligence, enabled:
  - Good planning to avoid engagements by staying out of kill zones (minimum or maximum altitudes and ranges)
  - Developed tactics that exploited minimum reaction time of missile systems when the kill zones had to be penetrated.

Recovering captured SA -8 (1987)

Counter Measures – Operational Procedures, Tactics, EW and Aircrew Protection.

Exploiting the environment:

- The terrain in the operational area was extremely flat which did not allow the enemy visual lookout posts to detect low flying aircraft (no hill or high ground over an area covering about 600 x 400 nautical miles).

- The country side is further generally wooded with randomly scattered “shanas” (shallow pans filled with water in the rainy season). The bush also becomes more dense towards the East in both Angola and Namibia (higher rainfall). This further restricted early visual detection of low flying aircraft - especially fast flying aircraft.

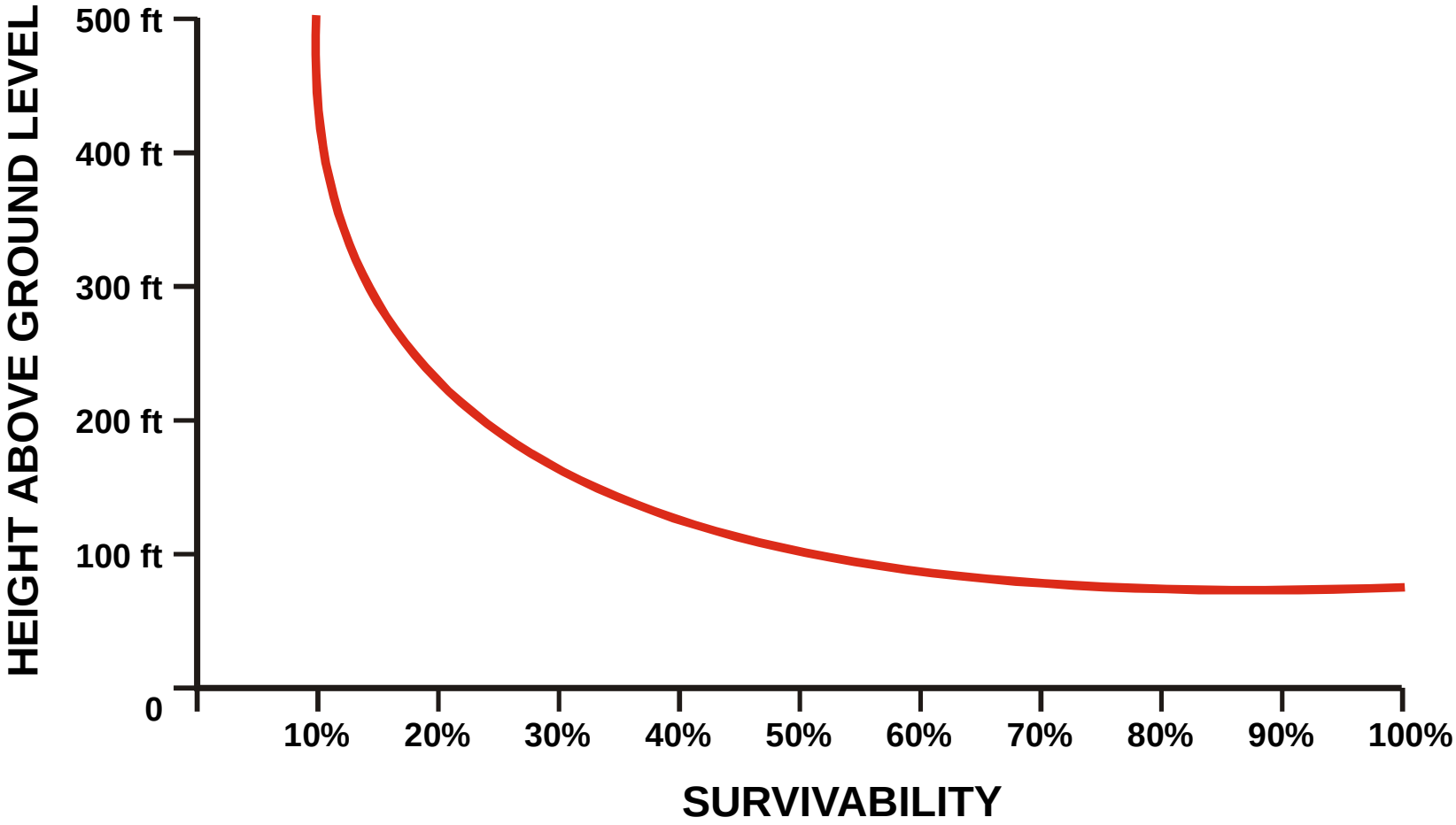
- Enemy radar coverage as we have seen, gradually expanded to become quite comprehensive. It was however never capable to provide early warning against own low flying aircraft.

