Abstract: Shared life in Go – an overview

Harry Fearnley, 38 Henley Street, Oxford, OX4 1ES, UK. email: harry@ZZZgoban.demon.co.uk

Abstract
The game of go [weiqi (Chinese/C)/ baduk (Korean/K)] has a number of distinct types of shared life [seki (Japanese/J)/ shuang1 huo2 (C)/ bik (K)]. There are more kinds of shared life than there are of independent, unconditional, life. We provide an overview, and outline an approach to a full classification of shared life, while referring to what is already published. We include positions in which capture is possible, but not desirable – e.g. hanezeki. We describe the components that are available, and indicate how we can systematically construct seki configurations using these components. We give some examples.

Keywords: go, baduk, weiqi, shared life, seki, shuang huo, bik, ko, jie, pae, non-removable ko threats, centre play, nakade, dianyan, chijung, hanezeki, jeochim bik, snapback, uttegaeshi, hwangyeok, daotei, daopu.

Introduction

Stones that are part of a group which has two eyes are independently alive. All other live stones will be part of a shared life configuration.
We make some simplifying assumptions in order to make our work easier. We use a Chinese method of counting, and we normally deal only with "terminal" positions, where it is unsafe/unwise for either player to play another move. There is a slightly weaker condition in which it is unsafe/unwise for one player to play, but safe for the other player to play – the other player's move may be a non-removable, one-sided, ko-threat. The two assumptions – Chinese rules, and terminal positions – can later be removed, and this will probably affect our results only predictably, and to a small extent.
We make one other important simplifying assumption: there are no cyclic positions (ko (dianyan(C), pae(K)), etc) already on the board. In some sekis without an *initial* cyclic position it will be possible for one player to choose to start a sequence which eventually gives a cyclic position (usually a ko). This will be allowed. If we later allow initial cyclic positions, we may have to make a number of adjustments to some of our analyses.
We define a "chain" as a collection of stones of the same colour that are already fully connected to each other. "group" is a less precise term – the meaning is always clear when describing terminal two-eyed groups. However, in shared life, especially where mutual capture is possible, it is sometimes not obvious which group a particular chain belongs to. We may therefore sometimes prefer to discuss chains, instead of groups.

Configurations for independent life

Independent life offers fewer complications than shared life. There is not yet a definitive classification of all possible configurations of simple 2-eyed groups. Fearnley9999a (unpublished) catalogues the topologically different configurations of from one to six two-eyed groups – two configurations are the same if their structure does not change when the colours are exchanged. Similarly, the exact position, or size, of the groups, is not important. All that is important is which groups touch which others, and which groups touch the edge of the board. There are 1, 2, 4, 14, 42, and 168 (total 231) such topologically different configurations which have 1 to 6 groups, respectively. Many configurations with substantially more than six groups are known – this includes the configuration (due to Ger Hungerink – see [Fearnley2001]) with the most (31) 2-eyed groups that can be fitted onto a standard 19x19 go board.
In independent life, the only other factor that can be changed is the types of the eyes. These differences of eye type do not increase the number of possible topologically different configurations.

Configurations for shared life

Positions supporting shared life are more complicated than those which have independent life only. There are also many more of them. Most, perhaps all, of the "independent life" configurations will have a corresponding, topologically similar, seki. Because these sekis do not require two eyes, they will usually be smaller. Sometimes, it may be hard to find examples of such comparable seki configurations – they may

involve multiple shared liberties, eyes of various sizes, uneven numbers of shared liberties, etc. A particular shared life configuration may involve two or more groups – all members of the same seki configuration share liberties either directly with the other groups, or (recursively) with further groups which in turn share liberties with them. In terminal positions, all shared liberties, are necessarily part of a shared life configuration.

Under our assumptions, in *independent* life all empty points (liberties) are adjacent to only one group -- they are the one-point-eyes. However, in seki, there are always some liberties which are adjacent to chains of both colours. Sometimes, there are also liberties that are adjacent to two different chains of the *same* colour – see Fig 1. Exceptionally, there may be a liberty which is adjacent to two white chains, and simultaneously adjacent to two black chains (see Fig 2), or even three black, and one white chain (see Fig 3) – yet, neither player wants to play the connection/disconnection. Such configurations make possible more complex topological arrangements than with two-eyed, independent life alone. There is no published catalogue of such positions.

In seki, there may be another source of complication – non-symmetric liberties – see Fig 4a, where Black has a guaranteed extra liberty, and Fig 4b, which share the further property that when Black plays a shared liberty, White will (probably) want to answer by plating the other one. It seems unlikely that these can play a role in *terminal* seki, particularly where only immediate capture is possible. However, with some other chains having two, or more liberties, we are less sure.

