



What was the Impact of the *Luftwaffe's*

'Tip & Run' Bombing Attacks

March 1942 – June 1943?



In March 1942, the *Luftwaffe* formed two dedicated units whose task was to carry out a bombing campaign against shipping and coastal military and industrial installations on the southern coast of England. By fitting bombs to Messerschmitt 109 single-seat fighters, these fighter-bombers, or in German *Jagdbomber* nearly always shortened to *Jabo*, began attacking targets as far east as Kent¹ and as far west as the Lizard in Cornwall. Known to the British as ‘tip and run’ attacks, they continued until the 6th of June 1943² prior to which the *Luftwaffe* had increased its strength of fighter-bombers on the western front from in the region of 28 to 118,³ which had prompted the following phlegmatic British comment:

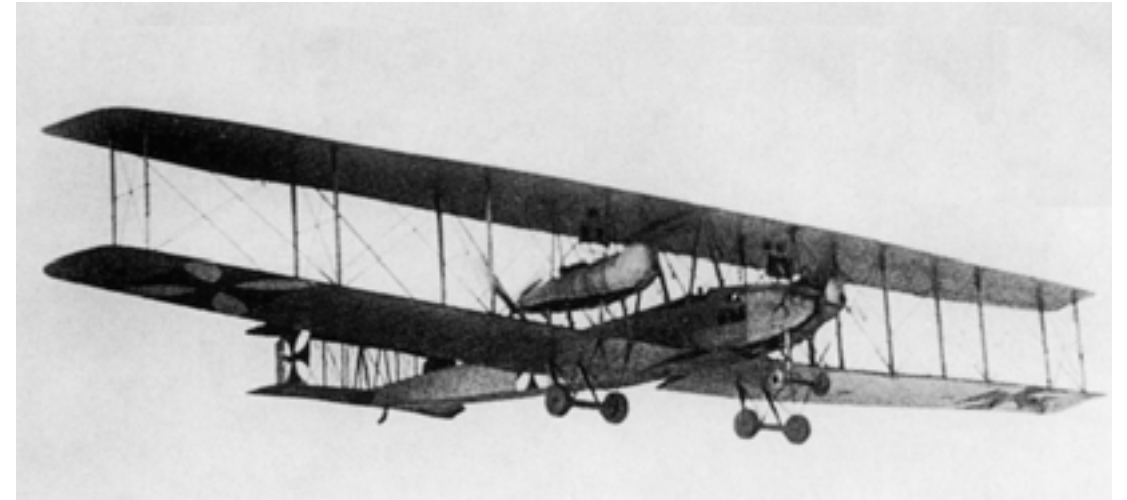
“...for the first three months of the year [1943], the position with regard to enemy fighter-bomber activity was not satisfactory...the problem was to get adequate warning of these low flying raids as, though enemy casualties were high, these casualties mostly took place after the bombs had been dropped...”⁴

Without warning, ‘tip and run’ attacks stopped following the attack on Eastbourne on the 6th of June 1943. The majority of German fighter-bombers were then transferred to the Mediterranean, leaving just 42 fighter-bombers⁵ which were used solely for attacks at night.

This paper will analyse the development of the German tactic of using fighter-bombers prior to March 1942. It will then discuss the impact from the viewpoints of both the *Luftwaffe*, the British military and the civilian population of the ‘tip and run’ campaign between March 1942 and the 6th of June 1943. It will conclude by questioning the German decision to stop such attacks, whether ‘tip and run’ attacks had been effective or not and the lessons that had been learned as a result.

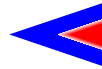
...Germany was keen to prove the superiority of its Zeppelin airships and its specially designed 'battle planes' such as the Gotha...

The origin of the term 'tip and run' is not known but it was first applied to the infrequent small-scale bombing attacks carried out on south-east England by aircraft of the German Imperial Navy in the First World War.⁶ Kaiser Wilhelm II had been begged to authorise limited air attacks against British coastal targets of a military nature and when in January 1915 he acquiesced, military facilities on the shores of the Thames Estuary became legitimate 'tip and run' targets. However, a lack of suitable aircraft, the distance from bases in Belgium and the greater importance of air operations on the Western Front limited the scale of such attacks and by the end of 1916, approximately 25 people had been killed but the military and civilian impact of such attacks is believed to have been minimal.⁷ By then, Germany was keen to prove the superiority of its Zeppelin airships and its specially designed 'battle planes' such as the Gotha and targets switched from 'nuisance raids' to aerial assaults on London and other major cities, something that was to be repeated in 1940. It appeared as if the memory of 'tip and run' attacks would fade into obscurity.



The single-seat Heinkel 51 biplane fighter was, until the arrival of the Messerschmitt 109 monoplane, the Legion Condor's principal fighter

It was in Spain in 1937 that the idea of 'fighter-bombers' was resurrected, a few German fighters in the First World War having been fitted with bombs as a crude way of stemming the Allied advance in the Summer of 1918, these aircraft being termed 'fighter-bombers'. In August 1936, Nazi Germany, concerned that Communists would get a foothold in Western Europe when civil war erupted in Spain, began supporting General Franco's Nationalist army. The *Legion Condor*, a semi-autonomous German air component, would play an important part during the civil war, allowing its aircrew to gain combat experience for the coming Second World War and for



...Henschel 123 dive bombers were quickly brought to Spain and used with great success

Paradoxically, it was the success of the fighter-bomber that ultimately spelt its demise. Impressed by the concept of close air support and pinpoint bombing accuracy, the Junkers 87 *Stuka* and Henschel 123 dive bombers were quickly brought to Spain and used with great success. It was this concept of operations that, following refinement in Spain, was used with great effect from the 1st of September 1939 when Germany invaded Poland and again on the 10th of May 1940 when Germany invaded France and the Low Countries. The *Stuka* suited the *Blitzkrieg* concept and with the air superiority achieved by the *Luftwaffe* in the first nine months of the Second World War, there was no need for a fighter-bomber. This was to change dramatically during the Battle of Britain.

On the 10th of July 1940, the *Luftwaffe* began attacking shipping in the English Channel and coastal targets, hoping to entice the RAF into battle and, by means of attrition, to weaken the RAF's ability to interfere with the planned German invasion of Great Britain. With the Germans anticipating the same air superiority they enjoyed in previous campaigns, it was thought that the *Stuka* would enjoy the same success. However, when the *Stuka* was at last committed *en masse* on the 8th of August

Luftwaffe senior officers to devise and prove a concept of air operations. However, it was in Spain in March 1937 that 'fighter-bombers' proved to be an effective weapon.

The single-seat Heinkel 51 biplane fighter was, until the arrival of the Messerschmitt 109 monoplane, the *Legion Condor's* principal fighter. However, it was becoming increasingly obvious that by February 1937, the Heinkel 51 was inferior to the Soviet fighters being used by the Republican forces. Faced with the inferiority of its principal fighter, the *Legion Condor* decided to enhance its offensive capability, particularly for the battle for Bilbao, by fitting its Heinkel 51s with fragmentation bombs and on the 31st of March 1937, these aircraft were used to bomb and strafe Republican front positions with considerable success. In the days that followed, the fighter-bombers proved ideal at neutralising those targets that medium to high-level bombers found harder to destroy.

