

# MOBILITY AND TECHNOLOGY IN THE KAKADU COASTAL WETLANDS

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## ABSTRACT

*Bipolar knapping is considered to be advantageous when mobility is low, and the relative abundance of bipolar cores may therefore be a measure of residential mobility. Using these propositions the difference between assemblages in the Kakadu coastal wetlands is explored by focusing on the frequency of bipolar cores within each site.*

Difference between artefact assemblages has long been a focus of archaeological research in northern Australia. Explanations for assemblage variety have concentrated on the idea that each assemblage can be considered as a toolkit, and that assemblages differ mainly because dissimilarity in the types of activities between sites call for different proportions of tool types. The most conspicuous application of this principle is found in Kakadu. For two decades seasonal abandonment of the lowlands was the preferred explanation for inter-site assemblage variation in Kakadu during the Holocene (Schrire 1982: 250). In this model, developed by White and Peterson (1969), seasonal use of wetlands food resources resulted in distinctive tool-kits. As dry season exploitation of the plains was diverse, and involved multipronged spears tipped with bone and wood points, stone points were rarely used. Retreat of people to higher ground during the wet season was accompanied by a shift in diet, to one focussed on terrestrial animals hunted with stone tipped spears, and consequently stone points were common in plateau valley sites (White and Peterson 1969: 60). In this way differences in assemblage composition were explained in terms of the kinds or frequencies of extractive or maintenance activities.

More recent interpretations of inter-site variation in Kakadu have rejected the idea of seasonal abandonment

of the lowlands, but have maintained the view that assemblage composition directly reflects the kinds of tool using activities. This perspective has been employed by Meehan *et al.* (1985) and Brockwell (1989) to characterise assemblage variation on the South Alligator River in terms of the dominant function at each site.

In this paper I consider mobility as an additional mechanism that has the capacity to affect assemblage composition in the Kakadu region. As an example of this perspective, an investigation of cores will illustrate the capacity of technological analyses to provide a measure of group mobility in this region. Cores as a class of artefact have received minimal attention in archaeological examinations in Kakadu, or indeed in Australia as a whole. And yet the technological difference between cores has the potential to provide information about the structure of prehistoric settlement systems. One example of this potential is the relationship between bipolar stoneworking and mobility.

## BIPOLAR TECHNOLOGY AND MOBILITY

An empirical correlation between high levels of bipolar knapping and sedentism in the late Holocene has occasionally been noted in Australia (e.g. Williams 1988). Similar observations in other parts of the world provide stimulus for a new evaluation of technology and settlement in Kakadu. For example, in a wide ranging review of prehistoric sequences in North America Parry and Kelly (1987) argued that bipolar stoneworking became more frequent in later assemblages associated with low residential mobility. Their suggestion was that a portable toolkit is a primary concern for mobile populations, whereas for sedentary groups the main consideration in their stoneworking is to have adequate usable stone available at locations where it is needed (Parry and Kelly 1987: 300). Unfortunately, the usefulness of this insight is severely limited by the framework employed by Parry

and Kelly to describe technology. Using the notion of expedient technology to describe bipolar stoneworking, they label this a "wasteful technology" and contrast it with "standardised" forms of reduction (Parry and Kelly 1987: 301). This leaves Parry and Kelly in the quizzical situation of arguing that raw material conservation is not necessary for sedentary people, because they either live near plentiful supplies of rock or import and stockpile large quantities of rock. By re-examining the function of bipolar stoneworking techniques it is possible to develop a more usable mechanism to explain the observed link between bipolar knapping and sedentism.

Of course bipolar techniques are inherently neither standardised nor unstandardised. For reasons discussed below bipolar practices may be effective on heterogeneous and tough rocks that are difficult to work in other ways. When employed on intransigent rocks of this kind, the resulting flakes may appear irregular. However, it is possible to use a bipolar technique with precision, to yield standardised products. For example, there is no reason that regular elongated flakes (blades if you prefer) cannot be created on bipolar cores. Consequently, to link bipolar techniques necessarily with a lack of technological standardisation is incorrect.

Nor is it true that bipolar techniques are wasteful. In many instances the flakes removed from a bipolar core may be relatively thick, thereby giving less edge per unit stone. However, there are other ways to maximise the use of available rock. One way is to prolong the reduction, and remove more material from the core. Of all percussion techniques bipolar stoneworking is unsurpassed in this regard.