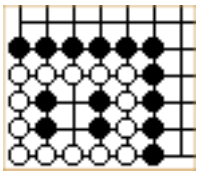

Fig 1: 2-1 shared

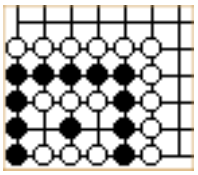

Fig 2: 2-2 shared

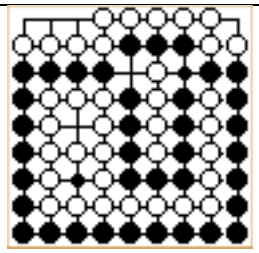

Fig 3: 3-1 shared

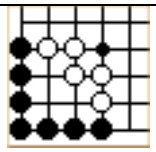

Fig 4a

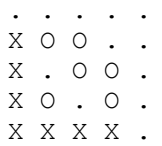

Fig 4b

Fig 4: Non-symmetric

No capture

There is no published catalogue of all such configurations. Ger Hungerink has published -- see [Fearnley2001] -- a seki thought to have the most (129) distinct chains . Note that this is very many more than the largest number (31) of two-eyed groups that can be fitted on a 19x19 board.

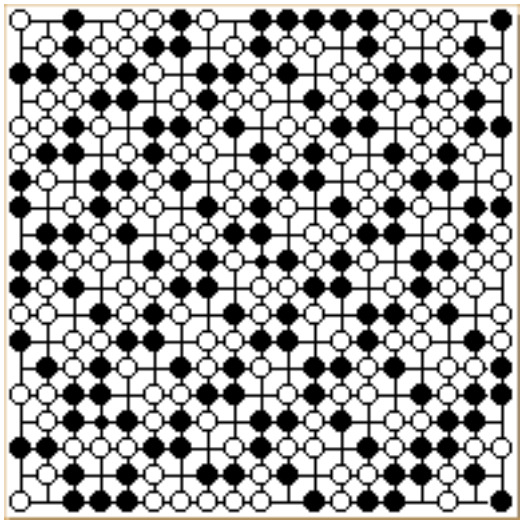

Fig 5: 129-chain seki

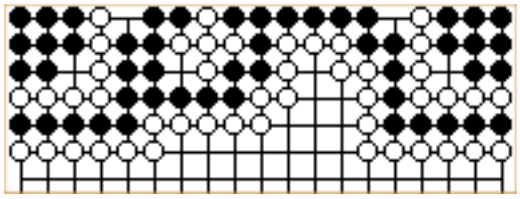

Fig 6: Seki with two Murashima's kos

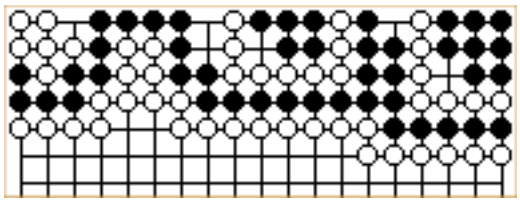

Fig 7: Different liberties/ sizes of groups

Capture

In seki we sometimes find stones which can be captured – perhaps on the next move. They are left on the board not captured, because to capture them would lead to a worse result than simply leaving them alone. In all cases, the capture does not guarantee independent life, but leads to various other possibilities: a second eye (only after winning a ko); one guaranteed eye, together with some liberties (perhaps with ko); or simply some liberties (perhaps with ko). Sometimes, there will be a choice between, on one hand, obtaining some liberties, and, on the other hand, obtaining fewer liberties, but with an additional ko. This choice may be the attacker's, and/or the defender's. Examples of all of these possibilities can be found in a discussion of generalized hanezeki [Fearnley9999b].

Another factor that may affect outcomes is whether an initial capture can be made immediately, or only after some further plays – delayed capture. An example of delayed capture might be one of the precursor positions for bent-4-in-the-corner. Positions involving delayed capture have not been fully catalogued yet, and should prove a fruitful source of unusual configurations – however they will not be considered further here. We expect that most, but not all, "delayed capture" configurations will be precursors of immediate-capture configurations.

Simple capture - nakade

The best-known example showing possible capture involves ordinary "nakade" (dianyan(C), chijung(K)) captures – a lump of stones is captured, the capturer is left with no cutting points, but does not have a guarantee of independent life – some in the corner may lead to ko. A paper on generalized nakade capture in seki [Fearnley 9999c] examines all combinations of one, or two, black groups in contact with all of two, or more, white groups, and where nakade captures are possible. There are many different other types of configuration in which these captures might also be used. The simplest seki with nakade has a single (black) group involved with several identical (white) groups, and sharing only one liberty with each of them – each white group can make an identical capture. Fearnley9999c provides a detailed analysis, and shows several configurations not published before, including ones based on Murashima's ko (see Fig 6). Fearnley9999c also examines configurations where the white groups capture different numbers of stones and share different numbers of liberties with the black group(s) – see Fig7. The "nakade" captures are one-sided, captures – if Black can capture some white stones, those same white stones cannot capture any black stones. In addition to these one-sided nakade, there are also several other situations where two-sided, mutual, capture is possible. Sometimes, immediate recapture is possible, and sometimes it is not. We consider both possibilities.

