Vertical and horizontal changes of North Pacific albacore derived from archival tag data. [1]

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Abstract
In this document, horizontal and vertical north pacific albacore movement was described from archival data and discussed briefly about fishery interaction. One tag was recaptured with long period from April 18, 2002 and February 25, 2003 (313 days) . From this tag, albacore around Japan move from warmer area (southern part) in winter to colder area (northern part) which characterized as higher productive area. Significant vertical swimming depth changes were identified when they move northward that swimming depth became shallower along with their northward movement. Another feature is that they stayed around emperor sea mount chain for approximately one month (September). Overall, this albacore stay at same area particular in the northern part where is high productive area. Vertical habitat is characterized as deeper depth (500m) in south of Japan with warmer temperature and shallower (>100m) in the Kuroshio Extension area with colder temperature. Albacore could be targeted by both longline and pole-and-line fisheries in winter and early spring time in south area near Japanese water, but only pole-and-line can target in norther area due to their shallower swimming depth in the Kuroshio Extension area..

Key words: North Pacific albacore (*Thunnus alalunga*), archival tag, horizontal and vertical behaviour, fisheries interaction

Introduction

Albacore tuna shows a wide-range distribution between 10°N and 50°N, changing their habitat seasonally (Laurs and Lynn, 1991). North pacific albacore migration route based on tag recovery data, and albacore migrate seasonally from near Japanese coast latitude at 30°N to around the southern areas of Emperor Seamount Chain and then return to near Japanese coast (Otsu and Uchida, 1963). Recent tagging research also shows similar results in northwestern North Pacific Ocean (Ichinokawa et al., 2008). Recaptured archival tagged albacore in the eastern north pacific ocean (EPO) shows that their horizontal habitat change seasonally (Childer et al., 2011). In this document, horizontal and vertical north pacific albacore movement were described from archival data and discussed briefly about fishery interactions from their vertical habitat.

Data

Released areas were shown in Figure 1a(gray squares). Release areas are separated into two areas as south of Japan and the Kuroshio Extension area. Number of released fish with archival tag was 7 in 2000 (Fig1(a);2000P1 and 2000P2), 40 in 2002 (Fig1(a);2002P1) and 36 in 2004 (Fig1(a);2004P1 and 2004P2). Length at releasing was between 50cm and 87cm (age 3-5). Four fish were recaptured by the Japanese pole-and-line and longline fishery (Table 1.)

The archival tag (NWT series version 1.1 and LTD2310, Lotek Wireless Inc., U.S.A.) was a cylinder of length 7cm, diameter 16mm and weight 52g. To detect light and external temperature, a thin extendable stalk 150mm long was deployed into the main body. The main body of the tag measures pressure and internal temperature.

Estimated daily locations of the fish were generated using the light-level data recorded by the tag. Locations were further corrected by the state-space models and SST (UKFSST model; Lam et al., 2008).

Results and Discussion

The albacore migration path throughout the investigation from the longest record (TagNo.2330) can be summarized as follows (Figure 1). Albacore moved toward the north-east and resided in the area around 40°N, 155°E for the whole of June. They migrated to the east, where it exhibited repeated behaviors of forwarding and staying. In mid-October, it changed direction to the west in area around 160°W and then returned to the region of initial release area.
Figure 2 represents swimming depth distributions, average water temperature and peritoneal cavity temperature in day and night time for each month. Significant diel migration was identified in Aril, 2002, Jan.-Feb, 2003. From May to Oct, albacore likely stay at the shallower depth between surface to 100m depth. Vertical water temperature from July to September changed sharply.

Figure 3 shows albacore positions (a) in quarter1(Jan.-Mar.) and quarter2(Apr.-Jun.), and their vertical behavior in same period (b) This albacore migrates in southern area in qtr1

and stayed especially in the specific area (see ISC/13/ALBWG-03/04). Its swimming depth is between 0 and 500m with temperature around 20°C.

From first quarter to second quarter, they move from the specific area to the Kuroshio extension area. Swimming depth in this areas is shallower (abount 100m) than the area in qtr1. From the vertical profile shown in Fig.3(b), this albacore passed across the kuroshio around end of May.

Generally, longline fishery target relatively larger size of fish that can migrate deeper, however, LL fisheries can target smaller size of fish in quarter 1 and 4 around Japanese water because their swimming depth was deeper. Conversely, swimming depth in the Kuroshio extension area (norther) became shallower with relatively colder water. Pole-and-line fishery can only target albacore rather than longline fishery in this season.