Stoneworking may be considered as a problem of core immobilisation. Unless it is immobile, a piece of stone will move rather than fracture when struck. The likelihood of the core moving varies with its inertia and the amount and direction of the force applied to it. Often the relationship between these factors creates no problem, but when the flake required is large compared with the size, shape and mass of the core, force will overcome core inertia and energy will move the core rather than create fracture. It is important for the knapper to control the movement of the core, because if it is unstable under the application of force, it is difficult to balance all of the variables involved in knapping and undesirable results become more likely. In situations of low inertia, detrimental alterations to the structure of the core may occur when large amounts of force crush, batter, and initiate fractures but do not remove flakes. Hinge and step terminations become likely, thereby altering core shape and making further reduction difficult. It is in these situations

that the knapper is most likely to be hurt, striking fingers or driving the core into the hand or leg.

The most effective way to immobilise cores of low inertia is the bipolar technique, which allows small cores to be immobilised while large forces are applied. Bipolar knapping consists of placing the core on an anvil and striking into a core at 90 degrees to the platform and in line with the point of contact with the anvil (Hiscock 1982). Because the core is immobilised by being held against the anvil, a large hammer can be used to apply large amounts of force and develop large compressional stresses (Cotterell and Kamminga 1987: 688-9; Faulkner 1972: 57-61).<sup>1</sup> As a consequence it is possible to use a bipolar procedure successfully on a core that is too small to be worked by any other percussion technique. An illustration of this will be provided below.

Bipolar techniques are therefore uniquely suited to situations in which low inertia poses a problem for continued reduction. For this reason bipolar knapping will often appear towards the end of a reduction sequence, and serves to prolong reduction, thereby extending the exploitation of cores. Following the logic of Parry and Kelly (1987: 301), this technique can be seen to confer advantages on a group with low residential mobility if they are not camped immediately adjacent to a large quarry. By employing a technique, such as bipolar knapping, that extends the life-span of imported rock, a group may reduce the rate at which it needs to transport rock to the residential locale. Added to this, with sedentary (or seasonally sedentary) camps the scavenging of previously discarded stone artefacts would be expected to increase as one means of limiting material importation. To reduce these previously discarded objects a bipolar technique suited to flaking small cores would be advantageous. In this way bipolar stoneworking can be one response to the economics of raw material usage associated with low residential mobility.

To employ this principle in archaeological analysis it is necessary to account for other factors that encourage the use of bipolar techniques in stoneworking. Perhaps the most important of these factors in Australia is the distance to a source of rock suitable for knapping. A number of studies have demonstrated that, except in regions where siliceous rock is ubiquitous, prehistoric people often responded to increased distance to sources of replacement stone by conserving the material at hand (Byrne 1980; Hiscock 1988; McNiven 1992). One rationing procedure was the bipolar technique (see also Jeske 1992). For this reason, identification of differences in residential mobility within or between regions might proceed by examining the frequency of bipolar cores in sites

at similar distances from raw material supply zones. One example of such an analysis is available from the open sites along the South Alligator River.

#### SITES NEAR THE CENTRAL SOUTH ALLIGATOR RIVER

It is now widely accepted that in the Late Holocene there was year-round occupation of the Kakadu lowlands (Brockwell 1989; Clarke 1987; Schrire 1982). Open sites along the margins of the South Alligator River floodplain have been taken to reflect sedentary occupation by large groups of people during the last 1,000 years (Meehan *et al.* 1985). Sites recorded by Meehan *et al.* (1985) were associated with large billabongs, and in the recent past were occupied for several months of each year. This interpretation was based primarily on ethnographic information, and reinforced by a perception of uniformly large archaeological sites.

A series of smaller sites exist in the nearby woodlands (Hiscock *et al.* 1992). Following from the above discussion, my contention in this paper is that assemblage differences between these woodlands sites and those on the floodplain margins reflect different levels of mobility.

The relationship between the woodlands and floodplain margin sites is currently ill-defined. Given their close proximity and ethnographic information, these sites may have been occupied by the same general group of people, perhaps during different seasons (Guse 1992; Brockwell 1989). If this was the case, the archaeological patterns are suggestive of seasonal difference in occupation location being linked with seasonally different levels of residential mobility.

Sites along the floodplain margins can be typified using eight open artefact scatters near the central portion of the South Alligator River, within one kilometre of the Kun-kundurnku 1 site previously described by Meehan *et al.* (1985). Positioned either on a laterite ridge or on a levee bank on the blacksoil floodplain, all eight sites are within 200m of the floodplain margin. The sites vary greatly in size, but display similarities in many assemblage characteristics such as diverse raw materials, including non-local stone, and an abundance of bipolar cores. The largest of these sites, Kun-kundurnku 1, provides an excellent example of the cores found at these sites.