Flying Tactics, Operational Procedures and EW Considerations:

- Low flying became a way of life …. but really low - even fast jets operating < 100ft. The terrain coupled with good training made it possible.

.

SURVIVAL AS A FUNCTION OF HEIGHT



Flying Tactics, Operational Procedures and EW Considerations:

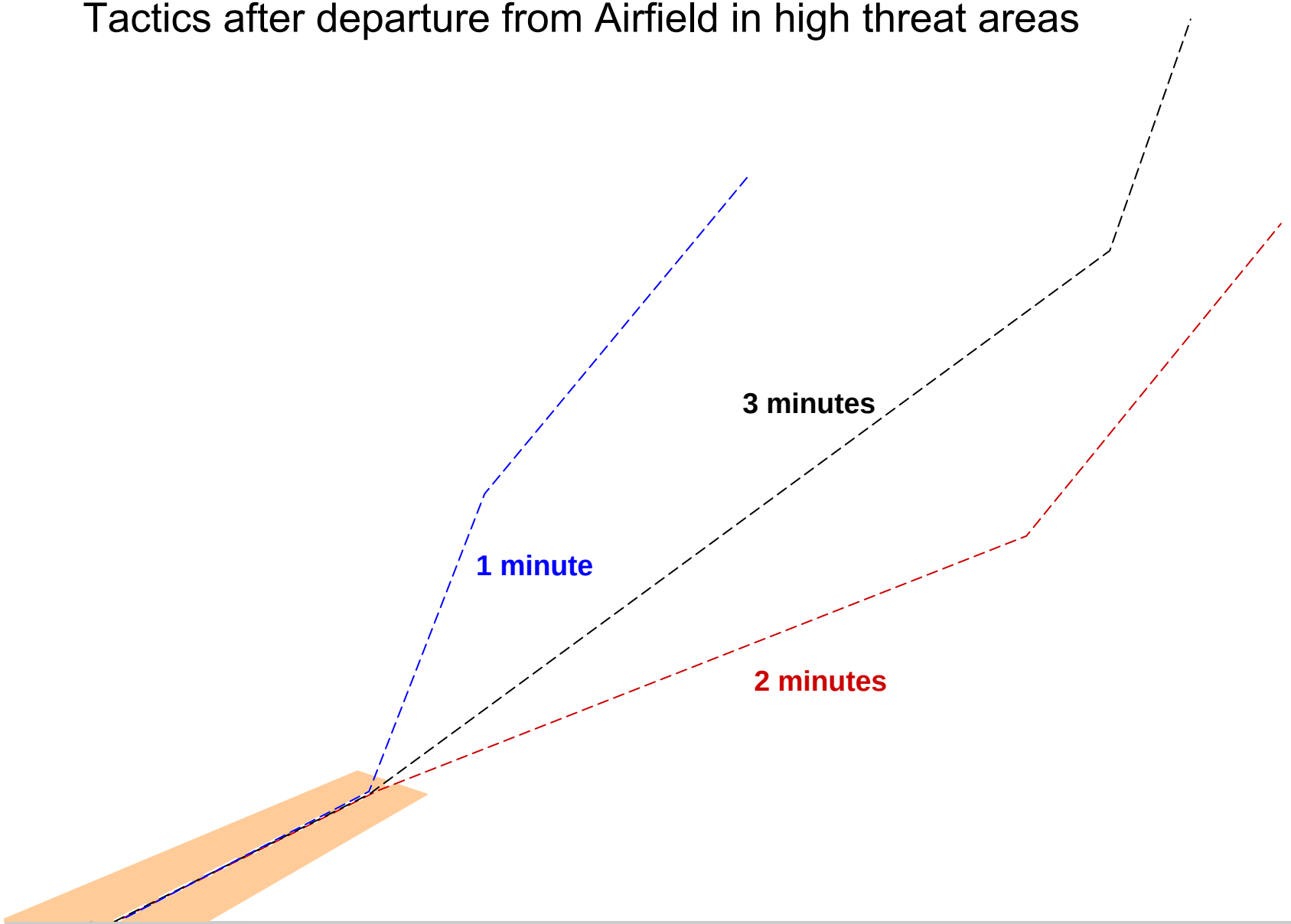
- Low flying became a way of life …. but really low - even fast jets operating < 100 ft. The terrain coupled with good training made it possible.
- Slow flying helicopters operated in the nap of the earth and avoided flying over open terrain like “shannas” where there was a higher risk of drawing small arms fire from the surrounding bush.
- Train as you intend to conduct operations. Optimize training to improve skills and exploit opponent’s weaknesses.
- Try to avoid doing things for the first time in operations if you are not properly prepared and trained for it. The importance that realistic “Golden Eagle” i.e. “Red Flag” exercises played, cannot be over emphasized.
- Tactical night capability was also developed for all the different types of aircraft.