In summary,

1. One recaptured tag (313 days) shows similar migratory pattern as Otsu and Ushida (1963) described, which was characterized as they move northward from winter to summer. Albacore somehow change its direction to the west around 160°W and then returned to the Japanese water.
2. Swimming depth is deeper (up to 400m) in winter time in south of Japan with warmer temperature.
3. Swimming depth is shallower (approximately 100m) in summer time in the Kuroshio Extension area with colder temperature.
4. Both pole and line and longline can target in the Japanese southern area especially in the first quarter and beginning of the second quarter due to their deeper swimming depth.
5. Only pole-and-dline can target in the Kuroshio Extension area (northern area) in quarter 2 and 3 due to shallower swimming depth.

References

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Table 2. Release and recapture information for 5 albacore with archival tags.

		Release			Recapture				
Tag type	Tag no.	Date	Location	size (cm)	Gear	Date	Location	size (cm)	Days at liberty
NMTv1.1	2330	18-Apr-02	31.5°N 137.5°E	78	LL	Feb-25-03	30°N 134°E	82.5	313
NMTv1.1	2337	09-Mar-04	32.1°N 134.6°E	74	PL	May-26-04	35°N 157°E	n/a	78
LTD2310	A1132	09-Mar-04	32.1°N 134.6°E	71	PL	Apr-22-04	35°N 145°E	n/a	44
LTD2310	A1127	14-Mar-04	31.9°N 134.9°E	77	PL	May-17-04	34°N 147°E	77.8	64

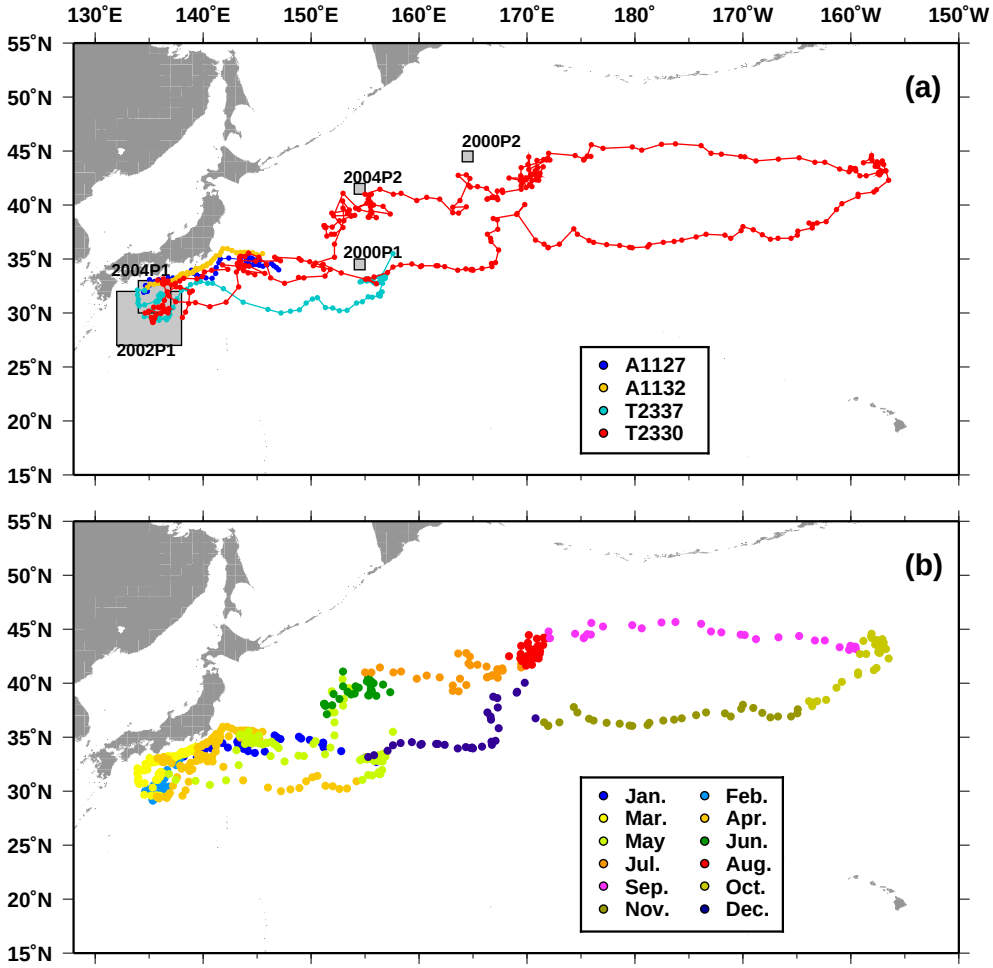

Figure 1. (a) Release area (gray area) and estimated positions by the UKFSST. (b) Monthly positions of each tagged albacore.