Cores at Kun-kundurnku 1 can be separated readily into those that have been worked using bipolar procedures and those that were not. Table 1 gives data on the weights of the two kinds of core. Although some hand held cores were 50-100g or heavier, most were less than 50g. Hand held cores become relatively frequent below

30g, but none are less than 18g. In contrast, all bipolar cores are lighter than 22g, and are frequent in weights *only* below 8g. Hence, with only a small overlap, bipolar cores are smaller than non-bipolar cores. This observation is consistent with the notion that bipolar techniques facilitate reduction of cores beyond that possible with hand-held direct percussion.

Core type	N	Mean	Std.dev.	Min.	Max.
Bipolar	48	5.39	4.85	1.0	22.0
Non-bipolar	21	36.62	27.85	19.0	131.0

Table 1: Weights (g) of cores at Kun-kundurnku 1

At all of the eight sites positioned near the floodplain margin in the Kun-kundurnku 1 area, bipolar cores are very common. In each site, the majority of cores are bipolar ones. The dominance of bipolar cores can be expressed using the ratio of bipolar to non-bipolar cores. Floodplain margin sites averaged a ratio of 6.7:1, with a range of 6.1:1 to 8.1:1. On these sites the vast majority (80-90%+) of hand-held cores have been transformed into bipolar cores, thereby prolonging reduction.

A very different pattern is found in artefact scatters located in the eucalypt woodlands five to six kilometres away from the main South Alligator River channel. Four sites in this setting were examined. These sites were positioned on the undulating lateritic surface east of the South Alligator River and south of Nourlangie Creek. All four sites were artefact scatters composed primarily of flaked quartz artefacts. Both bipolar and hand-held cores were found at these sites, and conformed to the weight characteristics described for Kun-kundurnku 1. Unlike the sites near the South Alligator River, these woodlands sites had roughly even numbers of bipolar and non-bipolar cores. Woodlands sites averaged a ratio of 1.5:1, with a range of 0.6:1 to 2.4:1. On these sites less than two thirds of hand-held cores have been transformed into bipolar ones.

Differences in the abundance of bipolar cores in these two landscape settings can be seen diagrammatically in Figure 1. Woodlands sites have relatively low numbers of bipolar cores, and the proportion of cores worked with a bipolar technique increases noticeably away from rock sources. This increase in bipolar working away from quarries is taken to reflect an attempt to ration available material, rather than return to source areas to obtain more rock. In contrast, the sites on the floodplain margin have far higher proportions of bipolar cores, even when the site is on or adjacent to a source of knappable rock. Fur-

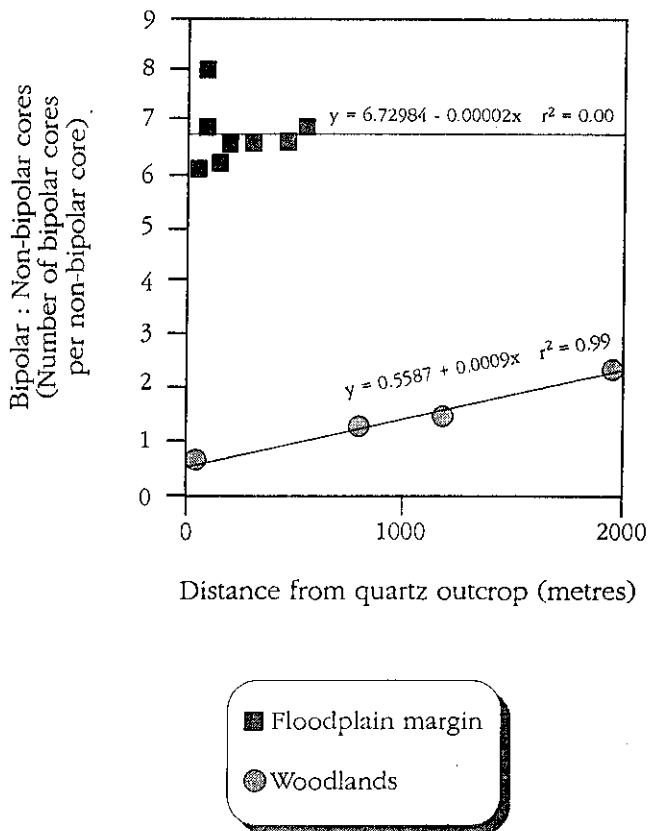


Figure 1: Relationship of bipolar core abundance and raw material proximity for two landscapes in Kakadu.

hermore, there is no noticeable correlation between the frequency of bipolar working and the distance to rock outcrops. I suggest that this pattern exists because almost every core that can be worked using a bipolar technique has been so worked, even though rock outcrops occur nearby. A plausible explanation of this intensive stone reduction is intensive occupation of these sites. Using the model developed above, the high frequency of bipolar stoneworking on sites at the floodplain margins indicates low residential mobility, whereas the low frequency of bipolar cores in woodlands sites is consistent with relatively high residential mobility.