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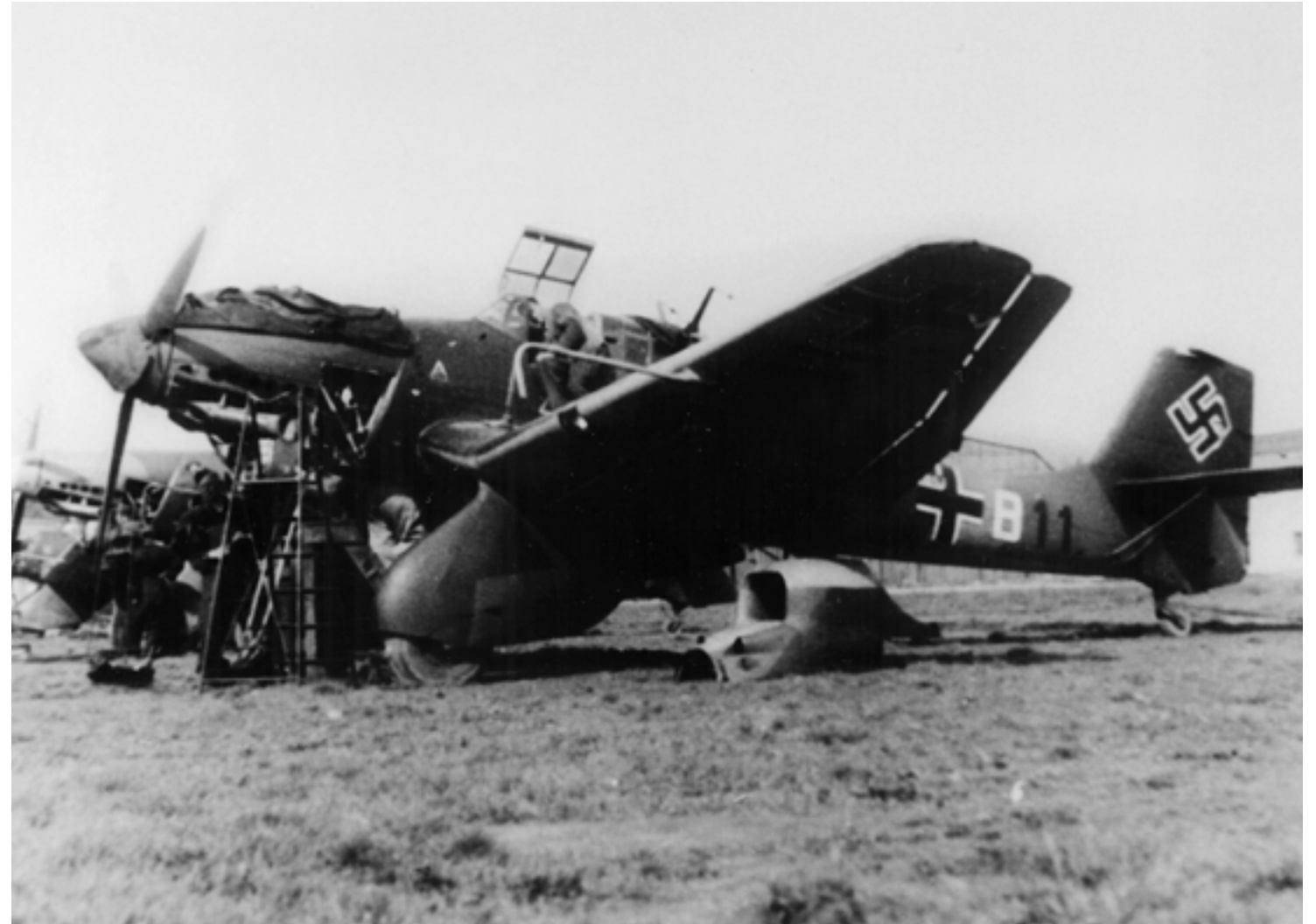
1940, it was clear that against far more superior fighters such as the *Spitfire* and *Hurricane*, the *Stuka* was vulnerable unless it had a substantial fighter escort.⁸ Nevertheless, limited *Stuka* successes on the days that followed appeared to lull the German commanders into using them against inland targets. The results were catastrophic with 25 aircraft shot down and five seriously damaged in the space of two days. The *Stuka* was immediately withdrawn from front line operations and the *Luftwaffe* now had no aircraft that could fulfil the close-support role.

Nevertheless, the *Luftwaffe* had been looking ahead. It was believed that the proposed twin-engined Messerschmitt 210 would be an ideal aircraft to be the

Stuka's successor as it was anticipated that it could be utilised in the close-support role and then be able to defend itself, a true fighter-bomber like the Heinkel 51. However, the Messerschmitt 210 was plagued by technical problems and as its entry into service slipped, the experimental unit formed to develop its use as a fighter-bomber pressed ahead with developing the fighter-bomber concept by using the Messerschmitt 110 twin-engined fighter and to a lesser degree the Messerschmitt 109.

It quickly became obvious that the Messerschmitt 110 was slow and vulnerable after dropping its bombs, any successes being achieved purely through the skill of the unit's experienced pilots. However, the Messerschmitt 109 was found to be a much better fighter-bomber and was able to defend itself so it was decided to develop this aircraft as a *jabo*.

A British intelligence report dated 21 Oct 1940⁹ condensed all that had been gleaned on bombing with the Messerschmitt 109 and appears to be the date that the RAF first acknowledged the existence of fighter-bombers, even though a Messerschmitt 109 captured on the 7th of September 1940 was found to be fitted with a bomb rack and bomb release mechanism.¹⁰



Furthermore, an attack against railway lines by a formation of Messerschmitt 109 *jabos* on the 15th of September 1940 had provoked an outcry by the British Press as to fighter-bombers being 'unfair'.¹¹ The report acknowledged that one German unit had had been practising by bombing with 250 and 500 kg bombs from as early July 1940 and that a third of all German fighter groups were now being retrained as 'Me 109 bombers'. However, by the time that this report had been written, the fighter-bomber phase of the Battle of Britain was almost over.

Following the major attack on London on the 15th of September 1940 and the failure of the conventional bombers in daylight, the *Luftwaffe* switched nearly all of its bombers to nocturnal operations. From the 5th of September 1940 onwards, German fighter pilots had started receiving rudimentary training in using their fighters as bombers, using the gunsight as a bombsight. From the start of October 1940, these *jabos* were then used to bomb at medium and high altitudes. At high level, they were particularly hard to intercept but with a normal bomb load of one 250 kg bomb being dropped by pilots unused to bombing and using a rudimentary aiming system, the accuracy achieved was generally poor and attacks soon began to decrease.

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Additionally, Winter brought with it poor weather which restricted fighter-bomber missions and with the majority of German fighter units being withdrawn to Germany for rest and refit, *jabo* attacks decreased further. Finally, the RAF started offensive fighter sweeps over the Continent on the 9th of January 1941 and this forced the *Luftwaffe* to commit more of its fighters to combat the increasing RAF incursions.

It is interesting to read what the German fighter pilots of 1940 thought about fighter-bomber missions. *General* Adolf Galland, who had been a ground attack pilot flying Henschel 123s prior to the Battle of France, commanded a fighter group during the Battle of Britain. Of fighter-bombers, he said:

"...we fighter pilots looked upon this violation of our aircraft with great bitterness. We had done everything possible to increase our performance in order to keep up with a progressive enemy. We had discarded everything dispensable in an attempt to squeeze another ounce of speed out of them. We had always demanded ejectable spare tanks in order to increase our range. Instead of that they now gave us bomb-release gadgets and we were forced to see a third of our aircraft drop out of air combat..."¹²

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from their nuisance value, [they] achieved very little of any military value"¹³ and that such missions had an adverse affect on the fighter pilot's morale:

"...it is disconcerting for a fighter pilot to have to fight without being able to take the initiative. The morale of fighter pilots was affected; they had to carry bombs, release them at great altitude on an enormous target without being able to observe the effect and then had to adopt a passive attitude towards enemy fighters..."¹⁴

With *Generalfeldmarschall* Göring highly critical of the failure of his fighter pilots and the ineffectiveness of fighter-bomber missions, it is surprising that just over a year later, the decision was made to recommence *jabo* attacks against British targets. This was the start of the *Luftwaffe's* 'tip and run' bombing campaign.