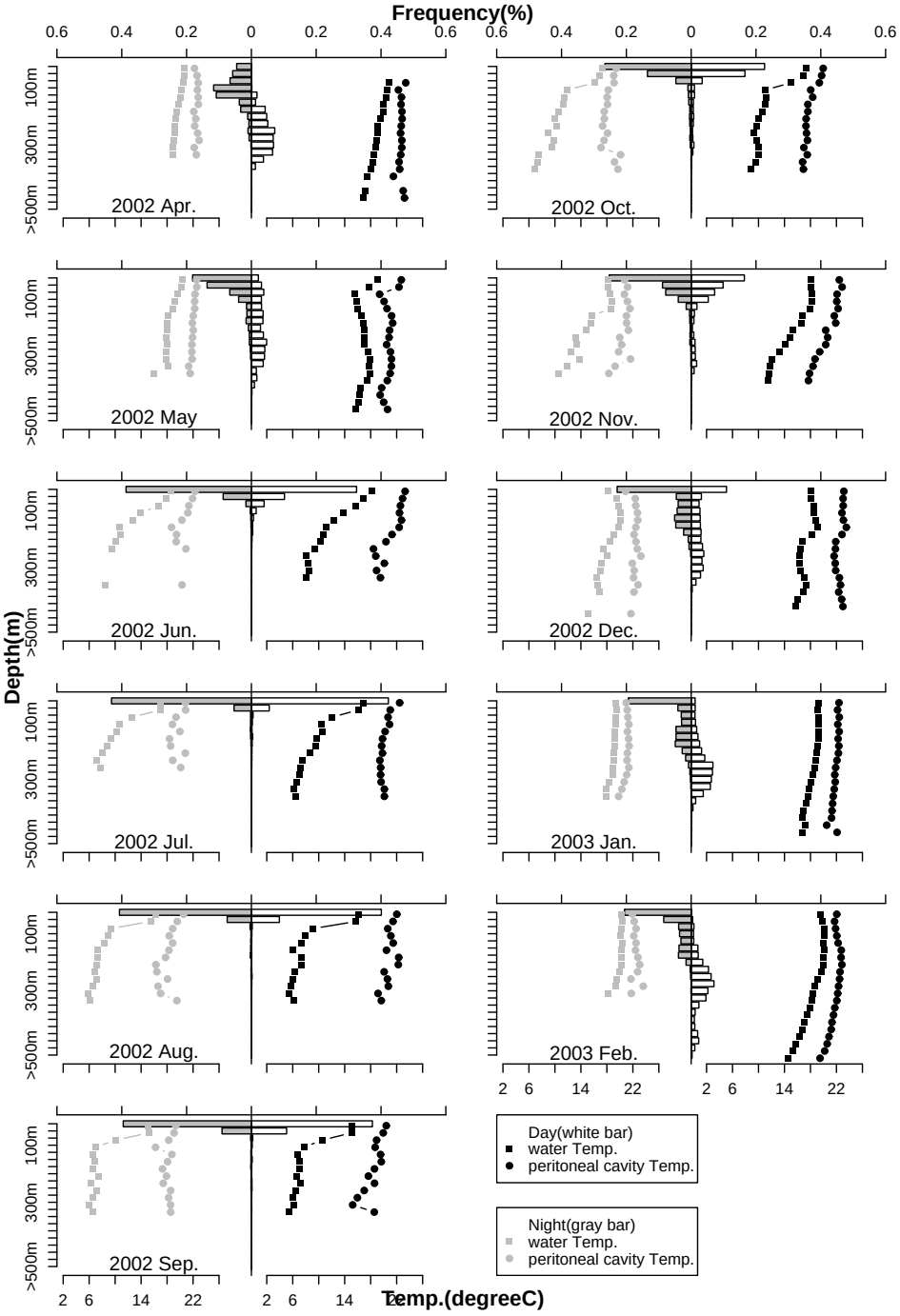

Figure 2. Depth distribution (bar) and average temperatures of albacore in each month between April 2002 and February 2003. Gray and white bar represents night (18:00-6:00) and day (6:00-18:00), respectively. Circles and squares indicate averaged peritoneal cavity temperature and water temperature, respectively.