.

- If at all possible, stay outside the kill envelope of threats and when penetrating kill zones is unavoidable, limit the time spent within it.
  - Operate either inside the minimum or beyond the maximum engagement ranges and altitudes and within the minimum reaction time of threat systems as far as possible.
- Always keep the opponents guessing, avoid being stereotype and predictable.
  - Do not fly line astern - the enemy will be ready for the following aircraft. (Lost a Puma before this became a standard operating procedure).
  - Do not re-attack the same target right away and fly well clear from the target area before commencing climbing - you have just alerted them. (Lost an Impala Mk II who made this mistake).
  - Do not use the same routes in a set (predictable) pattern. (MANPADS hit on C 47 and lost Mir F 1 as a result of this).

- When you have to climb, especially after departure from an airfield:
  - Stay low, turn randomly 10, 20, 30 degrees port or starboard just after take off but not the same direction as previous aircraft.
  - Vary the time spent at low level before starting the climb.
  - Aircraft type permitting, build some speed and zoom to limit the time spent in the vulnerable lower altitudes.

Tactics after departure from Airfield in high threat areas



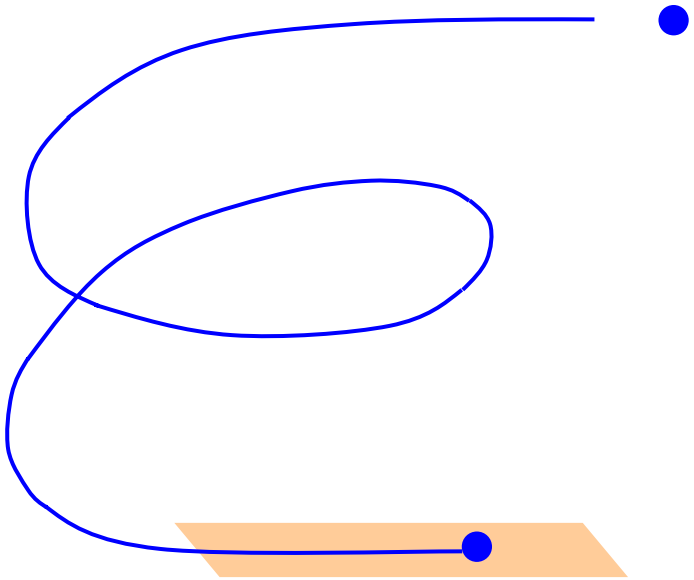
- When you have to climb, especially after departure from an airfield:
  - Stay low, turn randomly 10, 20, 30 degrees port or starboard just after take off but not the same direction as previous aircraft.
  - Vary the time spent at low level before starting the climb.
  - Aircraft type permitting, build some speed and zoom to limit the time spent in the vulnerable lower altitudes.

- When approaching an airfield to land, one of the following procedures were followed:
  - High approach
    - Fly overhead the airfield at approach speed while staying above the maximum engagement height of the MANPADS threat i.e. > 15000ft.
    - Reduce power to idle (present minimum IR signature), lower the landing gear etc and spiral down as tight as possible (forcing MANPADS operators to risk coming too close to the airfield for a successful missile launch).
    - Land directly without flying a long straight (predictable) leg on finals (which would have allowed MANPADS operators a lower risk launch opportunity).