The origins of the Second World War 'tip and run' attacks came in March 1941. One fighter group, *Jagdgeschwader 2* (JG 2), had continued to carry out fighter-bomber attacks but just against shipping. One squadron from JG 2 was given specific low-level bombing training by the Messerschmitt 210 operation evaluation unit whilst a further two squadrons carried out sporadic fighter-bomber attacks when pure fighter duties permitted. By June 1941, these latter two units had accounted for two freighters between 5,000 and 3,000 BRT and a tanker of 2,500 BRT as well as damaging a submarine, a cruiser of 10,000 BRT and a freighter of 3,000 BRT.¹⁵

Nevertheless, *jabo* missions were still secondary until one officer, wounded in July 1941, returned to operational flying duties. Frank Liesendahl commanded one of JG 2's squadrons which still carried out *jabo* missions. However, he had been replaced after being wounded and it is believed

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that as well as recuperating from his wounds, he worked on formulating tactics for low-level fighter-bomber missions. He convinced his senior officers of the value of what a low-level fighter-bomber could achieve against shipping and in November 1941 was given permission to form a dedicated *jabo* squadron.

From the 10th of November 1941 to the 18th of February 1942, Liesendahl's squadron trained and perfected the tactics they would employ against British shipping. Liesendahl devised what was called the 'Liesendahl Process' which was quickly adopted as the preferred method of attack. Approaching the target at 450 kph and at an altitude of five metres, 1,800 metres from the target the fighter-bomber would climb to a maximum height of 500 metres before levelling off, diving at 550 kph and a dive angle of 3° before pulling up and lobbing the bomb at the target.¹⁶

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The first recorded 'tip and run' attack was made against an unspecified target at Fairlight in Sussex on Christmas Day 1941¹⁷ and in January 1941, the first 'tip and run incidents' were reported in Kent (three), Sussex (nine), Dorset (two), Hampshire (one), Cornwall (28) and the Isle of Wight (one). However, it would appear that Liesendahl was still trying to convince senior

officers of the value of *jabo* attacks and this proof came on the 10th of February 1942 when the 3,000 BRT steamship *Lieutenant Robert Mory* was badly damaged in an attack off the Cornish Coast. On the 4th of March 1942, *Luftflotte 3's*¹⁸ Fighter Headquarters authorised *jabo* missions as well as ordering another fighter group, JG 26, to form its own *jabo* squadron with effect from the 10th of March 1942.

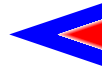
JG 26 was an a distinct disadvantage, having not been involved in JG 2's three month work up. Pilots who had limited *jabo* experience from 1940 and early 1941 were transferred from other squadrons in JG 26 and a number who came to the *jabo* squadron were either unsuitable as fighter pilots, undisciplined or had incurred the wrath of their squadron commander.¹⁹ With the unsuitability or unwillingness of some of its pilots for 'tip and run' missions and with a lack of training, the effectiveness of 10/JG 26 (as the *jabo* squadron was designated) was questionable. British analysis of 'tip and run' attacks supported the imbalance of missions between JG 2 and JG 26 in March 1942, the first month of authorised operations. 17 'tip and run' attacks were carried out in JG 26's area of operations (Sussex and Kent) whilst JG 2's area of operations (Hampshire westwards) reported 49 such attacks. Admittedly JG 26 was operating in an area heavily defended by anti-aircraft guns and the fighter aircraft of the RAF's Number 11 Group but the successes of 10/JG 2 were impressive and a concern to the British. For example, on the 7th of March 1942, four Messerschmitt 109s roamed unmolested in the Exmouth-Teignmouth area, attacking numerous targets and even shooting down one of the RAF fighters trying to take off to intercept them whilst during the month, 10/JG 2 had attacked at least two convoys, claiming to have sunk three ships of varying tonnages and at damaging at least two more.

In April 1942, 'tip and run' attacks increased dramatically, with British intelligence reporting 156 such attacks. April also saw a shift to land targets, particularly gas holders as these were such prominent targets. The *Luftwaffe's* intelligence during the last war has been criticised as being inaccurate or misguided. However, 'tip and run' targets attacked in April and May 1942 did show a high degree of good planning (or possibly luck). For example, the Germans were aware of an underground explosives store inland from Poole and unsuccessfully tried to attack it five times in April and May 1942 whilst two fighter-bombers attacked the Betteshanger Colliery in Kent precisely at shift-change causing damage and civilian casualties. Of greater concern were two attacks carried out by 10/JG 2 against the Telecommunications and Research Establishment (TRE) at Worth Matravers in Dorset. Described as '...one of the country's single most important defence research related establishments during the whole of the Second World War...',²⁰ much of Britain's radar and radar-related research and development was being carried out at Worth Matravers. In April 1942, the TRE was studying the effect of the ionosphere on 'Gee' transmissions, 'Gee' enabling RAF bomber crews to fix their position by using pulse signals from three widely separated transmitters. 'Gee' could also be used to find targets when they were obscured by cloud. In the early evening of the 6th of April 1942, three aircraft from 10/JG 2 attacked the site causing unrecorded damage; at lunchtime two days later, another attack killed two and injured six, whilst a bomb passed through the 350 foot tall 'Gee' tower, causing slight damage. The site was unoperational for four days and because of the risk of a further more devastating attack and German reprisals for the Bruneval Raid,²¹ the TRE was moved to Malvern in Worcestershire in May 1942.

It should be emphasised that during 1942, the combined strength of 10/JG 2 and 10/JG 26 was rarely more than a maximum of 28 aircraft²² but their effectiveness was keenly felt by the British who quickly voiced concern as to means of combating 'tip and run' attacks. The official narrative produced after the war by the Observer Corps was quite specific as to the threat and the difficulties posed, saying:

"...In view of the persistent attacks made by the enemy using very low flying aircraft on coastal targets along the south coast of England, various methods were tried to facilitate interception. The difficulties were great as, in view of the low altitude, RDF [Radio Direction Finding or radar] information was seriously limited with the result that anti-aircraft defences were frequently unable to come into action until the attack had been delivered..."²³

Furthermore, the only anti-aircraft weapons that could counter these low and fast attacks were predominantly the 40mm light anti-aircraft guns. When the 'tip and run' attacks commenced, Anti-Aircraft Command only had 43 40mm calibre guns in position on the south coast and these were assigned to protect military installations, the sort of targets that the fighter-bombers were not attacking.²⁴ Even then, these guns had their failings as an attack on the airfield at Bolt Head in Devon on the 1st of May 1942 showed. Five Spitfires were damaged, a pilot badly wounded and many buildings damaged and the following report was submitted in respect of the anti-aircraft guns failing to engage the attackers:



“...the RAF 4 AA Flight twin Lewis gun posts and one Bren gun²⁵ were in action firing 304 rounds. Hits were claimed on all aircraft but no damage was observed. The Bofors guns²⁶ made a rather poor showing. Number Four gun fired only two rounds before the traverse gear jammed and Number Two gun fired one round, the case of which could not be ejected....”²⁷