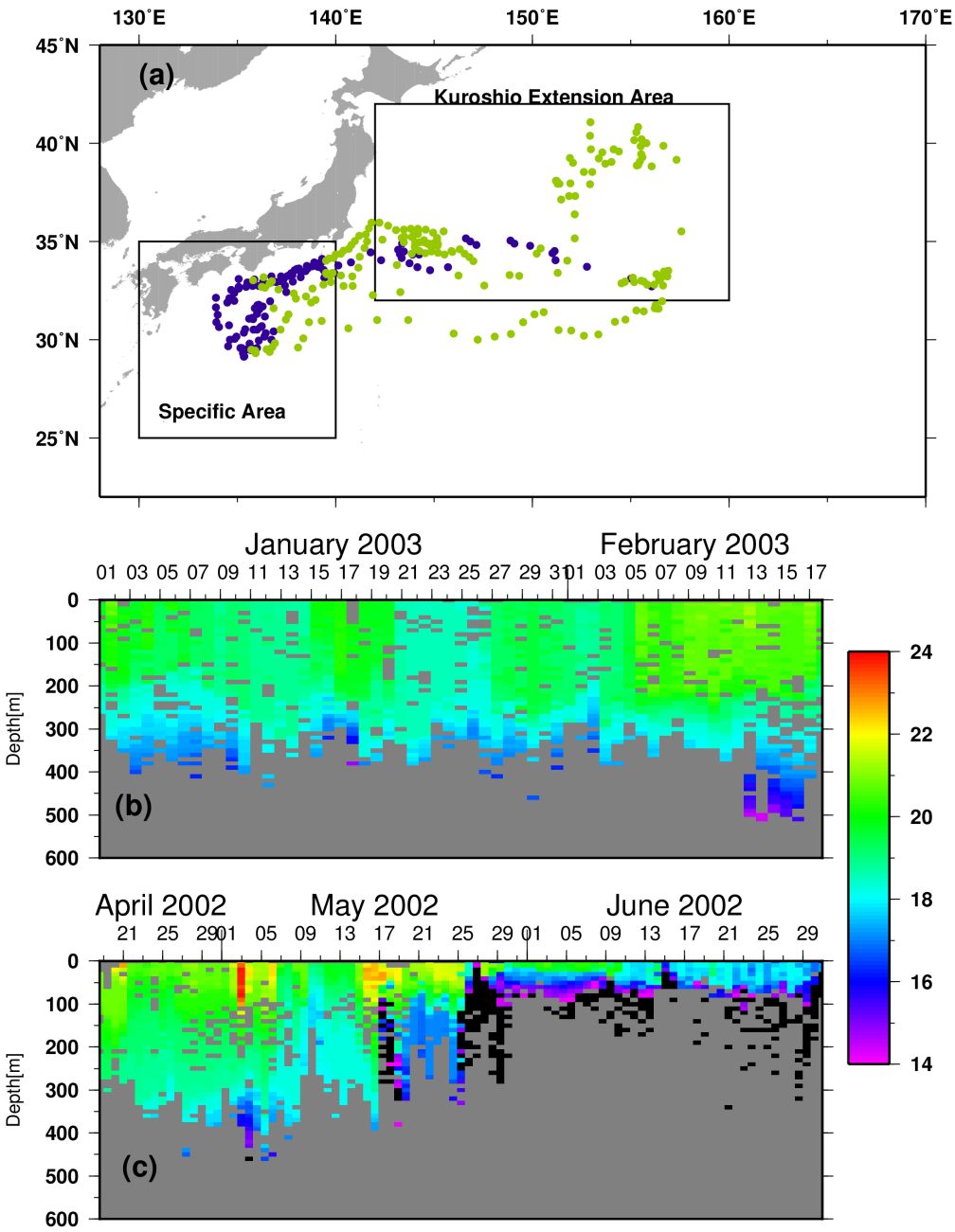

Figure 3. (a) Tagged fish positions in qtr1 (blue) and qtr2 (green). Depth and water temperature in specific area (b) and Kuroshio extension area (c). Note that (b) and (c) are derived from TagNo.2330.