- When you have to climb, especially after departure from an airfield:
  - Stay low, turn randomly 10, 20, 30 degrees port or starboard just after take off but not the same direction as previous aircraft.
  - Vary the time spent at low level before starting the climb.
  - Aircraft type permitting, build some speed and zoom to limit the time spent in the vulnerable lower altitudes.

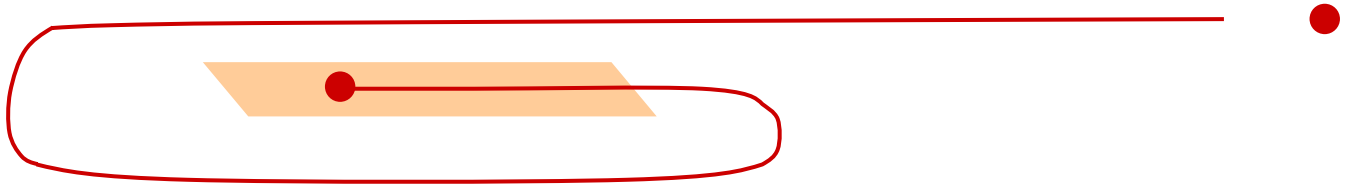
- When approaching an airfield to land, one of the following procedures were followed:

High approach

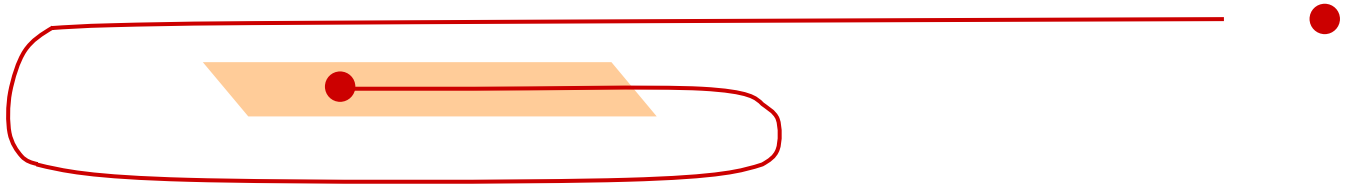


- Low approach

  - Join the airfield at low level, either at initial, down wind or for a “straight in” approach. Stay low level all the way until touch down (below minimum MANPADS launch height/launch angle).



- Low approach



Note: **A helicopter “gun ship” (Alouette III with 20mm cannon operated by the flight engineer) was always airborne and positioned appropriately when other aircraft landed or departed – further discouraging MANPADS operators!**

- Know the threats you are up against - without this knowledge, development of skills, good planning and successful execution of missions are impossible and probability of survival reduced.

- Know own capabilities and limitations and operate at the edge there-of but within it. Do not have unrealistic expectations.

- Prevent or at least reduce effective tracking of the threat systems by combining flying manoeuvers and ECM.

- Keep continuous situational awareness of current situation and react accordingly. (Use inputs from own sensors, intelligence picture, “mental time clock” when engagement zones of threat systems are penetrated)

Electronic Warfare:

The sustained effort launched in the 1970s to establish a comprehensive EW capability resulted in the following Self Protection EW Systems.

- **Counter Measures Dispensing Systems (CMDS) & Radar Warning Systems (RWS):**
  - The locally designed CMDS and RWS built under license, entered production by 1980 and was fitted to all fighter and attack aircraft.
    - The long “EW” fleet embodiment programs, flight clearances, etc. delayed aircraft reaching operational status until about the middle 80s. The Mirage F1 did not become operational with CMDS until it was too late.
    - Both Chaff and Flares proved their worth once they became available. IR missiles hitting flares directly were observed on a number of occasions.
    - RWS was invaluable and boosted aircrew’s confidence and allowed timely decisions which saved many aircraft. Very useful intelligence was gathered as well.