OTHER PORTIONS OF KAKADU

At a broader level these conclusions may apply not only to the South Alligator River wetlands, but also to the Kakadu escarpment and outliers (see Figure 2). In the north of the Kakadu region, to the east and west of the

East Alligator River, three sites excavated by Schrire (1982) have sizeable assemblages and are reported to contain bipolar cores (called fabricators by Schrire).

At these sites there are no counts of cores available, so the relative frequency of bipolar cores can only be expressed as a ratio of fabricators to implements (Table 2). The two Jimede (sometimes spelt Jimeri) sites in the plateau valley have relatively few bipolar cores, whereas the plains outlier site of Badi Badi (sometimes spelt Pari Bari) has proportionately twice as many bipolar cores. Using the arguments described above, this pattern suggests lower mobility, perhaps as longer residence and with larger group size, at the floodplain site of Badi Badi.

Sites	Level	Schrire 1982:	Fabricators	Other implements	Implements : fabricators
Jimede 1	I + II	Page 187	15	519	33.6 : 1
Jimede 2	I	Page 215	20	574	27.7 : 1
Badi Badi	All	Page 72	6	73	11.2 : 1

Table 2: Frequency of bipolar cores in sites near the East Alligator River

Data on bipolar cores from Ngarradj Warde Djobkeng superficially conforms to the pattern identified for the Jimede sites. Only 18 of the 134 cores were identified to be bipolar (Allen and Barton 1989: 49). These data give a bipolar to non-bipolar ratio of 0.13:1, indicating that cores were typically worked using non-bipolar knapping techniques. This depiction reveals a large assemblage, rich in stone points, and displaying little bipolar stone working. Like the broadly similar assemblages at Jimede 1 and 2, this composition could be interpreted in terms not only of site function but also of the duration of residence at each visit to the site.

In comparison to the sites on the South Alligator River, bipolar cores are extremely rare at Narradj Warde Djobkeng. However, strict interpretation of published data from Narradj Warde Djobkeng is problematic. Allen and Barton (1989: 48) reveal that in layers I-III, 60% of cores weigh less than 20g. Elsewhere in Kakadu cores of such weights are mostly reduced by bipolar knapping. Unless these specimens are not complete cores, being heat shattered fragments for example, most if not all will be bipolar. Therefore, it is likely that approximately half the cores at Ngarradj Warde Djobkeng are bipolar ones. If this is so, then the bipolar to non-bipolar ratio would be approximately 1.5:1, a result entirely consistent with that from the woodlands sites on the South Alligator River. Even with such recalculations, the Narradj Warde Djobkeng assemblage reflects relatively little bipolar