By the end of April 1942, it must have been increasingly clear to the *Luftwaffe* of the value of such ‘tip and run’ attacks, specifically against shipping. Post-war analysis shows that between July 1941 and February 1942, German aircraft had sunk or damaged just 32.35% of the ships they attacked in daylight but in the period March-October 1942, this increased to 64.4%.²⁸ Still, the *Luftwaffe* did not expand the two units but at the end of May 1942, co-located both units and subordinated them to the *Luftflotte 3*’s Fighter Headquarters for operational, and later administrative, command and control. This was a clear indication that greater direction in fighter-bomber operations was at last being realised. Then, in mid-June 1942, both units were withdrawn piecemeal to near Paris where they began re-equipping with the Focke Wulf 190. Accordingly, ‘tip and run’ attacks decreased, dropping from 105 in May, to 77 in June and 37 in July 1942.²⁹

This was a worrying development for the British. The Focke Wulf 190 was superior in all flight parameters, except turning radius, to the best Allied fighter at that time, the Spitfire Mark Vb. It was 25 to 30 mph faster at all altitudes up to 25,000 feet and had the highest rate of roll of any fighter of the last war. As a fighter-bomber, it could carry a single 500 kg bomb under the fuselage and four 50 kg bombs under the wings, more than doubling the bomb load of the Messerschmitt 109. Furthermore, if the Messerschmitt 109 had been hard to shoot down (10/JG 2 had so far lost four to anti-aircraft fire and two to RAF fighters whilst 10/JG 26 had lost three to anti-aircraft fire and one to a fighter), the Focke Wulf 190 was faster, more suited, because of its air cooled engine and robust construction, to fighter-bomber operations and far more capable of taking care of itself when confronted by RAF fighters.

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days later doing the same again, claiming to have sunk two and damaged one. From now on, at least one ‘tip and run’ attack a day was planned or flown and as yet, the British had no means of countering them.

Because radar was rarely unable to detect such attacks, the first line of defence had to be the Observer Corps. Selected posts were ordered to fire a rocket (known as ‘Totter’) as soon as low-flying aircraft were seen and to continue to fire them whilst they remained in their vicinity. Furthermore, in order to speed up the reporting of low-flying fighter-bombers, the Observer Corps post would immediately pass the code word ‘Rats’ to the Observer Centre before passing any plot. This was then passed immediately to the Sector Controller, such messages having full priority to then scramble, or if airborne direct, RAF fighters to intercept.³⁰

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The ‘Totter’ and ‘Rats’ systems were still inadequate. It took until November 1942 before standing patrols of two fighters (with another two on standby on the ground) were introduced at anticipated vulnerable points and even then, successful interceptions were infrequent. Furthermore, the existing spacing of the Observer Corps posts still made it possible for enemy aircraft to fly for appreciable distances overland at very low altitude without their tracks being maintained sufficiently to enable fighters to intercept and air raid warnings given. For example, an attack on Salisbury in Wiltshire at

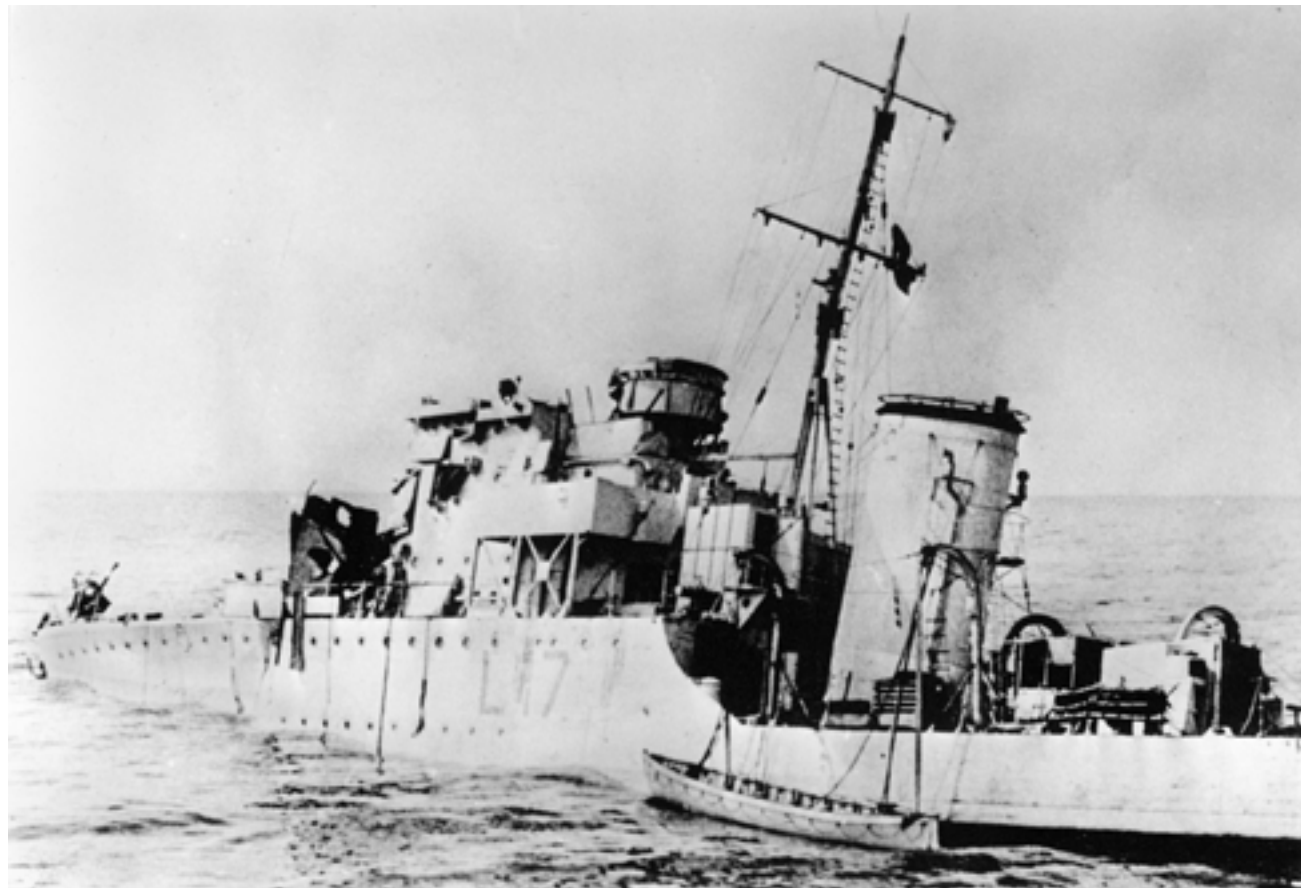
the start of August 1942 was so sudden and fast that no RAF fighters were scrambled to intercept and the air raid sirens not sounded until the two Focke Wulf 190s were well south of the Isle of Wight on their way home. It was therefore decided to form approximately 150 satellite reporting posts, connected to the nearest Observer Corps ‘parent’ post which would increase low coverage in a belt 30 miles width from the coast. These satellite posts were simply to report during the hours of daylight low flying ‘doubtful’ aircraft.³¹ Nevertheless, with both German unit’s fully operational with the Focke Wulf 190 by mid-July 1942, ‘tip and run’ attacks still continued with virtual impunity even though by the end of the month, each unit had lost one Focke Wulf 190 to anti-aircraft fire from the ships they were attacking. These losses had resulted in the deaths of each unit’s experienced commanding officers, one of which was the ‘tip and run’ exponent Frank Liesendahl. However, their replacements were equally experienced and even though the deaths of the two were keenly felt, there was still no respite in the attacks.