- **Active RF Jammer:**
  - RF jammer pods were acquired in limited numbers. The Buccaneer, Canberra, Mirage FI AZ and Mirage III RZ were equipped with the pods.
    - Active (deception) jamming proved it's worth and as said before, defeated both the SA - 6's "Straight Flush" and SA - 8's "Landroll" tracking radars and prevented missile launches.
- **IR suppression:**
  - Screening of engine exhaust pipes and in some cases also cooling of exhaust plumes.
  - Camouflaging aircraft with specially developed paint that scattered IR energy to prevented reflections (which is often a major source of IR energy).
    - As mentioned before, this effort achieved quite useful results on aircraft types with not too big IR signatures. It allowed such aircraft to continue operating in environments that would not otherwise have been possible.
    - Efforts on aircraft fitted with turbo and jet engines were however not successful. The Alouette III was an exception (engine's air mass flow is rather small).

- **Test, Measurement and Evaluation Systems:**

  EW systems and flying tactics to use in conjunction with the EW, cannot be developed and optimized without the means to test and evaluate the effectiveness there of. *The importance of this is vital – not having the facilities and not doing this, is unacceptable and irresponsible.*

  It is further vital that such facilities is well maintained, kept updated to stay abreast latest technology of threat systems and **used regularly !**

Air Crew Protection

- A program to protect helicopter and C 47 aircrew from small arms fire was also launched. Armor strengthened seats were developed and continuously improved to reduce mass and increase strength. It saved many aircrew from being wounded and killed by ground fire from below.

- “Flak jackets” were also worn by helicopter aircrew to increase protection when drawing fire while flying low. Although uncomfortable, it proved it’s worth.

Are the lessons learnt during this conflict nearly two decades ago applicable to International Peace Operations of today?

- In general, as far as the kind of threats that might be encountered are concerned, the following :
  - The Air Operations conducted in the more conventional phases of the conflict are more applicable to Peace Enforcement Operations.
  - The on-going counter insurgency type air operations are on the other hand more relevant to Peace Maintenance and Peace Support Operations.
- Other considerations that must be kept in mind is the environment in which the Peace Operation takes place:
  - The prevailing political, military, social and economic situation.
  - The mindset and culture of the parties and people involved.
  - The terrain.
  - The infrastructure or lack there-of.

- Enough useful “common denominators” however exist that warrants mentioning.
- In general, participants in Peace Keeping have to support their deployed forces (which requires transport aircraft) and provide tactical mobility in the area of operations (which requires helicopters) especially where:
    - Distances are long.
    - Infrastructure is poor.
    - The threat situation and/or road conditions makes traveling by vehicle risky.

Operating Environment during Peace Keeping Operations:

- Unreliable intelligence about threats.
- Guard against routine-like operating procedures which tends to become predictable and therefore dangerous (especially if restricted to operate as you would prefer).

Helicopters are quite vulnerable to air defences due to their limited ability to absorb battle damage and relative slow speed.

Transport aircraft are also quite vulnerable during departures and arrivals due to slow speed and predictable flight paths.

- This makes the requirement for countermeasures, good tactics and skills to increase survivability, compelling.

Countermeasures

- Hardening
  - Definitely not feasible on helicopters and unlikely for transport aircraft.
  - Protection for aircrew must be addressed.

- Signature Reduction
  - New seeker head technology limits success in this regard. Only reduction of the missile's engagement envelope is achieved which is not really good enough.
  - This is further influenced by the prevailing background (cloud cover, mountains, etc) which reduces the effectiveness significantly and unpredictably.
  - This in turn could create a false sense of security for the aircrew.
- EW Self Protection suite
  - Missile Warning System with automatic and intelligent decoy dispensing logic regarding timing and dispensing direction. Any system relying on aircrew involvement, is doomed to fail.
  - RWS might be required depending on sophistication of opposing parties.
  - CMDS with effective decoys and sufficient payload quantities.
  - DIRCM is an option but initial cost, life cycle cost, spatial coverage, and multiple threat handling capability against short range missile launches, are limiting factors.

Operating Procedures

- Should be as unpredictable as possible when forced to operate within the kill zone of threats to minimize engagement opportunities (do not be where the enemy expects you to be i.e. time / location).

Flying Tactics

- Should be aimed to avoid kill zone of threats as far as possible to avoid being engaged.
- If kill zones of threats have to be entered, spend the shortest time possible in those kill zones to reduce engagement time and opportunities.
- Should attempt to enhance countermeasures effectiveness by appropriate manoeuvres and tactics and exploit weaknesses of threats.