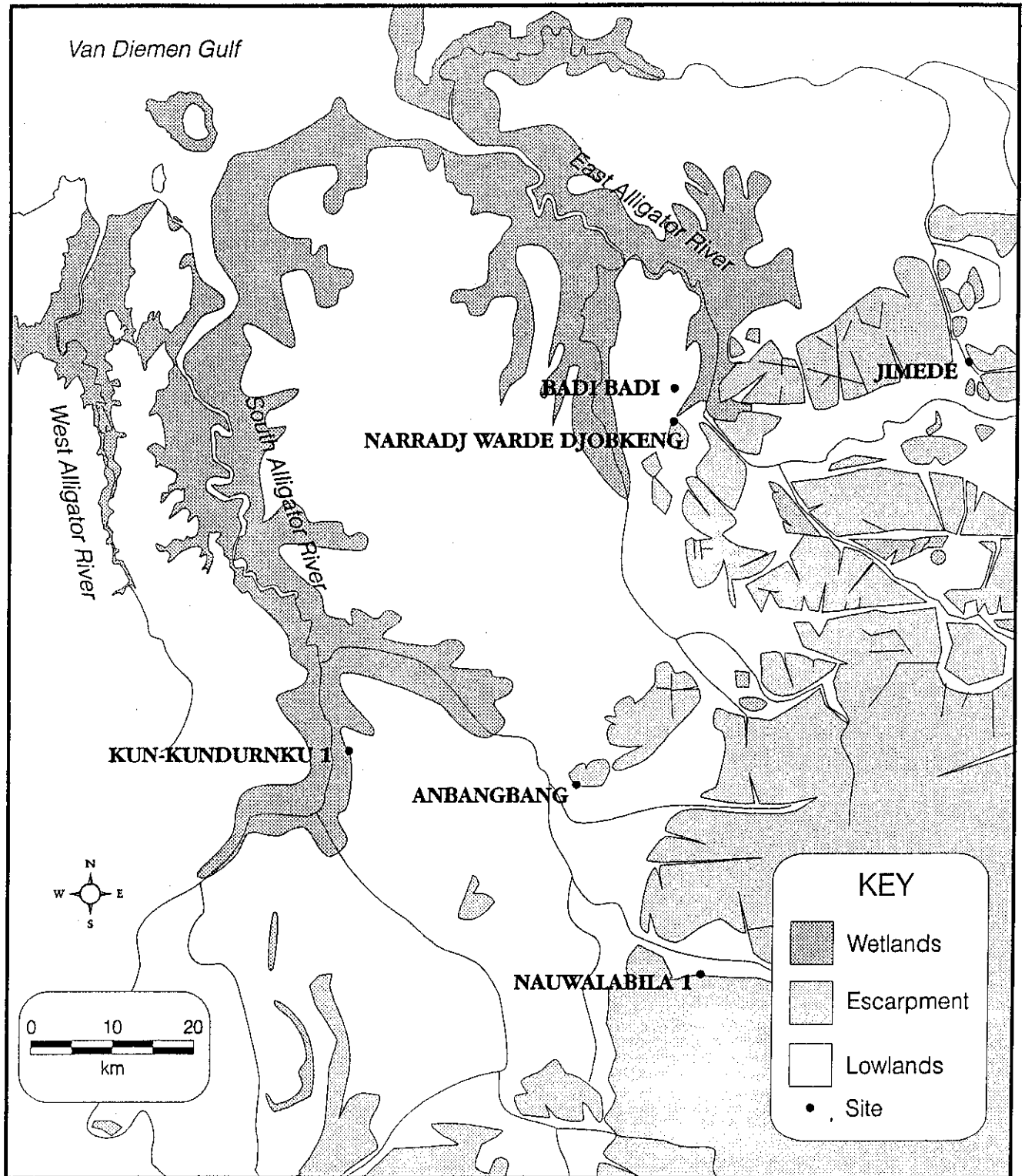


Figure 2: The Kakadu region showing sites mentioned in text.

knapping. Following the model outlined above, the low frequency of bipolar knapping may indicate relatively high residential mobility.

No data on bipolar cores is reported from several other Kakadu sites, such as Anbangbang 1 and Nauwalabila 1. Absence of bipolar cores from these sites might indicate a local settlement system with extremely high group mobility, and/or that these sites were visited only briefly. Alternatively it is possible that prehistoric occupants at these sites employed different technological procedures to cope with economic stresses associated with prolonged occupation. However, the lack of information on bipolar cores at these sites may simply indicate that the analyses did not focus on such technological information. It is imperative that future work on these assemblages accurately identify the abundance of artefacts made using bipolar techniques.

### CONCLUSIONS

I have demonstrated that in the lowlands surrounding the South Alligator River there are two groups of sites, floodplain margin sites containing high proportions of bipolar cores and woodland sites containing far lower frequencies of bipolar cores. Using a model in which sedentism encourages the kind of raw material conservation available through bipolar technologies, this pattern was interpreted as one of lower residential mobility along the floodplain margins. Such an interpretation is consistent with a range of other data (see Meehan *et al.* 1985).

I have further suggested that variation in mobility may partially account for the frequency in bipolar cores in assemblages throughout the Kakadu region. A simplified interpretation is that floodplains sites such as Kunkurnku 1 represent a relatively sedentary component of the settlement system, at which people heavily reduce the rocks they have. Woodlands sites near the South Alligator River, and cave sites in outliers such as Badi Badi, represent examples of greater residential mobility. The Jimede sites represent the opposite extreme, with high residential mobility manifested in relatively short-term occupation, and only initial reduction of locally plentiful rock.

These issues, particularly residential mobility, are widely discussed in Australia, usually in the context of the intensification debate. We need to comprehend assemblage variation as a different manifestation of the same issue, rather than invoking ethnic or functional differences. It is therefore time for a new regional synthesis of assemblage variation.

### NOTE

1. It is possible to immobilise a core or retouched flake simply by leaning it against the anvil, without altering compressional stresses or directing blows into the piece. Such situations are not bipolar reduction, and have been specifically excluded from the following analysis.

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