It was at the start of August 1942 that changes to the pattern of attacks occurred. 10/JG 26 moved back under the control of *Luftflotte 2*’s Fighter Leader and again started carrying out more attacks on Britain’s south-eastern coast, stretching British defences to their limit. In addition to shipping and coastal targets, the pattern of targets attacked by 10/JG 2 now showed a shift towards specific inland targets such as Helston and Bodmin in Cornwall, Salisbury and on the 5th of August, Yeovil in Somerset. The reason for this change in targets was hinted by a German war reporter who wrote about the Yeovil attack:

“...until now, every mission flown by the *Red Foxes*³² has only been aimed at the south coast of England. They have not yet made an attempt to attack the English hinterland. So they prepare Operation *Ypsilon* all the better because this attack

shall hit industrial works on the other side of the range of hills which stretch behind the south coast. Only two planes are going to carry out this difficult mission. First of all they have to wait for appropriate weather. Up to now, those designated for this attack had to turn back twice because they had not been able to break through the line of English fighter patrols..."³³

The full report, much of which should be regarded as German propaganda, is interesting for three reasons. Firstly, it gives the rationale for attacking targets other than coastal ones. Secondly, it acknowledges that 'tip and run' attacks relied on good weather and thirdly, the British defences, even though they might not be aware of it, did manage to cause some 'tip and run' attacks to be aborted. Nevertheless, this attack was a success. Just two 500 kg bombs destroyed 15 buildings with a further 972 suffering varying damage whilst three civilians were killed and 26 injured. It was thought at the time the target was the Westland aircraft factory but in fact the railway line and station and the centre of the town were the intended targets. The effect it had on the civilian population was not recorded but the audacity and the success of the attack did result in much analysis afterwards, particularly by the Ministry of Home Security.³⁴



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For the following weeks, the occasional coastal target was attacked but an increase in Allied air and sea activity was noted and the reason for this became obvious on the 19th of August 1942 when a predominantly Canadian force carried out a raid on the French port of Dieppe. German twin-engined bombers were quickly committed but did not arrive over the beachhead until just before midday and then had to contend with smoke, anti-aircraft fire and a massive Allied fighter umbrella and so Dieppe became an ideal battlefield for fighter-bombers to utilise their speed and skill to attack Allied shipping. 10/JG 26 was based close to Dieppe and was committed throughout the day against purely naval targets, but both 10/JG 2 and 10/JG 26 attacked warships, transports, torpedo boats and landing craft throughout the day, 10/JG 26 losing just one aircraft and its pilot. The more experienced 10/JG 2 proved the value of 'tip and run' tactics being employed against ships off Dieppe, claiming to have sunk two

destroyers, two large landing craft and two other ships, damaging a further destroyer, transport ship, landing ship, two other ships and shooting down a Spitfire for no loss. The validity of these claims are hard to ascertain but the Royal Navy did lose the destroyer HMS Berkeley which was a considerable embarrassment, especially as the destroyer was also being used as a forward air controller for the Allied fighters and those fighters had been helpless to prevent bombs from just two 10/JG 2 fighter-bombers from breaking the destroyer's back.

It would appear that the German successes on the 19th of August 1942 in respect of employing 'tip and run' tactics against shipping were not developed further as from now on, land targets were concentrated on and by that Autumn, no further Allied ships would be attacked by German fighter-bombers, prompting the German Navy to state that it "...regrets every bomb that is not dropped on shipyards, ships etc".³⁵ 'Tip and run' attacks would continue to be a constant source of irritation and threat but now the Allied defences were forced to try and counter them more effectively.

September and October 1942 saw a reduction in the number of 'tip and run' attacks with Kent and Sussex receiving the brunt of the attacks. In order to ensure the success of attacks in this region, the fighter-bombers now had their own escorts but the majority of fighter-bombers lost during these months were still due to anti-aircraft fire.³⁶ The *Luftwaffe* also employed fighters on what was termed by both sides as nuisance or disturbance attacks in Kent and Sussex, the effects of which were minimal.

It was about now that the RAF assigned a new weapon to counter the 'tip and run' raiders. The Hawker Typhoon had been introduced into service in early Summer 1942 and so far had proved to be a disappointment. In August 1942, the commanders



of the three Typhoon squadrons complained that the Spitfire, not the Typhoon, was better used on offensive sweeps whilst the Typhoon's superior speed and fire power would be better used countering 'tip and run' Focke Wulf 190s and by basing the three squadrons near the eastern, south-eastern and south-western coasts.³⁷ This was accepted and by the end of September 1942, a total of five Typhoon squadrons were employed in this manner.

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The tactics adopted by the Typhoon squadrons was another matter. It would appear that those developed by one squadron of 15 patrols a day by two aircraft flying at low or even lower altitudes with a further two on 'cockpit readiness', were soon adopted by other squadrons. Standing patrols then positioned themselves two to six miles from the coast and waited.³⁸ There was an additional hazard in that the Typhoon at some angles could look like its German opponent but this was partially solved by painting both the Typhoon noses white and black and white stripes under the wings. Still, success was hard to come by as a squadron records:

“...what with having to keep one eye on engine temperature, scan the air for enemy raiders, watch each gun position and Spitfire with suspicion and guard against crashing into cliffs or balloons, the whole enterprise seemed unprofitable. By the end of November [1942], with nothing to show for it, anti-aircraft fire had claimed one Typhoon, the weather two Typhoons and their pilots...”³⁹

There was another reason for this lack of success. On the 8th of November 1942, American forces landed in north-western Africa and the Germans immediately moved fighter units, including both fighter-bomber squadrons, to southern France as a precaution against any Allied invasion. Both fighter-bomber squadrons remained there for just over a month and between the 1st of November and 16th of December 1942, only one 'tip and run' attack was made. The unit responsible for this sole attack had been withdrawn temporarily from North Africa to exchange its Messerschmitt 110 fighters for Focke Wulf 190 fighter-bombers and cost the German squadron two fighter-bombers, intercepted by a standing patrol of two Typhoons thus validating the RAF's new aircraft and tactic.

However, prior to the southern France detachment and the inactivity of the last two months of the year, it should be stressed that the new British aircraft and tactics were unable to prevent what was the *Luftwaffe's* largest daylight attack on Britain since 1940. Hitler, increasingly annoyed by Bomber Command's offensive, ordered a full strength vengeance attack against Canterbury on the evening on the 31st of October 1942. The attack was carried out purely by fighter-bombers, 19 coming from the two recognised fighter-bomber squadrons and which were reinforced by an unknown number of temporary fighter-bombers drawn from fighter units and the unit which had been temporarily withdrawn from North Africa. The total force, including escorts, numbered 62 Focke Wulf 190s.⁴⁰

The attack was an embarrassment to the British defences. The German formation approached the Kent coast at wave-top height in three waves, hedgehopped approaching the outskirts of Canterbury, then climbed, dropped 31 bombs which killed 32 people and damaged countless buildings, and streaked back for France. British defences claimed to have shot down 10 fighter-bombers and suspected a further aircraft had been destroyed hitting a balloon cable. The true cost was one fighter-bomber lost to anti-aircraft fire after it had dropped its bomb, one fighter-bomber lost part of its wing to a balloon cable but returned safely and one of the escorts was shot down by an RAF fighter. To add further embarrassment, German fighters shot down two RAF fighters. As a vengeance attack, the attack on Canterbury was an unmitigated success with the British

acknowledging that 70% of the total weight of bombs fell in the target area but failing to acknowledge their failure to intercept the raid.⁴¹