Capture, immediate re-capture (CIR)

We will consider three kinds of CIR – snapback; the in-line capture-immediate-recapture seen in hanezeki; and the capture of a single stone in the corner to give one of the positions in simple corner nakade with eye – see Fig 8 -- these are examined in a paper on seki with nakade [Fearnley9999c].

CIR -- snapback

Snapback (uttegaeshi(J), hwangyeok(K), daotei/daopu(C)) is a well known example of a CIR position – mutual capture is possible, and one side can recapture immediately – Fig 10 is a diagonal snapback in the centre of the board. Fig 11 is an in-line snapback -- these cannot help us construct seki. Fig 13 is a precursor of the snapback in Fig 12. Precursor positions are also useful to us. Corner positions differ from all those in the centre of the board – e.g. after White captures in Fig 14, the two white stones can be recaptured with two plays. The Japanese, and Koreans, have had special rules (torazu san/go moku (J)) covering some of these positions, if left at the end of the game. There is another configuration -- related to snapback, and to capture delayed recapture (CDR) – see Fig 9 – if Black captures White we will get snapback, however, if White plays first then Black can still reduce White's eye space to one eye. Fearnley9999d has done a preliminary analysis of seki involving these configurations, as well as snapback, and their precursor positions. These positions can also be used to build sekis with capture.

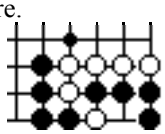

Fig 12: snapback

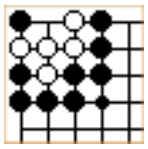

Fig 8: pre-1-eye

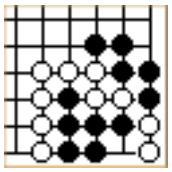

Fig 9: half-snapback

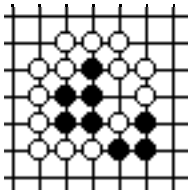

Fig 10: diagonal

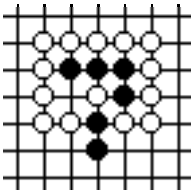

Fig 11: in-line

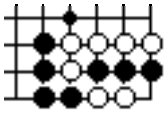

Fig 13: pre-12

CIR – hanezeki

The other CIR that we consider involves generalizing the shapes seen in hanezeki (jeochim bik(K)) -- see Fig 15 and Fig 16. These consist of two components – a nakade component, and a special mutual-capture component. The mutual-capture component behaves like a nakade capture for one player, but for the other player, when they capture their capturing stones can be re-captured immediately. If such a position is a seki then this capture-recapture must not be favourable for the other player – this may depend on the size/shape of the initial capture. In Fearnley9999c there is a complete analysis showing 154 different configurations where such shapes are coupled with simple nakade. We do not know of any published analysis of such mutual-capture components, either with non-nakade captures, or on their own.

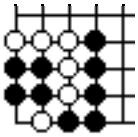

Fig 14

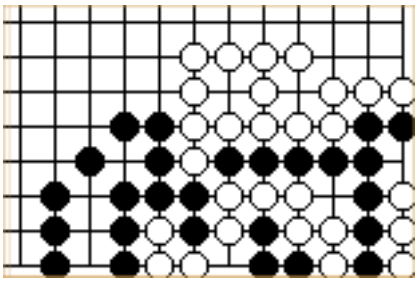

Fig 15: Shimada's hanezeki

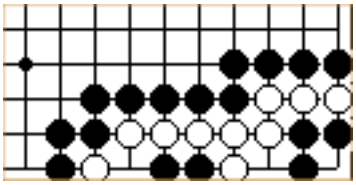

Fig 16: smallest hanezeki

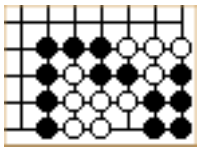

Fig 17: CDR

Capture, delayed re-capture (CDR)

There are several other examples of positions where mutual capture is possible, but where the capture alone does not guarantee independent life. In a study of CDR in seki, the first step is similar to that in CIR. We need to identify captures which do not guarantee life (either two eyes or a self-contained seki) – in the corner, especially with cutting points, forced sequences may lead to the creation of killable 7-nakade with 2, or more stones inside. Fearnley9999e has examined such configurations where the mutual captures are both possible immediately, but where there is only delayed re-capture (CDR) – a simple example is shown in Fig 17. These positions can be combined to provide configurations of interest to us. Mutual *delayed* capture is also possible, but more complicated, and requires cataloguing. All of these "capture-delayed-recapture" (CDR) may be combined, either with others, or with immediate capture (CIR) configurations, to create positions of potential interest.

Conclusions, extensions, further work

Gourvitsch