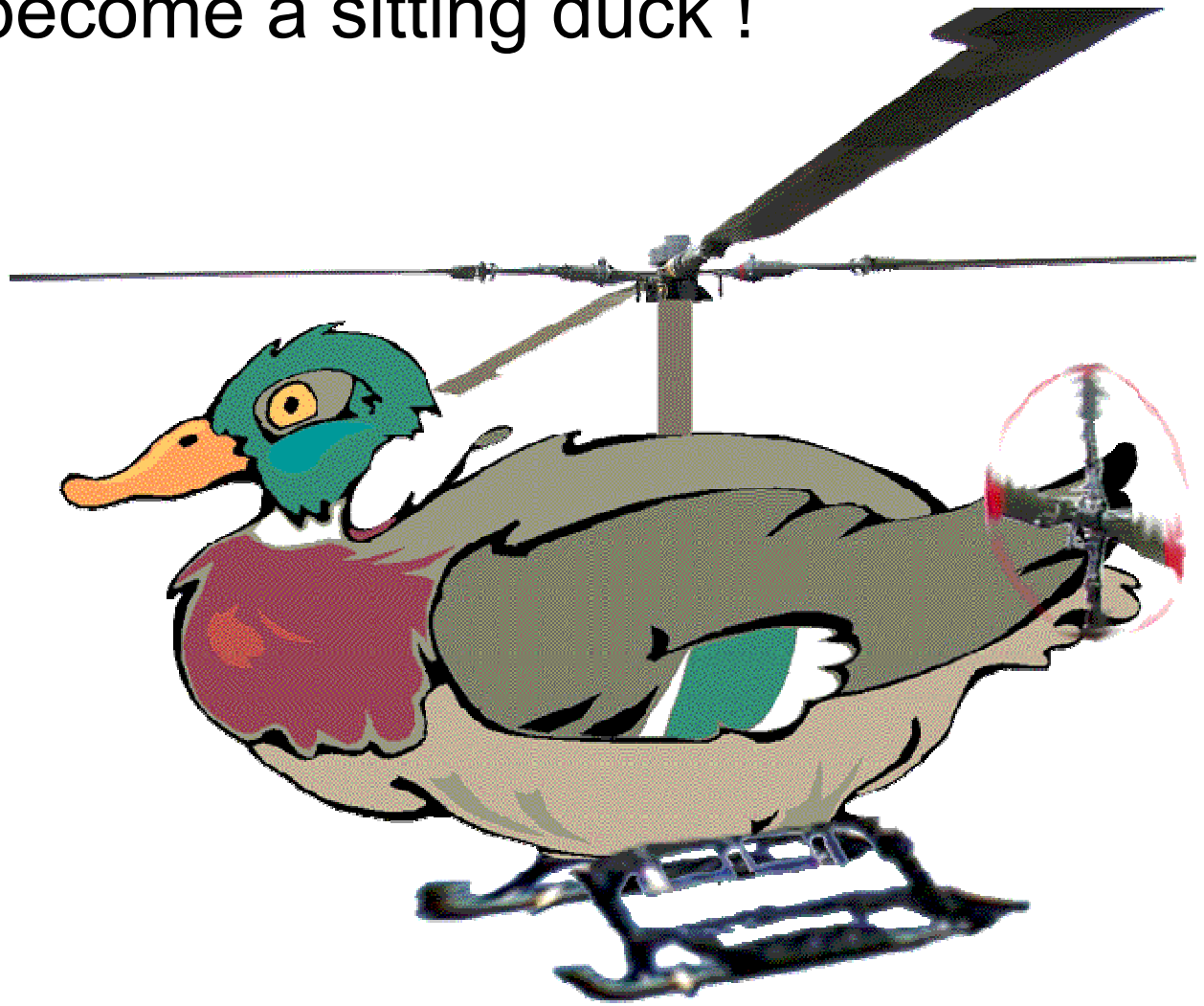
Aircraft type and mission has big impact on how successful this can be executed.

The biggest lessons are to be prepared, not to become complacent, stay alert to small incremental changes in the overall environment, know the threats, think innovatively

and…

Never, ever underestimate adversaries

Don’t become a sitting duck !




www.saabgroup.com