The attack of 31st of October 1942 was effectively the last ‘tip and run’ attack of any substance for 1942. The Home Office, amongst other political and military organisations, was quick to analyse the successes and failures of the ‘tip and run’ attacks over the preceding nine months. In an end of year report produced by the Key Points Intelligence Directorate, it said of ‘tip and run’ attacks:

“It is clear that attacks were directed against gas and electricity undertakings, railways, trains and in some cases a terror raid was made on residential and shopping areas. Gas works and electricity undertakings in exposed coastal sites provide in themselves a good target and it may well be that the enemy were encouraged to develop these attacks in view of the repeated warnings of the Government for the necessity of limiting both industrial and domestic fuel. The undertakings at Brighton suffered severely in the several attacks made on them and as a result of the attack on the St Ives undertaking in August, domestic supplies were held up for about two months....”⁴²

An analysis carried out by the War Office on ‘tip and run’ attacks up to the end of 1942 was even more blunt.⁴³ Bearing in mind that the maximum number of fighter-bombers available to the *Luftwaffe* at this time was 28, 40% of all daylight attacks in 1942 were carried out by *jabos*, with low-level attacks being preponderant in the latter half of the year. Four out of every five fighter-bombers attacked recognisable military targets, average efficiency on each attack was 71% and German losses had been light.

From a British viewpoint, the small number of German fighter-bombers was creating far more work for the Observer Corps, RAF and anti-aircraft defences than they should have. In addition to an expansion of the Observer Corps satellite posts and increased fighter defences using new (and untried) tactics, the increase in anti-aircraft defences was dramatic. The numbers of light anti-aircraft guns assigned to combat ‘tip and run’ attacks rose from 43 in March 1942 to 543 in November 1942. Searchlight battery personnel were withdrawn from their primary duties and trained to man twin machine guns whilst the RAF Regiment anti-aircraft guns and personnel and 400 Royal Navy rocket projectors which fired wire obstacles into the paths of enemy aircraft were also assigned to the battle.⁴⁴ Despite all of this:

“...the increase in gun strength was not accompanied by any corresponding rise in the success rate...The first big weakness lay in the early warning arrangements which failed to record raid approach or did so too late. Out of 44 attacks



From a British viewpoint, the small number of German fighter-bombers was creating far more work for the Observer Corps, RAF and anti-aircraft defences than they should have

A reminder of the ineffectiveness of British defences was cruelly reinforced early in the New Year by another German 'vengeance' attack

in August 1942, only eight were preceded by radar warning..."⁴⁵

British defences was cruelly reinforced early in the New Year by another German 'vengeance' attack. As a reprisal for Bomber Command's attacks on Berlin on the 16th and 17th of January 1943, 28 fighter-bombers attacked the London Docks area at lunchtime on the 20th of January 1943 whilst a further 12 fighter-bombers carried out a diversionary attack on the Isle of Wight and Tunbridge Wells. Another 16 Focke Wulf 190s were used as escort whilst 39 German fighters carried out a diversionary fighter sweep off the Kent coast.

A reminder of the ineffectiveness of

The attack achieved total surprise. The balloon barrage in that area of London had been brought down for maintenance during that lunch hour and the fighter-bombers attacked as that part of London's inhabitants were going to or at lunch; they were unaware of an attack until the first bombs exploded and only then the sirens sounded, by which time they were too late. With impunity, the fighter-bombers dropped their bombs and strafed buildings before heading south, their only loss being suffered on the return flight. A gasholder was set alight, the Royal Naval College at Greenwich was hit as was the Deptford West Power Station and Surrey Commercial Docks. To add insult to injury, the Germans also shot down ten barrage balloons, the barrage being hurriedly winched back up during the attack.

The loss of life was high and the effect on morale considerable. A school was hit, killing 38 children and six teachers, countless others were injured and many buildings and vehicles destroyed and damaged. So serious were the after effects of the attack that, for the first time, the problem of 'tip and run' attacks was debated in the House of Commons. A petition was signed by local residents complaining about the inability to prevent this attack and questions were asked why the defences were down and what was being done to combat 'tip and run' attacks. In a particularly evasive reply, the Secretary of State for Air, Sir Archibald Sinclair, said that the balloons were down for maintenance and that "...the best deterrence to such attacks as that on the 20th of January is the infliction of heavy casualties on the attackers..."⁴⁶ which was precisely what did not happen – all but one of losses suffered by the Germans were from the diversionary sweeps whilst the only fighter-bomber was lost after it had dropped its bomb. A further question, asking whether the Secretary of State for Air was satisfied that everything was being done to combat 'tip and run' raids, resulted in a similar response: "...the tactical measures best suited for defending this and other areas which are subject to varying forms of attack are under constant review..."⁴⁷

The attack received unprecedented publicity in the days that followed which was not helped by the captured German fighter-bomber pilot who, whilst being interrogated, stated that *jabo* pilots:

"...have been told to attack anything and everything liable to terrorise the British public. Trains, motor buses, gatherings of people, herds of cattle and sheep etc have been mentioned specifically at the briefing as likely targets..."⁴⁸

All of this still did not alter the fact that Britain's capital city had been bombed in broad daylight by a force which penetrated nearly 100 miles at high speed and low-level into enemy territory and still managed to drop its bombs onto recognised targets with good effect and then returned virtually unscathed.

When the weather permitted, for much of January and February 1943 more traditional 'tip and run' attacks were carried out from as far west as Torquay to as far east as Margate with the usual results – destroyed gasholders, hotels where trainee aircrew were being billeted, railway junctions and lines and, more often, town centres. It also appeared that the British defences were at last exacting a toll against the attackers – Typhoons accounted for five fighter-bombers in these two months, light anti-aircraft fire a further three. However, again all eight aircraft were shot down after dropping their bombs on the designated target and these losses did not deter the *Luftwaffe* or affect the potency of the attacks. In fact, a greater number of attacks were now flown when the weather improved in March and a number of these were by much larger formations of 20 or so fighter – bombers. As the Observer Corps narrative noted:

...Britain's capital city had been bombed in broad daylight by a force which penetrated nearly 100 miles at high speed and low-level into enemy territory and still managed to drop its bombs onto recognised targets...

"...many minor attacks were made by aircraft in small formations with occasional more ambitious attacks by formations of between 12 and 30 fighter-bombers with or without an escort or rear cover. In January [20th], 12 [sic] fighter-bombers bombed the crowded areas round Poplar and Bermondsey from low altitude with considerable moral effect. This was followed by several other similar attacks on Eastbourne, Hastings, London and Ashford..."⁴⁹

If the attack on London on the 20th of January had "considerable moral effect", similar attacks in March 1943 had an even greater adverse moral effect for British civilians

If the attack on London on the 20th of January had "considerable moral effect", similar attacks in March 1943 had an even greater adverse moral effect for British civilians. The attack against Eastbourne on the 7th of March by 18 fighter-bombers was undetected until the first bombs exploded; no RAF fighters were able to intercept and 14 civilians and seven servicemen were killed and countless buildings destroyed or damaged. Then again on the 11th of March, 27 fighter-bombers attacked Hastings, killing six civilians, destroying 40 houses and blocking the railway line. No German aircraft were lost even though anti-aircraft defences claimed to have shot down three but as Headquarters Number 11 Group noted:

"...standing patrols were immediately detailed to the raid but the attack was so sharp that the enemy were passing out to sea six minutes after they were sighted..."⁵⁰

The following day saw another reprisal for Bomber Command's continued attacks against Berlin with 24 fighter-bombers, this time with a massive escort, dropping bombs on Ilford and Barking in Essex and the eastern outskirts of London. Only minor

damage was inflicted but the residents of Ilford were vociferous in the failure of the defences preventing the attack and sirens again being sounded only after the attack had started. The RAF did manage to intercept the formation but not until it approached the Belgian coast on the return flight where two fighter-bombers were eventually shot down.

The final massed attack took place against Ashford in Kent on the 24th of March and was the most successful by far. The official report is graphic as to the attack's effectiveness:

"...this attack was heavier and more successful than the enemy's previous efforts. The enemy aircraft flew across Ashford at low level from south-east to north-west. Two of the five bombs aimed at the railway works did considerable damage whilst three bombs which fell to the north of the works damaged rolling stock. The remaining enemy aircraft appear to have made an indiscriminate attack on the town. One enemy aircraft made a cannon attack from roof top height on a petrol lorry standing in the yard of an agricultural works and the lorry exploded. The bomb carried by this aircraft was hit by light anti-aircraft fire and the enemy aircraft blew up. Extensive damage was caused to the works as a result of the double explosion..."⁵¹

All this increased activity, with 'tip and run' attacks now spreading further north-east as far as Walton-on-the-Naze in Essex, coincided with a massive expansion and reorganisation of the German fighter-bomber force in France. In addition to the two established fighter-bomber squadrons, a dedicated *jabo* group had begun to form in December 1942.

Schnellkampfgeschwader 10 (SKG 10)⁵² flew its first operational sortie on the 7th of March 1943 and by the 31st of the month, had 90 aircraft available to attack Britain, an additional 28 being assigned to it when the two original fighter-bomber units came under its aegis early in April 1943.⁵³

...the Luftwaffe High Command, probably due to incomplete intelligence, believed that daylight jabo missions had not achieved the desired effect...

The British were unaware of this massive force of fighter-bombers and if the *Luftwaffe* had utilised it in a similar tactical manner to the 'tip and run' attacks of the previous 13 months, would have been a formidable weapon which the British

defences would have had considerable difficulty in countering. Crucially, the *Luftwaffe* High Command, probably due to incomplete intelligence, believed that daylight *jabo* missions had not achieved the desired effect and therefore the vast majority of SKG 10 was to be trained for nocturnal attacks, to the incredulity of many of its pilots:

"...they got the idea that attacks would be practicable at night...such an absurd idea. The...pilots of SKG 10 had no qualifications for night missions. There was no experience in night and instrument flying and no [night] navigation system was available..."⁵⁴

April 1943 saw daylight 'tip and run' attacks continue but on a much reduced scale, as much of SKG 10 trained for nocturnal

operations, and only five separate attacks were carried out. Only one of these was a mass attack and took place on the 3rd of April when 16 fighter-bombers, yet again, completely surprised the defences, caused considerable damage and all aircraft returned safely. A minor attack on the 8th of April by a smaller formation caused considerable damage to military and industrial targets on the Isle of Wight but two fighter-bombers were lost, one to a Typhoon on a standing patrol, the other to light anti-aircraft fire.

This reduction in 'tip and run' activity did not go unnoticed and although no obvious reason could be given for it, the British still saw 'tip and run' attacks such as the one on the 3rd of April as wholly successful and that "...it is clear from the results achieved in the 'tip and run' raids on coastal targets that our defences can be improved...".⁵⁵ Furthermore, a similar report analysing nocturnal bombing did not connect the reduction in daylight attacks with a commencement of fighter-bombers attacking by night, stating:

"The fighter-bomber appeared for the first time as a night bomber on the 16th/17th of April and it is presumably the new fast bomber ⁵⁶ which has been mentioned recently in German broadcast claims...They have operated mostly in the London and Home counties..."⁵⁷

May 1943 saw a sharp increase in massed 'tip and run' attacks with 12 specific attacks on seven days. On two days, two attacks were made simultaneously in an attempt to split the fighter defences, all the attacks occurring either early in the morning, lunchtime or late in the evening, maximising their irritation to the civilian population. The fact that Great Yarmouth and a nearby radar station was under attack by 20 fighter-bombers on the 7th of May was not evident until the first bomb exploded whilst a similar attack four days later was equally successful. Only two aircraft were lost in these attacks, one of them to British defences again after the bombs had been dropped. The following day, Lowestoft was attacked by 25 fighter-bombers just before sunset; the results were predictable:

"...the first warning received by anti-aircraft sites was the noise of falling bombs; the official warning was given two minutes after the first bomb had dropped. In addition to 21 bombs on



... 'tip and run' losses for the first 20 days of May 1943 numbered two whilst nocturnal losses for the same period were higher despite such attacks only being flown on four nights



land, several bombs were dropped in the sea near the harbour. Nine anti-aircraft sites were attacked with cannon and machine gun fire and the gas works, electricity mains and a hospital were damaged...⁵⁸

Yet again, no German aircraft were lost.

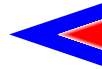
It would appear incredible that the *Luftwaffe* was not aware of the successes it was achieving in May 1943 and even German radio broadcasts, usually boastful of such attacks, preferred to play down the successes of the 'fast bombers'⁵⁹. The frequency of nocturnal missions now began to increase as daylight attacks decreased but even then, 'tip and run' losses for the first 20 days of May 1943 numbered two whilst nocturnal losses for the same period were higher despite such attacks only being flown on four nights.

'Tip and run' attacks would occur only on three more days in May 1943 and all attacks but one were devastating. On the 23rd of May, simultaneous lunchtime attacks were launched against Hastings and Bournemouth. At Hastings, anti-aircraft sites appeared to be the chosen targets but, for a change, these sites and the fighter standing patrol had received ample warning. The town was still bombed and the two German losses, one to a Typhoon, the other to anti-aircraft fire, occurred after the bombs had been dropped. Despite a six-minute warning, the attack on Bournemouth was a total success. Considerable damage was caused to the town centre with five buildings destroyed and a further 3,000 damaged whilst civilian casualties were 77 killed, 45 seriously wounded and 150 slightly wounded. Far more serious was a direct hit on a hotel being used by trainee RAF aircrew; 31 service personnel were killed, three missing and 38 wounded. Two days later, Brighton suffered another mass attack. Again, there was five minutes warning of the attack but the fighter-bombers still succeeded in damaging the railway and locomotive works and appeared to be targeting, with considerable success, Brighton's larger buildings.

The only failure that month was on the evening of the 25th of May when adequate warning enabled Spitfires to break up an intended attack on Folkestone. Slowed down by their bombs, the fighter-bombers jettisoned them into the sea and turned for home. Spitfires claimed to have shot down six fighter-bombers but only one was lost.

The final attacks of the month took place on the 30th of May. Torquay, another location where RAF trainee aircrew were billeted, had always been a popular target for 'tip and run' attackers; this time five servicemen were killed and 11 wounded. However, one of the five fighter-bombers lost in the attack did so because it collided with a church steeple; its bomb was thrown clear to explode on a Sunday school, killing 21 children and three of their teachers; the morale of the town's inhabitants was, obviously, badly shaken and the fact that five enemy aircraft had been lost during the attack was of little recompense. An attack on Walton-on-the-Naze that same evening also caused much damage but no casualties.

It could have been safe to assume that 'tip and run' raids in June 1943 would continue in the same vein. Indeed, this was the case for the five mass attacks that took place on the first six days of the month. Each attack was analysed by the British as being a total success, particularly the attack against Eastbourne in the early afternoon of the 6th of June 1943. However, 'tip



and run' attacks expected on the days that followed did not materialise; no further such attacks would occur against the British mainland for the remainder of the war.

The reason for the sudden cessation of 'tip and run' attacks has never been satisfactorily explained

The reason for the sudden cessation of 'tip and run' attacks has never been satisfactorily explained. The Observer Corps Narrative tries to explain it by saying: "...at the end of the first week in June [1943], these 'tip and run' raids ceased. Undoubtedly, the enemy had found it increasingly dangerous to make daylight sorties over this country..."⁶⁰

Another source supports this explanation by saying "...Göring decided that the losses were too great and in June [1943] the...attacks petered out..."⁶¹

However, I have tried to show that contrary to the above, 'tip and run' attacks had met with considerable success, especially for much of 1943, by normally hitting the designated target whilst keeping fighter-bomber losses to a minimum. There were a very few exceptions to this and in particular, the attacks carried out in June 1943 were seen by the British as being 100% successful.

I believe that there are three simple reasons why 'tip and run' attacks stopped. Firstly, German post-attack intelligence, normally quite poor throughout the war, underestimated what the attacks had achieved; even the German radio broadcasts were unusually non-committal about the achievements.⁶² Secondly, the *Luftwaffe* mistakenly believed that by using the fighter-bomber at night, similar results could be achieved whilst the darkness would help protect the aircraft. However, advances in British air-to-air radar technology and the superiority of British night fighters proved that darkness was no protection, German losses were high and effectiveness very poor. As one German commander, who had flown such missions in 1943 and 1944, made clear after the war:

"...the night action of the Focke Wulf 190 against London was not very successful. It was a real makeshift. This type of aircraft was neither designated for this kind of mission nor was it suitable for this task..."⁶³

However, the final reason why tip and run attacks stopped was far simpler in that there were no fighter-bombers available for 'tip and run' missions left in north-west Europe by the middle of June 1943. On the 12th of May 1943, German forces had surrendered in North Africa and it was clear that the Allies would soon invade southern Europe. The Germans thought that the greater threat was now in the Mediterranean, the 'soft underbelly of Europe', so in order to reinforce one wing of SKG 10, a second was rushed from France to southern Italy in the second week of June 1943 whilst a third wing was withdrawn from France and operational from Italy by the end of June 1943. By then, the only fighter-bomber unit still in northern France was the nocturnal wing of SKG 10.

So to conclude, what was the impact of the German ‘tip and run’ campaign? The Germans had discovered a unique use for its fighter aircraft and after much trial and error and even opposition, the fighter-bomber proved to be a very effective weapon against shipping. Extending its usage to coastal targets was also a success and the British defences had great difficulty in preventing many devastating attacks on numerous coastal towns and latterly inland targets.

For much of the 15 months that ‘tip and run’ attacks occurred, the Germans could only muster a maximum of 28⁶⁴ aircraft to attack targets on a coastline which stretched from Great Yarmouth to the Lizard, a distance in excess of 1300 kilometres. However, this length of coastline and uncertainty of what would be attacked also played into the German’s hands. There were insufficient anti-aircraft guns of the correct calibre to counter a low-flying high-speed threat, whilst:

“...the RAF could offer no positive defence against these fast, low-flying fighter-bombers which achieved an effect out of all proportion to the effort they represented. The Chain-Home and Chain-Home Low radar stations...were unable to plot the movements of the *jabos* on account of their low altitude and Fighter Command was forced to mount standing patrols in order to counter the threat...”⁶⁵

It is interesting to note that wartime analysis stated anti-aircraft guns accounted for 55 ‘tip and run’ attackers during the period March 1942 to the 6th of June 1943; fighters were said to have accounted for a further 51.⁶⁶ Analysis carried out by myself tells a different story – anti-aircraft fire actually accounted for 28 fighter-bombers, fighters a further 28, one aircraft was shared whilst a further five either collided with buildings, high-tension wires or other aircraft.⁶⁷ It is clear that to lose 62 aircraft and 62 pilots over a 15 month period was high but at this stage of the war, this was sustainable. Furthermore, these losses should be compared against a comparable German twin-engined bomber group which, for the same period, lost 122 aircraft in attacks on Britain, costing in the region of 480 aircrew killed, missing or prisoners of war.⁶⁸

From a military viewpoint, ‘tip and run’ attacks did result in many more anti-aircraft guns and associated personnel being dedicated to defend potential targets. Furthermore, Fighter Command was forced to dedicate many aircraft to try and prevent the fighter-bombers from dropping their bombs, something normally met with little success. These assets could have been better used.

What of the impact on the civilian population and the Government? The inability to prevent such attacks was a great worry to those living on the south coast. For example, Torquay was attack eight times over the 15 months, two of the attacks being severe and resulting in considerable loss of life. Two other attacks in 1943 so incensed civilians living in the towns affected that petitions were written and questions asked in the House of Commons. However, it would appear from the non-committal responses that ‘tip and run’ problems were left purely to the military and ‘tip and run’ attacks remained a constant irritation to civilians living on or near the south coast.



What then of the value of the 'fighter-bomber' as a weapon? The Germans did indeed develop the idea but the Allies copied and perfected it. Every Allied fighter introduced during the war had to have, with minimum modification, the capability of carrying a bomb and the best example of this was the Hawker Typhoon. In the second half of 1943, the Typhoon found a new role as an all-weather intruder and then close-support aircraft, armed with bombs and rockets. In the battle for Normandy in the Summer of 1944, the Typhoon made a name for itself as a first-class anti-tank, anti-vehicle, anti-building and anti-strongpoint weapons platform, something the Germans never managed to achieve after the early success of the war.

It is therefore my conclusion that 'tip and run' attacks did have an impact on both the British military and, to a lesser extent, the civilian population living on Britain's southern coast but there is scant evidence that the Government was overly concerned, unless a Member of Parliament's constituency was a regular target. From the German viewpoint, they underestimated what they were achieving with what was a very small force of fighter-bombers, a force which was too small to cause massive damage. The decision made in 1943 to use the fighter-bomber at night was misguided and even when the *Luftwaffe* had a massive fighter-bomber force at its disposal, it failed to utilise it in a way that would have swamped British defences and allowed the fighter-bombers to attack more targets, further inland, with virtual impunity.

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- 2 Reaching a peak in the Summer of 1942.
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- 4 *Royal Observer Corps Narrative 1943* p.101.
- 5 Balke, U (1997), p.391.
- 6 Steel, N & Hart, P (1997) p.262.
- 7 Ibid.
- 8 Even though the convoy was nearly annihilated, eight *Stukas* were shot down and a further seven damaged.
- 9 AI 1 (K) Report No 781/1940.
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- 11 Goss, C H (2000) p.145.
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- 19 Caldwell, D (1996) p.214.
- 20 Pomeroy, C A (1995) p.115.
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- 43 BC/G/11 p.3.
- 44 Routledge, N W (1994) p.403.
- 45 Ibid.
- 46 Parliamentary Debates Commons 1942-43 Vol. 386 p.477.
- 47 Ibid.
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- 57 AWA Report No BC/19 p.1.
- 58 AWA Report BC/20 p.4.
- 59 *Diary of Day Raiding - April and May 1943* p.2.
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- 65 Wood, T & Gunston, B (1977) p.62.
- 66 Routledge, N W (1994) p.404.
- 67 Sources for the German losses are the *Luftwaffe* Quartermaster General's Returns and *Deutsche Dienststelle*. Sources for how these aircraft were shot down came from the Command, Group and Squadron Records books held either at the Air Historical Branch or Public Records Office.
- 68 Balke, U (1997) pp.428-457.

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